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A Study of Project Work Using ICT as a Mediating Artefact

NTNU Trondheim
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Preface

Life in the classroom is complex with all sorts of action taking place all at once. During project work this complexity is even more visible due to intense pupil and teacher activity. The project work method and the use of ICT give the teachers more strings to play on, but it demands more of them to play in tune. In such a setting the pupils also act differently than in traditional classrooms. They need help to work together in groups, they need help to use the various tools properly, among them ICT, in the work process, and they need help to structure their work to guide them towards their goals, to mention just a few of the challenges teachers will encounter in their teaching practice. The research process has helped me to obtain a deeper understanding of the processes involved in project work using ICT as a mediating artefact.

During my research I have had dialogues with many people who have helped me on my way to the finished text, thus I have many people to whom I owe a debt of gratitude. During the research process I have received help and inspiration from both my mentors, Sigrun Guðmundsdottir and Annlaug Flem, who have always found the time to answer my questions, answers that I found were crucial to my work. Their availability made it possible to get immediate feedback on questions that at first glance might seem simple, but which were very important to me when I was in the middle of the research process, as they encouraged me to continue my work. I have also taken part in a discussion group led by my mentors together with my student colleagues. In this group we have read, discussed and reflected on texts that had inspired me in my work. I would especially like to thank Janne Madsen in this group for reading and commenting on my emerging texts.

I would also like to thank the municipal and the school administrations for giving me access to the various schools. I am grateful that Steven, Sarah and Marion, my key informants, their teacher teams and the pupils and their parents that allowed me to enter their classrooms and stay there from August to December. Without their consent this work would have been impossible.

Last but not least I would like to thank my friends and my family, and especially my daughter Maiken and my son Ben and my granddaughter Maria, for being patient while I have been probably far too busy working on my research.

Trondheim, October 2002 May Britt Postholm

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Chapter 1
Introduction

"I can't find my grandma on the Internet," says one of the pupils a little sardonically while most of his classmates rush to the computer lab. The pupils are trying to find some material for the topic of their project work. Obviously this pupil believes that he can obtain more information for his topic from his grandmother by talking to her face by face than on the Internet. Not only is computer literacy considered to be the key to employment, it is also viewed as having an impact on pupils' learning in school. The development of computer literacy and the use of the project work method were made obligatory components of education in the 1997 Norwegian National Curriculum. Thus most teachers have two new elements to deal with, project work and information and communication technology (ICT). This also rises the important question of how these two elements are integrated into a seamless whole.

Two important observations on computer use are first that computers alone do very little to enhance learning. Pupils can use computers for various tasks, such as writing, drawing or making graphs, but this does not transform what they could have done without computers. On the other hand, computer use could make the enterprise more efficient and more fun. Second, it has become evident that no single task or activity can affect learning profoundly or give rise to learning that lasts. It is rather the culture of the learning environment that can affect learning in important ways, both in environments with and without computers (Salomon & Perkins 1996). Another finding is that the interface between the learner and the technology does not determine the quality of the understanding the pupils acquire. Learning is inseparable from how education is defined by culture. Thus both the promises of the technology and the changes in the real learning environment that would help realize these opportunities have to be taken into consideration (Mercer 1993).

The first computer programmes paid little attention to the possibilities school or classroom environments gave for computer activity. Rather they were conceived of as possible substitutes for teachers. These programmes were made on the basis of behaviouristic conceptions and practices and were designed for computer-assisted instruction (CAI). CAI software is often said to constitute "drill and practice programmes" which are individualized and thus geared to each learner's level and pace. A more advanced version of these programmes is called "Intelligent Tutoring Systems" (ITS). Founded upon research in Artificial Intelligence, these programmes were made on the assumption that computers could

play the role of a skilled teacher (Crook 1994, Koschmann 1996, Light 1997). Even though the CAI paradigm has a behaviouristic approach and ITS has a cognitive one, in research on ICT in education these two paradigms both take this to be a given (Schommer 1990).

For years there were predictions that teachers, textbooks and even schools would be replaced by new teaching and learning technology. It was also anticipated that the major method of learning by 2000 would involve the use of computers at all levels and in almost all subject areas (Bork 1980). These predictions do not appear to have come true. Findings from the SITES[1] research study (Second Information Technology in Education Study) conducted from 1995 to the spring of 1999 indicate that the number of computers in classrooms has indeed increased, but there is a long way to go before all pupils have a computer to work on. The results also show that some countries have more modest expectations when it comes to the use of computers in schools. The lack of equipment and the more guarded expectations regarding computers are certainly two reasons why classrooms have not developed as anticipated by the most optimistic proponents of the new technology.

The question one may ask is then twofold. First, why have computers not invaded the classrooms as predicted, and is there still an optimistic expectation for what computers can contribute to teaching and learning? Research shows that it is not enough to motivate teachers to introduce computers into their classrooms. It is essential that teachers have training for the activities they want to bring into their teaching (Ryan 1991). The success of computer-supported learning would then be dependent on what pedagogical experience teachers have with technology. Teachers have most likely felt the pressure for innovation from above. They have not been through the process of planning conscious aims or plans for the use of the new technology. It is claimed that the use of computers has to fit into the teachers' pedagogical view of teaching and learning, and if implementation of computers in school is to be successful, one must start with the question of why they should be used and not how (Cuban 1986, Cohen 1987). At the same time that school budgets are appropriating more money for computer technology and teacher training, research on ICT in school activities is continuing, as researchers want to find out how and when computers can help pupils to learn. It is argued that some features of ICT must be seen as potentials that have to be implemented in contexts of learning (Säljø 1999).

[1] SITES is a study conducted by IEA, the International Association for the Evaluation of Educational Achievement. The study focused on primary and secondary schools. Twenty-six countries participated in Europe, but not all countries took part at all levels.

Cuban (1993) has described what he calls the "dominant cultural norms" with respect to learning, instruction and the nature of knowledge. Learning is seen as a passive acquisition of an established knowledge. The teacher's role is to learn this formal knowledge, find ways of transmitting it to pupils and find out if they have learned what was taught to them. Learning is then looked upon as a process of transmission. Social institutions, and thus schools, have a remarkable capacity for "neutralizing" the effects of new developments. It is therefore expected that classrooms may prove to be too well buffered to be much affected by computers and indeed may assimilate computers entirely into their existing ways of doing things (Cole 1991). This means that the processes in the classroom have to be removed from the boundaries of a traditional teaching setting. Project work as a work method is an exception from the traditional teaching and learning practice.

As a teacher and also a researcher I have observed pupil activity during project work. The pupils I have observed have been using different aids during their work to find information and also to present their findings. ICT has been one of the elements in these projects, and this tool appears to me to have a potential to create an environment that can support pupils in their activities if teachers consciously use it to enhance the learning processes they are trying to arrange for. I was curious to find out how ICT can be integrated in project work to enrich the learning processes. During project work the classroom activity differs from traditional teaching and Cuban's "dominant cultural norms". As a consequence of this, I also presumed that this work method could promote computer activities that are not present in traditional classrooms.

The making of computer programmes and the research on their effects on learning have been framed by a traditional view on teaching and learning. The CAI and ITS programmes differ more in degree than in kind (Koschmann 1996), and imply that the relationship between pupils and computers can be viewed as an analogue to the traditional relationship between pupils and teachers, with the computer replacing the teacher. Thus computer technology can be considered as a new tool for transmitting knowledge or as a new way to explain knowledge that replaces the teacher. I am primarily interested in how computers transform the way cognitive activity is organized. Therefore, social and cultural factors are decisive elements that have to be taken into consideration in research on ICT in learning. Research also shows that the effects of computers to a large extent are dependent on the social and educational contexts within which they are used (Sheingold, Hawkins & Char 1983).

A new paradigm is emerging in research on ICT (Koschmann 1996). The paradigm is based on social constructivist viewpoints that assume that learning, and thus knowledge, is constructed in social processes. This paradigm also brings social issues into the foreground as the central phenomena for study. Computer Supported Collaborative Learning (CSCL), as it is called, can describe activities in a variety of settings. It can be used about activities that connect users across classrooms, about activities outside the classroom and also about collaboration processes in the classroom (Koschmann 1994). Research in this paradigm looks at how social factors affect the learning processes, how ICT actually is used in the learning processes and how learning is reflected in the language of learners. The central focus for research in CSCL is thus on instruction as enacted practice. Work in the CSCL paradigm tends to focus on process rather than outcome, and there is an interest in understanding the process from the participants' viewpoint. CSCL studies also aim to make thorough descriptions of the phenomena under study, and therefore these studies also tend to be descriptive.

To develop a picture on how ICT is used in project work I gathered data from three classrooms at three lower-secondary schools. I have named these schools Applebee, Bridgeford and Cooper Schools. The teachers Steven, Sarah and Marion[2] respectively, are the key informants at these schools. During the observations that lasted from the start to the end of the project periods in these classrooms, the main focus has been on ICT as a mediating artefact. As a theoretical framework for this classroom study, theories that build a bridge between the individual and the social and cultural contexts are used to approach the research field, and to analyze and interpret the collected data material. The research study is thus a study of project work with the focus on ICT as the central mediating artefact in a social constructivist perspective. Both project work as a work method and ICT as a tool are, as mentioned, most likely new classroom elements for many teachers. The rationale for this study is to develop a thinking tool for school teachers, teacher educators and others interested in educational issues to help them integrate ICT in the learning processes during project work.

The main research question for the study is: *"How can information and communication technology be integrated in project work and what does this mean for the pupils' learning?"* In addition to this overarching question, I also generated several sub-questions or problem formulations that I wanted to investigate. These were:

[2] The names are of course pseudonyms.

(1) An important issue, I felt, was to find out *where the equipment and the computers were placed*, as it is also claimed that the location of ICT equipment is a significant factor in the learning processes (Schofield 1995).
(2) I also believed that *the number of computers* would play an important role in the organization of the teaching and that this organization would probably also have consequences for the pupils' activities.
(3) Another factor that I anticipated would have significance for the processes in the classroom was how the teacher's work was supported by the school administration, *if there was a willingness to use some money from the school budget to buy necessary equipment and programmes, and, furthermore, if funding was allocated for maintenance of the equipment.*
(4) Another aspect I felt would be important was how the classroom context and the school environment can create a learning community for the pupils. In connection with this I wanted to focus on the *teachers' attitudes, how the teachers cooperated and how this cooperation could influence the processes in the classroom*.
(5) At the classroom level I wanted to focus on *how the teachers guided the pupils* on their way to their goals, and I also wanted to examine *how the teachers organized the group work.*
(6) Furthermore, I wanted to see how the *collaboration between the pupils* would help them obtain answers to their questions, and I wanted to focus on *how the ICT equipment as a tool could help the pupils during these processes.* In this connection I wanted to see if there were any *differences between boys and girls with regard to computer use.*

During the work the focus has also been directed to how the pupils use ICT when they gather information and how they use the tool to communicate the answers to the thesis question they made in the planning phase of the project work. The study also takes into consideration *what knowledge or understanding the class or the learning community mutually creates*, and a*ssessment processes are also given a prominent focus*. Therefore my work focuses both on the context for and the processes actually taking place in the classrooms.

In Part 1 of the text I deal with the theoretical and methodological approaches, which both frame and guide the research study. The first chapter in this section deals with socio-cultural theory, Dewey's idea-based social constructivism, the theory of project work and perspectives on ICT as a mediating artefact. In the next chapter I bring the methodological

approach into focus, and describe the research process and how the analytical categories[3] were formed. In Part 2 of the text, Chapters 5-7, project work as an activity is described from the beginning to the end of the project periods. In this description the voices from the pupils, the teachers and the researcher are heard. The contexts that lay the premises for the actions during the project periods are also presented. The next four chapters, Chapters 8-11, deal with the analytical categories that were created on the basis of the collected data material. These chapters, Part 3 of the text, are introduced by a presentation of Vygotsky's and Bakhtin's concepts on language, dialogue, learning and understanding. Chapter 8 looks at the teachers' scaffolding activities when pupils use ICT as a mediating artefact. Chapter 9 examines pupils' collaboration processes while using ICT as a tool. Chapter 10 deals with knowledge building and examines the teacher's role in creating mutual engagement and common understanding in classrooms working with ICT. Chapter 11 looks at the assessment issue and deals with this topic in connection with project work and the use of ICT in such a framework. Finally, Chapter 12, Part 4 of the text, examines the findings from the study in both a historical and future perspective.

This study provides a description of how ICT is used in three classrooms, and also describes the social factors that are found in the context. In Chapters 8 and 9, dialogues are used as illustrations for both the scaffolding and collaboration processes. Chapters 10 and 11 contain dialogues between teachers and pupils when knowledge is created and also assessed. These dialogues are used to analyse the ongoing process and also to discover what learning the language reflects. Due to the focus, the method and the theory used, the research study may be perceived as a study in the CSCL paradigm.

[3] An analytical category forms the basis for a chapter in the text in which theory is illustrated with examples from the classroom. At the end of the chapter the findings are discussed in a greater context.

Part 1:

Theoretical and Methodological Approaches

Chapter 2
Social Constructivist Perspectives as the Theoretical Frame of Reference

Over the centuries there has been a pervasive mind-world conflict. The distinction between mind and world, the mind-world dualism that separates the knower from the object to be known, has been reflected in teaching in schools, and still has a significant impact on school practice. Mind is viewed as something that extends beyond the flesh, it is something that is often both socially distributed and connected to the notion of mediation (Bateson 1972, Geertz 1973). According to this, mind is something more than activity limited to merely taking place inside the head. In this text I use the words "mind" and "world" as well, and also give them an extended meaning compared to how they have traditionally been perceived. I comprehend the word "mind" as a term that includes the whole person (see Appendix 8, Figure 17, p. 411) or the whole identity as Resnick, Pontecorvo & Säljø (1997), Wenger (1998), Wells (1999) and Daniels (2001) would say. Furthermore I perceive the term "world" as both the physical and social world in which the person acts.

Social constructivism represents a worldview that tunnels through the Cartesian wall, between the mind and the world, rationalism and realism. The belief in social constructivism is that an active person constructs knowledge in social activity in the world, and thus learn and develop its understanding during these processes. The mind has continuous influence upon the world and vice versa, thus knowledge is created in mutual processes between mind and world (Prawat 1996). Knowledge in a social constructivist view is thus constructed and developed, not an absolute entity withhold from change. Socio-cultural theory and Dewey's idea-based theory are versions of social constructivism that connects the entities mind and world. Next I present these two theories, starting with the socio-cultural theory.

Socio-Cultural Theory

Socio-cultural theory goes under many names. Some Soviet psychologists refer to theory that is based on Vygotsky’s thoughts and ideas as the “cultural-historical theory” (Davydov & Radzikhovskii 1985), others names it the “socio-historical theory” (Leontèv & Luria 1968). U. S. psychologists often seem to have Vygotsky's theory in mind when they talk about the “Soviet socio-historical approach” (Scribner 1985). In Europe and in the U.S. “socio-cultural theory” is probably the most usual label for the theory that is founded on Vygotsky’s ideas (Wertsch 1991, Wertsch, Rio, Alvarez 1995). Chaiklin (2001) argues that Vygotsky himself

used the term “cultural-historical”, and he himself has decided to use the same term as the original. Cole (1996) has connected the term cultural-historical to the Activity Theory, and thus named it the Cultural-Historical Activity Theory. I have decided to name the theory that builds on Vygotsky’s fundamental thoughts and ideas “socio-cultural”, which is the most used label in the west. On the other hand I connect the term “cultural-historical” to the Activity Theory and thus names it the Cultural-Historical Activity Theory (CHAT). The roots of the socio-cultural theory are commonly associated with the three Russian scholars Alexi Leontév, Alexander Luria, and Lev Vygotsky.

The philosophical roots of this theory are first and foremost the work of Marx and Engels. They claimed that neither mechanical materialism nor idealism was a proper way to look upon the human being and its development, because materialism rejects the human agency, and idealism or rationalism look upon human agency as something that is in the head or soul of the individual (Marx & Engels 1968). The socio-cultural approach to learning and development were first systematized and applied by Vygotsky and his co-workers in the 1920s and 1930s in Russia. This approach is based on the idea that human activities take place in cultural contexts and are mediated by language and other symbol systems. Furthermore, the socio-cultural approach takes the stance that human activities can best be understood when investigated in their historical development. In contrast to theories focusing on mind or world, or rational and realistic theories, Vygotsky looked upon development as the transformation of socially shared activities into internalized processes (John-Steiner & Mahn 1996). He thought that the individual and the social environment could not be separated. The individual and the social environment should rather be conceived of as mutually constitutive elements of a single, interacting system. The connection between the social organization of behaviour and the individual's organization of his thinking, is also emphasized in Vygotsky's claim that "the levels of generalization in a child correspond strictly to the levels in the development of social interaction. Any new level in the child's generalization signifies a new level in the possibility for social interaction" (Cole 1988, p. 148).

Leontèv (1981) has argued that one of the most major accomplishments of Soviet psychology has been to recognize the integral relationship between internal and external activity. Internal activity that has arisen out of external practical activity, has a fundamental and two-way connection with it. It is not separate from it and it does not rise above it. Intellectual activity is thus not isolated from practical activity, and this activity is present both in material activity and in activities that are looked upon as intellectual. In the general genetic

law of cultural development Vygotsky (1978) explains the relationship between the internal and the external processes:

> *An interpersonal process is transformed into an intrapersonal one. Every function in the child`s cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological), and then inside the child (intrapsychological) (p.57).*

Thus every processes appears twice, first in the social world and then in the internal state of each individual taking part in the social process. The internalization process in this way forms a bridge between the outer and inner processes, between mind and world. In contrast to Aristotelian logic that places mind and matter into fixed, unchanging phenomena, Vygotsky (1978) analyzed higher mental functions as developmental processes in a constant dialectical change. He looked upon mind and matter, mind and world as parts in a dynamic interrelated process, and he included a "scientific explanation of both external manifestations and the process under study" (p. 63).

Vygotsky used three central tenets to describe the concept of internalization. These were: social sources of development, semiotic mediation and genetic or developmental analysis (Wertsch 1991, John-Steiner & Mahn 1996). As I have mentioned, internalization starts on the external plane. The social sources lay the foundation for the development of inner mental processes. Even though Vygotsky (1981b) and his colleges saw social reality as having a primary role in determining the nature of the mental processes, the individual was not looked upon as a passive part of this process. The consciousness is not a product of society, rather it is produced in interaction between the individual in society. The Vygotskian approach rejects the assumption that the structures of external and internal activities are identical and the assumption that they are unrelated. There is a developmental relationship between the external and internal activity in which the external processes are transformed to create internal processes. Vygotsky said: " It goes without saying that internalization transforms the process itself and changes its structure and function" (p. 163). This shows that the individual is active with both transforming the process and also changing it structure. Vygotsky (1981b) says further that all higher mental functions are internalized social relationships. Human beings retain the functions of social interaction in their private sphere, and even their mental processes are quasi-social. Leontèv (1981) expresses this phenomenon as follows: "Thus the process of internalization is not the transferral of an external activity to a pre-existing internal plane of consciousness: it is the process in which this internal plane is formed" (p. 57).

Genetic analysis means that focus is not placed on the product of development, but on the very process by which the higher forms are established. Vygotsky's genetic orientation asserted that it is possible to understand many aspects of mental functioning if one understands their origin and the transitions they have undergone (Wertsch 1991, Wertsch & Toma 1995). Vygotsky was concerned with the developmental process of growth and its source, not "fossilized behaviour" (Vygotsky 1978). He said that to explain human mental processes is to examine their origins and development (Wertsch 1981). In his empirical research Vygotsky focused mostly on the development of the individual, on ontogenesis, but his analysis also applied to genetic domains such as phylogenesis, historical data and microgenesis (Wertsch 1981, 1985, Scribner 1985). Vygotsky's theory of the study of higher mental functions is often called the "cultural-historical theory of mind" because historical analyses were such an important element in it (Wertsch 1981). In ontogenesis, Vygotsky stated, the cultural line of development involving mastery of the culturally mediational means is combined with a natural line of development that involves development and maturation (Scribner 1985, Wertsch 1985, 1991). Microgenesis as part of ontogenesis was also of interest to Vygotsky and his followers. It means that the focus is placed on how mental processes develop in an individual over a relatively short period of time, and how different skills are gradually acquired during training (Wertsch 1981).

The Prominent Role of Artefacts

Artefacts have a prominent place in socio-cultural theory, and artefacts are even looked upon as extensions of the individual (Prawat 1996). Wertsch (1991, 1998) defines agents as "individuals-acting-with-mediational-means" to describe the close relationship between actor and mediational means. When Luria (1928) wrote about "tool" mediation he did not only have practical tools in mind, such as hoes and knifes. He considered language to be an integral part of the overall process of cultural mediation, and thus conceived language as the "tool of tools". Vygotsky looked upon semiotic mediation as the key to all aspects of knowledge co-construction. He claimed that semiotic mechanisms connect the external[4] and the internal, the social and the individual. Vygotsky (1981a) listed a number of examples of semiotic means: "Language; various systems of counting; mnemonic techniques; algebraic, symbol systems; works of art; writing; schemes, diagrams, maps and mechanical drawings; all conventional signs" (p.137). Vygotsky (1986/2000) also believed that the "tool of tools" was language, and

[4] Vygotsky stated that when talking about process, "external" means "social". Any higher mental function was external because it was social at some point in time before becoming an internal, truly mental function (1981b, p. 162).

thus was convinced that the communicative processes were the main medium by which individuals could form their consciousness. He also approached language and other sign systems in his analysis in terms of how they are part of and also mediate human action (Wertsch 1991). He claimed that language and signs were the most important means employed by humans to organize social interaction, to regulate others and to regulate oneself. In this way people not only communicate with signs, but they are also to a large degree controlled by them (Wertsch 1981).

Luria (1981) emphasized the mediational means' origination in social life, stating: "In order to explain the highly complex forms of human consciousness one must go beyond the human organism. One must seek the origins of conscious activity and "categorical" behaviour not in the recesses of the human brain or in the depths of the spirit, but in the external conditions of life. Above all, this means that one must seek these origins in the external processes of social life, in the social and historical forms of human existence" (p. 25). This indicates that human consciousness is created in the interaction processes between individuals and the means that are part of their social environment. In socio-cultural discourse, computers are also recognized as important elements in the appropriation of knowledge by the individual through representational activity (John-Steiner & Mahn 1996).

Artefacts are usually understood as tools. An artefact is a part of the material world that has been modified throughout history by taking part in goal-directed actions (Cole 1996). "By virtue of their changes wrought in the process of their creation and use, artefacts are simultaneously *ideal* (conceptual) and *material*. They are ideal in that their material form has been shaped by their participation in the interactions of which they were previously a part and which they mediate in the present" (p.117). Tools are defined both as "technical" and "psychological" tools (Wertsch 1985, 1991, 1998). When artefacts are defined this way, both language and forms of artefacts such as chairs and tables can be looked upon as artefacts (Cole 1996). Wartofsky (1979), who said that "an artefact is to cultural evolution what the *gene* is to biological evolution" (p. 205, italics in original), described artefacts on three different levels.

The first level is *the primary artefacts*. These artefacts are directly used in production, and examples of such artefacts are axes, clubs, needles and bowls (Wartofsky 1979). Cole (1996) also includes words, writing instruments, telecommunications networks, and mythical cultural personages in this category. While such artefacts are directly tied to production, they are also factors in the social life of a person. Carpenters use various aids when they build a house. They use tools which generations before them have created and developed in practical

work. In the kitchen the housefather or housewife uses tools to help in the cook. In this way such artefacts become a part of the social life directly when they are used in the working community, or indirectly through what is made. They acquire a social meaning for people, for instance for a family gathered around a dinner table (Postholm, Granum & Gudmundsdottir 1999). At school, response groups are often used in connection with writing. The pupils need to give and receive comments. The teacher can show the pupils how such response-giving can be conducted. Modelling with the help of words becomes an important instruction tool or cultural artefact in this process (Hoel 1997).

Secondary artefacts are defined as representations of primary artefacts and actions in which primary artefacts are used. These artefacts play a central role with respect to preserving and transmitting modes of actions and beliefs. They include recipes, traditional beliefs, norms and constitutions (Wartofsky 1979). School has the tradition through which the textbook is the starting point of the teaching. This is a norm teachers in traditional schools follow. The tradition to use a textbook becomes a norm or cultural artefact that the teachers use in their teaching situation, and the activity in the classroom thus becomes a secondary artefact (Postholm et al. 1999).

At the third level we have the *tertiary artefacts*. These artefacts form a relatively independent "world" in which rules, conventions and results do not appear in the practical world. Such imaginative artefacts may colour the way we look upon the real world, and thus they can change the current practice. The concept of tertiary artefacts can be used in connection with art and play activities. A puppet show is an example of a cultural artefact on this third level. A puppet show can impress some people in the audience so that they change their opinions and thus presumably their actions in real practical life (Wartofsky 1979, Cole 1996, Postholm et al. 1999).

Unmediated and Mediated Functions

All elementary forms of behaviour are described by the S-R or stimulus-response formula. The structure of sign operations requires an intermediate link between stimulus and response, between subject and object, mind and world. This sign creates a new relation between S and R. The person draws in the second order stimulus (sign), and is thus actively engaged in making a link between the subject and the object. This sign also has the characteristic of reverse action that means that it operates on the individual and not the environment. Using these extrinsic or second order stimuli, individuals may control their behaviour from without. This auxiliary stimulus transfers the mental operations to higher and qualitatively new forms,

described as culturally based mental processes. The intermediate link between S and R is not just an improvement of this operation, but it is a qualitatively new process. This is visualized in Figure 1 below:

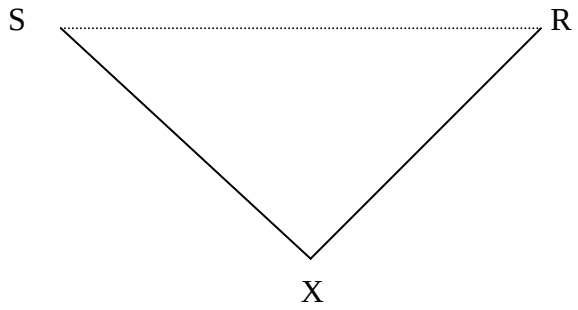

Figure 1: Vygotsky's (1978) triangle showing the intermediary step between the stimulus and response through the auxiliary stimulus

The functions that are called natural or "unmediated" are those along the line between S and R. The functions that are cultural and "mediated" are those moving along the two lines making a triangle. The mediated actions thus make a link between the rational mind and the surrounding world. Mediated activity does not replace natural or unmediated activity. Mediated actions operate synergistically on the same routes as unmediated actions and thus create a new structural relation, where both biological and cultural development are interweaved. Human thought is thus the intermingling between natural, direct experiences on the one hand, and indirect, cultural experiences on the other (Cole 1996). Artefacts and actions do not exist in isolation. They are interwoven with each other and with the social world of human beings. Thus artefacts and human beings acting in their social world form vast networks of interconnections (Latour 1994). The idea of mediation by tools and signs breaks down the Cartesian wall "that isolates the individual mind from culture and society" (Engestøm 1999, p. 29). It was Vygotsky's basic idea that human ontogeny differs from animal ontogeny in that it combines two lines of development, the biological natural line and the cultural line, and that these two lines are present at the same time[5] (Scribner 1985, Valsiner & van der Veer 2000).

[5] Vygotsky did not provide a detailed definition of these two lines of development. He was particularly unclear about the natural line. Vygotsky's claim that these two lines of development operate in isolation during the child's first years has also been questioned because of recent research on infancy (Trevarten 1979, Uzgiris 1989).

Vygotsky distinguished between higher and lower mental processes. The higher processes are called higher because they are lower processes that are transformed. Higher processes are perceived as cultural because they involve use of cultural procedures and means that vary across cultures. To use mnemonics to remember is a higher cultural process. Higher processes are also considered to be social. The process of pointing is developed from an infant's unsuccessful attempt to grasp an object. The adult interprets this action as pointing and reacts accordingly. The child will gradually make use of this social effect, and in this way it is the social other who initially attaches meaning to the child's movement. Thus the pointing gesture has a social origin (Vygotsky 1978, Wertsch 1985, Valsiner & van der Veer 2000). Higher processes are internal because they have undergone the processes of internalization. In this higher process mediating artefacts are initially used until the person manages to accomplish the actions without this aid. All the same, many higher processes will always be carried out with the help of some artefacts (Wertsch 1998, Valsiner & van der Veer 2000). Mediating artefacts, cultural differences and social origin are all concepts that give coherence between higher mental processes and the environment surrounding the human being, thus a bridge is built between external and internal processes, between mind and world. According to Leontèv (1981), internal activity, which has arisen from external, practical activity, is not separated from the practical activity, nor has it risen above this, nevertheless, it retains its fundamental, two-way connection with it.

The Cultural-Historical Activity Theory

Artefacts also play a prominent role in the Cultural-Historical Activity Theory (CHAT) that Leontèv has developed on the basis of Vygotsky's thoughts and ideas (Wertsch 1981). In Stalinist Russia too much attention on mentalistic constructs, such as meaning, was politically risky. This trend in Vygotsky's work was regarded as dangerous. Vygotsky's follower, Leontèv, distanced himself from his teacher. Instead of emphasizing meaning and further downplaying the role of psychological tools as mediators, which was Vygotsky's focus, Leontèv preferred to highlight the importance of the child's actual relations with reality (Kozulin 1990). In the 1960s Ilyenkov was able to relax a bit from the focus on practical activity. His version of Activity Theory allowed for nonmaterial phenomena like meaning and value (Bakhurst 1995). Thus it was the political atmosphere that forced Leontèv to downplay the role of psychological artefacts. Nevertheless, a careful reading of Leontèv's work reveals that both mediation by signs and subject-subject relations play an important role in the theory

(Engestrøm 1999).[6] He believed that our knowledge of the world is mediated by our interaction with it. This was a criticism of theories that treat humans as if they were passive receivers of stimuli. Such a view is also a criticism of idealistic theories that treat humans as if they created their knowledge of the world through conscious reflection. Neither the external world nor the human being in isolation is responsible for developing knowledge, but both of them in interaction. Leontèv claimed that "activity" breaks down the distinction between the external world and the world of internal phenomena (Wertsch 1981).

Cultural-Historical Activity Theory has several features that correspond to Vygotsky's fundamental thoughts. In this theory activity has got a prominent place and is analyzed on three different levels. The constructs *activity, action* and *operation* have been used to describe these levels. The activity contains the actual motive behind the actions taking place. Activities are composed of actions, which are coordinated to reach certain goals, which represents intermediate steps in satisfying the motive. Actions in turn are composed of operations, the means whereby an action is carried out under specified constraints (Leontév 1981). During a project at school, general, or holistic, competence may be the underlying motive behind the activity. Thus project work methodology is used to support the overall development of a pupil's personality. It is, however, difficult to emphasize all the areas of competence, or skills, which the pupils ought to develop during one and the same project. Therefore it will be natural to choose specific goals to be worked on during each project. The activity consists of different actions that are co-ordinated in order to attain the goals of each of the project sessions. These goals are thus preliminary stages en route to the main objective or motive behind the activity. The various actions lead to targets under the goals that together may satisfy the overarching objective or motive, which is holistic development. The operations are distinguished on the basis of the conditions under which they are carried out. The project may be organized in different ways. Pupils may sit individually or in groups. How the interplay between these pupils functions may differ. How teachers guide pupils during the project may also differ from classroom to classroom. The environment and the factors which impact the various actions will hopefully satisfy the objective of the work, and give the actors a sensible feeling of the overarching objective (Postholm et al. 1999).

In Cultural-Historical Activity Theory goals and goal-directed actions are given emphasis. The goals are not segregated from the process, but are instead a part of the educative process. Another central feature for the Cultural-Historical Activity Theory is that

[6] In my analysis I contemplate language as a mediating artefact equal to technical tools. According to Engestrøm & Miettinen (1999), the integration of discourse into the Cultural-Historical Activity Theory has only just begun.

actions are mediated. According to the theory, each local activity has a connection to historical and culturally formed mediating artefacts, artefacts that are common to the culture (Wertsch 1981). The mediating artefacts have a hand in forming and creating an activity in a special way. These artefacts are combined, used and transformed in new ways in a local joint activity. Local, concrete activity is thus at the same time both unique and general, momentary and durable. In a unique way local problems are solved by using general, cultural artefacts created by previous generations (Engestrøm & Miettinen 1999). In Cultural-Historical Activity Theory development at several levels also plays a central part as in social-cultural theory (Wertsch 1981).

In Cultural-Historical Activity Theory the externalization process is also central (Leontèv 1981, Engestrøm 1999). The two processes, internalization and externalization, are processes that continuously operate at every level in human activity. Internalization is related to reproduction of the culture in question. Externalization means processes that create new artefacts or new ways to use them, thus enabling development and creative processes. A graphical expression of the two interwoven processes internalization and externalization is given by the expansive cycle (Engestrøm 1999).

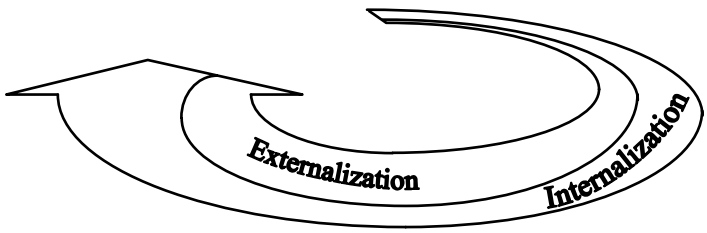

Figure 2: The expansive cycle

The expansive cycle of an activity begins with an emphasis on internalization. In this process the novice members of a community are trained and socialized into the activity that is routinely executed. Externalization as creative action occurs in innovative, individual processes. When the activity becomes more demanding, self-reflection and externalization increase. The process of externalization has reached its peak when a new model has come into existence. Then the process of internalization again becomes conspicuous, as the inherent ways and means of the new model have to be learned (Engestrøm 1999). The expansive cycle clearly shows the close connection between the individual and its environment, between the mind and the world.

The Activity System

Leontèv expanded on Vygotsky's theory, while the Activity System has been developed on the basis of the Cultural-Historical Activity Theory (Engestrøm 1987, Engestrøm 1999, Engestrøm & Miettinen 1999). In the collective Activity System human activity is structured and visualized by several triadic relations. This system is visualized in Figure 3 below.

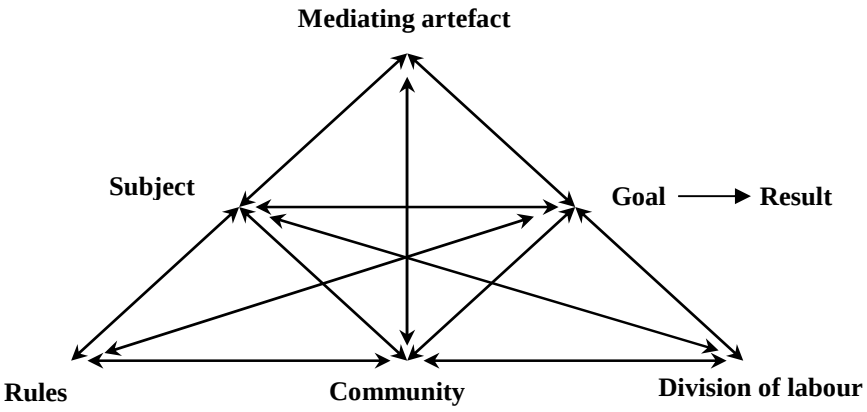

Figure 3: The complete Activity System

The upper triangle in the Activity System is the same as Vygotsky's fundamental triangle, but it is turned upside down with the mediating artefacts at the top (see Figure 1, p. 15). The concept of mediated action or cultural mediation that is the central point in socio-cultural theory advances Vygotsky's ideas that the individual's mental activity is founded and integrated in a mutually social, cultural, educational and historical context (Wertsch 1991, 1998). The minimum elements of an Activity System include, subject, mediating artefacts (signs and tools), goals, rules, community and division of labour (Engestrøm 1987, Cole & Engestrøm 1993). These factors make up several triadic relations, and these relations are (re)presented in the Activity System.

Mediated actions are integrated in the system in the upper triangle. Mediating artefacts function as intermediary aids which the acting subject chooses to use when trying to attain the goals for the actions. The system shows the close connection between the acting subject, which can be either an individual or a group of people (Engestrøm 1999), and the context. Context is not reduced to something that just surrounds, but is interwoven in the actions, becoming a single process. The actions exist only in relation to the context that is visualized by the three triangles at the bottom of the Activity System (Cole 1996). The context that

comprises the factors “rules”, “community” and “division of labour” lays the premises and also possible restrictions for the subject’s goal-directed actions.

Rules include norms and conventions that direct the actions in the Activity System. The factor "community" refers to all people that share the same goals. Division of labour means that the work or the goal-directed actions are divided between and conducted by people belonging to the community. The concept "division of labour" makes it possible to distinguish between collective activity and individual action (Engestrøm 1987, Cole 1996, Engestrøm & Miettinen 1999). When people divide work between themselves, each their own result does not satisfy their needs. Rather their needs are satisfied by the portion of the product of their aggregate activity they gain in their social relation during the working process. The Activity System as a unit of analysis makes the system view and the subject’s view complementary factors (Engestrøm & Miettinen 1999). The factors in the Activity System are in mutual relation to each other and are continuously changing because of human actions and interplay. The internal tensions and contradictions of such a system are what make the foundation for change and development (Engestrøm & Miettinen 1999). Change and development are accentuated by continuous transitions and transformations between the factors in the Activity System just mentioned, and between embedded factors, such as collective motive-driven activity, individual goal-driven action and automatic operations driven by tools and conditions of action (Leontèv 1978).

As the Cultural-Historical Activity Theory focuses on different developmental processes as a foundation for the Activity System, different developmental processes are thus also present in the Activity System. In this system both the unmediated, biological process and the mediated and cultural processes are represented by the upper triangle (Vygotsky’s fundamental triangle turned upside down (see Figure 1, p. 15). The Activity System thus visualizes that both lines of development co-occur and are fused (Scribner 1985). When growth and development are studied as transformations resulting from tensions between the different components or levels represented by the Activity System, historical data also naturally become an integral part of the continuous process (Engestrøm & Miettinen 1999)

As mentioned there are mutual relations between all the components in the Activity System. The cultural mediating artefacts function as the connection between subject and object, between the subject and the goal, and thus the mediating artefacts connect the mind and world dimension. The artefacts are used by the members of the community, at the same time as the community members change and develop them to reach the altering goals for their activity. Thus the artefacts affect the acting members of the community at the same time as

the community members transform them and in that way have influence on the artefacts they have at their disposal. When we consider the notion of internalization, that is concerned with the ontogenesis of the ability to carry out socially formulated, goal-directed actions with the help of mediating artefacts, the Cultural-Historical Activity Theory fits well in a theoretical framework based on Vygotsky's ideas (Wertsch 1981).

In the post-war decades the Cultural-Historical Activity Theory was mostly developed within the psychology of play, learning, cognition and child development, but it now encompasses such topics as the development of work activities, issues of therapy and implementation of new cultural tools such as computers (Nardi 1996, Engestrøm & Miettinen 1999).

Dewey's Idea-Based Social Constructivism

Dewey believed that to have an idea about a thing is to receive certain sensations from it. You have to be able to respond to the thing in view of its place in an inclusive scheme of action. The correlation to thinking of facts, data and knowledge already acquired, are suggestions, inferences, conjectured meanings, suppositions and tentative explanations, which stand for a person's ideas. The idea is to foresee the drift and the probable consequences of the action of the thing upon us, and our action upon it (Dewey 1916). In this way the idea functions as a bridge between the world and the mind, between the thoughts that affect the physical environment and the affected environment that again influences our thoughts. Hence to develop and train the mind is to provide an environment that induces activity, but mere activity does not constitute experience and change. When the change produced by action is reflected back to a change in the human being, the activity is significant and the people involved learn something. Dewey (1916, 1938) also talked about continuity of experiences. He believed that the achievements of the past provide the only means for understanding the present, and the experiences of the present have meaning or consequences for the future. Thus understanding and meaning develop in a dialogical and continuous process between the past, present and future. In Dewey's opinion people are most prepared for the future when their learning is based upon present life experiences with both the past and the future in mind, not just upon transmitted knowledge created by other people's experiences in the past.

Dewey saw social activity as an important element of an individual's development. He also claimed that thinking and feeling in connection with an action in association with others is as much a social mode of behaviour as the most overt cooperative activity. If persons are to be partners in a shared activity, Dewey felt that the actors have to have the same interest in

accomplishing the actions. In such a case they would share ideas and activities. Dewey contended that persons conducting activities could not have a direct influence on each other apart from using the physical environment as an intermediary. Such a thing as a smile, a frown, a rebuke, a word of warning or encouragement involves some physical change. The environment is a social medium in which individuals grow up. The individual's responses become intelligent because he or she lives in a medium of accepted meanings and values. Through social intercourse, through shared activities, the individual gradually acquires a mind of his or her own. Dewey maintained that certain capacities of an individual are only activated under the stimulus of associating with others, for instance during group work (Dewey 1916), and he believed that the mind cannot be regarded as an individual, monopolistic possession, rather it is developed in an environment which is social as well as physical, and that social aims and needs have been most potent in shaping it (Dewey 1900). The idea that children need to work alone to be free and develop their individuality comes from measuring individuality by spatial distance, which means that it is looked upon as a physical entity (Dewey 1916).

Dewey saw the importance of language, but also stressed that the meaning of language had to be attained in connection with shared experiences. Later when people experience together and obtain the same mental understanding of words, language can also function as an extension and refinement of the principle that things gain meaning by being used in shared activity. Dewey claimed that language should play a large part compared with other tools because language can represent physical conditions that have lost their original quality in becoming social tools. Through language we have the opportunity to share vicariously in past human experiences, and we are able to imaginatively anticipate situations. All language, all symbols, are implements of an indirect experience, and the experience which is procured by their means is mediated. Physical things according to Dewey, do not influence the mind unless they are implicated in action for prospective consequences. Dewey felt that the difference between an adjustment to a physical stimulus and a mental act is that the mental act involves response to things in its meaning and that the former does not.

The concept of interest means, in Dewey's view, that self and world are engaged with each other in the developing situation. The word "interest" expresses the whole state of active development, the objective results that are foreseen and wanted have a personal emotional inclination. Interest also means the point in time when an object touches or engages a man (Dewey 1916). Dewey arrived at a developmental theory of emotions and said that certain movements can be reduced to tendencies to action, to attitudes. As such they can serve as

means for realizing ends. On the contrary, if the organic activity represented by the attitude is different from that which stands for the idea or end, there is a struggle between the organic attitude and the idea. If one could let the coordination of the two entities be affected in one single act, instead of a successive series of mutually exclusive stimuli, Dewey believed that one could also talk about interest (Dewey 1895).

An activity that has an aim implies a distinction between an earlier incomplete phase and a later completed phase. Thus there are intermediate steps between these two phases. To have an interest is to enter into a continuously developing situation, without any isolated intermediate steps. This process demands continuity and endurance, and through this activity man can learn. Learning is to learn something from experiences that will help one to cope with difficulties in later situations. Learning takes place when both young people and adults discover something new to them, even though everybody else in the worlds knows it. These people, young and old, experience the joy of intellectual constructivity and creativity. Dewey also believed that when persons engage in continuously developing situations they also learn to learn (Dewey 1916).

From Dewey's perspective, education is neither a process of unfolding from within nor a training of faculties resident in the mind. Nor is it a formation of the mind through subject matter presented from without (Dewey 1916). The mind is not looked upon as a fixed thing, but a process of growth (Dewey 1900). Ideal growth results from a constant reorganizing or reconstructing of experience. Thus learning content cannot be transmitted to the pupil from the teacher, nor can the power latent in the pupils' minds be unleashed by influences from without. Knowledge is created in an active participating process in which the mind develops a better understanding or meaning of the actions taking place. The attained meaning can in the next instance create new ideas that can influence the activities the person engages in and thus can reconstruct the current activity. In this way learning experiences can modify the activities, both in the pupils' minds and the environment. Learning is affected by the results that are noted after the activity, but often the pupils in school have to act according to rules, and they are not led to see the connection between the answer or result and the method pursued (Dewey 1916). This leads to Dewey's ideas on aims.

In Dewey's opinion, aims should be a part of the educative process instead of being furnished from without. An aim is not attained when a person performs discontinuous actions as spontaneous self-expressions. An aim implies an orderly and ordered activity, which leads to a progressive completion of a process. Dewey talked about aims in education when the conditions permit a preview of the result, and thus the person is stimulated to look ahead to

see what the outcome of a given activity will be. The foreseen end in this way also gives direction to the activity. This preview functions in three different ways. First it involves cautious observation of the situation to see what means are available for reaching the end and to discover possible obstacles. Next the preview presents the proper order in the use of the means, and third the foresight makes choice of alternatives possible. When the pupil is given one single outcome from without, the mind has nothing else to think of. To see an end of an activity is to have a basis upon which to observe, to select and to order objects and its own capacity. When a mind accomplishes an action it is also capable of seeing a future possibility, and thus the person can make a plan to accomplish his or her actions. The mind has the capacity to refer the present conditions to future results, and likewise future results or consequences to present conditions. This is what is meant by having an aim or purpose. Acting is thus an intelligent activity. Consciousness is referred to as an abstract noun, but it should not be forgotten that it comes from the adjective conscious. To be conscious indicates the deliberate, observant, planning traits of activity. Consciousness is thus the name for the purposeful quality of an activity that is directed by an aim. To have an aim therefore means to act with meaning, Dewey claimed.

To be considered good, aims also have to meet certain criteria. Educational and moral theories about the proper end of activities assume ends lying outside our activities. These aims are something for which we ought to act, and therefore limit intelligence. They are imposed by some authority external to intelligence, and thus the activity is nothing but a mechanical choice of means. A good aim must be an outgrowth of existing conditions, and thus based upon considerations of what is already going on. A good aim also has to be flexible and capable of alteration to meet circumstances. A good aim can also help to change current conditions, to make desirable alterations in them. A farmer who passively accepts things just as he finds them makes as great a mistake as a person who makes his plans without considering what premises are set by the conditions, Dewey explained. A good aim takes into account the present state of experience of pupils, and forms a tentative plan for their education. These plans are constantly modified as the conditions develop. The tentative aim is thus constantly growing as it is tested in action. A good aim always represents a freeing of activities. An end in view is suggestive because it puts before the mind the termination of some process. In this connection it is important to remember that it is not the aim or target, but *hitting* the target that is the end in view. The target or aim and other objectives that are thought of, function as a means of directing the activity to this end. An end that evolves within an activity as a plan for its direction is always both an end and a means. Each means is

a temporary end until we have attained it, and each end becomes a means of carrying activity further as soon as it is achieved. An end thus marks the future direction of the activity in which we are engaged, and a means marks the present direction. Any aim that assists observation, choice and planning in carrying on the activity from moment to moment and hour to hour is of value. It is harmful if any aim obscures the individual's common sense. An educational aim must be founded upon the intrinsic activities and needs of the individual who is to be educated. Aims created outside the pupil's activities are uniform and thus neglect the specific powers and requirements of an individual, and forget that all learning is something that happens to an individual at a given time and place. Educational aims, in Dewey's opinion, must be capable of translation into a method of co-operation with the activities of those undergoing instruction. Educators have to be their own guards against ends that are general and ultimate, aims that are passed on to them from the authorities above their own realm of decision.

Dewey maintained that all information that is cut off from thoughtful action is dead because thinking is the method of intelligent learning. To stimulate thinking we need to have means that give rise to processes that are not routine, but rather present something new that is still connected to existing habits to elicit effective responses. A problem that exists naturally within a situation or personal experience can lead to intellectual thinking. It is important that it is the pupil that finds his or her own problem or question if it is to lead to effective learning. Another question is how far general conditions at school supply a context of experience in which problems naturally exist. No amount of improvement on the personal technique of the instructor will fully remedy this state of things, according to Dewey. To create this learning opportunity there must be more relevant material, more tools and more opportunities for doing so that the pupil can adapt the material to his own question. Thus the pupil can solve his own problem and not the problem of meeting the peculiar requirements of the teacher.

The mind–world dualism also involves the conclusion that method and subject matter are two separate issues. Dewey compares this separation with a person eating a meal. This person does not divide his act into eating and food, but a person who wants to investigate this phenomenon would examine on the one hand the properties of the nutritive material, and on the other hand, the man eating it. This reflection gives rise to the distinction of what we are experiencing and the experiencing, the how. Subject matter and method are terms that suit this distinction, which is important for certain purposes, and can be treated as a distinction not just in thought, but also in experience. Thus there is a division between the self and the environment, or the world, and this separation is the root of the dualism of method and subject

matter, Dewey explained. Experience is not a combination of mind and world, method and subject matter, but a single continuous interaction of different energies. Method is a statement of the way in which the subject matter of an experience develops effectively and fruitfully. From the learner's perspective the scientific form of knowledge is an ideal to be achieved and not a starting point for the learning processes (Dewey 1916). The challenge for the teacher is to "psychologize" the subject matter, and to keep the experience of the pupil moving in the direction of what the expert already knows. The teacher's role is to guide pupils towards a goal, and in that way function as a leader of group activities. Thus the teacher must be familiar with both the subject matter and the pupil's needs and capacities. Dewey meant that there had to be an interaction between subject matter and the interest of the pupils. The teacher has to recognize that the natural course of development always lies in situations that involve "learning by doing", and that this purposeful doing involves dealing with persons as well as things. Social knowledge is learnt in social intercourse with others, and as a part of this intercommunication one learns a great deal from others (Dewey 1902, 1916, 1938). Dewey (1916) said: "The ear is as much an organ of experience as the eye or hand" (p. 186). Dewey also claimed that genuine education is created by experiences that pave the way for further experiences, and that the teacher's main responsibility is to shape experiences that lead to growth through environmental conditions that are also shaped by the local community as well as in the classroom (Dewey 1916). An intellectual freedom emerges in pupils who have a question which sparks their curiosity, and who work under conditions that give them the opportunity to find the required information, using equipment that gets them involved through their interests (Dewey 1938).

Dewey also believed that the activities in school had to be more related to life outside the classroom. He said that resources were being wasted if the school did not utilize the experiences children gained outside school. The pupils also lost the opportunity to apply what they were learning at school in their daily lives because school was isolated from life outside its walls. Dewey wanted a child to come to school with a whole mind and body, and leave school with a fuller mind and even healthier body. He contended that all studies arise from aspects of one earth and one life lived upon it, claiming that we do not live in a series of stratified earths, rather we live in a world where all sides are bound together. From this it follows that there should be no strict boundaries between different subject matter. The teacher's task would be to bring the different factors of education together, to an organic union with everyday life. With a question as the starting point, the subject matter would also be naturally integrated in the solution or answer. According to Dewey, true reflective attention,

involving judging, reasoning and deliberating, on the bearing and relations of the collected material, is stimulated when the question is the pupils' own (Dewey 1900), but as already mentioned, he added that there should be an interaction between the subject matter and the pupils' interests, and that the teacher's role was to help the pupils in the direction of what the expert already knows (Dewey 1902, 1916, 1938).

Fundamental Thoughts in Socio-Cultural Theory, CHAT and Dewey's Idea-Based Social Constructivism – Similarities and Differences

Both socio-cultural theory and Dewey's idea-based social constructivism build a bridge between the dualism of mind and world. In socio-cultural theory, "psychological" and "technical" tools are the mediating artefacts between the individual and his or her surrounding world. In Dewey's idea-based social constructivism, the idea functions as a corresponding bridge between these two entities. The artefacts human beings use influence their activity, while at the same time they develop or create new artefacts that again affect their actions in new ways. In the same way, Dewey felt that people's ideas or thoughts affect the physical environment and the affected environment in turn influences their thoughts. In both theories the person is looked upon as conscious and active in the reciprocal activities that take place. This reciprocal connection also means that the environment for actions has a prominent place in both theories.

In socio-cultural theory, all higher mental functions are looked upon as having a social or cultural origin, as stated in the general genetic law of cultural development (Vygotsky 1978). Dewey (1938) was also interested in how the environment could become a social source for people’s experiences. He claimed: “It ought to be necessary to say that experience does not occur in a vacuum. There are sources outside an individual which give rise to experience" (p. 39). Dewey also said that the mind cannot be regarded as an individual, monopolistic possession. The mind, he said, is developed in a environment which is social as well as physical, and social aims and needs have been most potent in shaping it (Dewey 1900).

Even though Dewey saw the importance of the social environment as a medium for growth, tools never had as prominent a place in his philosophy of education as in socio-cultural theory. The idea of tool mediation was not new to the early Russian cultural-historical psychologists. They knew about John Dewey and where he placed tools in his theory (Cole 1996), but in socio-cultural theory tools or artefacts are more prominent, as they are looked upon as extensions of the individual (Prawat 1996). In socio-cultural theory, language is

looked upon as the "tool of tools" (Luria 1928, Vygotsky 1986/2000). Dewey (1916) said that the ear is as much an organ of experience as the eye or hand. He claimed that social knowledge is learnt in social intercourse and that one also learns a great deal from others as part of this intercommunication. Dewey therefore does not give prominence to language as the "tool of tools", but equates the ear, the eye and the hand as tools of experience and thus of learning. All the same, he also claims that language has a large part to play compared with other tools because it can represent conditions that have lost their original quality in becoming social tools (Dewey 1916). This shows that language as a tool also has a conspicuous place in Dewey's theory.

The Cultural-Historical Activity Theory connects the two concepts of internalization and externalization to learning. In socio-cultural theory learning is about how people use tools that exist in a given culture or society for thinking and acting (Wertsch 1991). Internalization is related to the reproduction of the culture, whereas externalization means processes that create new artefacts or new ways of using them (Engestrøm 1999). These thoughts are also present in Dewey's theory. He maintained that learning takes place when young people and adults discover something new to them, even though everybody else in the world knows it. As he put it, these people experience the joy of intellectual constructivity and creativity. Dewey also claimed that experiences are the foundation for learning and that learning experiences can modify activities both in people's minds and in the environment (Dewey 1916).

In the Activity System, the close connection between the acting subject and its context is made visible (Engestrøm 1999). Context is not looked upon as something that just surrounds the actions but is interwoven in them (Cole 1996). Dewey (1938) also proposed a relational theory to describe what happens between the acting subject and its context through his use of the word "situation". He said: "What is decided by the word situation is not a single object or event or a set of objects and events. For we never experience nor form judgement about objects and events in isolation, but only in connection with a contextual whole. The latter is what is called `situation`" (p. 66). Dewey's equating of the word situation with a contextual whole is a proper description of the word *context* (Cole 1996).

Dewey's ideas also show clear parallels with the Cultural-Historical Activity Theory. He also stressed that goals should be an integral part of actions. Dewey (1916) looked upon goals as "ends in view". They were something that gave direction to action. The end in view in a way forms a framework for the actions that take place in its context, it drives these actions. A motive or objective is also the overall goal or "milestone" for actions accomplished in an Activity System (Engestrøm & Miettinen 1999). The factor "goal" in the Activity

System can thus be looked upon as comprising partial goals that have to be reached on the way to the objective or milestone, which the acting subject continually will strive to reach. When goals are reached, others will replace them, continuously moving the acting subject towards an unattainable objective. Dewey also talked about goals and means in the learning processes, and said that each means is a temporary end until we have attained it. Each end becomes a means of carrying the activity further as soon as it is achieved. This shows that learning in his theory and in Cultural-Historical Activity Theory is looked upon as a process of growth with social arrangements as an important factor interwoven in the learning processes.

For both Vygotsky (1981b) and Dewey (1900) mind was not a fixed thing but an energy process of change and growth. When pupils work in a project-directed way, the assessment process also deviates from a mechanical goal-means thinking, a thinking that just looks upon the result to find out if the pupil has reached the listed goals through a various array of actions. In project work the process is also an important measure of the process of growth or how competencies have been developed. In this way the goals are not segregated from the process but are instead a part of the educative process (Wertsch 1981, Postholm et al. 1999). In Dewey's (1916) opinion this is one criteria for a good educational aim. Because of all the factors that resemble the Cultural-Historical Activity Theory and Dewey's theory, the Cultural-Historical Activity Theory is also looked upon as a continuity of Dewey's theoretical stance in the U.S. (Valsiner & van der Veer 2000).

Dewey (1938) claimed that the environment provided the opportunity for people to have experiences that were related to familiar experiences they had been through and furthermore created consequences that people could relate to in future experiences. Thus the past and present processes acquired meaning for future actions. Therefore, as we can see, in connection with his central concept of experience, the past and thus history also plays a part in Dewey's theory, as it does in socio-cultural theory. Everyday experiences or activities also have a prominent place in both Dewey's theory and socio-cultural theory. Leontèv said that learning often happens in practical activity, often during everyday activities (Wertsch 1981). Dewey also believed that activities in school had to be more related to the life outside the school building. He also said that pupils should be given the opportunity to utilize their everyday experiences in school (Dewey 1900). Vygotsky (1978) said that reading and writing must be "relevant to life" (p. 117-118). By this Vygotsky probably also meant the meaningfulness of relating educational activities to real life. This was also implied by his

theory as a whole (Wells 1999). In this way everyday experiences are important elements in both theories.

Vygotsky (1978) developed the concept “zone of proximal development” (ZPD).[7] This concept is defined as the difference between what one person can do alone and what he is capable of doing with the help of an adult or more capable peer. In the Vygotskian perspective help from a more capable person is looked upon as close interaction during the completion of tasks. Dewey describes the teacher's role during project work as that of an advisor for the pupils during their work (Dewey 1916, 1938). In this way there are differences in Vygotsky's and Dewey's comprehensions of the tutors' tasks. In Vygotsky’s theory the tutor's task is a close interaction between the tutor and the pupil throughout the entire exercise. Even though Dewey does not think of the tutor as controlling the activity, he thinks that there should be an interaction between the subject matter and the pupils’ interests, and thus the teacher’s role is to guide the pupils towards a goal. Dewey also talks about the challenge teachers’ have in "psychologizing" the subject matter for the pupils, and moving them in the direction of what the expert already knows (Dewey 1902, 1916, 1938). In Vygotsky's environment, pupils were given aims formulated by society. As a consequence of this the classroom became a social organization that represented the larger social community. In such cases the social organization or the greater social community is the agent of change in the individual. In Dewey's pedagogical stance, the individual could also function as an agent of change in the social organization (Glassmann 2001).

The epistemological stance in both Dewey’s idea-based social constructivism, social-cultural theory and Cultural-Historical Activity Theory is that learning and thus knowledge construction, is created in the meeting between mind and world, that means in the interaction between the acting subject and the object world. When people construct and reconstruct ideas in social activity, knowledge is not presented to them, not from without nor unfolding from within. People construct their knowledge during socially mediated activity. People learn through the experiences they attain from social activity, and thus they obtain more knowledge that makes them more prepared to meet demanding experiences in the future. Past experiences then help them to tackle both present and future experiences. People learn through social mediating actions that thus help them on their way to an objective or milestone. This is an objective they as learners always will be on their way to, as they make their way on their

[7] The concept of the ZPD is discussed in more detail in Chapter 8, which deals with scaffolding processes, and in Chapter 10 entitled "Shared Knowledge", which deals with the joint enterprise in classrooms.

developmental path, because this objective changes in accordance with their development. When they have reached one goal, this will then function as a means to reach another goal.

Internalization is a concept that strives to capture the learning processes that are present in both activity and dialogue. In the following text I will present dialogue and activity as central concepts in social constructivism, and further discuss the concept of internalization in connection with these terms.

Dialogue and Activity

Dewey (1916) said that the natural course of development lies in situations that involve "learning by doing" at the same time as he contends that this purposeful doing is helped by the interplay between both persons and things. Dewey explained that experience is not a combination of the mind and world, but a single continuous interaction of different energies. Today's thinking in socio-cultural psychology also underscores the merging of persons and their social context, and dialogue and activity have become two concepts that bring together these two entities (Valsiner & van der Veer 2000).

The focus in dialogue is on language, whereas activity in the first place brings the use of technical tools to the forefront. For all that, both dialogue and activity can be present in the same process and these two units are thus merged. A dialogue can be looked upon as an activity while there is no doubt that language can also play a central role when people interact with technical tools. James Wertsch, Barbara Rogoff and Michael Cole all present theories on these entities and how they give meaning for a holistic approach to human activity.

In Western culture, Wertsch is probably the theoretician who has based his theories most on Vygotsky's fundamental thoughts and ideas. Wertsch has integrated the focus on semiotic mediation, an idea developed on the ideas of Vygotsky's beliefs (Wertsch 1979, 1983). In his book *Voices of the Mind* (1991), Wertsch presents a dialogical perspective. Wertsch also refers to Mikhail Bakhtin's[8] work, which he uses to analyse and understand dialogues between people. Wertsch relied on the view that all social functions are social first before they become personal through the process of active transformation. This was one of the basic tenets in Vygotsky's theory and also in the Cultural-Historical Activity Theory, which built upon Vygotsky's foundation. Wertsch took both activity and dialogue as analysing units that merge the individual and his or her social context.

[8] Bakhtin's work and Vygotsky's ideas on thought and language are presented as an introduction to Part 3 that include Chapters 8-11. In these chapters dialogues are used as illustrations to acquire a deeper understanding of the activities described.

The proliferation of the Cultural-Historical Activity Theory has probably led psychologists to concentrate upon activity and the study of complex, observable activity settings. By using such holistic schemes as units of analyses, they could also transcend the analysis concentrating on different parts of a whole (Valsiner & van der Veer 2000). Rogoff (1990, 1992, 1993, 1995a, 1995b, 1996) focuses upon activity in which persons and their social context are unified as the unit of analysis. During this activity the person is looked upon as active, and the social guidance given by others is considered to be a complement to the person's own constructive role in his or her own development. The person is always an active apprentice who participates in socially-guided activity settings. The central point in Rogoff's theory is that persons and activities mutually constitute each other. In her view, which she calls "mutually constituting", the aspects comprising a whole are taken into consideration. These aspects are the individual and the social-cultural influences in activities. According to Rogoff (1992), one can bring one of these aspects to the foreground, while at the same time considering the other aspect in the background, thus not losing sight of their inherent involvement in the whole.

Cole also focuses on both activity and semiotic mediation in his cultural practice theory. His book "Cultural Psychology" (1996) clearly refers to Dewey's theory as he also sees culture and cognition as mutually constitutive processes. He has also uttered that: "culture and cognition create each other" (Cole 1985, p. 146). The concept of internalization became a problem in theories focusing both on dialogues and activities as analysing units. In the following I will elaborate more on this issue by presenting ideas that have led to the use of other concepts.

The Concept of "Internalization" – Discussion and Elaboration

Wertsch (1998) says that the use of particular tools leads to the development of particular skills and not generalized abilities or aptitudes. Analyses of how individuals master the use of different tools are often formulated in terms of internalization. According to Wertsch, this concept is quite misleading. The construct of internalization involves a kind of opposition between the external and internal processes. This can lead to the mind-body dualism that has been conspicuous in philosophy and psychology for centuries, and also to the view that individuals are passive receivers in this internalization process. Some interpreters of Vygotsky focus on dyadic interaction: the more knowledgeable “other” structures learning and experience for the learner. This interpretation of the Vygotskian theory is similar to information processing theory in its realist epistemology (Prawat 1993, Rogoff 1995a).

Wertsch (1998) on the other hand claims that a discussion of this concept between parties can be fruitless because they have different phenomena in mind when they use the term. To avoid such discussions he thinks that the persons involved need to specify examples of what they have in mind.

The concept of internalization, according to Wertsch (1998), is used in situations in which processes that were first carried out on an external plane are then conducted on the internal plane and thus made invisible. Counting can at first be conducted with the help of material cultural tools such as sticks or one's fingers. These tools later disappear when the activity has been internalized. When internalization is embedded in an analysis of mediated action in which the mediating artefacts do not disappear, he names the process "mastery", which means “knowing how" to use mediational means with ease. Wertsch claims that most activities never turn inward, and they are therefore performed with the help of tools. He therefore also argues that the metaphor of "internalization" is too strong because it indicates something that often does not happen. Wertsch therefore finds the concepts "mastery" and "knowing how" to have some advantages over the general notion of internalization.

A great deal of contemporary research on cognitive science deals with processes that are never intended to be internalized. This is a point made by many researchers who analyze “socially shared cognition” and “socially distributed cognition” (Wertsch 1998). Hutchins (1993) describes navigators using different tools to navigate the ship. These navigators could not have performed this activity without these tools and without co-operating by doing their part of the necessary work. This means that the activity could not have been internalized in the usual image alloted to the concept. Wertsch (1998) argues that most activities carried out by persons alone, where they use mediational tools to solve cognitive tasks, are never fully internalized. In this connection he mentions multiplication and argues that the cultural tool people use to solve this problem is never fully internalized because the mediational tool or multiplication procedure does a great deal of the work even though an acting agent is involved. He believes that the concepts of mastery or knowing how should be used in this situation as well.

In addition to mastery, the agent's relationship to mediational means may be characterized as “appropriation”. In many cases mastering and appropriation of cultural means are intertwined processes, but they can be distinguished both analytically and empirically. Examples of such a difference can be shown through the use of words as cultural tools. Some words can be difficult to make one's own, even though one can properly use them in dialogues. Wertsch (1998) uses the word "appropriation" as a translation of what Bakhtin

said was to take something that belongs to others and make it one's own. Bakhtin (1981) said that "language, for the individual consciousness, lies on the borderline between oneself and the other. The word in language is half someone else's" (p. 193). He further stated that not all words are that easy to make one's own. Words may resist speakers trying to appropriate them. Bakhtin's point in this connection was to point out that tools are not always smoothly appropriated by agents. When people speak, they have to use words that are culturally created to express their own meaning. In this way words can also become restrictions on what a person actually wants to say because these words do not completely encompass the content he or she wants to communicate. In the process of talking, speakers can actively embrace or strongly resist words. People can master the use of words, but they have not appropriated them or made them their own. This exemplifies the distinction between mastery and appropriation. When a person uses a cultural tool with a feeling of conflict, the acting person may refuse to use this tool altogether, even though he masters its use. He has mastered its use, but he resists making it his own (Wertsch 1998).

Rogoff (1995a, 1995b) also discusses the words internalization and appropriation. In her view the concept of internalization refers to a process in which the individual passively transmits something external. She thinks the word appropriation includes processes that can be described as having three uses. The first use of the word appropriation is simply the same as internalization in which something external is imported. The second use is still a version of the concept internalization. This use includes something external being imported and transformed to fit the purpose of the person himself. Rogoff calls the third use of the word participatory appropriation, the boundary between the person and the external is questioned. The person is looked upon as part of the activity, not separate from it. In this connection it is misleading to say that the social world is external. In Rogoff's view appropriation is a process of transformation, not a precondition for this process. Rogoff indicates that the translations of Vygotsky's work refer to internalization, but she also says Vygotsky's view may be similar to her notion, at least in the emphasis on transformation involved in the process.[9]

This is also in accordance with my own view. The Activity System is graphically developed on the basis of the Cultural-Historical Activity Theory, and this system underscores that the acting subject is a part of or member of a collaborating community. This relational system clearly shows the interconnecting lines between the different factors constituting the system of activity. Because of this, internalization and externalization are also

[9] Rogoff's thoughts are also part of the theoretical framework in Chapter 10 "Shared Knowledge".

concepts that indicate a continuous reciprocal connection between the internal and the external, the individual and the social world. Thus it is not, in my opinion, relevant to talk about a static relationship between the internal and the external, but about dynamic relationships between these two entities. In this way there is no clear line of demarcation between the external and the internal in Cultural-Historical Activity Theory.

In the preceding text representing original theories I have used the same concepts as the theoreticians. As I have chosen to work both on the activity and dialogue or semiotic mediation levels, I have decided to use the concept of appropriation for general learning processes. The concept of appropriation eliminates the differences between these two levels regarding the presence of tools or not. I will also use the concepts of internalization and mastery when situations are clarified. The concept internalization I use in connection with activity settings in which artefacts that are first used, are removed. This could be sticks that are used to learn to count. When the individual can count without using the sticks, the process is internalized. The word mastery I will use in connection with situation when individuals learn to use various tools.

Computers are cultural tools that pupils learn to use during activities in the classroom. The question we may ask is if this cultural tool can help pupils to learn more with it than without it. Do the pupils have a kind of "cognitive residue" or "effects of" using computers? (Salomon 1990, 1992, Salomon et al. 1991, Salomon & Almog 1998). In this connection it would have been suitable to use the concept of internalization for the process that indicates that knowledge that was learnt in front of the computer also can be used in other contextual situations without a computer. Another question is whether learning is reduced to mastery or knowing how to use computers as tools, that means that there will be no "cognitive residue" or learning that can be used in other settings. Another approach could be that people in a school community master their use, but all the same find other cultural tools more or at least just as useful as the computer. In this connection both teachers and pupils can resist using them, even though they master or know how to handle the tool. In such situations the acting agents have appropriated knowledge about which situations computers are useful and thus they can resist to use them in improper settings. It is seemingly that teachers and pupils in other classrooms will embrace this tool and find it convenient to use in these settings. When and why does this happen? In which situations does it appear that the computer is a helpful artefact (effects with) (Salomon 1990, 1992, Salomon, Perkins & Globerson 1991, Salomon & Almog 1998) and in others not? In which situation does it even seem reasonable to think that learners can have an experience and thus acquire competencies that can be used in similar

situations without the computers as a mediating artefact (effects of). Throughout the text I will give illustrations on these problem formulations. In the following chapter I will present the project work method that makes up the framework or activity for the actions taking place in the classroom during the observed processes. Moreover I present ICT as a mediating artefact, and in this connection also refer to related research on ICT.

Chapter 3
The Theory of Project Work and Perspectives on ICT as a Mediating Artefact

The Project Work Method

Project work is an approach to learning and teaching that differs from traditional instruction. In the traditional classroom the teacher is the active party in the processes that take place. The pupils' main task is to perceive what the teachers transmit to them. To conduct this task the teacher has used books that have represented the wisdom to be taught. This knowledge has done very little to help the young people in their endeavours to cope with matters in their daily lives or prepare for their future. The question is then what knowledge young people need to cope with their lives and to meet the demands from the environment they are living in. Dewey believed that a very new attitude to education was needed, and that traditional education had to be improved and even replaced by a new approach. He believed that the content of the education could be created by an interaction between the knowledge developed by the older generation and the interests or internal states of the pupils (Dewey 1902, 1916, 1938).

During project work the teacher is not the "sage on the stage", but a "guide on the side". An important component in project work is the question or problem that drives the pupils' work. Both the teachers and the pupils can be responsible for the question or the problem that serves as the starting point for the work. The teachers may present an overarching theme to which the pupils make associations or questions, or the teachers may present questions and the pupils then find interesting aspects to work with. The teacher shall see to it that the question covers themes in the Curriculum (Rettleiing L-97, 1998) [Advising document C-97, 1998], but project work is never so constrained by the teachers that the outcome is predetermined. The pupils are given room to develop their own answers to the questions. They gather information, use different information-seeking strategies, assess the use of the information they have compiled and make a synthesis of it. The outcome or the result can be arranged in different ways, from a presentation to classmates to a web page with the whole world as the audience (Berthelsen, Illeris & Poulsen 1987).

Project work requires the pupils to be active during an extended period of time. During a project period the strict borders between the different school subjects are erased, and replaced by links between subject matter disciplines. In project-based learning pupils are

acting in realistic situations in which they solve relevant questions that also are of interest to them. In this way project work can build bridges between activities in the classroom and real-life experiences (Blumenfeld et al. 1991). The teachers' main task is to create a supportive environment that helps the pupils structure the process and handle the obstacles they run into during their work, but the teachers' actual role practice depends on how they view both knowledge and learning and how they thus comprehend their own and the pupils' roles.

Background

One of Dewey's students and friends, Kilpatrick, wrote an article in 1918 entitled "The Project Method". In this article he described four types of projects. When working on a Type-1 project, where the aim is to embody some idea or plan in external form, the project will be something like building a boat, writing a letter or presenting a play. During Type-2 projects, where the aim is to appreciate an aesthetic experience, the activity could be to listen to a story or a symphony, or to appreciate a picture or painting. In a Type-3 project the aim is to find an answer to an intellectual question or to solve a problem. The problem could be to discover whether or not dew falls or to find out why New York became bigger than Philadelphia. In a Type-4 project, the purpose is to acquire some item or degree of skill or knowledge. This knowledge could be, for example, some irregular verbs in English. Kilpatrick (1918) felt that pupils should direct their own work, motivated by their "wholeheartedness". Even though Kilpatrick was Dewey's student and based his theory on his thoughts and ideas, Dewey raised some objections to Kilpatrick's one-sided focus on the child. Dewey contended that project work was a joint activity for both the students and the teachers. Thus Dewey emphasized the teacher's role as an advisor and also a person who directed the pupils' work. Dewey felt that the teachers' role was to guide the pupils towards a goal, and thus to function as a leader of the group activities (Dewey 1902, 1916, 1938). Nevertheless, Dewey felt that his way of thinking compared to traditional thoughts about teaching could be looked upon as the revolution introduced by Copernicus when the astronomical centre was shifted from the earth to the sun. "In this case the child becomes the sun about which the appliances of education revolve; he is the center about which they are organized" (Dewey 1900, p. 34).

Dewey (1916) was also interested in making society more democratic. He said:

> *A democracy is more than a form of government; it is primarily a mode of associated living, of conjoint communicated experience. The extensions in space of the numbers of individuals who participate in an interest so that each has to refer to his own action to that of others, and to consider the action of others to give point and direction to his own, is equivalent to the breaking down of those barriers of class, race and national territory which kept men from perceiving the full import of their activity (p. 87).*

A democratic society that lets all its members participate for its goods on equal terms, and has institutions which ensure flexible readjustment through interaction of the different forms of associated life, is democratic. Such a society has to give the people an education that provides them with a personal interest in social relationships and control. Dewey (1916) claimed that when a democratic society repudiates the principle of external authority, it has to replace it with voluntary disposition and interest. In school, pupils should work on topics they are interested in, not just topics imposed by the teachers, and they could be given the opportunity to practise reflective thinking. Dewey's ideas on education are also present in today's ideas on project work.

Pupil activity and group work has been a working principle in the Norwegian education since the first half of the twentieth century. Already in the Curriculum of 1939 (N-39, Normalplan 1939), pupil activity was the backbone principle together with group work. In the Curriculum of 1974 (M-74, Mønsterplan 1974), the relevance of pupil activating working methods are emphasized, among others group work. In the Curriculum of 1987 (Mønsterplan-87), theme- and project work are recommended working methods, while they in the Curriculum of 1996 (Læreplanverket-97) were made compulsory working methods. Pupils from the 4th to the 7th grade are recommended to work theme- and project directed in 30 % of their school work, while the pupils at the 7th to the 10th grade are prescribed to work on themes or projects 20 % of their time at school (The National Curriculum 1996).[10]

Theme work and project work are defined in different ways. There is a distinction between interdisciplinary themes on the one hand and problems that determine the integrated subjects on the other. During a project work a problem or a question decides which subjects that are naturally integrated in the work, and thus the subject integration are problem directed (Kristensen 1987). Terms as formal subject integration for theme work and functional subject integration for project work are also used (Nielsen 1992).

Berthelsen et al. (1987) define project work as follows:

> *We define project work as a pedagogical working device in which pupils, in co-operation with teachers and/or others, explore and address one or more problems in their social conditions and the reality it/they are a part of. This means that the work will be giving a constantly stronger experience, a deeper comprehension and an increased perspective, that problems will be attacked and illustrated from different angles regardless of traditional borders between subject matter, and that choices of theories, methods and tools will be influenced by the chosen problems. The teacher's role is not just to impart knowledge, but also in solidarity with the pupils to function as a person who gets things started, an inspirer, a person who sets the rules,*

[10] This percent share has later been changed to be just a recommended percentage rate (Rundskriv F-44-1999) [Regulation F-44-1999].

an advisor and a consultant. The outcome of the work is to be a specific product that can be either an oral or a written report, or can be expressed by other media or actions (p. 25).

The question one may ask is why project directed working methods have such relevance in today's society. The social background for project work is said to be the fundamental demand placed on employees in modern society to be flexible and reliable (Berthelsen et al. 1987). In a society that constantly has to readjust itself, it will be vitally important to educate pupils to be "work creators", not "work takers" (Høringsutkast til plan for tema-og prosjektarbeid 1995, p.1 [Green Paper on the curriculum for theme and project work 1995, p.1]). The point of departure for project work was two-fold qualification; both qualification for and qualification against adaptation in society. The pupils should be educated to live under the current conditions and also to change them. The focus on qualification against adaptation has been changed from a focus on class struggle to democracy and self-management (Illeris 1993). Bearing Dewey's (1916) ideas of education in mind, Berthelsen et al. (1987) think that project work represents a break with traditional education where pupils are presented knowledge that is isolated and structured beforehand. The potential for project work is that the intellectual processes, emotional experiences, social development and verbal fluency can be integrated in a holistic learning process that develops the entire personality.

Three Pedagogical Principles

Berthelsen et al. (1987) have formulated three equal pedagogical principles for project work. These are: problem orientation, participatory management and solidarity, and the exemplary principle. The aim under the principle of problem orientation is to ensure that the work is relevant and challenging for the pupils. This means that it is important that the problem formulations are in accordance with the pupils' experiences, imagination and interests. With the formulation of a problem as the starting point for the work, the traditional division between subjects will be erased. Illeris initially felt that the problem should be a social problem that was experienced by the participants. But gradually a more pragmatic relationship to the concept "problem" has been developed and it has often been looked upon as a question (Skrøvset & Lund 1996). Participatory management and solidarity is the second pedagogical principle. This means that both teachers and pupils together have the responsibility for the management of the project. Solidarity means that all participants treat each other with mutual respect, empathize with each other and care for each other (Berthelsen et al. 1987). Participatory management means that the participants conceive the project as their own. While this is a major premise for the motivation needed to carry out the project, it is the

principle that is most often sinned against (Illeris 1993). The exemplary principle (or representative experience and learning) is about choosing a theme for the project. "Exemplary" or "representative" means that the problems that are chosen can together say something about how things function in connection with the overarching theme (Berthelsen et al. 1987). For the most part teachers choose the overarching themes to which the pupils associates and finds topics and forms questions to work with. Answers to formulated problems centred on a topic in one class can have a lot to say about the theme that was the joint basis for the questions or formulated problems.

The pedagogical principals formulated by Berthelsen et al. (1987), reminds of Dewey's theory. The question have to be the pupils' own (Dewey 1916), and the project is a joint activity for both the pupils and the teachers. The last principle also reminds us of Dewey's thoughts about the interaction between subject matter represented by the common theme for the work also often presented by the teacher, and the interests or the internal states of the pupils (Dewey 1902, 1916, 1938). Project work is a method that contains of different working sequences. These sequences or phases I present next.

The Phases of Project Work

The project period is broken down to eight phases (Berthelsen et al. 1987). The phases are not to be understood as prescriptions as all projects do not necessarily have to go through all these phases. *(1) The introduction phase.* The project starts with an introduction phase. The goal of this phase is to arouse motivation and to give the pupils knowledge about the work method. During this phase, the external frames for the project period are set. It is especially important during the first periods the pupils are working in a project-directed way to have the method described and explained to them. *(2) Choice of theme phase.* In this phase the pupils divide themselves into project groups and choose topics or problem fields which their project will focus on. *(3) The problem formulation or question phase.* The project groups define precisely and instantiate their question by formulating several subquestions. *(4) The planning phase.* This is the phase in which the groups make the plans for the project period. They plan the use of time, they organize the work and divide it between themselves, they decide which literature and other tools they are going to use and how they are going to present the results. In this phase appointments with places they are to visit are arranged and preparations are made for trips and excursions, if these are involved. (5) *The realization phase.* In this phase the members of the group try to realize the plans and goals for the group, and the members try to find answers to their question or formulated problem by collecting data material and adapting

it to their question/problem. *(6) The product presentation phase.* In this phase the product is created and made available to others. This could be a written report, an exhibition, a film, a newspaper article or a meeting. (7) *The product assessment phase.* In this phase the product is presented and assessed both by the members of the group themselves, the other pupils and the teacher. In some cases the work will end with a formal exam. *(8) The complementary work phase.* This is the phase in which the members of the group sum up their experiences and learning, eventually correct their product, make generalizations in relation to others fields and also pinpoint clear possible consequences.

All these phases show that project work has aims or aspirations for presenting the results that is naturally created of a continually working process. The pupils put their effort in problem formulations or questions they have made themselves and are thus most seemingly interested to find answers to. This may also be decisive for the pupils' learning. According to Dewey (1916) a problem that exits naturally within a situation or personal experience can lead to intellectual thinking and thus learning, because the pupils are active in the learning situation.

Project Work Visualized in the Activity System

Project work as an activity placed in an Activity System could be visualized as in Figure 4 below.

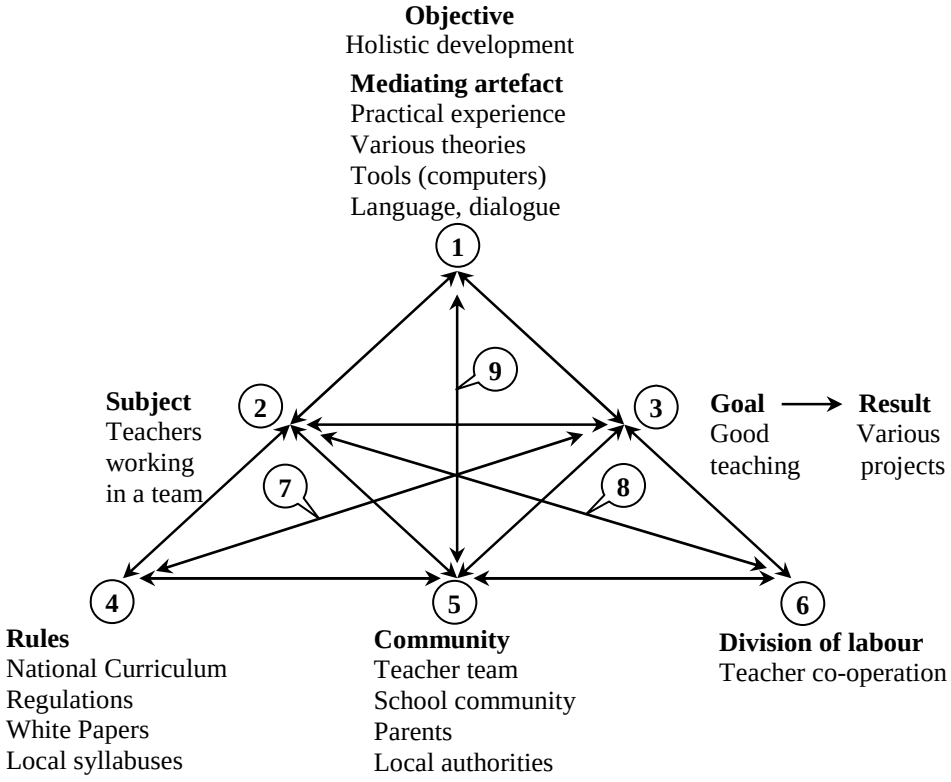

Figure 4: Project work visualized in the Activity System

The objective, the “milestone” or the motive for project work in the Norwegian school is holistic development, which means that the pupils can develop their academic, social, aesthetic, methodological and learning competencies (Postholm et al. 1999, see Appendix 8, Figure 17, p. 411). A report to the Norwegian parliament (Stortingsmelding nr. 29, 1994-95) [White Paper no. 29, 1994-95] also claims that the overall aim for the teaching in the Norwegian school is that the pupils shall develop their entire personality. The Activity System shows how different factors affect the actions during project work. The triadic relation (1, 2, 3) shows how the acting subject (teachers in a teacher team) use mediating artefacts to help the pupils to attain the goals of the teaching process. The teachers of course use their practical experience and various theories as aids in their teaching. Various tools, such as computers and language used in dialogues, are also artefacts the teachers can use in the learning processes. All these mediating artefacts help the teachers to attain the teaching goals, and the teaching will therefore hopefully also move the pupils towards the overall goal or objective – holistic development.

The triadic relation (2, 4, 5) shows that the teachers have to take into account the requirements in the National Curriculum, various regulations, White Papers and local syllabuses (rules). The school community, which the teachers and the teacher team are a part of, also influences the teachers in their teaching, and impacts the teaching practice in every classroom. To have understanding and respect for teaching methods that depart from traditional teaching and an accepting attitude is needed in the school community. How the local authorities grant and distribute funds will also affect the schools’ possibilities of buying tools and equipment, which probably will also influence the results of projects. As members of the local community parents may also influence the project results by helping their children in their schoolwork, and by being resource persons in the classrooms. The class environment that the teachers are a part of affects the teachers and this milieu also influences the way the teachers approach their work.

The triadic relation (2, 3, 5) shows how the community at different levels can help the acting subject (the teacher team) to attain its goals. All the community members have according to the definition of community (Engestrøm & Miettinen 1999), the same goals as the acting subject because they are members of the Activity System and the acting teacher team is also part of this community. The community factor, together with the components "rules" and "division of labour", creates the context for the actions taking place in the classroom.

The triadic relation (3, 5, 6) shows that there is a division of labour both between the teachers as the acting subject and between the people belonging to the community. The teachers in the teacher team divide the work between themselves so that all of them are taking part in the formation of goals in the planning process, and that they are all influencing the result by being active participants during the entire project period. The goals for the project period and the project content will also naturally affect the division of labour between the teachers.

There are also intersecting lines across these triadic relations. Line 7 between points 4 and 3 shows the connection between rules and goals. Curricula, regulations, White Papers and local syllabuses are factors that decide the goals for the project periods. The goals affect the teachers' practices and how they plan their teaching. The teaching practice can also affect how the "rules" are interpreted, so there will be a mutual relationship between the factors rules and goals. Line 8 between points 6 and 2 shows that the collaboration between the teachers will affect how the teacher team manages to attain the goals of the project periods. Each teacher's interest and enthusiasm for his or her work will influence how the teacher team functions. Line 9 between points 1 and 5 reveals a relationship between the community and mediating artefacts. The members of a community decide which artefacts they want to use during a project period. The teachers' attitudes and their way of seeing possibilities are factors that affect their choice of artefacts. The artefacts will also affect the community members and the learning process in which both the teachers and the pupils are taking part. The local authorities may decide that the teachers should have the opportunity to take part in a continuing education course in project work, or the school administration might decide to purchase literature that helps the teachers to develop their teaching practice. Thus this training course or literature can function as mediating artefacts for the teachers in their work processes as they move towards their goals for the teaching.

In the coming text I will look at ICT as a mediating artefact in project work. Furthermore, I will present some related research that has been carried out on the use of ICT in the classroom before I move on to explain how my own research study fits into the picture.

ICT as a Mediating Artefact

In project work, the traditional view of teaching is set aside in favour of Dewey's educational philosophy, which lays the foundation for this work method. This means that the use of ICT in such an environment also has to be adjusted accordingly. Salomon and Almog (1998) as Cuban (1993) believe that the more a technology, and its use, fits traditional teaching

philosophy and its pedagogical application, the more it will be used. But, they add, it will then have less effect.

Koschmann (in press) examines the question that if we change our practice when we use ICT, what sort of changes will then occur? He argues that new technology will influence our view of learning and enhance the view that learning is work-in-progress. In this progress of learning, the teacher's role, he says, is to provide "scaffolding" to support the learners in the inquiry process. In this connection he also mentions that the teacher has to be looked upon as a "termless" learner, not the all-knowing expert that has traditionally been the illusion of a teacher. While Koschmann examines the types of change that will occur if we alter our practice when using ICT, Salomon and Almog (1998) look at this from another angle and find that a change in practice is necessary to exploit the possibilities of the artefact. This change in practice means that both teachers and pupils have to enter new roles. This also means that project work can meet the demands of an environment in which ICT could be used beneficially. During project work the pupils usually work in groups with the teacher facilitating the group activities, but what then are the consequences for the teachers' and the pupils' actions in a classroom where ICT is used as a mediating artefact? Salomon and Almog (1998) find that much of the learning comes from the distributed scaffolding during the interpersonal activity. They also find that teachers in such learning environments usually work in teams. An important question that then comes to mind is how this "work-in-progress" unfolds in the classroom, and what role the new technology plays in this environment?

During project work ICT may provide a number of tools. ICT can be used to search, sort, process and design information (Hewitt & Scardamalia 1996). According to Salomon and Almog (1998), a proper harnessing of technology leads to the realization of a novel psychological understanding of learning, as expressed through social constructivist epistemology. In this situation the technology is subservient to the pedagogy, which provides the rationale, and the technological the means to achieve the aims of the teaching. As technology develops at an increasingly rapid pace, pedagogy can no longer keep up. This means that new forms of technology also need novel psychological explanations and justifications. This will then start an interplay between educational psychology and technology (Salomon & Almog 1998).[11] Draper (1998), on the other hand, claims that the educational practice should decide when and how ICT is to be used as a mediating artefact in

[11] I need to reiterate that my encounter with the data in the present study is guided by the rationale of social constructivism, which is exactly the same view Salomon and Almog (1998) mention as an epistemology for approaching novel ways of using technology.

classroom activities, but he also believes that ICT can improve the quality of the teaching and learning processes.

Two expressions have been introduced to describe two effects that arise when using computers in the classroom. These two terms considered the concept of internalization as "effects of" and as "effects with" computers. The expression “effects of” technology indicates that there is some cognitive residue from the use of computers that is manifested beyond the context in which it has been acquired, or in other words, there is a more lasting effect from the use of computers. The expression “effects with” computers covers the activities computers enable the individual to perform while working with the tool, and thus the immediate changes that take place when pupils use this tool (Salomon 1990, 1992, Salomon et al. 1991, Salomon & Almog 1998). The expression "effects of" also has connotations to a traditional view of transfer. While in my research study I focus on work-in-progress and describe and analyze the observed activities, I also aim to ascertain if the pupils acquire competence that also can be used in other situations. In this context other situations means similar situations, in other words that there is a "relation between the knowing agent and the situation" (Greeno 1989, p. 313). The same activity or task can thus be encountered in new situations. This highlights the significance of teacher-mediated activities that make transfer possible (Newman, Griffin & Cole 1989).

We can look upon and comprehend the expression "with computers" in different ways. When I think of the concept "effects with technology", I imagine a classroom full of pupils working in groups and using several tools to help them, among them ICT. I thus think of ICT as a tool that enables pupils to accomplish various activities. When Crook (1994) talks about “learning with” computers, he is thinking of a classroom in which the pupils are guided by computers, replacing the social guidance of the teacher. This is also the focus in the Intelligent Tutoring System paradigm (ITS), in which Crook (1994) identifies the role of the computer as the "computer-as-tutor".

The idea of the ITS paradigm is to make programmes that incorporate whatever is important in novice-expert dialogues. There are enthusiasts for this approach (Henderson 1986, Collins 1988, Brown, Collins & Duguid 1989) who believe that the computer can simulate the teacher as a guide quite effectively. This type of computer use has not had a great deal of acceptance in schools, except in situations were technical skills are being trained, such as elementary arithmetic where rote learning has been used for a long time (Crook 1994, Light & Littleton 1999). If the teacher's role in the classroom involves knowing certain facts about the subject matter being taught and some rules of the profession of teaching (Dreyfus &

Dreyfus 1986), a programmed computer simulation can play the role of a teacher, but the teacher's role is something more than just technical rules and facts (Crook 1994).

Dialogic presuppositions and shared understandings are a basis for conversations between teachers and pupils (Crook 1994). The teacher's task is to guide the pupils on their way to the goals. The teacher's first step is then to interpret the learner's situated intentions, beliefs and motives. The next step is to ascertain how best to scaffold the pupil in the learning situations.[12] This means that the teacher has to know about different ways of helping pupils. Some pupils need a great deal of help with their task, while others require just a hint or perhaps a little provocation to continue their work. This is something that a computer programme cannot manage, according to Crook, who argues that human tutors act upon an inherent capacity for intersubjective understanding. He further states that such a successful practice depends upon the motivation to use this human capacity, a capacity that can be developed through experience. Instructional talk thus seems to be a "collaborative, situated achievement: one founded upon human intersubjectivity" (p. 96). This means that knowledge is not a storehouse of representations, but creative constructions in ongoing situated activities.

The computer is also looked upon as a medium through which a teacher and a learner can communicate, and not as a tool for autonomous learning or a surrogate, robot teacher (Jones & Mercer 1993). In this way the computer as a medium is not replacing people, but creates new environments for communication among them. It is reported that there is a shift towards a less didactic and more open style when computers are used. This means that the teacher's role is to stand back, allowing the pupils to develop their own ideas. In this way the teacher takes on the role of a co-worker or a facilitator. Teachers can choose to take on two roles to create a creative learning environment in which the pupils are active, sharing experiences with each other. The teacher can increase the time in which he stands back, or he can refrain from structuring the activities so that the pupils lose all their freedom (Fisher 1993).

It is recommended a move from design strategies based upon interacting with computers. It is instead suggested that computers should be treated as a context for social interaction (Crook 1994). This also coincides with my interpretation of Salomon's "effects with" computers, where he sees ICT as part of the context of the social interaction. In such a connection, designers should be more concerned with how computer activities can serve as occasions for classroom discourse. Crook (1994, 1999) talks about interaction "in relation

[12] Crook (1994) defines intersubjectivity as shared understanding that is mutually recognized. Descriptions of the concepts "intersubjectivity" and "scaffolding" are part of the theoretical framework in Chapter 8.

to"[13] computers when describing these types of situation. The talk between teachers and pupils is regarded as important; the computers are just mediating this. This talk may include dialogues between teachers and pupils when a pupil or a group of pupils are working on a task with the computer as a mediating artefact. This could also be a more open-ended and communal kind of interaction that takes place in larger groups of pupils or the whole class. This discourse principle is also referred to as "common talk" (Edwards & Mercer 1987). In this way a simple computer activity can be drawn into the wider context of classroom life. Teachers are warned against separating computers from mainstream classroom life (Crook 1994). When collaborative interaction happens “in relation to” computers, computers become a part of the classroom environment, used in parallel with other tools. Activities at computers that are separated from other activities will prevent the activity at the computer from becoming an experience shared by all pupils in class. If the pupils work alone, the teacher is also deprived of the possibility of creating continuity between different situations that may enhance the process of transfer.

Computers are proposed and used to support learning through pupil collaboration, but how can technology serve effectively as a resource for collaborative learning in schools? Group work at computers may be a consequence of a lack of equipment (Jackson, Fletcher & Messer 1988, McMahon 1990, Blaye, Light & Rubtsov 1992, Light 1993, Hoyles, Healy & Pozzi 1994, Fitzpatrick & Hardman 2000). Research shows that peers working together off computers may affect the pupils' learning positively (Slavin 1983, 1990, Damon 1984, Tudge 1990).[14] It is also reported that collaboration and the use of language to mediate meaning and arguments is decisive for learning in groups and for creating common knowledge in class (Elbers & Streefland 2000). On the other hand, the assignments given to the pupils also have an impact on the discourse processes and whether a lively exchange of ideas is created between the pupils. At the same time, the functional aims the pupils have adapted to their work seems to determine if the pupils engage in critical knowledge building (Arvaja, Häkkinen, Eteläpelto & Rasku-Puttonen 2000). However, when collaboration seems so important for the learning processes in non-computer activities, why should not pupil

[13] Crook has developed concepts on pupil interaction and computers. He talks about interaction "at", "around", "through" and "in relation to" computers. These concepts are described in detail in the introduction of Chapter 9 "Pupil Collaboration". In the text I also use these concepts with the same conception as Crook.

[14] There are, however, some conditions that need to be met if learning is to be effected positively during collaboration. Damon (1984) claims that the pupils need to respect each other. Tudge (1990) states that pupils stop or even relapse to lower developmental levels if their self-esteem is lower than the pupils they are working with, at the same time as these pupils are at a lower developmental level than themselves.

collaboration with computers as a mediating artefact affect the pupils' learning in a positive way, and what role does the computer play in this collaborative situation?

Throughout the 1980s and 1990s many experimental studies of collaborative computer-based interactions were carried out. These studies were initially concerned with when and whether working together with another pupil or pupils was more effective than working alone (Littleton 1999). Strictly controlled experiments show that there are individual gains from working in groups at the computer. Blaye, Light, Joiner and Sheldon (1991) researched information searching and planning tasks disguised as adventure games with eleven-year-old children and found advantages for paired as opposed to individual modes of learning, both when groups of pupils were going to perform together and in terms of subsequent individual performance on similar tasks. This has also been reported by Griffin, Belyaeva and Soldatova (1992), who experimented with pupils at different ages at the primary school level. These pupils were working both alone and in groups. Their research showed that pupils working in groups had less trouble than pupils working alone when trying to solve the computer activities they were working on. Mevarech, Silber and Fine (1991) reported from a study conducted in Israel of post-tests of twelve-year-old children who had worked with drill-and-practice software, that children working in pairs had better achievement levels than pupils working alone.

Research also shows that language use is sustained during computer work (Hill & Browne 1988, Shooter, Lovering & Bellamy 1993), which means that meaning can be created during the collaboration processes (Bakhtin 1981). An observational study of nine- and ten-year-old children undertaken by Scanlon, Issroff and Murphy (1999) also indicates that groups focused around a computer task do better than most other group formations with regard to sustaining task-related interaction over a long period of time. In a study of elementary and middle-school pupils it was found that the pupils appeared to interact more on learning tasks and asked each other for help when using computers to learn to program in Logo than in non-computer settings. It is also claimed that if pupils limit themselves to particular roles, and these roles become sustained patterns, the learning outcomes could be adversely affected as a consequence as there is no need for interaction between the pupils (Sheingold, Hawkins & Char 1984). An experimental study of nine- to eleven-year-old children shows that much of the advantage of pupil collaboration appears to stem from verbalization, and it is thus a prerequisite for learning that talk is made possible and necessary in collaboration situations (Fletscher 1985). In a study of pupils from nine to fourteen years of age using software in hypothesis testing activities, it was also found that language plays a

central part when pupils interact face to face with a computer as partners in this collaboration process. All pupils using software that gave contingent prompts produced higher levels of testing than pupils who used software giving no help through contingent prompts. It was concluded that this was also a consequence of the language use these software programmes mediated (Howe & Tolmie 1998).

The enhancement of learning is also dependent on other factors. Simply putting learners together in front of a computer will not automatically ensure peer facilitation of their learning. In a study of eight years old pupils, it was found that pupils had to be engaged in the task and also with one another to enhance individual learning. The pupils were working with a version of the Towers of Hanoi task, which asks the pupils to move three or more tiles from one peg to another. The rules assert that the pupils can move just one tile at a time, and a larger one must never be put on top of a smaller one. The researchers decided to give both pupils in the work pairs a different part of the keyboard, and both pupils also had to key in a given instruction before it was executed. Under these circumstances the pupils gained better results on the individual post-tests (Light, Foot, Colbourn & McClelland 1987). It is also found that pupil pairs in elementary school using two mice and two cursors when playing a collaborative puzzle game were more engaged in the computer activity than pupil pairs working with just one mouse and one cursor (Inkpen, Ho-Ching, Kuederle, Scott & Shoemaker 1999).

Another research study of pupils from eleven to twelve years of age, reported by Light, Colbourn and Smith (1987), shows that pupils collaborate as much when they are one to a machine as when four or two are collaborating in front of a computer. No overall differences in learning outcome were found between the three conditions, and the interaction was largely unrelated to the number of machines available. The study shows that the students who had their own machine had a very high level of task related interaction with their neighbours. In contrast to several experimental studies where the individual condition meant a pupil working alone at the computer in a room separated from the other pupils, this study allowed communication between all pupils because the research setting was the pupil's classroom. In this way the result indicates that there is no clear-cut answer as to how computers best enhance learning.

While Light (1993) tells us there are many interesting findings from experimental studies on ICT use, he also informs us that the results are not entirely consistent. On the other hand, he claims that no study has found that pupils working alone at the computer have done better than those working in pairs. Watson (1990) also fails to find a single claim that solitary

use of computers in classrooms is a preferable use of the technology. Thus research also shows that computer-based resources may not necessarily empower learning activities, but neither do they inhibit learning. The important question is how the settings when pupils use computers have an effect on the social interaction in the classrooms and what this social interaction means for the pupils' learning (Crook & Light 1999). What is interesting is the dynamic between the social exchange in the classroom and the structure of computer-based tasks. It is claimed that the effect of computers comes from the interactional environment in which the ICT equipment is used. It is also stated that the use of computers has the potential to enhance collaborative learning that can lead to improved outcome at the individual level (Light 1993). Crook (1998) also suggests that computers may become a powerful resource that can mediate pupil interaction and help them to be successful collaborative learners.

A study reported by Johnson, Johnson and Stanne (1986) shows that co-operative learning situations are likely to be more effective than competitive situations. They studied pupils from eleven to thirteen years of age working on a computer-based geography simulation task that involved mapping and navigation. One third of the groups worked alone, another third worked competitively and a third of the pupils co-operated. After they had finished their work the pupils were tested. The pupils who had worked alone were told that they would be graded in accordance with an absolute standard of excellence. The pupils who were in the competitive situation were told that they would be graded according to how well they did relative to the other pupils in the group. The pupils in the co-operative situation were told that they would be graded by the average of the scores of the group members' individual tests. The study shows that children in the co-operative situation gained higher levels of achievement than both the pupils working alone and those in the competitive situation.

Research has also found that the school and classroom cultures influence the pupils' collaboration processes. It is reported from three experimental studies carried out at all levels (high school, third and seventh grade in elementary school) in the school system in Finland. It is found that the Finnish educational culture, and particularly the communication culture, either supports or inhibits the collaborative activities at the computer. The Finnish education culture is too strongly focused on the transmission of factual information to create an environment that fosters the development of collaborative skills. Thus the communication culture that has been conspicuous in the classrooms can get in the way of a new practice characterized by collaborative learning. The pupils need experience of collaborative learning from the computer to effectively work together with computers as mediating artefacts (Hakkarainen, Järvelä, Lipponen & Lehtinen 1998). This view thus coincides with

Koschmann's (in press) prediction that new technology will influence how we regard learning and that it will be seen as work-in-progress. Like Salomon and Almog (1998), Hakkarainen et al. (1998) think that a change in the school practice that will lead to a free exchange of ideas between the students is necessary to fully exploit the possibilities of ICT.

It is said that members in every group that collaborates effectively are able to introduce knowledge and ideas to the other members, and that they will, in turn, be able to accept information from their partners (Underwood & Underwood 1999). However, whether or not the group process becomes functional depends on its composition. It is found that groups with both girls and boys could perform less well than single-gender pairs. Girls worked collaboratively whatever the instructions they were given. The largest gains were found when boys were told to work together. The benefits of the collaboration processes were most prominent when group members discussed the problem and agreed upon a joint action (Underwood, Jindal & Underwood 1993). It is also claimed that when pairs of children solve a problem together, they think more effectively than when they work alone, but this is not the case for all tasks and for all gender combinations (Underwood & Underwood 1999).[15]

In a study conducted both as an experiment and with close observations of the ongoing action, Hoyles et al. (1994) found that successful group work when using computers as a mediating artefact can be facilitated by adequate computer access and software which provides pupils with the opportunity to talk about their ideas. The task must be designed in such a way that it provides a forum where these ideas can be discussed and also evaluated away from the computer. Borrowing Crook's words, this means that the pupils have the possibility to talk "in relation to" the computer activity. The pupils should also be able to exploit the learning opportunities that are shaped within such a setting. In a study in which the pupils were from nine to twelve years of age, it was found that the oldest pupils could exploit the above-mentioned conditions best. It was also a prerequisite that the pupils managed the task requirements and that the group was more or less harmonious, that is unimpeded by antagonism (Hoyles et al. 1994).

Studies have also been conducted on the effect of the number of pupils in front of the computer screen. A study in which pupils were provided with notebook computers (Apple eMate notebook computers) in several predetermined pupil-to-computer ratios (1:1, 2:1, 4:1), have been conducted. The pupils, from one to fourth graders, were working on writing

[15] The topic “gender and computers” constitutes a very large part of the literature dealing with ICT. The research results the literature presents are in no way consistent (Keogh et al. 2000). In the data material I compiled, this issue was hardly addressed, and therefore I do not focus on this topic in this review of accomplished research.

assignments when the equipment was used. The aim of the research study was to ascertain if pupils learned more with or without computers. Another aim was also to find out which of the student-to-computer ratios enhanced learning most. The study shows that the pupils in the 2:1 ratio showed the greatest improvement over time, and that the pupils without notebook computers had the least improvement. The other two groups (1:1 and 4:1) showed intermediate levels of improvement. It was found that the poorer performance of the pupils in the 4:1 group was due to the pupils having less time per pupil for computer-based writing, and the teachers also had to use more time on management and discipline issues in these groups. What the research shows is that pupils working in pairs learn more than pupils working alone. This result indicates that interaction between these pupils influences their learning positively, and that a setting in which each pupil has a computer is not an ideal to be aimed for (Owston & Wideman 2001). It is also reported that groups of two or three pupils are the most effective, with two being the optimum size when they collaborate in front of the computer. A forth student will have to wait too long for his or her turn, and it is also difficult for all of them to read off the screen at the same time (Fisher 1984).

Studies have also been conducted to ascertain if there are any differences between collaboration in front of the computer and collaboration off computers. In a study it was found that there was a significant amount of what was defined as collaborative activity both off and in front of the computer for pupils aged seven and nine, the ages of the target group. However, it was found differences in the interaction pattern between computer and non-computer tasks. During the task at the computer, which involved matching the beginnings and endings of words to create new words on several levels of a house, a fireman with arrow keys was used to select the appropriate ending of a word. This was done in order to rescue stranded people. The pupils used more suggestions in this activity than in a non-computer task. During the non-computer task, a board game where the aim was to reach the home square as quickly as possible, there was a significantly greater frequency of descriptions, explanations and declaratives compared to the interaction during the computer task. Thus, this research does not show that computer tasks are more likely to generate more collaboration than non-computer tasks, but it suggests that there may be differences in the nature of the collaboration (Fitzpatrick & Hardman 2000).

As with Fitzpatrick and Hardman (2000), Faulkner, Joiner, Littleton, Miell and Thompson (2000) also found that the pupils' collaborative activity is mediated by the environment it takes place in. In their experiment they found that the computer-mediated version of the task provided the pupils with a more reliable joint problem-solving space than

the physical version of the task. The pupils, who were nine to ten years of age, were to mix different colours to make yellow. The researchers also found differences in the way the pupils communicated. In their research study the computer environment also seemed to mediate more productive interactions than the real-world environment.

Most of the studies referred to above present findings that focus on the individual outcome after the collaboration processes in front of the computer screen have ended.[16] Such studies give no information about how the pupils in a group actually co-construct knowledge (Crook 1998). Studying and understanding the temporal dimensions of collaborative work is both a theoretical and a practical challenge. The use of experimental studies that involve brief circumscribed sessions of computer-based collaborative work is far from the ideal approach to studying collaborative activity because they are based on a concept of changing a single factor in a complex situation, while keeping everything else the same (Liu, Macmillan & Timmons 1998). Much of the research on ICT seems "bolted on", and thus the studies do not take into account the classroom culture (Crook 1999). To fully understand the collaborative process, researchers have to recognize that the observed interaction is located within a historical and a cultural context, which brings us to socio-cultural theory (Littleton 1999). It is further claimed that we need rich descriptions, conceptualisations and evaluations of the ways teachers support or scaffold pupils during collaborative work, and how this support in turn influences the collaborating processes and the outcome of the joint work (Wegerif & Scrimshaw 1997).

The significant role the teacher plays is pointed out in classrooms where ICT is used (Walker in press). The teacher's role is said to be as a model, a guide and a supporter of the pupils' learning when they act in multimedia-based contexts (Kumpulainen & Mutanen 1998). Kumpulainen and Mutanen found that pupils need skills in information searching and processing to fully exploit the possibilities of a multimedia context. They report from their study that pupils' talk is focused on procedural issues, and not on scientific concepts, which was the aim of the educational process. Kumpulainen and Mutanen conclude that the educational potential of multimedia may not be discovered unless the context in which the equipment is embedded is carefully addressed. The teacher also appears to have the main role in the joint knowledge construction in class. If the conversations between the pupils in the groups during the activity at the computers are separated from the mainstream classroom life, the pupils in this group can support each other's learning. There will of course also be situations in which the pupils in the group need some scaffolding from their teacher, but this

[16] An exemption from this generalization is the work of Fitzpatrick and Hardman (2000) and Faulkner et al. (2000). These studies take into account the process of the activity and the pupils' verbal interaction.

does not mean that the performed work is woven into a joint experience in the classroom. The teacher will be the key person who consolidates these experiences through classroom discourse. According to Crook (1994), teachers must be skilled at saying and doing things that make up situations as resources for common knowledge in class.

There is also reported a degree of scepticism about experiments and their usefulness for teachers. The best way for teachers to treat research in this field is by looking at the results as an indication, and as a tool for evaluating or re-evaluating their own practice. Furthermore, the best way for researchers to make progress is to work and do their research much more in contact with the teachers and the activities in the classroom (Light 1993).[17]

In the next chapter I will present the method I used to approach the research field. I wanted to study activities in the classroom in a natural setting so I could make a thinking tool for teachers, teacher educators and others engaged in educational issues, a thinking tool that would enable them to reflect on and develop practice (Light 1993, Gudmundsdottir 1997a). My focus was on how ICT is used as a mediating artefact or tool in project work, and I therefore wanted to provide a thorough description of how this tool is used during the work processes, which is also an aspect taken into consideration in the CSCL (computer supported collaborative learning) paradigm. The theoretical framework that I have presented in this chapter helped me decide the direction of my research at the three schools.

[17] Research conducted in a naturalistic way and which focuses on meaning in the processes is presented as part of the theoretical framework in Chapter 9 ”Pupil Collaboration”.

Chapter 4
Approaching the Research Field

A fundamental claim of the socio-cultural approach is that mental functioning is assumed to be inherently situated with regard to cultural, historical and institutional contexts (Wertsch & Toma 1995, Daniels 2001). The essential assumption of the socio-cultural approach to the mind is that what is to be described and explained is human action (Wertsch 1991). In this view human beings come into contact with and also create their surroundings as well as themselves in the actions they engage in. Dewey (1900) also talked about the social relation of human practice. He believed that the mind cannot be regarded as an individual, monopolistic possession. If one wants to study human action one has to be close to the scenes in which these actions takes place. Luria (1981) contended that if we want to explain complex forms of human consciousness we have to go beyond the human organism to the external conditions of life.

With these assumptions as part of the theoretical framework for my study I wanted to investigate both the learning processes and the environment for these processes to find answers to the central question and the sub-questions for the research study. In this way I could approach the processes in the classroom with a holistic perspective and thus avoid to meet the processes with a reductionistic perspective that takes into account either the mind or the world dimension (Valsiner & van der Veer 2000). If the aim is to provide an account of the actions that are observed, one must also invoke facts about what forms of mediation are involved (Wertsch 1991). To discover how information and communication technology (ICT) as a mediating artefact is integrated in project work and what the pupils learn during these processes, I entered the classroom scene to observe the actions taking place there.

I wanted to stay in the classrooms during the entire project periods to obtain a thorough description and understanding of the processes during the activity. While we find some prescriptive literature on how project work is to be organized (Berthelsen et al. 1987), there is little evidence of how the processes in the classroom actually are carried out. Before I entered the classroom scene I had read theory on project work, learning and using ICT as a mediating artefact in learning processes. Before my research I had also taught in the lower secondary school for several years. With these qualifications and background I met the classroom processes with an interpretative approach. To arrive at an in-depth description of the processes in the classroom and thus meet the rationale for my study, to make a thinking or

intellectual tool for people engaged in educational issues, I decided to use the case-study method. The choice of research practices depends on the questions that are asked (Nelson, Treichler & Grossberg 1992). In my opinion there is always a close connection between your theoretical stance, the question asked, the method chosen and the way the data material is collected, analyzed and interpreted. Thus there is a "basic set of beliefs that guides action" (Guba 1990, p. 17).

In the first part of the coming text I write about the case study approach as a research method conducted in an ethnographical framework. I present the findings of the study as a narrative, a genre known to most people and thus a genre that (re)presents reality in a way that can give the readers experiential understanding of the described situation (Stake 1994/2000). Before I provide a description of the narrative genre, I present the analytic processes and the use of theory. In the second part I describe the research process and the choice of schools and the informants. Furthermore, I describe the data collection process and how the various categories and chapters were developed. I define all these issues as classroom research because the classroom scene was the field of my research study.

Classroom Research[18]

Qualitative research is a situated activity that locates the researcher in ongoing processes in the real world. This world or reality is made visible by material practices that are interpreted by the researcher. This practice transforms the world because it turns the world into a series of (re)presentations. When observing specific activity, qualitative researchers use a naturalistic approach to the world that also gives a holistic perspective on the observed processes. In their work they try to make sense of the observed phenomena in terms of the meanings people give to them (the emic perspective) (Denzin & Lincoln 1994/2000). When using a naturalistic approach, qualitative researchers can use the case-study method to give understanding to the observed practices (Merriam 1988, Creswell 1998).

A Case Study

A case study is defined as an exploration of a "bounded system", a system bound by place and time. The case being studied can be a program, an event, an activity or individuals. Both one and more cases may be the focus of case-study research, and will be studied in depth (Stake

[18] Classroom research has three distinctive features. (1) The question or problem formulation is based on learning and teaching processes in the classroom. (2) Relevant theories are used to throw light on the participants' perspectives. (3) The rationale for the research is to inspire and initiate to debate and discussions, so that teaching practice constantly develops and is thus improved (Gudmundsdottir 1997a).

1995, Creswell 1998, Bassey 1999, Hammersley & Gomm 2000). Data collection in case studies is extensive, and multiple sources of information are used. An essential feature of a case study is that sufficient data are collected so that researchers are competent to explore important features of the case and to interpret the processes that are observed. Case-study research has no unique method of inquiry, but the method is eclectic and uses data collecting strategies that seem appropriate and practical. These sources can include observation, interviews, audio-visual material, documents and reports (Yin 1994, Stake 1995, Creswell 1998, Bassey 1999). In case studies, strategies such as questionnaires may even be used (Bassey 1999), and devices such as statistics, tables, graphs and numbers can also be used in qualitative studies (Denzin & Lincoln 1994/2000).

It is necessary to learn the culture of the group being studied before trustworthy explanations of the actions of the members in the group can be given (Hammersley 1990). A case study gives detailed descriptions of the case and its context. To describe the context of the case means to situate it within its setting, which can be the physical setting or the social, historical and/or economic setting for the case. A case can be studied because of its uniqueness, what we call an intrinsic case study, or the case can be used instrumentally to illustrate an issue, called an instrumental case study. When more than one case is studied, the research is called a collective case study (Stake 1995, Creswell 1998).

A case study is also defined as a study of actions in everyday life (Yin 1994). Case studies provide a holistic way of studying phenomena in their natural surroundings (Orum, Feagin & Sjoberg 1991, Stake 1995, Creswell 1998, Bassey 1999). By presenting in-depth descriptions of the processes, the "invisible everyday life" in the classroom scene becomes visible (Erickson 1986). A case study is seldom just a description of people and episodes (Denzin 1997). Usually the researcher must create recognizable narratives, and this means that the stories are representative (Shulman 1981). Naturalistic, ethnographic case materials can give processes focus and thus an understanding of this material because they are comprehended as parallel experiences (Stake 1994/2000). These processes are called naturalistic generalization (Stake & Trumbull 1982). Through "thick descriptions" that present the particular perceptions of the actors (Geertz 1973), readers of a case study can experience a fit between their own situation and the situation of the activity (re)presented. It is the particular, not the general that triggers emotion and moves people (Connelly & Clandinin 1990). Transferability of conclusions from one case to another is derived from a similarity or a fit between the cases (Lincoln & Guba 1979/2000, Guba & Lincoln 1989). Case studies are “steps to action” (Adelman, Kemmis & Jenkins 1980, p. 60). Thus case studies are conducted

in the world of action, and they also make contributions to actions carried out in this world. The insight gained from case studies may be directly interpreted and used in the world of practice. My study is a qualitative, instrumental, collective case study of project work with the use of ICT as a mediating artefact. Project work is bound both by time and place. Project work has a beginning and an end, and the place for its action is for the most part the classroom or other convenient rooms in the school building, even though some pupil groups working on a project may collect some data material outside the school area. I also want to describe the context that involves cultural, historical and social aspects for the actions taking place during project work.

Ethnography[19] refers to a research approach that gives a description of a social group or a system. In such a study the ways of life of the culture-sharing group are studied. This is done through prolonged participant observation and interviews of the group members in a cultural setting that sets the terms for them (Creswell 1998, Fetterman 1998). During ethnographic studies, people's behaviour is studied in everyday contexts, and the focus for this method is usually a single setting or group (Hammersley 1990). The borders between different qualitative approaches to phenomena are blurred.[20] With my focus on both action and context together with prolonged observations in the classroom, I therefore define my study as a case study conducted in an ethnographic framework. This two-way perspective also coincides with the underlying ideas on the Activity System (see Figure 3, p. 19), with both the focus on action and context as the collective, cultural and historical system.

The Role of Theory

In case studies and in other qualitative studies the researchers strive for understanding of the complexities of the field to be studied. Qualitative research was born out of the concern to understand "the other" (Denzin & Lincoln 1994/2000). The uniqueness of individual cases and contexts are treated as important to understanding. An ongoing interpretive role of the researcher is demanded throughout the study. Understanding has a psychological aspect (von Wright 1971), which means that the researcher is the main research instrument in case studies

[19] Ethnographic studies may be conducted both at the micro and macro level. The ethnographer's theoretical disposition and problem selection will determine which study the researcher is doing. A micro-level study is a close-up view of a small social unit or an identifiable activity within the social unit (Fetterman 1998). A case study of the activity project work in schools will thus be a study conducted in an ethnographic framework at the micro level.

[20] "A cultural system may be explored as an ethnography, whereas a smaller "bounded system", such as an event, a program, or an activity, may be studied as a case study. Both are systems, and the problem arises when one undertakes a microethnography, which might be approached either as a case study or as an ethnography" (Creswell 1998, p. 227).

conducted through an interpretive approach (Stake 1995). Researchers try to impose meaning on what they hear and see, something that is fundamental to all understanding and interpretation (Gudmundsdottir 1997b). Interpretation means uncovering and expressing understanding (Ormiston & Schrift 1990). As a former teacher the classroom scene was a familiar stage for my observations. To make the processes objects for analyses and understanding I had to read a great deal of theory on a continuous basis. According to Gudmundsdottir (1992), researchers using an interpretive approach employ theory in a systematic way both when they approach the field and when they give reasons for the interpretations. There is a constant interaction between studied theory and the collected data material (Yin 1994). Then the familiar everyday life can be made unfamiliar by the theoretical perspectives in such a way that it is possible to be discovered and understood.

An interpretive approach in research studies has its roots back in the eighteenth and nineteenth centuries where we find Schleiermacher and Dilthey's work on promoting understanding of human interaction through textual analyses. The reading of data viewed by theory gives theory a central position throughout the whole research period. The hermeneutic circle, also called a spiral, makes up the core of processes creating meaning and exchanges of meaning (Gudmundsdottir 1997c). The understanding of a text takes place through a process in which the meaning of the separate parts is affected by the global meaning of the text, as people anticipate it. A closer look at the different parts will in turn change the originally foreseen meaning of the whole, which again influences the meaning of the separate parts. In this way the spiral is created by this two-way interaction between the whole text and the various data material or parts. The different parts of a history and its totality have to be brought together (Bruner 1996). In the classroom we find a continuous interaction between the different sequences observed and the total impression gained from the classroom processes. These processes are made meaningful through the use of theory that makes deeper understanding possible.

(Re)presenting the Classroom Processes in a Narrative

A narrative means an approach that includes both phenomena and method (Connelly & Clandinin 1990), meaning that both human experience and the meaning-making process of the researcher are told. The informants' words are often formed as a narrative. Informants tell stories or extracts of stories when we talk during interviews. The rationale for interpretation is understanding (Bruner 1996), and narratives are the most suitable tool for mediating this. The telling of a story is also the genre that remains most authentic in relation to the form through

which people experience their own lives (Orum et al. 1991), and narratives can thus lay the foundation for naturalistic generalizations. The narrative aspect is also present during the whole research period, and during the data collection, transcriptions and interpretations. A narrative way of thinking and the written word are two components that give form to each other (Bruner 1996). During these processes the researcher continuously tries to construct meaning (Gudmundsdottir 2001). The separate narratives told to the researcher during the research period affect the complete narrative or the understanding the researcher obtains from the research field. The narrative as a whole in turn influences the meaning of the parts. Thus there is a constant interaction between the various parts and the anticipated activity as a whole. At the end of the research period the various narratives in which both the voice of the participants (emic) and the researcher's voice (etic) are present, create a narrative of the observed activity as a whole that gives meaning to both the researcher and the participants. The result of ethnographic research can never be reduced "to a form of knowledge that can be packaged in the monologic voice of the ethnographer alone" (Marcus 1997, p. 92). Gudmundsdottir (1998a) summarizes the different ways in which narratives work in this way: (1) Narratives are a culture's primary meaning-making tool. (2) They are at work when we as researchers listen, observe and try to understand. (3) Narratives are a way for researchers to tell others about practice in writing.

The narrative also exists on two levels (Ricoeur 1981). The first level consists of the social actions that have been carefully chosen from a complex, specific reality. These actions are separated from the original situation when they are written down and in this way become part of the complete narrative. By choosing an episode from a complex, social situation in which several persons are involved, it has already been given a meaning. That meaning is ascribed to it when the narrative is constructed. This is the second level. If we are to look upon a text as a model for understanding, it has to meet various requirements. Social actions presented in a text have to have four hallmarks if they are to be perceived as written narrative. The first is fixation of action. This happens when the narrative is written down. At the same time that this action is written down it becomes detached from the actual place and people making up the action. This second requirement means that the written text becomes meaningful outside its original context, and thus is independent of the original participants. The third hallmark is that an action can acquire greater meaning than the participants could imagine. An event can go beyond the original social situation and become recreated in other social contexts. The fourth hallmark is that the social events should be perceived as an "open text" (Ricoeur 1981). Reality is contemplated as an open text in narrative research. The

classroom can also be viewed as an open text, both in terms of the oral and the written narratives. A narrative approach to classrooms also creates texts that open for naturalistic generalisations.

During the research period, the number of expressed words is virtually infinite. Just a few of them are captured and written down. Nor will all the words that are perceived and written down become significant data that will be treated in various ways during the interpretation process. Ricoeur (1977) suggests the following criteria for significant data material: (1) The experiences have to be expressed in words. The informants have to tell about their world using words that in a way makes the experience meaningful for the researcher who has not had the same experience. The informants' task is to present a section of their total reality so that others understand it more or less the same way. (2) The experiences have to be expressed to someone, that someone in a research study being the researcher. (3) Furthermore, the words or the narrative have to be reality, a truth, not fiction. The informant has to talk about the experiences in an honest way, the way he or she perceives the experiences. (4) Moreover, significant data have to become part of the themes or categories researchers develop during their research. In this way they will be included in the written narrative or report. The task of a case study is to produce a report of experience which invites others to make decisions and, moreover, offers evidence to which judgement can appeal (Stenhouse 1980).

Ensuring the Quality of the Study

The question the researcher must ask herself is if he has presented the report, the narrative or the story "right". The researcher has to understand the distinction between the socio-cultural realities he observes when doing his fieldwork and the accounts or narratives he makes of these observations. Furthermore, tellings are always an intersection of culture[21] and autobiography (Bruner 1984). The accounts will be affected by the researcher's experiences, thus his historical and cultural background will have an effect on the narratives. The research field which he enters will be contemplated through his subjective cultural glasses. Furthermore, the language that presents the observed and experienced activity will not fully encompass the accomplished actions (Bruner 1984), because language offers both a unique set of affordances and constraints (Whorf 1956, Lucy 1992). Thus we have to accept that we never receive the whole story (Fingarette 1971, Crites 1979, Sarbin 1980). The produced

[21] Spradley and McCurdy (1972/1988) defined culture as the knowledge people use to generate and interpret social behaviour.

narrative provides a window into what was thought and expressed by a particular subject at a particular time and place. It is a glimpse of the past, of what happened (Denzin 1977).

"Wisdom sits in places". Places can, according to Basso (1996), become keepers of traditions. Even though people may interpret stories in their own way, people living in the same culture have almost the same background for understanding the stories told to them. By participating in a culture, one is included as a participant in the narratives of that culture (Richardson 1990). The culture and the tradition people live in will also colour their interpretations. The knowledge people acquire is not a mirror of reality, but a social construct of it. "Truth" for people living in a community will be constituted through narratives and through dialogues. That is, there is no knowledge without knowing subjects. Historicity and culture will nonetheless be factors that diminish subjective relativism, which neither builds on common values nor on influences represented by culture, which means that everything can mean everything. Nevertheless, every story is given meaning by each listener or reader. Tellings and readings always involve active selves engaged in interpretive processes (Bruner 1984). This is also the case for people observing processes in the classroom. When I, the researcher, listen to the teachers' stories, their thoughts and reflections, I interpret what I hear with the background in my autobiography. The observed processes in the classroom are also understood in the framework of my background, including readings of theory and experiences. The teachers interpret the processes in the classroom in the framework of their historicity. To make the emic perspective prominent in the story, I let the teachers' and the pupils' voices make up the text together with my words. A standard intention of interpretive approaches in research is to give voice to the participants (Creswell 1998).

The final narrative written about the observed processes is a story made up of multiple voices. In this way the narrative is not knowledge presented without a knower. The knowledge created is neither objective knowledge detached from a knower nor subjective knowledge bound to one person. The knowledge or presented narrative from the classroom thus becomes an intersubjective story (Kvale 1996), presenting an understanding or meaning that is common for the different actors in the classroom scene. The human action is thus interpreted in its situational context (Angrosino & Mays de Pérez 2000). Reality is constructed by the individuals involved in the research situation, it is not understood as truth to be interpreted, but as mutually evolving (Heshusius 1994). Nonetheless, the researcher has to separate his view from that of his informants. The informants' truth must never be conceived of as the researcher's truth, without any theoretical foundation (Gudmundsdottir 1992). To ensure quality of the (re)presentation of the observed activity various strategies can

be used. Member-checking is one procedure of verification I used. I also wrote down my thoughts and continuous reflections in my logbook after each visit at the different schools. In this way I could become aware of my own thoughts and analysing processes, and the effort to document them was also made easier because of these logbook entries.

Another verification procedure is to give "thick descriptions". As mentioned earlier, these descriptions allow the reader to find out if there is a fit between his situation and the world presented in the narrative that makes transferability possible (Lincoln & Guba 1979/2000, Guba & Lincoln 1989). Through "thick descriptions", the physical environment including, for instance, a description of numbers of computers, other equipment and some other factual knowledge, can be made known to the reader. Such observations are low-level observations of facts that people agree on (Phillips 1992). At this level there will thus be no subjectivity. Through interviews or active listening to other people talking to each other, one can become aware of people's thoughts and meanings. A narrative including thick descriptions showing how people interact with the physical world and each other using technical and psychological tools, may lay the foundation for the transition from one setting to another. Observations at this level are more exposed to subjective consideration than low-level observation. Both the participants acting in the situation and the researcher observing it have interpreted the actions so that they can give meaning and understanding. The narrative or report of the observed world is thus tied to the people involved, or to the situational setting. The knowledge created in the narrative is therefore also connected both to the people involved and the context they act in. Narratives containing thick descriptions can be made possible by using triangulation as a strategy. Triangulation is also a verification procedure that ensures the quality of a research study. In addition to the use of member-checking and rich, thick description, I have used triangulation by employing different strategies to collect the data material to ensure the quality of the research study. I also triangulated by using different sources (Creswell 1998) that made it possible to tell the story from different points of view. These verification procedures will make the research rapport or narrative trustworthy.

Truth is an essential “regulative ideal” (Popper 1968). With the use of member-checking as a verification procedure, I have tried to create a knowledge that is not just bound to my own interpretations and understanding of the activity in the classrooms. Together the participants in the research study and I have constructed a narrative, knowledge or a theory about the classroom activity that is neither subjective nor objective, but inter-subjective, and this narrative is comprehended as a true one by all the parties (see Appendix 1A, p. 357, 1B, p. 359, 1C, p. 360). The final narrative is written down by the researcher, but stories can be

both made and true at the same time (Phillips 1997). The narrative I have written is my attempt to give a picture of what actually happened during the studied process in the classrooms.

The Research Process

In the Norwegian compulsory ten-year school, the educational approach emphasizing the active pupil has been the prevailing directive on teaching practice for a long time. Nevertheless, research shows that the teaching practice in several classrooms has not changed from traditional classroom teaching despite the shift in theoretical guidelines. The National Curriculum (1996) that came into effect as of the 1997 school year, made project work an obligatory working method in the Norwegian school. The same year ICT also became an obligatory tool to be integrated in all subjects, with the exception of physical education. This meant that teachers had two and for many of them new aspects to introduce into their classroom. The rationale for my research study was to create a thinking tool for teachers that could mediate change and improvement in their teaching practice in school and in teachers' college. Key findings or outcomes from research studies are also called "intellectual tools for mastery of practice" (Engestrøm 1999, p. 36). I also wanted to give a description of project work with the use of ICT that presented both variations and common patterns. The rationale for the study determined which classrooms I wanted to observe and what experiences the schools and the teachers (the informants) preferably would have. I decided to observe three classrooms at the lower secondary level that were conducting project work with the use of ICT in various ways. I wanted to examine both ICT integration and the organization of the project period.

The Choice of Informants

Informants can be selected at random or on the basis of particular preferences. To select informants for the purpose at hand is the most suitable approach (Miles & Huberman 1994). As I wanted to conduct the research study in school communities that were familiar with project work and also with the use of ICT, I had to find schools and teachers that had experience in both these areas. In addition to preferring informants who had knowledge about project work and the use of ICT, I wanted teachers who liked to talk about their teaching and reflect on their school practice. It is important that the informants are good tellers, otherwise researchers may end up filling in the holes in the narratives with their own knowledge, thus creating two narratives, the researcher's and the informants' (Connelly & Clandinin 1990). I

wanted to use video cameras and tape recorders in my data collection so the informants also had to deal with being the focus both for the camera lenses and microphones. I had planned to stay in the research field for a long period of time, including observation of the whole project period and period of time before the project work started to become acquainted with the school, the teachers and the pupils. The teachers then also had to be open to a fairly intense and long period of cooperation. I had planned to have one key informant at each school, but I also wanted to observe the entire collaborating teacher team to find out how they cooperated throughout the project period.

When searching for schools and teachers that could meet my requirements, I was given the names of three schools by the district teachers college. This was the way I found two of my informants. A teacher who was both the ICT contact and had worked with project development work for the local authorities became my third informant.[22] I talked with the teachers and the headmasters to explain my project, telling them about the theoretical focus, the rationale for the research study and the demands such a project would place upon the involved teachers. Having an enquiring researcher follow them with eyes and ears, microphones and lenses did not seem to frighten them, and they all invited me into their classrooms. After the informants had responded positively to my intention of studying the work processes in their classrooms, the next step was to formalize the oral consent they had given me. Letters were sent to the headmasters, to parents and to the municipal authorities for permission to carry out the research work (see Appendix 4A, p. 381, 4B, p. 383, 4C, p. 385). I also contacted the Privacy Issues Unit of the Norwegian Social Science Data Services concerning the establishment of an index of names, something that was evaluated as unnecessary in my study. With permission from the informants, the headmasters, the local authorities and the parents, I could start my research work.

Prior to the data collection work I visited the classrooms to become acquainted with the teachers and the pupils. In this way they could also become acquainted with me and the equipment that I would be using in the classrooms. Ethical responsibility and scientific adequacy could therefore go hand in hand (Erickson 1986). During the visits at the schools before the three projects periods started, I could prepare on the pupils and teachers for what

[22] I present the classrooms at the three schools as follows: Applebee School, Bridgeford School and Cooper School. I have called the key informant at Applebee School Steven. The other teachers at this school have been named Anne, Owen, Harold and Helena. At Bridgeford School the key informant has been called Sarah. The other teachers are called Deborah, Susan and Brian. At Cooper School the key informant is Marion, while the other teachers in the teacher team are Ben and John. Each teacher is profiled in Chapter 5-7 in which the three schools are presented.

was going to happen in their classroom, what my role was and why I was doing this. The processes in the classrooms could therefore be conducted naturally with little disturbance from me or my equipment. The informant at Bridgeford School said: "My impression is that you quickly found the tone, and thus became one of us. You were explicit about what you were and weren't going to be doing, and you kept it that way". The key informant at Applebee School stated that it took some time before he got used to the equipment and someone observing everything he did with "eagle" eyes. He also said that when I had explained my intentions to the pupils they became confident with the situation. The teacher or key informant at Cooper School said: "After a while both the pupils and the teachers became accustomed to the visit in the class, even if they in the beginning were not used to video cameras and tape recorders **(**Appendix 1A, p. 357, 1B, p. 359, 1C, p. 360). When the preparation for the data collection was completed, I could start to collect material.

The Data Collection Process

I started to collect data at Applebee School from the middle of September 2000 and ended the process five weeks later, by which time I had observed and collected data from fifty-seven school periods. The data collection process at Bridgeford School started in the beginning of November 2000 and ended in the middle of December the same year. During this time I had observed forty-eight periods. The project period at Cooper School started late in August 2000, and ended with an exhibition in the middle of November the same year. I also visited the school on the seventh of December when the teachers had assessment conversations with the pupils. In this way the data collection period lasted almost the entire semester. The pupils had altogether nine project days at school with three lessons each day in this project. At this school I thus observed twenty-seven school periods altogether, besides the pupils' exhibition and assessing conversations.

The Activity System (Figure 3, p. 19), together with other theories on ICT and learning and project work that I had studied, served as the glasses through which I watched the classroom processes. The theory had helped me to develop my idea of what I was searching for. Therefore I had clear research questions or working hypotheses (Miles & Huberman 1994) before I entered the research field. These questions could thus both restrict and illuminate the actions in the classrooms during the research process (Wolcott 1982). I was also open for and aware that the categories for the material gathered in the research study would change and develop as the field experiences continued. Thus there would be a constant dialogue between deduction and induction.

Experiences both as a researcher and as a teacher also helped me to conduct and understand the processes in the classroom. Theory is especially important in classroom research when researchers are teachers. The researchers are on "home ground", and therefore need strong glasses to see anything at all during the observation period. Theory makes the known unfamiliar, so that it can be discovered and understood (Spindler & Spindler 1982, Erickson 1986, Gudmundsdottir 1992, 1998b, Moen & Gudmundsdottir 1997). Kluckhohn puts this nicely when he said that the fish is the last one to discover the water (Erickson 1986, Gudmundsdottir 1998b). Good interviews require expertise, both in subject matter and human interaction (Kvale 1996). This means that researchers have an advantage if they have been teachers, as long as theory is used as a tool to help understand the observed processes. The mark of good qualitative researchers-as-instruments is also that they have some familiarity with the phenomenon and the setting to be studied (Miles & Huberman 1994).

Observation and Interviews as Strategies in the Data Collection Process

I wanted to observe the actions in the classrooms and also acquire an overview of the contexts the actions took place in because the contexts lay both the premises and possible limitations for the actions that take place. You have to observe more than actions and discourses in the classroom because it is believed that discourse is always more than what is said or seen (Denzin & Lincoln 1994/2000). As members of a community we always make observations of the everyday world. In this way we obtain cultural knowledge (Johnson 1975). What distinguishes the observations of a social scientist from those of everyday-life actors is that the scientist or the researcher is systematic and purposive (Fontana & Frey 1994/2000, 1998). Nonetheless, qualitative observation can be fully naturalistic in essence, meaning that it occurs in the natural context of occurrence. The actors would then naturally be participating in the observed interactions (Adler & Adler 1998), and the researcher can see what would happen had they not been there (Stake 1995).

This was also the intention of my observations, not to disturb or intrude on the ongoing actions. I was a person in the classroom who the pupils appeared to become accustomed to. I just interacted with the pupils casually and non-directly. Thus I remained a researcher and did not cross over the line into friendship. My role could be described as observer-as-participant (Gold 1958, Adler & Adler 1994). Theory on project work and its various work phases together with my readings about the teachers' and the pupils' roles during project work focused my observations. I brought a notebook into the classroom, divided the pages in two, and started to jot down my observations. On the left side of the divided page I

wrote down what I actually saw. On the right side of the page I noted immediate interpretations and also questions these observations gave rise to.[23]

With the Activity System I had some predetermined categories to help me in the research field, but as mentioned above, these categories never restricted me from developing other categories throughout the study. The empirical examples collected from observed actions filled up the categories in the Activity System, but my reading of theory and the data collection process also laid the foundation for the development of other categories. The data I collected led me to read theory to help me understand and give the data material meaning. Theory also helped me detect processes that I otherwise not would have found. Thus there was a two-way connection between theory and the data material that helped me understand the classroom processes that took place. I also wanted to gain a deeper understanding of the teachers' thoughts and ideas behind the actions they initiated in the classroom. Psychological phenomena are always something more than physical responses (Ratner 1997). By going beyond the observed actions my approach expanded the realist, empiricist approach. With this in mind, I decided to interview the teacher who was the key informant, the teacher teams he was a part of and the headmasters at each school. I used a tape recorder to record all the interviews, which were also transcribed.[24] In this way I could concentrate fully on what the informants, the teachers in the teacher team and the headmasters, said during the conversation. Then I was able to listen to the talkers in an active and constructive way. According to Gudmundsdottir (1997b), listening to an informant in an interview situation is a very special way to listen because we are constantly trying to construct understanding and coherence. The interview is a kind of conversation; someone asks questions and someone else answers them. The research interview is made into a research tool. Both the researcher and the informants put the parts together to make a meaningful whole that gives meaning to all participants. I felt that the group interview with the teachers would give me another perspective on my research question that I would not get if I only interviewed the key informants (Fontana & Frey 1994/2000, 1998). What we say is always affected by what

[23] At Cooper School, the pupils commented on my writing observation notes. A pupil said: "I can't see how you don't get bored sitting their writing all the time" (obsnot 090700. “Obsnot” means observation notes, and 090700 means September 7, 2000. Throughout the text I use various abbreviations such as “obsnot”, “trec”, “vrec”, “inthead”, “intinf”, “intteam”, “intdephead” when referring to the data material. These abbreviations are explained in Appendix 2, p. 363). A week before the exhibition evening at which the results of the pupils' work were to be presented, one pupil at Cooper School asked me: "Are you coming with us to the exhibition evening? Could you come without sitting there taking down notes?" (obsnot 110900).

[24] I transcribed all the recorded or videotaped material during the research study myself. According to Atkinson and Heritage (1984) the production and use of transcripts are "research activities" because they involve close, repeated listenings to recordings that often reveal previously unnoticed features of the conversation.

people say and do, and by what we think other people expect us to say or do (Wertsch 1991, Dysthe 1995). My knowledge from school practice, the reading of the National Curriculum (1996) and the mutual relations in the Activity System also led me to focus on whole teachers teams. My experience as a schoolteacher and theories about project work as a work method also made me aware that this method demands more collaboration processes between teachers than traditional teaching does.

Throughout the research process I understood that my key informant at Cooper School had agreed to become my informant because she knew that another teacher in her teacher team could meet my demands with respect to computer literacy. Bearing this in mind, I found it beneficial that I had decided to focus on the entire teacher teams to highlight and understand the collaboration processes between the teachers. I also wanted to observe what consequences these processes could have on the actions in the classrooms. I was moreover present at team meetings[25] to observe the processes that took place there. Not only did I observe and interview the team members, they also wrote answers to written prepared questions made by me (see Appendix 6E, p. 395). The aim of these questions was to obtain background information on the teachers, how they had practised project work, about their attitude to ICT and about their teacher careers. During the interviews the conversations were for the most part about the current, observed processes.

The observations in the classroom together with my own experiences and the continuous reading of theory and transcriptions of the collected material created questions that I wanted the team members to reflect on. The most important requirement for researchers is to explain the subject's point of view, which requires the researcher to be present in the situation and engaged in constant interaction between observation and interview (Spindler & Spindler 1987). In addition to this, I had questions ready to ask beforehand, and the conversation between the members in the teacher team and myself also progressed as a mutual dialogue in which the teachers brought up themes they wanted to discuss. Sometimes the questions I asked also started long discussions between the teachers. In this situation I could just sit there and listen to teachers discussing topics, thus bringing to light their thoughts and ideas. In this way the conversation with the teachers could be defined as semi-structured interviews (Fontana & Frey 1994/2000, 1998,) **(**see Appendix 5A, p. 387, 5B p. 388). A group interview

[25] I attended few team meetings at Cooper School because teachers for another class at the same level also participated during these meetings, and these teachers did not want to take part in my research study. Instead I had two meetings in which I asked questions and communicated with just the teachers that worked in the class I observed.

can reduce the interviewer's control of the interview situation (Morgan 1988), but I think that this conversation shed light on the questions I asked, and thus helped me to discover and understand the teachers' actions. During the observations I also had informal talks with the teachers. They could come up to me and explain their teaching procedures and how they perceived the current situation, or they could tell stories about the class. I also wanted to familiarize myself with the school communities so I talked with the other teachers and the headmasters at the schools. I socialized with all the teachers in the staff rooms at the schools during the data collection process. In this way I gained more insight into the school community, and I also had informal conversations with other teachers than the ones I was observing. These informal talks could also be called unstructured interviews (Fontana & Frey 1994/2000, 1998).

During my stay at each of the schools I interviewed the headmasters. Through these interviews I wanted to become more familiar with the school communities and what terms these framed for the teachers and thus for the actions in the classrooms. For these interviews I had one set interview guide for each of the headmasters. During the interviews I also allowed room for the headmasters to talk about anything they felt was of significance for the school community and about project work with the use of ICT as a helping tool. In this way the dialogues between the headmasters and myself could also be characterized as semi-structured interviews (Fontana & Frey 1994/2000, 1998), (see Appendix 5C, p. 389).

Most of the interviews or dialogues were with the key informants. The observations in the classrooms, continuous reading of theory, the transcription work and my own experiences also helped me think of topics that I wanted the informants to talk about. Trough these dialogues I wanted to capture the teachers' thoughts and feelings about the actions and choices they made in connection with the teaching situation. These interviews also became a mixture of structured and unstructured dialogues (Fontana & Frey 1994/2000, 1998) because during the conversations and influenced by the questions they were asked, the teachers also thought of other aspects than what I had foreseen in my written questions. The key informants also claimed that my questions made them think more deeply about the classroom processes (see Appendix 1A, p. 357, 1B, p. 359, 1C, p. 360). The interview situation was also gradually contemplated as an interactive and structured context in which information and interpretation flowed both ways (Marton 1981). The qualitative research interview can thus be a favourable experience for the person being interviewed, because both parties can talk about a theme of mutual interest (Kvale 1996).

The Choice of Pupil Groups and the Use of Audio-Visual Tools

Before I entered the classrooms I had decided to have a close up observation of two pupil groups throughout the entire working process to ensure I had a thorough description of the working processes and also to have the opportunity to present a variety of group processes. These groups were more or less randomly selected. At Cooper School one of the groups decided right from the beginning that they would present their project result on a web page. This project work was interesting for my research question so I decided to choose this group as one of the two groups that would be the focus for my study at this school. The other pupils group was selected randomly. At Applebee School three pupil groups worked on the topic "Our Town" and three other groups worked on the topic "Our School". Therefore I decided to choose one group working on each of the topics. Throughout the work process the pupils also worked in different groupings, for example as film teams and editing groups. I also had a close up study of two film teams and both the editing groups that were established. At Bridgeford School I randomly chose two pupil groups right from the beginning, but also decided to record communication processes that seemed interesting in one other group working on a Power Point presentation at the end of the project period.

I tape recorded all communication processes in these groups during the entire project period. I transcribed all the recordings to obtain a text that could show how the pupils collaboratively learned and recognized learning as having occurred because talk is the artefact that both supports and is produced by the collaborating, learning teams. Talk also shows the participants' own accounts of their work (Koschmann 1996). The pupils did not seem to be disturbed by the small tape recorder lying on their desk. Actually some of the pupils became very accustomed to the situation and even began to take responsibility for taking the tape recorder with them when they went from one room to another to continue their work, or if I was in another room they would turn the tape around if they saw that the tape was about to run out.[26]

I used the video camera in the classrooms to film the organization of the pupil groups and the physical environments the pupils were working in. In this way I could recreate the atmosphere from the classroom to my office and have the feeling of being there when I watched the film after I had withdrawn from the classrooms. I also filmed lessons when pupils

[26] I had some very amusing comments from the pupils regarding the tape recordings. A group at Applebee School said: "You use a lot of tapes. It must be very expensive for you" (trec 101300). At Bridgeford School one pupil said to the other: "If the cassette stops, then you can turn it around". And the other pupil answered: "Yes, yes, I know" (trec 112700).

were introduced to new topics or tools, or when the class was to sum up processes they had been through. Thus the filming was done when the pupils were gathered sitting at their places for a long period of time. I found it difficult to do some filming of the pupils when they were working in groups because they were constantly moving from one place to another, from the library to the computer room and back to the assigned place for the group again. I found it more convenient to observe the pupil groups by placing a small tape-recorder beside the group when they were working by the computer, at the library or at their desks.

In addition to observation notes, the data material included interviews, audio-visual recordings, answers to written questions to teachers, material such as school documents, logbooks, pictures and answers to written questions to pupils. I transcribed the recorded and videotaped material as soon as possible and preferably before the next visit in the classroom. I also read through my field notes before I went to the schools for more observations and interviews. In this way I could pinpoint still unanswered questions and topics I wanted to ask more about. Then the transcription work and the readings of field notes could make up the target for the next round of data collection.

The Use of Questionnaires

During the observed project periods I wanted to ask all pupils in the three schools some questions that could help me describe and understand the processes in the classrooms. Instead of interviewing the pupils I wanted them to anonymously answer the questions each for themselves. Experience had shown me that pupils can answer questions more freely when they do not have to consider the researcher's and teachers' expectations and attitudes. Moreover, it would have taken an enormous amount of time to interview all the pupils.

In the beginning of the project period I asked all the pupils the same open questions, using experience and relevant theories to help me form these questions (Questionnaire 1, Appendix 6A, p. 391). The aim of these questions was to help me understand the situation in the classrooms before the research study started. At the end of each project period I also asked all the pupils open questions. If these questions were to help me obtain a deeper understanding of the observed processes, they also had to be adapted to the pupils. In this way the questions asked at the various schools were different but relevant to the different processes.[27] In this second questionnaire I also wanted to obtain an understanding of the

[27] Both the researcher's and the teachers' understanding of the processes change and develop during the research study. Thus it is not suitable to use the concept reliable, for which the normal criterion is that the results can be reproduced or replicated. In the classroom, no process can be repeated in exactly the same way because the interpretation of the situation depends on the teachers, the pupils, the activity, the physical and social

learning results from the pupils' perspectives (Questionnaire 2, Appendix 6B, p. 392, 6C, p. 393, 6D, p. 394).[28] As already mentioned the teachers also answered questions, which aimed to obtain background information needed for thorough descriptions of the research fields (see Appendix 6E, p. 395).

As told I transcribed the compiled material after each day I had collected the data, because I found this most convenient as the transcription processes also led me to other questions I wanted to ask the teachers in the school community. Thus the data collection process was an intense period, visiting the schools, observing, interviewing, recording and also transcribing the collected material (Appendix 2, p. 363, gives an overview over the collected data material at all three schools). During the observing, recording, interviewing and transcribing processes, the analysis of both the data material and the processes themselves were started, not just for the researcher, but also for the informants, as they started to analyse and develop their own practice during the research period (see Appendix 1A, p. 357, 1B, p. 359, 1C, p. 360). The next step was to continue this analytic process by coding the material. "Coding is analysis" according to Miles and Huberman (1994, p. 56), because you have to dissect your material meaningfully while also keeping the relations between the parts intact.

The Development of Categories and Chapters

Before I started to collect data in the classrooms, I used theory on this field and my own experiences in the classroom to help me formulate working hypotheses (Miles & Huberman 1994). During the research my intention was to give illustrations on these hypotheses or problem formulations. The main aim of my study was to describe the teachers' and the pupils' actions during project work when using ICT as a mediating artefact, and thus creating a text as a thinking tool for both teachers, teacher educators and others interested in educational issues. During the visits to the classrooms and throughout the transcription work I began to see that the processes in the classrooms, and thus the material I collected, could be structured around certain key words or concepts.

When all the material was collected and transcribed, I first wrote down what actions or processes were taking place in the right margin of the transcription papers (see Appendix 3B,

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environment, the researchers and thus on all the factors that influence the classroom processes. When the involved people have been through such a process they will never conduct the activity the same way again because the experience has given them another understanding or new insight in their next encounter with the same process. Bearing this in mind, the concept of reliability is substituted with dependability (Lincoln & Guba 1985).

[28] The summary of Questionnaires 1 and 2 is presented in Appendix 7, p. 397 and is entitled Descriptive material presented in tables.

p. 377, 3C, p. 378, 3D, p. 379). I did this for all the transcribed material from all three schools. During this process I began to see that the comments I had written on various but similar actions could be put into the same categories. It is said that definitions of the codes or groupings of the material must be rooted in a conceptual structure in research (Miles & Huberman 1994). During the data collection process the continuous reading of theory and the focus I already had before I started collecting the data, helped me to develop such a conceptual framework or codes. Categories emerge from an interaction of theory and data, and a grouping of data that has similar characteristics will in all instances help us to understand a phenomenon better (Blumer 1962). With this close reading of the transcriptions from all three schools, I found that various actions were prominent at each of them.

At Applebee School the teacher team processes were clearly prominent. The team members discussed educational questions, and appeared to be genuinely enthusiastic in their work. I obtained a great deal of data that expressed the teachers' collaboration both in the classroom and in the planning and reflection processes before and after the actions in the classroom. Throughout the observation in Applebee School I also saw that the teachers structured and organized the teaching for the pupils so that this structure also became a kind of helping device for the pupils in their work. During the training course the pupils were introduced to various tools, and the teachers had clear thoughts about how and why they could structure the processes to make good learning situations for the pupils. During the actions the teachers helped the pupils in dialogues they had with them, and in most activities the pupils were also put into groups to work and help each other. The collaboration processes between the pupils gradually constituted a large part of the data material. The pupils in the observed class were exempted from the Curriculum and traditional grading with marks, but the teachers and the headmaster were occupied with how and why pupils shall be assessed. Much of the data comes from interviews with both the key informant, the teacher team and the headmaster on the assessment of the pupils' learning. The concepts that I found became prominent and descriptive for Applebee School were team work, support, structure and assessment.

Structure also became a conspicuous concept for Bridgeford School. In this school the pupils were given clear directions on how to work on their tasks during the introductory course that was completed before commencing the part of the project that was more pupil controlled. When the pupils began to work on their projects, they were also given a planning document that structured their process. Each pupil group was allotted an advisor they could turn to for assistance throughout the project. This advisor also actively broke into the group processes to help the pupils structure their work. At Bridgeford School, the pupils also

worked in groups to help each other find answers to their thesis question. Thus the collected data material from this school also gave several examples or illustrations of both supporting and structuring processes. Throughout my observations I learned that knowledge acquisition and subject matter were highly emphasized in the school community and by the teachers I observed. An explanation of how the pupils' work should be assessed was given to the pupils right at the beginning of the project. At the end of the project period the teachers' work was also highly concentrated on giving the pupils feedback and grades relating to the executed project work. The concepts I found that described the processes in the classroom at Bridgeford School were learning, subject matter, support, structure and assessment, in order of priority. The ranking of these concepts changed throughout the process because I found it hard to decide which of the concepts of learning or subject matter were the most prominent factor in the school practice.

In Cooper School the motivation process was heavily emphasized in the beginning of the project. Marion, my key informant, also told the pupils several times throughout the project that it was their own project and that it was their interests that should be the catalyst. Dialogues between the teachers and between the key informant and me often dealt with the problem of how to help structure the pupils' work. The conversations thus centred on topics such as advising processes and how to assess the pupils, not on how these processes were satisfactorily executed, but how the teachers thought they failed to carry out this part of their work. The atmosphere and tone between the key informant and the pupils also gave me the impression that the teachers were concerned about the pupils' personalities, and their need to feel self-confident was highly stressed. Subject matter and learning were hardly mentioned throughout the project period. As mentioned above, the teachers talked a great deal about how they should go about assessing the pupils. After the pupils had ended their work by holding an exhibition, the teachers also held assessment talks with all the pupils. This practice was probably the germ of an idea that had grown out of the teachers' discussions during the project period, because the teachers had not considered such a practice beforehand. The first main concepts that I found in the processes and from the data material at Cooper School were motivational and assessment processes. Illustrations on structure and support were also present in the data material, but were most prominent from the teachers' perspective in the material containing dialogues between them and me, not as much in illustrations collected from classroom actions. On the other hand, dialogues between pupils gave several examples of how the pupils helped each other during the work processes. The main categories I had

from visiting Cooper School and the classroom, transcribing the data material and reading through the material were motivation, support and assessment.

During my observations and from my transcription and reading of the data material, I found that much of the material was about processes in which both the teachers and all the pupils were organized to take part and thus experience the same introductions, actions and conversational processes. This was the case for all three schools in connection with the presentations of the pupils' results. At Applebee and Bridgeford Schools, the introductory courses also gathered the pupils and teachers around joint actions. I decided to code the data material that covered these processes under the category "shared knowledge". Thus the categories I found for the there schools are:

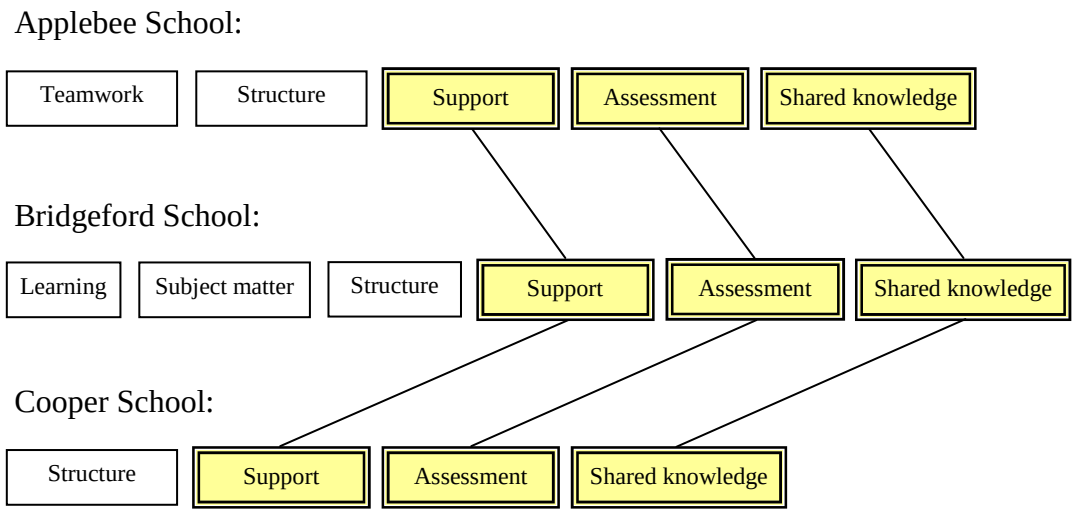

Figure 5: The categories for the three schools

With these categories helping me to reduce the data material, I continued the coding of the collected material that already had been commented on on the right side of the written pages. The data material was in this turn clustered into categories that were decided as relevant for each of the schools. The data material from the three schools I found could be differently categorized, but three of them were also common for all the three schools. These three categories were called “support” “shared knowledge” and “assessment”.

My next decision to make was if I should present the data material from each school separately or if I should find common categories and present them with examples from the three schools. The focus for my research study was how ICT can be integrated in project work and what the pupils learn during these processes. With the main research question and the

collected data material in mind, I decided that the common phenomena could be furnished with empirical examples from each school. Thus I made an analytical generalization across the cases because of the fit to the theory that could be used to analyse the gathered material (Yin 1994, Miles & Huberman 1994). Analyses and interpretations of the categories could make both the common phenomena and the processes at the various schools more understandable. In this way I could also satisfy the rationale for the study, to present both variations and common patterns with respect to my research question.

I ended up with four analytical categories.[29] The category which I first called "support" actually contained both teacher support and pupils working in groups helping each other. In the coding process I distinguished between these two forms of support and called them "scaffolding", for teacher support, and "pupil collaboration". In connection with Applebee School I decided that aspects such as team work and structure could be a part of the description and in that way obtain a good representation. I also decided that the categories learning, subject matter and structure for Bridgeford School should have proper scope in the description of this school. For Cooper School I decided that the category motivation should be included in the description of the school. Thus I had four analytical categories that should form the content of four chapters in the text. These were "scaffolding", "pupil collaboration", “shared knowledge” and "assessment" (see Figure 5 above).

During the categorization of the material I realized that a large part of the data material consisted of transcriptions of actions conducted in connection with computers or other external equipment. During this process I used the constant comparative method, and asked myself when, why and under what conditions the themes occurred in the classroom (Glaser & Strauss 1967, Strauss & Corbin 1990). For the categories "scaffolding", "pupil collaboration" and "shared knowledge", the data material also consisted of various processes that could be combined and thus make up sub-categories. These sub-categories were "information searching", "learning programmes", "using external equipment" and "making presentations". I found that the assessment aspect was present in all processes during the project period. This category therefore embraces all the other categories. The aim of all the processes in the schools is learning. Both the main categories and the sub-categories with learning as the central goal are visualized in Figure 6 below.

[29] An analytical category makes up the basis for a chapter in which theory is illustrated by examples from practice. At the end of the chapter the results are discussed and commented on in greater detail.

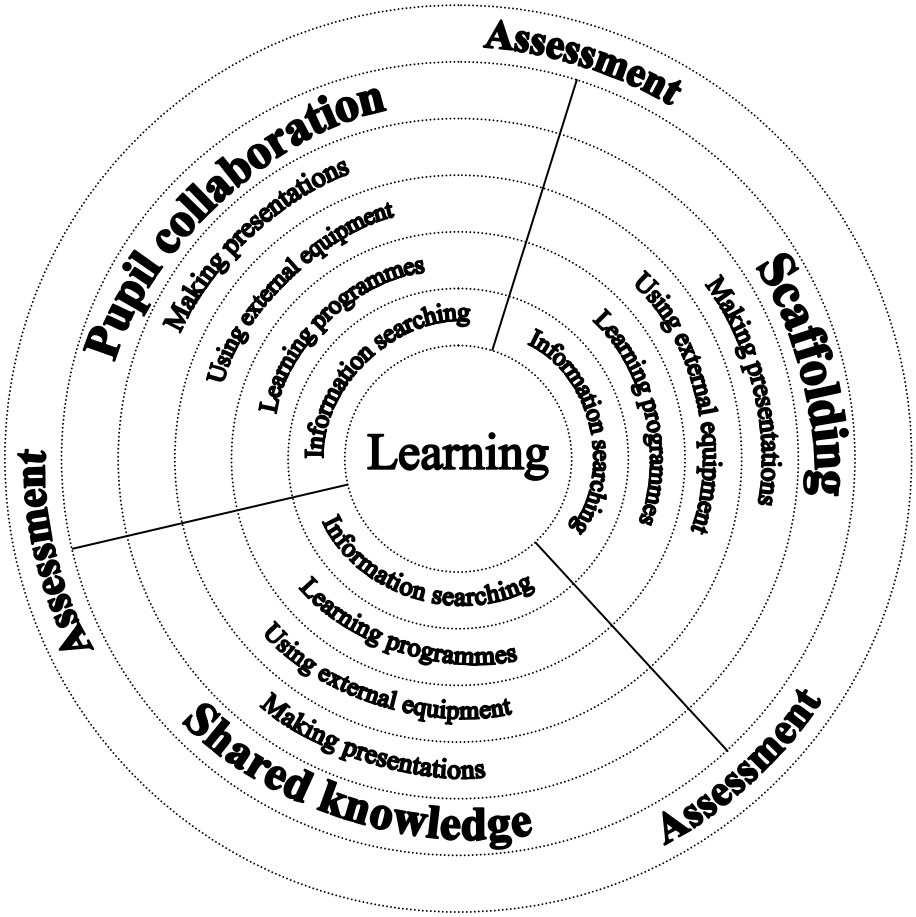

Figure 6: Analytical categories

During the coding process I had identified themes or categories that could be used in the entire data material or transcribed texts. I had carried out a great deal of analyses and interpretations all the time, from my observations and transcriptions to my categorization, and all these continuous and ubiquitous analyses could help me understand and interpret the observed processes. The grouping of the data material in categories made up the chapters for the text, and thus this categorization made the material more reportable (Garfinkel 1967, Sacks 1992).

Throughout the categorization process some of my working hypotheses were confirmed, others were disproved, while some topics that had not even been considered were brought into sharper focus. My belief that collaboration and supporting processes were prominent in the teaching and learning processes was confirmed. Furthermore, the data material also showed that structure or how the teachers organized the work was prominent in two of the schools. The categorization of the data material also shows that I approached the classroom both deductively and inductively. Beforehand, I had never considered that the

categories assessment and shared knowledge would emerge from the data material. On the other hand, the difference I had anticipated between boys and girls with respect to computers never emerged as a significant issue in the research process. Nevertheless, the teachers were asked about this theme, and their answers are included under the descriptions of each school. A great deal of my working hypothesis dealt with how the context for the actions in the classroom would affect the processes actually happening there. I obtained some answers to these questions in the interviews with both the headmasters and the teachers, and also from observations of the physical and social environment in and outside the classrooms. Moreover, the written questions I asked the teachers gave information that I needed for a description of their schools. I see the actions as being conducted in cultural, historical and institutional settings (Wertsch & Toma 1995, Daniels 2001), and these settings are also looked upon as influencing the actions taking place. This process is visualized in Figure 7 below.

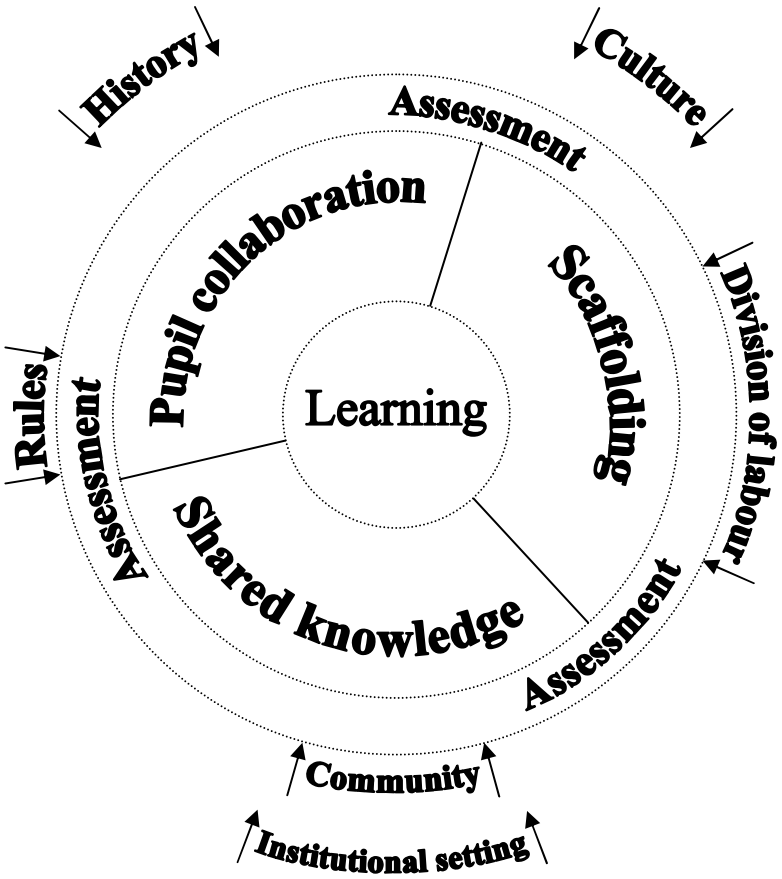

Figure 7: Actions conducted in a cultural, historical setting

The cultural-historical environment represented by the system and the individuals or groups performing the actions impacts each other's present and future position and situation.

In the Activity System, the factors "rules", "community" and "division of labour" constitute the context for the actions taking place **(**see Figure 3, p. 19). As the Activity System illustrates, there are mutual relations between these factors. The Activity System also shows that there are close relationships between all the factors that constitute the system. In the following text I will use these factors as categories to provide a thorough description of the schools and the project periods examined in this study.

The following chapters are both descriptive and interpretive. In the next part of the text, Part 2 including Chapters 5, 6, 7, I describe the entire activity, with a focus on both the actions and the context at the three schools. In Part 3, Chapters 8, 9, 10 and 11, I interpret important parts of the actions using dialogues as illustrations to obtain a more thorough understanding of the entire process. Thus I use both activities and dialogues as units of analysis to arrive at a proper understanding and representation of the observed processes. Illustrations from all three of the schools furnish each category with empirical examples. During the interpretations of the dialogues within the framework of relevant theories, I treat talk as the artefact that represents learning. These dialogues are understood as windows into the pupils' and teachers' experiences. The coming descriptions of the three observed schools constitute the background of the analytical categories so that the actions they present can be understood in their wider context. Thus the entire social scene in which the conversations are embedded is the unit of analysis, not just language within the utterances (McDermott & Tylbor 1995). The descriptions of the activity at the three schools also narrate how ICT was actually used during the project periods.

Part 2:

Activity;

Descriptions of the Activity Project Work Performed at Three Schools

Chapter 5
Description of Applebee School

The Context

Applebee School is a suburban, open school with 277 pupils, from thirteen to sixteen years of age, so this is a lower secondary school. Thirty-two teachers work at this school. An open school means that the classrooms are not completely separated from the other parts of the school by walls and doors. The classrooms are not isolated units as the semi-partition walls do not stretch all the way to the ceiling, and the entrances are much wider than a normal doorway. This means that the pupils in the classroom areas have more contact with the other pupils and teachers in the total school community.

The school's emblem, a crow, reflects the fact that before the school was built in 1976, there was a little grove in about the same place where the school is now, with trees, flowers and mushrooms. Every evening hundreds of crows used to gather there, where they found warmth and security and preened their feathers and wings. One can assume that they also shared information about where food was to be found. When the morning broke, they flew off to different places and returned in the gathering darkness to find a good and safe branch. When the school was built, they had to leave. Many people look upon the crow as a scavenger, but research now shows that the crow is social and resilient (from the school's activity plan).

Ever since the school was established, the teachers in the school community have decided upon a joint work basis. They are currently working on project work as a work method, on creating a positive relationship to their multicultural school, and on establishing a better school milieu by creating good attitudes and efforts to improve well-being at school. All pupils do not necessarily work on the same theme at the same time.

Before the 2000/2001 school year some pilot projects in the use of ICT in the learning processes have been introduced at the school. In the autumn of 2000, a project with ICT as the central mediating artifact was started in one of the 8th grade classes, or work teams as they are referred to. This class or work team was the pioneer group for the project the school was implementing, and it was with these students and teachers that I carried out my field work.

The headmaster states that one of the school's main aims is to help make the pupils better in activities or subjects they already master.

> *It is our concern to concentrate on giving the pupils the possibility of developing in fields in which they have a potential (…). Our aim is that the pupils can develop and build their identity in connection with activities they master. I think it's important that the pupils feel that they succeed and master activities and problems, and that they get the opportunity to develop fields they are good at. By succeeding, pupils who for example are struggling with double consonants will gain confidence to tackle this problem as well (inthead 100900).*[30]

The headmaster went on to say that it is a human right to know something when you leave school, to have some basic knowledge, but each and every child should have the opportunity to choose the upper limit for what he or she is going to learn in different fields. The headmaster has visualized his thinking by using several pillars. To climb too high up one difficult pillar means too much energy is expended compared to the learning. The pupil might rather try to reach as high as possible on the next pillar and just stop when he or she has reached his or her upper limit. Then the pupil can move on to the next pillar, and perhaps reach the top here. In this field the pupil has found his or her potential (inthead 100900).

All the teachers at the school have taken part in a continuing education course in project work. The school has plans to develop the ICT competence among both the teachers and the pupils. Teachers who are motivated to take courses in the use of ICT are given the opportunity to do so and the school covers the costs. The headmaster informs me that last year five teachers took up to ten credits in this study area. These teachers will then hold courses for the other teachers at the school, thus becoming the experts with the necessary ICT competence to satisfy the aims of the competence-raising program they have planned internally at the school. The headmaster says:

> *It's about the view on learning at the school, you see, to the pupils we say that the most important thing they can do in their learning process is to actively tell about their learning in one way or another. This presentation can be conducted in different ways, but should not involve just speaking to others while using an overhead, but also through art expressions and video expression, for instance. What's important is the presentation part, and this applies just as much to the teachers (inthead 100900).*

The headmaster goes on to say that there are two benefits to this: First the teachers consolidate their knowledge when they talk about it to the others, and second they in a way pay back to the teacher community what they were paid to learn in the first place.

At the school all the teachers share four computers and one printer in their work area. There are two computer labs at the school: one with nine Mac computers, two printers, a scanner and a server. This lab on the ground floor in the arts and crafts area also has a video projector and a screen. The other lab on the first floor, next to the work team's area, has eight

[30] Throughout the text I use various abbreviations such as "obsnot", "trec", "vrec", "inthead", "infinf", "intteam", "intdephead" when referring to the data material. These abbreviations are explained in Appendix 2, p. 363.

Mac computers and ten somewhat older PCs. The classrooms or work areas have two PCs that the school has received from the local authority. The headmaster at the school managed to obtain some funding from the Ministry of Cultural Affairs in 1996 when he wrote an application for financing to purchase a Mac and other external equipment to help implement their pedagogical ambitions that were connected to the production of video, film and animation as presentations of learning processes. This was their first ICT equipment. At first one teacher and twelve pupils started to use it, with fairly good success. A little later the school administration got to know that Apple, the Mac computer organization, was intending to establish a structure in Europe similar to one they had in the USA, where the company establishes a network between a number of schools which they furnish with equipment they are testing and developing. The headmaster sent an application to the Apple organization, and received a positive response. The school became an Apple Distinguished School, and it is from this organization the school has received fourteen of its Mac computers, while it has also bought seven so it has twenty-one Mac computers altogether (inthead 100900).

The school has been given some equipment from the private sector. They received a server from the business firm LindMac A/S, and three digital video cameras from Canon.

> *It's clear that I've tried to work a lot with the private sector. It's an obvious way to go because I'm really into this kind of work in school. You don't get paid for this type of work. If we'd expected that we'd have given up a long time ago. But when the teacher team starts to use these tools in the teaching, then it really becomes interesting. What we're doing is leading the way, testing the equipment for the others (intinf 092900).*

Four teachers at the school are given some time to maintain the equipment. My key informant, Steven, has four paid hours a week to service the Macs in one of the labs. He also uses some of the time to learn the new software programmes. The other teachers have six and a half hours a week altogether (inthead 100900). All the teachers at Applebee School believe that the ICT equipment should be placed both in the pupils' work areas, making it possible to integrate ICT in the various subjects, and in computer labs so that the teachers have the possibility of giving the pupils training in the use of ICT (Questionnaire, Appendix 6E, p. 395).

The teachers in the team that is breaking new ground for the rest of the school community also have general aims for their teaching. These aims also reflect the pedagogical platform that forms the basis for the learning processes at the school. Before I write about their articulated goals, the rules for their work, the mediating artifacts used in the learning processes and their division of labour during a project period, I will present each teacher in this team and some of their ideas.

There are five teachers in the observed team. Steven, the key informant, teaches the pupils in the subject of arts and crafts. Moreover, we can see from the timetable that he teaches the class for four lessons when they have project work. During the project period I observed, Steven is hired for all the lessons when the pupils are working on their project. Steven has been a teacher at this school for twenty years. His main degree is in teaching arts and crafts, but he has also taken some courses at the Norwegian School of Management BI, and has a trade certificate as an industrial mechanic. Anne has worked at this school since 1986 when she obtained her bachelor's degree. She has English and French as the main subjects, and various courses in history, sociology and social studies. She has taken eight credits in information technology, and has also studied at the Norwegian School of Management BI. She teaches the pupils in English, social studies and French. Owen has worked in the lower secondary school for thirty-five years, thirty-one of these years as a teacher and four years as a deputy headmaster. Since 1981 he has worked at Applebee School. He also has a bachelor's degree, with Norwegian and History as his main subjects, and undergraduate studies in German. He teaches the work team of pupils in Norwegian and German. Harold has a varied background from his time before he started at the Teacher Training College. He has worked at a nursery school, as an unskilled support teacher, been night watchman at a hotel, performed his civil service at a hotel and worked for five years in a bank, to mention the most important. He has worked for six years after completing teacher training, all of them at Applebee School. He teaches the subjects: mathematics, natural science and physical education. Helena has worked for two years after she finished her teacher training, and her responsibility is the special-needs education in the class, Norwegian for pupils with Norwegian as their second language and teaching in religious and moral education (Questionnaire, Appendix 6E, p. 395).

The headmaster says that three or four years ago, when the current National Curriculum (1996) entered into force, he asked the teachers in the school community who wanted to break new ground and do pioneer work. The teachers were divided into three categories: teachers who wanted to follow virgin paths, those who wanted to make the next turn and those who wanted to follow the beaten path (inthead 100900). The teachers in the team described above wanted to break new ground and try to use ICT as a tool in project work, in a new way.

All the teachers in the team describe the teacher' s role during project work to be that of a guide who is to help the pupils reach their goals. The pupils' interests are the basis for the work, which starts with a problem, something the pupils want to find out, and ends with a

presentation or some sort of result. Steven states that during project work the teachers have to attach importance to the planning stage and preparatory work, not so much on touching-up work. The teacher also needs to be prepared to meet a variety of topics, and must be capable of using tools. Anne does not feel that the teacher's role changes that much when ICT is used as a mediating artifact during project work. Our role as a teacher changes from traditional teaching during a project, she says, and if some of the teachers do not have the necessary computer literacy, the teacher with such competence could end up carrying a disproportionate share of the workload. Anne sees the danger of being forced to use more time on technical problems than on guiding the pupils, and she has indeed learned from experience that one often encounters problems with the equipment. Harold also thinks that the teacher's role during project work coincides with his role when ICT is used as a mediating artifact. The teacher is a guide and a person who inspires the pupils. Steven claims that you can completely lose your grasp of the situation. It is not easy to guide the pupils, he says. He believes the teacher's competence decides how much the teacher's role will change during project work with ICT as a mediating artifact. There are lots of possibilities, he says, and it will be easier to guide the pupils as one's ICT literacy improves. Owen also points out that expert pupils can help other pupils and that it is a challenge for the teachers to create learning situations where peer tutoring is possible (Questionnaire, Appendix 6E, p. 395).

I asked the teacher team what they felt was the underpinning of a well functioning team, which led to this dialogue between the teachers:

Harold: *They should at least agree on just about everything.*
Owen: *Yes.*
Anne: *That the aims are the same, that we are striving to attain the same goals. Of course we can have some disagreement on how we're going to reach these goals, but you have to have a joint understanding of the aim. That has to be a premise, I think.*
Owen: *Yes, I fully agree with you.*
Anne: *That we have a joint understanding of the goal, but I also think that if a teacher team is to work well together, the teachers have to talk over and find concerted ways to get at these aims. We have to feel free to talk and feel secure in the company of each other, that in a way we can both agree and disagree, and we really do both. Five persons cannot agree on everything. It's unnatural to think it could be any other way. But we can discuss things and come to an agreement, that can be supported by everyone. It's important that the pupils feel we're all on the same page (intteam 101300).*

Next, I asked the teacher team about the goals they were talking about and what they really were. This question also started a short dialogue between the teachers. Owen started the conversation:

Owen: *We do have an overarching aim.*
Harold: *That we have the same philosophy in a way.*
Anne: *What we want in a way is to teach the pupils to feel responsible, to mention something, you see, that they can think for themselves, take responsibility, instead of us in a way performing that role for them. That's a general aim.*
Harold: *The aim is also that we, that we agree about stimulating their creativity.*
Anne: *Mm.*
Steven: *What we're talking about now are aims focusing on attitudes. But we also have aims in the different subjects, and that the pupils shall obtain a certain learning competence.*
Anne: *Yes, we do have the aims of the different subjects, that's right, but there are some that will be general, for example that we wish to highlight that the pupils shall learn to present and be good verbally, that's a general aim that permeates our work in all the subjects.*
Harold: *I think the two days we had before the teaching started this school year were necessary to talk things over and find out what we really wanted. That's a circumstantial process, and I think that it's important to use time in an early phase to come to an agreement and be on the same page.*
Anne: *Yes, we have to talk to each other, and we need the time to do that.*
Steven: *I want to comment on one thing you said, that we need time to work out a common scheme. Then you'll know at once if you want to continue to cooperate. If you found that you disagreed on several topics, you could have said: This isn't for me. In a way we secure the quality of our plans by talking about things that can be difficult. And then you have a basis you can develop.*
Harold: *But we're different kinds of people.*
Owen: *I was just about to say that.*
Harold: *That's always exciting.*
Owen: *Yes.*
Harold: *When we go into it with our different perspectives, …*[31]
Owen: *Yes, it has its strengths.*
Harold: *Yes, that's a great strength, and I feel that we get energy from it, each and everyone of us.*
Owen: *I think that it's just the same when we talk about the pupils, who also sit there with their aims, you see, to such a degree they manage to act on each others qualities, then it's a strength. So, in a way there's a connection there.*
Steven: *Yes, but disagreement is a strength too, you have to argue in favour of what you believe in.*
Owen: *I'm surprised by something that often happens. When we come to school some days, one of us talks to someone else in the teacher team about something that he or she was thinking about the night before, and then you find that one of the others has thought about exactly the same thing. That's pretty strange, and it happens quite often (intteam 101300).*

Owen's last statement indicates that the teacher team has gained intersubjectivity and that they are working on a joint basis. Steven says that everyone working in a team has to be cooperative, and that they have to decide on the same goals. They have to use the same methodology, and they have to share the same view of the pupils. He goes on to say that the teacher team feels that the pupils should be the active party in the learning process. The teachers should not be the imparters of knowledge to the pupils. He had no faith in that, thus it is also important that the teachers view the acquisition of knowledge in the same way. This view is after all decisive for the teaching, for the methodology. Steven thinks that the

[31] Throughout the text I use three dots , ..., to visualize that the person speaking is interrupted.

composition of the team is vital. He says: "The project work is settled when the teacher team has been put together" (intinf 091500).

The National Curriculum is one of the “rules“ the school community and the teacher team have to follow. The pioneer class has an exemption from this plan, and from ordinary evaluation and grading as well.

> *It's important that the school takes care of each and every child in such a way that all the pupils can find their special field where they can succeed and develop, the headmaster says: But if teachers are to feel free to do that, it will have some consequences for the National Curriculum, the subject part of it at least.*[32] *Because there'll be some topics that are not covered, because each and every child is your stating point. And then we have to be released from the Curriculum and to a greater extent from the traditional grading with marks, he adds (inthead 100900).*

I asked the teacher team about what directed their work (rules) when the National Curriculum no longer strictly guided the teaching practice in the teacher team. My question once again triggered a brief conversation between the teachers.

> *Harold:* *We don't deviate from the Curriculum that much.*
> *Owen:* *No, no.*
> *Harold:* *From the National Curriculum. It's more about how we teach. In other areas I don't think we differ that much. We're aiming at getting all the pupils through it, at least the clever ones.*
> *Owen:* *I think, if we look at the Curriculum for every subject everyone of us teaches, there's probably no great disagreement between each of us and what's written in the plan and what's important. Like that, but the way we do it, and when we get the opportunity to do it, we don't like to be controlled too much.*
> *Steven:* *But we do have an advantage because we have so many years of teaching behind us, that we know the plan well and have used it. If you were fully inexperienced, then it would probably have been difficult to see the overall picture, I think.*
> *Owen:* *We try to arrange the learning situations so that they give opportunities, no one should be hindered.*
> *Anne:* *Yes, that's pretty clear, but in a way, instead of forcing everyone through that Curriculum, we'll let everybody get the opportunity to learn the most important things, while at the same time everyone feels comfortable in school, and feels that they can succeed while working on their topics. That's one of the differences (intteam 101300).*

The team also has other “rules” that help them to regulate and arrange the learning processes in the classroom. When a group of pupils has finished an exercise the teachers always try to set aside time to talk with them and let them try to explain in their own words what they have written. They work for that the pupils shall understand that they have to explain what they are doing, and that they therefore will take this into account during the work process as well. In a way there is no great distinction between what is the goal and the rule in this connection. It is both a rule and a goal that the pupils are going to explain what

[32] The Norwegian National Curriculum is divided into three different parts; a general part, a part on rules and guidelines, and the subject part.

they have learned. Harold thinks that the pupils often feel they have finished the work when they have written something on their sheet of paper, without really understanding it. Anne also states that their teaching practice can change the pupils' attitude to learning (intteam 101300).

There are two work teams in the same grade. Usually these work teams have 50-60 pupils, but in the 2000/2001 school year there are fewer pupils in the 8th grade level. The work team I observed has thirty-nine pupils, nineteen girls and twenty boys. Anne feels that the pupils got to know each other quite quickly after they started together this autumn. She feels this might be due to fact that the school has focused on this from the first day. Harold says that the pupils feel that the social milieu is good. Nevertheless, he has observed that some of the pupils appear to be playing roles because they lack self-confidence, but altogether he thinks that the atmosphere in the class is good. Steven thinks that the class shows signs of their age. There are some boy/girl conflicts, nevertheless the overall situation is good, he thinks. Owen feels that the class milieu is developing in a positive direction. Gradually they are getting to know each other when they are given tasks that tie them together, he says (Questionnaire, Appendix 6E, p. 395).

The pupils are divided into three groups with Owen, Anne and Harold functioning as the form teachers. Each work team has basic groups of pupils that normally stay together for a period of a school year. The basic groups are established on the basis of information from the parents, from the support service and the primary school. These groups have four or five pupils. The teachers in the teacher teams put the groups together (the school's activity plan). Other criteria for the group formation were observations from a school trip at the start of the school year, the pupils' logs with their own wishes for co-partners and the teachers' first observations. Putting together pupils from different primary schools was also a part of the teachers' considerations when they formed the groups (intteam 090400). "They're heterogeneous groups. The same number of boys and girls, strong and weak pupils as regard subjects, and they have some acquaintance with each other from before," Steven, my key informant says (intinf 092900).

The teachers have decided to form basic groups of pupils because they think these groups are important elements in teaching pupils to learn to cooperate and help each other. Their opinion is that the basic groups create a feeling of belonging and confidence. The school's pedagogical stance is that it is much easier to plan and work through a job when each person in the group can share the responsibility. The basic groups also make it easier to organize the work in the pupils' work teams (the school's activity plan).

The Project Period

In the observed project period the pupils are going to make two films, each with a duration of one and half a minutes. As an Apple Distinguished School (ADS) they are going to make films in the same way as fourteen other classes in different schools in different countries in Europe. As these films are to be put on the web, the restriction on the length of the films is to facilitate downloading. The project period started in the middle of September and ended five weeks later. During these weeks the pupils worked for fifty-seven school periods on their project.

The Basic Course

During the three first weeks the pupils were introduced to different tools and taught to use these tools or mediating artifacts, because they were going to use them to carry out the project. These lessons were labeled the “toolkit” lessons. In this period of three weeks the teachers had a clear “division of labour”. The pupils were divided into three groups. On the first Tuesday Steven introduced the I-movie programme to the pupils in the computer lab on the ground floor. One of the other two groups was working together with Anne learning to use maps and an atlas as tools. The third group was working with Harold on an experiment using scientific research methods. At the beginning of the lesson the pupils talked about Galileo and the stargazer. Each pupil was to read a text and answer tasks based on this text. These tasks were to be finished by Friday when they continued to work on this research method by doing an experiment in the chemical lab. When they had finished the exercises and written a thorough report from the experiment, they received a lab certificate. The pupil groups that were working with the atlas and maps on Tuesdays, worked on a word processing programme called Apple Works on Fridays where they learned to move a text from the left side to the right side of the page, and to use different characters and different font sizes. They also learned to underline, to italicize, to use bold and to change the colour of the text (obsnot 092600, 092900). On Fridays the pupils who have worked with the I-movie programme, get their first opportunity to write an e-mail and use the camera to make a film. The first lesson all the pupils are gathered together and introduced to the video camera. The second lesson they are divided in two, one half of the group will get their e-mail address and write an e-mail, while the other half continues to use the cameras. The organization of the basic course is visualized in the table below.

Table 1: The organization of the basic course

	Tuesday (4 lessons)	Friday (4 lessons)	
1.group	I-movie programme	Video camera	e-mail
			Video cameras
2.group	Maps/atlas	Apple works	
3.group	Scientific research method	Experiment chemical lab	

Steven introduced the I-movie computer programme to the pupils. Steven organized the pupils in such a way that all pupils sat together in pairs. He said:

> *I put the pupils together because I want them to collaborate right from the beginning. They're going to learn collaboration. And when they learn something in a community, they in a way learn to collaborate, and I want to ensure that everybody participates from the beginning, because that also gives a feeling of belonging, that everybody is succeeding. You have to be aware that some can be more active than others, and you have to make sure that the persons that are going to work together match each other. And if a pupil needs some support, I consciously place this pupil with someone who is able to give some assistance (intinf 102500).*

To motivate the pupils at the beginning of the training session Steven shows the pupils a film where they are the actors. The film, from a school trip at the beginning of the school year, leaves the pupils smiling and nodding recognizably at the screen. Steven also tells them that he has used the editing programme that they are going to use, the I-movie programme, but that they are going to make two films of one and a half minutes each. The film he was showing them had a playtime of three minutes he told them. Steven uses the video projector and the screen when he explains the most important symbols the pupils will encounter on the first page when they start up the Mac computers. He tells them how to get to the I-movie programme, and then the pupils begin to work in their groups. Steven gives the pupils one paper at a time, and he says to them: “You have to read every item, point by point, and then discuss them: is it like this or like that. That's why you're sitting in pairs, to try to find solutions” (trec, vrec 092600). Steven also says that he only gives the pupils one piece of paper with just one exercise at a time, to ensure that everybody is coping. He says that he could have destroyed the feeling of community if he had given them the whole bunch of papers at once (intinf 102500), but he tells the pupils that in the last lesson they can experiment a little because they will then know enough about how to use the programme (trec, vrec 092600). After three hours two girls are racing from one new task to the next. In a dialogue with Steven they express their enthusiasm.

Molly,
Sheila: We've finished (the girls are shouting eagerly together).
Steven: Have you finished, yes, then you can have the next task.
Molly: I think it's easy! (enthusiastically).

Steven: *Yes, it's not difficult (affirmatively).*
Steven: *Have you done this?*
Girls: *Yes (answering in unison).*
Steven: *Good, good! Here's exercise seven, and you'll get number eight straight away, it's fast.*

(A few minutes later)

Steven: *Have you finished task nine?*
Girls: *Yes (eagerly in unison).*
Steven: *You're really good. I hadn't the faintest idea that we would make it this far today. Are you moving on to task 10? (trec, vrec 092600).*

When Steven asks another pupil if it is fun, the reply is that "it's really cool", and the pupil asks where he can buy the programme. Steven tells him it is readily available, but that the aim of the training is that they are going to use the techniques they learn to edit their own films. During the lesson Steven also comments to me that once you get the pupils turned on, you can start to increase the expectations of what they are to do. He says that it is a delight to see the pupils working so eagerly. During the lesson several pupils are heard to say that this training is "cool" (trec, vrec 092600).

When the pupils are introduced to the video camera in the first lesson, they also receive some instructions to read on their own. Before they get the equipment Steven ensures that everyone understands that the job is not complete before all of them learn how to use the equipment. He also adds that it is everybody's duty to ensure that each member of the group understands what to do, and that everybody must be active in this learning process. They learn to put the camera on a tripod, and the most important function buttons. Steven walks around and watches as the different groups of pupils collaborate on getting the camera steadily on the top of the tripod. He encourages pupils who are good at it to help the others in their group. After about twenty minutes of training the pupils again gather around a big table made of a number of pupil desks. The next lesson, one half of the pupils go to the computer lab to work on e-mail, while the other half remains in the same room.

These pupils are going to make a film. Steven points out that the pupils are going to decide the content of the film. The only restriction he gives them is that the film is limited to five minutes: "When you come back," he says, "we're going to watch the films together. This activity is just for training, we're not going to use these films later". He also tells them that he will comment on how they control the camera, but he adds this is of course with good intentions in mind: "Perhaps you can make better films later," he adds. Then he asks the pupils if they think the exercise is acceptable, and they nod their assent. When each group has made its film, all the pupils and Steven watch them together (trec, vrec 092900).

The other part of this group of pupils worked on composing and sending e-mail in the computer lab. Anne informs the pupils that they have an e-mail account so that they can communicate with other pupils during the "Net-days" in November of the same year. They also learn to use this tool so that it can be a helpful artefact during later projects. Anne then proceeds to ask her students if they know what the word “netiquette” means. She connects this word with the concept of “etiquette”, and explains to them how they are to behave when they are on the Internet. Their first e-mail is to be written to her: “Your first e-mail is not going to be sent to anybody, you're going to send it to me,” she says to them with an expectant expression on her face. When they have opened their accounts and written their e-mail letters, one of the pupils asks Anne if they are going to chat on the Internet, to which she replies: “No, chatting is not on the schedule today. You see, now you're going to have a ten-minute break, and then you can chat for real with each other, not virtually" (trec, vrec 091500). The pupils are taking this training in turns, so that when the first three weeks have passed, all pupils have been through all the activities and are ready to start on the planning of the “real project".

The Introduction Phase

Before the "real project" started, the pupils brainstormed on the project themes. In this introduction phase they work on the theme “Our town" the first day. Anne starts this lesson by reminding the pupils about the project. At first she asks the pupils if they remember what the “Net-days-week” is. One of the pupils answers that they will get the opportunity to travel.[33] "I'm not so sure if I shall say yes to that," she responds. Another pupil says that they are going to make a film about their town, while another remembers that they are going to make a film about their school. In this dialogue the pupils are also reminded that they are going to send the films to Paris and that it will be possible to watch them on the web. The films, Anne says, are just going to be one and a half minutes each, maximum, and she tells them they can make links to the information that will be given in the film. Anne gives the pupils in the basic groups the challenge to think of an approach to the question: "What is it you would like to present from your own town".

In the introduction phase of the real project work the choice of theme and the thesis have already been arranged. In conjunction with the Apple project group, Anne and Steven

[33] The pupils are told by the teachers that they perhaps can be picked out by the Apple organization to present their work at a conference in Paris.

have decided which themes the pupils are going to work on. In the introduction Anne and Steven also make questions that motivate the pupils to associate different topics as solutions or answers to these questions. Steven tells them that it has been determined that the town is to be presented from three different perspectives; past, present and future. The pupils are encouraged to offer suggestions for all three perspectives (trec, vrec 092700). All the teachers in the teacher team are present when the pupils brainstorm on the topic, and otherwise also on all occasions when the class makes a joint decision on the further work process. The next day the pupils brainstorm on the theme “Our school”.

The pupils are gathered and Anne helps the pupils reflect on the theme “Our school”. They have to think about what they want to present to other pupils in Europe. Anne asks the pupils if they can think of something they are proud of, something they can present with pleasure, something that is unique, something special? She asks them if there is anything special about the way the school organizes classes and groups. Steven asks the pupils if they had heard anything about the school before they started there. He suggests that it could be important to present something positive from the school. He mentions that there might be both pictures and films at the school that the pupils can use, but he stresses that the ideas must be the pupils'. Anne tells the class that pupils from Russia and Turkey will be taking part in the Apple project and looks especially at pupils in the class who were born in these countries. Steven asks the pupils if they understand what Anne is trying to say. He goes on to ask the pupils what advantages they have when they are going to use the film as a performance tool. He asks them if they can use different languages. Anne continues by suggesting that perhaps they can wish viewers welcome in Turkish and Russian. After this introduction by the teachers the pupils brainstorm on the theme “Our school” (trec 092800). After this second brainstorming session the teachers categorize the pupils' suggestions and put subtopics under each of the six main topic classifications they have made.[34] The following week the pupils will start up the “pupils' project”, the planning and the actual project work itself that will end up as two films. The training session during the three first weeks of the project period has taken 26 lessons (two more than planned), now they have 31 lessons over two weeks to finish their work (the class’s periodic plan).

During the weekend Steven had reflected on the social dynamics in the class and the pupils’ skills during the training period and put the pupils into six production teams. He

[34] These six main topic classifications are; "Our town" in past, present and future perspectives, and "Our School" with the subtitles: "The Multicultural School", "The Physical Environment Inside and Outside the School" and "The Organization of the Pupil Groups".

presents his proposal to the rest of the teachers in a team meeting at the beginning of the school week. The teachers discuss back and forth and move pupils from one group to another before they reach agreement. When the meeting is finished, the class has been divided into six groups consisting of six or seven pupils each (obsnot team 100200). When they start the lesson, the pupils are placed into these groups, but no one has been informed which pupils will be doing the filming yet. The teachers call the groups of pupils production teams, and tell the pupils that they have put people with different and complementary skills together. They inform them that some members of the group will be doing the filming and that others will be undertaking the research work, that means that their job is to develop the background information on the different topics. Anne highlights that some of them are going to make this background information, and she goes on:

Anne: *And it's not just people here in the Nordic countries that are going to watch the films and read the background information on the web. There are also people from Germany, Russia, and France. Do they understand Norwegian?*
Chris: *No.*
Anne: *What do we have to do then?*
Chris: *English.*
Anne: *Yes, we have to translate it into English, yes. Mm, and that means that some people in the team have to film and edit the film and some others have to do the research. And that means that they're going to get hold of information, make a text and translate it into English, so that this pupil group will be a production team. Now the work you have done during the training phase has consequences for the work you will be challenged to do now. And we need you to work well together.*
Steven: *Have you seen the credits after a film? The scrolling list of people who have participated in the production of the film is normally very long.*
Harold: *And we want to add, the most foolish thing you can do is to be negative and drop out of the group. If you do, you won't be able to join the film group the next time either.*
Anne: *Do you think that this arrangement seems ok? (trec 100200).*

Steven goes on to tell the pupils that they have to finish in eight days, and that this schedule means that they have to plan carefully. "You have to decide when you're going to film, where and what you're going to film," he says and proceeds to inform the pupils that one member of each production team will be picked out to edit the film on the basis of the teachers' observations during the work they have ahead. The pupils in the production teams are given the task to agree on two topics, both from the school and town themes, and to put these in a priority list. They are also encouraged to give reasons for their choices. The next day each pupil group receive a topic to work on, based upon their choices and reasoning (trec 100200).

The Planning Phase

The following day the pupils start the planning in the production themes. They plan what to film, when and what type of text, and which comments and background information they

want to connect to each of the film shots. A pupil interrupts the teacher and asks if they can use the Internet to gather some background information. Anne then answers: "You can't use the Internet, because you haven't learned the information-searching strategies yet" (trec 100300). They also have to make a plan in connection with the translations. Anne concludes before the pupils begin with their planning: "We think you'll need several lessons to make a really good plan, and that the plan is the key for a good result, and we teachers will walk around and sit in on the groups" (trec 100300).

All but one group receives a topic that was on their priority list. This one group the teachers say, is given this topic due to the observations they made the other day. They add that this is a vote of confidence in this production team. The teachers have led the pupils to believe that some would have to work on topics they had not chosen themselves. But the idea should be that during project work pupils should have the opportunity to work with topics that interest them. One of the pupils in this team says during the planning phase: "We're trapped in this project. Freedom to get even better in something you could do before, freedom at this school" (trec 100300). She has a rather ironic tone to her voice. Even though Harold thinks that a group conflict could develop even if the group was given a task that interested them, Anne thinks that this episode is thought provoking. She says:

> *It's clear that we were suggestive, among other things that we were adamant about the importance of including the topic that no one wanted to work on, even though someone had brought up this aspect during the brainstorming sessions. And we think that this topic about the school organization is about basic groups, whole classes and half-classes, that we think of, you see, and the pupils didn't like this exercise at all, and it's clear that this is thought provoking (intteam 101300).*

During the planning process one of the pupils in this group takes the initiative to re-group the pupils after the group split up during the work process. Because of her positive behaviour in the group conflict that occurred, this pupil was rewarded with a place in the film group when this was announced at the end of the school day. The pupils know that the teachers are observing them and that they will be picked out on the basis of their observations. Steven says to them:

> *We're not looking for "bright" pupils, but for how conscientious you are, how good you are at collaborating, how responsible you are and if you take the lead in the group. We look closely at stuff like that. You can acquire knowledge your whole life, but good behavior is difficult to learn if you don't learn it at an early age. Do you think that seems right? (trec 100300).*

The teachers emphasize that the whole class is working together, that they are like a work community. They also point out to the pupils that the result will not be good if only the

film group or the research group is working, everybody has to take part in the work process. Both the groups are encouraged to do their best to achieve a good result. Steven reminds the pupils that first they received training to learn about the different tools, and that everybody was to participate. The next step was that everyone had the opportunity to brainstorm around two themes and the third step was that the pupils were to decide a priority of themes. Steven concludes by saying that if the whole class is going to go to Paris, everyone must have responsibility, and must play their part in the result. Anne adds that no one should see himself or herself as a non-paying passenger. She says that everyone has to contribute to reach their common goal (trec 100300). All the pupils work on their themes for three days the forth week of the project period, and they have altogether eleven lessons at their disposal. If they found that they had enough time to plan the filming and the research work, they were encouraged to work on other subjects.

The Realization Phase

The following and last week of the project period each film group was given time to do the filming. Steven had to help one group at a time because two of the Canon cameras had not yet been delivered to the school. Each film group had half a day to do their filming so that all the six film groups were finished after three days. During the entire process the teachers had advising dialogues with the groups of pupils. When pupils in one of the production groups ask Anne how they are going to plan their work, Anne comments in a dialogue with them:

Anne: *It's up to you, it's not me who is going to decide what you're going to do.*
Chris: *Yes, but you're going to help us?*
Anne: *Yes, but we aren't going to help you by telling you how to do it, we can help you by giving you some advice (trec 100300).*

The day they were going to film, Steven talked to the pupils and helped them structure the process they were entering. During the work process Steven also took aside all the film groups to talk with them and get an overview of their plans and ideas.

A group of pupils are sitting on a sofa in one of the corridors next to their work area. Steven wants to talk to them about their planning so far. This pupil group is working on "Our school" as a theme, and the school's organization of the pupil groups as the sub topic. As you will see when you read the dialogue, the pupils are not interested in the different pedagogical groupings the teacher has foreseen as the main content of this topic. Steven sits with his hands on his knees, relaxed, and opens a dialogue with the pupils.

Steven: *What do you think the film will be like?*
Heidi: *We've talked to the pupils in the drama group, but they're not doing any acting yet, now they're just reading.*
Steven: *Yes, then it will be difficult to do some filming. Are there other ways to film drama teaching lessons?*
Molly: *Yes, we could do some filming in the auditorium?*
Steven: *Yes, how could you film there then?*
Heidi: *We could film the posters there, and we could zoom them in so that they get closer. (Posters are hanging on the auditorium walls, one from each theatrical performance over recent years).*
Steven: *Are there other things you want to film?*
Heidi: *We can film that we have a great deal of freedom?*
Steven: *How is it possible to film freedom?*
Heidi: *We could film people who are playing the guitar or something? Could we start already on Monday?*
Steven: *We'll see, if it's nice weather. If it is, we have to let the people who are going to film the town go first. Do you have something more, maybe you need some more time to finish the planning?*
Heidi: *Mm, definitely, we have just started then, you see (trec 100400).*

The dialogue with the four girls continues until they decide to do more planning. Steven had this type of structuring dialogue with all the pupil groups. He wanted to help them get everything ready in time, and wanted to ensure that the pupils had arranged all appointments with people who were responsible for the buildings the pupils were going to visit and make a film of or people who were going to take part in the film. The groups of pupils were quite concerned about the fact that the films were time-limited. This preoccupation also emerged when the pupils in the group cited above continued their collaborative dialogue to bring the planning to a close. They have decided that they want to have the school canteen in their film:

Kristin: *Just tell what you're writing, write: here they sell,*
Heidi: *Yogurt....*
Kristin: *And the midday break, and…*
Molly: *Juice,*
Heidi: *I have written that, you see.*
Heidi: *We can also do our homework here.*
Kristin: *I can say it, and then we can find out how many seconds it takes. We can start like this: One, two, three.*
Molly: *One, two, three (wants her to start).*
Heidi: *Wait, wait (reads to herself, fast).*
Heidi: *Here you can buy yogurt, juice, milk and fruit during the midday break. Here you can eat and do your homework. Sometimes classes have their lessons here (reads).*
Maggie: *Ten seconds, I think.*
Kristin: *Ten seconds, just the canteen?*
Molly: *Just the canteen?*
Maggie: *We have to film it then.*
Heidi: *I can try to say it a bit faster.*
Heidi: *One, two, three (trec 100400).*

Steven decided the order in which the film groups were going to film. When he had a conversation with all the groups, they were allowed to state their preferences for when they wanted to film, and Steven also had a general overview of which groups needed more time to

make appointments. The teachers also ask the pupil groups one by one in the whole class to make sure that they are all ready to do the filming. During this dialogue between the teachers and the groups Kristin, one of the girls in the dialogue rendered above, asks if they are going to comment on the pictures during the filming or afterwards. Anne answers that they have agreed that the comments are to be recorded afterwards, just the group working on the multicultural-school theme will have to record the sound at the same time when they have various pupils wish the viewers welcome in their mother tongue (trec 101000).

The production teams that have finished the planning and have some more time before they are to film are encouraged to work on the background material, the information that was planned for use as comments on the films and links that would provide a more thorough description of the filmed shots. They also have to finish the translation work. As it turns out at the end of the work, just one girl reads all the comments on both films, a girl who has good English. When the project period has ended, the links cannot be found on the web, the pupils never finished the written material. "You might not reach all your planned goals. Maybe we, the teachers, have to finish this work," Anne comments (intteam 101300). When all the film groups have done their filming, one pupil from each group formed into two editing groups, three pupils working on the theme "Our school", and the other three on the theme "Our town".

During this process the pupils had another opportunity to use the I-movie programme. The pupils sit in two groups working in the computer lab on the ground floor during the editing process. Both groups have two girls and one boy, and they use about ten hours to finish the films. At first Steven fields many questions on how to use the computer program. When the pupils want to edit the length of the shots, they have to ask Steven to help them.

Molly: *Steven, what are we going to do now?*
Jack: *I don't remember.*
Steven: *Well, you have to tell me what the problem is.*
Molly: *We're going to cut the length of the shots now.*
Steven: *Yes, you can do that.*
Molly: *But we don't remember how to do it, you see.*
Steven: *Yes, then I'll show you. First you have to find the shots you want to cut (trec 101200).*

This work process features intense collaborative dialogues between the pupils. They have to agree on which shots they are going to have in the film, how long each sequence is to be, how these sequences are to be put together, what background music they are going to use for some of the sequences and which sequences are best without accompanying music. They also have to agree upon which colour the written comments are to have and how big the letters are to be. They also have to agree on the scrolling text at the end of the film. Moreover, they need to

help each other to operate the I-movie programme so they can use it properly to attain the outcome they want.

This activity really appears to motivate the pupils. During the editing process you can hear comments like: “This is cool”, “Smashing”, “This is really professional”, "iiiiiiiiii", “We're that good” and “This is incredible fun”. When Harold comes to look at the activity in the computer lab, their enthusiasm is also manifested in a dialogue they have with him in front of the computer screen. Harold comes up to them and asks if he can watch their film.

Harold: *Is it possible to watch now?*
Mary: *Do you want to watch it?*
Molly: *Are you going to watch? (enthusiastically)*
Mary: *Ours is really cool, but we haven't finished the end yet.*
Look how it starts then (eagerly).
This is good. It's me talking (listening to a voice commenting on a shot) .
Harold: *It's elegant. Hmm, Yeah.*
Mary: *Look, look, look (raises her voice).*
Harold: *(chuckles).*
Mary: *Look how professional, look now, look now, look now! (She eagerly prepares him for the next shot).*
Harold: *(looks and chuckles cheerfully).*
Mary: *Watch now, watch!*
Harold: *(Chuckles).*
Mary: *Yeah (she stretches her arms high in the air when the film ends and shows distinctly that she is satisfied).*
Harold: *(chuckles) (trec 101300).*

Steven comments that film is a medium the pupils are familiar with, and if they have the right equipment, he says, they get a qualitatively good result. Steven adds that he thinks they identify their result or production with films they watch in their leisure time, and then it is a familiar context for them (intinf 102500).

The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase

When both the films are finished, all the pupils in the work groups are gathered in the school's auditorium to watch them. When Steven comes into the room, a pupil asks him if they have finished the film. Steven comments on this to the whole class, assuring the pupils that the entire class has made these films, and that it is a class project. He reminds the pupils that the work started with the brainstorming processes in the basic groups, and that they then were divided into production teams where some were assigned the task of making the films, some were given the editing task and so on. He tells them that all the pupils could not edit the film at the same time, and that next time someone else would have the opportunity to make the final product. He goes on to say that he knows there are several pupils who could do the editing process, and that they are going to work a lot this way.

Anne asks the pupils what they think has been most interesting about this process, what they liked best. Some of the editing pupils answer that they liked that work very much. Then she asks the pupils if they liked the introduction of the I-movie programme, and the pupils respond with a convincing "yes". After they have watched the film the class applauds enthusiastically. The pupils and the teachers discuss the different shots, which ones were chosen and their length. Then Steven draws the pupils into a dialogue comparing these films with the first ones they made in the training period. Harold comments that he has never been through a teaching process in which such professional works have been made. Owen suggests that they can use this media in the Norwegian subject, in connection with role-play. He continues, suggesting that perhaps they can make their own movie (trec, vrec 101300).

The pupils have made their first production and their first project period has come to an end. This year the pupils are in their “training phase”, Steven explains, next year the heading for the work is "assignment" and the last year the focus will be on “self-elected processes”. When I visited the school some time after the project period has ended, Steven tells me that all the pupils in the class or work team had had the opportunity to make their own film and do the editing work. All the pupils had a training course learning to use the I-movie programme, and thus the chance to develop their skills. When I ask the teacher team after the project period has ended if they would have changed anything, Steven answers convincingly: “I think I would have conducted it the same way” (intteam 101300). It is worth mentioning that the class represented by two pupils and two teachers, and thus not the whole class, was actually invited to present their project results during the official opening of the Netd@ys Europe 2000 fair in Paris (A European Union Project).

A Summary of the School Visualized in the Activity System

The different factors affecting the learning processes in the three schools can be visualized in the Activity System as below.

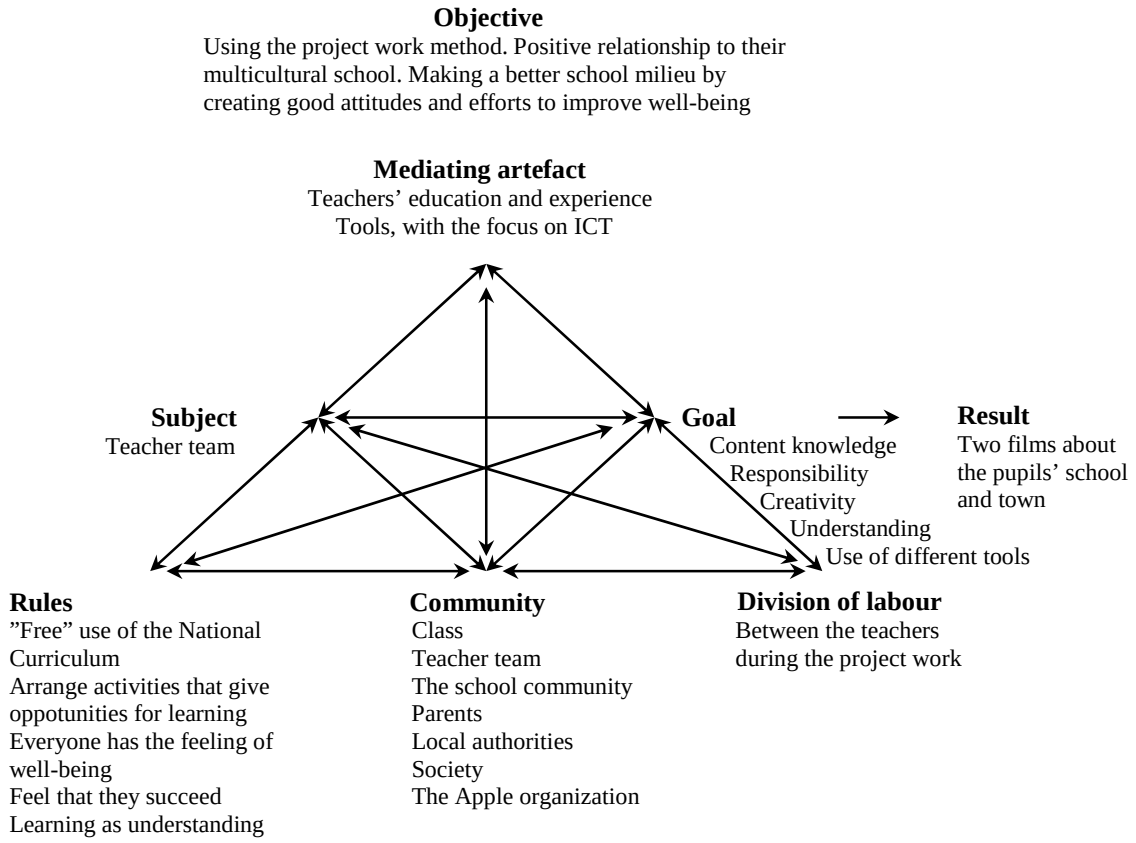

Figure 8: A summary of Applebee School visualized in the Activity System

The teachers in the team (the acting subject) have their experiences and their education in theories of learning and knowledge as factors that assist them in the classroom processes. During the observed project period I have focused especially on ICT as a tool and thus placed this factor together with experience and education as mediating artefacts for the teachers in the practice of creating supportive and structured learning processes for the pupils. The various issues listed under the items rules, community and division of labour form the context in which the actions that attempt to move the pupils in the direction of the listed goals and objectives take place.

Chapter 6
Description of Bridgeford School

The Context

Bridgeford School is a suburban, open school (see description of Applebee School, p. 85) with 450 pupils, and the children are from six to sixteen years of age. There are 140 pupils in the lower secondary school section, and the school has forty-four teachers. The school's activity plan starts with a poem:

> The moment of life
> Those wonderful seconds
> are when children and young people meet adults who:
> see them
> care about them for what they are
> enjoy being with them
> are involved in what they are doing
> listen to what they have to say
> are delighted being with them
> inspire them
> can see when they want some peace
> are there for them in body and soul.
> It is in such moments
> that children develop.
> Therefore, humans can never be replaced by machines.
> (Eilif Olsen, own translation)

Since the school was founded in 1977 the school community has had a joint basis as a framework for its teaching. One common ground for its work is that the child's interests can be best addressed when the child's three arenas, home, school and the local environment, co-operate. Another joint basis is that the parents are the most important grown-ups for the children. A third consideration that helps form the basis for the teachers' actions is acknowledging that the world has a wide range of possibilities and opportunities. The school community wants to give the pupils an understanding and awareness of computer technology so that they can handle the flow of information in a positive way. The fourth consideration is to focus on the potential of each and every pupil and the belief that everyone has the right to succeed. A fifth joint basis is the importance of giving the pupils the feeling that they are responsible and that they are expected to produce something and present what they have done. In this way they are expected to grow and develop both in their own and others' opinions. The sixth and last common basis is that the school is a knowledge-producing organisation. The

view that the teachers need to develop a holistic learning environment for the pupils must be developed in interdisciplinary teacher groups. This everyday knowledge has to be reflected on and systematised.

The objective for the school is to give the pupils overall action competence by using the National Curriculum (1996) as one main “rule” for their work. With the pupils needs and energy as their starting point, the teachers try to work towards this objective by taking the pupils’ role, the teachers’ role, the subjects, the school schedule, year syllabuses and the physical environment, the special-needs service and the parents into consideration. The teachers in the school community have also made a local “social curriculum”. The overall aim for this social plan is that the pupils become confident and self-asserting youths with a social competence that will lead them to co-operate with peers and adults in a positive manner. One enterprise to be used to this aim is to give the pupils knowledge about being a human being and about the interplay between people through collaboration training and learning about group dynamics and communication. One sign indicating that the pupils are on their way to this goal is that they can use techniques that make theme and project work effective learning methods. The teachers have drawn up a list of criteria under the headings empathy, self-control, the control of anger and self-assertion. The teachers concentrate on various projects involving topics such as ICT, culture, the library, and also a project more specifically aimed at the lower secondary school level (the school’s activity plan).

The objective for this specific project is to create a learning environment in which the pupils can flourish, are involved, feel responsible for their own learning and in which they are given the opportunity to influence their own school day. The aim is that by empowering pupils in this way, they will construct their own knowledge and express it in their own way. They have the opportunity to do their homework at school, with assistance from teachers if needed. They have less subjects at one time as they are clustered and taught in blocks of time rather than have the same schedule day in and day out over the entire school year. They have "flexitime" at school, one hour in the morning and one and a half hours in the afternoon that can also be taken off during school days (the school’s activity plan). The headmaster says:

> *We felt that something was in disharmony. We had to look at things once more to gain the best adaptation for each and every child. And they had to have more impact on and more possibilities to direct their own school day. Some of the clever pupils were shirking school. They weren't motivated. We felt that we had to reshuffle the deck. The pupils also got the opportunity to be co-planners when the project plans were put together (inthead 120400).*

The teachers in the school community also concentrate on the use of ICT. The overall objective is that both pupils and teachers at the school should use ICT as a tool on their own

level when this aid is felt to be useful in the learning processes. The goal they are working towards is that teachers and pupils will acquire good competence in the technical use of ICT, and knowledge about how this tool can be used in their subjects. The teachers of each class orders training for pupils when needed. The ICT group at the school is responsible for this training. This ICT group, consisting of three teachers, also offers help and guidance to the other teachers at the school. Courses are held during study days and during personnel seminars. “All the teachers have received further education in project work, but the competence they have in ICT was learned at this school. But it is clear that some are more eager than others and work on their computer at home, while some teachers need a bit more time to get used to the computer,” the headmaster adds (inthead 120400).

My key informant Sarah, a member of the ICT group, comments that the school activity plan covers a three-year period. However, they develop action plans for just one year. Sarah says: “ What I have experienced concerning the planning of the use of ICT is that it's useless to plan for a longer period of time.” She adds that the pupils are learning more and more about ICT themselves so that it is useless to make a strict plan for a three-year period, and that the development goes in different directions and so fast that it is difficult to foresee (intinf 112800).

The teachers have five computers, a scanner and a printer in their workplace. The ICT equipment, which the pupils I observed use, is mainly situated in two parts of the school, both of them nearby the pupils’ work area. As mentioned above, this was an open school with no doors separating each room from one another on the floor on which the eighth, ninth and tenth grades are working. Just a short partition wall divides the work area where the pupils’ desks are placed and the corner in which six computers and a printer are situated. These computers are used by the eighth and tenth grades. The pupils in the seventh and ninth grades also have six computers near their work area. The library, just a few metres from the pupils’ work area, also has eight computers. In addition to this, one computer is placed in the arts and crafts area and one in the audio-visual room so the lower secondary school level has altogether twenty-two computers at its disposal (obsnot 110600). The teachers in Bridgeford School say that they think that the ICT equipment should be placed close to the pupils' workplaces. In addition all of them stress that they should not just be placed here and there (Questionnaire, Appendix 6E, p. 395).

The teacher in the school commnuity have focused on the development of ICT in their school for six years, and when they started in 1995, they applied for money and received 150 000 NOK from the local authorities. Later each class also received one computer each from

the local authorities. The school also has four PCs, two portable PCs, a projector and a digital video camera from a project directed by Telenor and the local authorities. These computers are distributed throughout the school area. The school has altogether three digital still-photo cameras and two digital video cameras, but one of the video cameras is not functioning (intinf 120400).

The teachers in the ICT group are paid to spend some time on maintaining the equipment and developing teaching which uses ICT as a learning tool. Sarah, my key informant, receives pay for three hours a week, and the other two receive six and a half hours altogether. One of the three has the responsibility for the network, another for the technical equipment and Sarah has the main responsibility for the use of ICT in the learning processes (intinf 120400, inthead 120400).

I have now presented the school context which frames the actions that take place in the classroom. This context formed both the premises and the restrictions for the actions during the observed project period. Before I describe the processes during the project work, starting with the teachers articulated goals, the rules for their work, how they conduct different roles (division of labour) during the project and describe how ICT actually is used during the project work, I will present the teachers working in Sarah's teacher team and some of their and Sarah's opinions.

The teacher team has five teachers.[35] Sarah, the key informant, teaches social studies, Norwegian and religious and moral education. She has her degree from teacher training college, but she has also taken some courses at the university, among others in computer technology (3 credits), in geography and in social studies. She has been a teacher at Bridgeford School since 1985. Sarah became the form teacher for one part of the pupils on the eighth grade level, 8B, this school year, so this is the first year she has the main responsibility for them. Sarah has worked both as a pedagogical counsellor in the development of project work teaching in a school district and as an ICT co-ordinator in the same district. This year she is also working for the municipal chief officer, leading a group that is developing the use of ICT in the pupils' learning processes. Deborah has worked at this school for sixteen years. She has four years of education from teacher training college. She is the form teacher for the other half of the pupils at the eight grade level, 8A. She teaches them in the social studies, religious and moral education, Norwegian, home economics and physical education. During the observed project period she had leave from her work and was replaced by a substitute

[35] One of the teachers in the teacher team was not involved in the observed project period.

teacher. Susan has a fresh bachelor's degree from the teacher training college. It is her first year as a teacher. She teaches the class in the music and she has some lessons with pupils with special needs. Brian also has some lessons in the class with pupils with special needs and he teaches the class in arts and crafts. He has taken courses in Norwegian, education science, religious and moral education, mathematics and arts and crafts both at university and teacher training college. He has taught at this school since 1985 (Questionnaire, Appendix 6E, p. 395).

Sarah defines project work as a work method in which the pupils make a question on a given topic, and find a solution or an answer to this question on their own. The answer, she says, then has to be presented to the other pupils and the teacher(s). She adds that the frames for the pupils' projects may vary, and who makes these frames may also vary. Sarah concludes that it is important that this skeleton for the pupils' work is explained and presented to the pupils when the project period starts. Deborah says that project work is a method that gives the pupils the opportunity to do some research and in that way study some topics in depth. In project work, in her opinion, the pupils can plan and carry out their work more independently. Brian defines project work as a matter of curiosity. The pupils ask questions because they are inquisitive and want to find answers to them. Susan describes project work as an active learning situation in which the pupils themselves are trying to find answers to their problems or questions (Questionnaire, Appendix 6E, p. 395).

Sarah says that the teacher's job during project work is to be a supervisor in the introduction phase and in the presentation phase, and a person who scaffolds the pupils during the realization phase. In connection with the traditional teacher role this is something completely new, Sarah states. The teacher's traditional role was to decide the learning content, when the pupils should learn this content, which persons they should learn it from and how and at what speed it should be learnt. "What do you think about that," Sarah concludes, emphasizing "that". She adds that the teachers are on the same level when ICT is used as a mediating artefact, just as in project work. Brian, Susan and Deborah describe the teacher's role as a person who assists the pupils during the work processes. The teachers are more in the background, they say. Deborah does not think that the teacher's role changes when ICT is used during project work. She says that they also use ICT in other work activities. Brian thinks that the teacher has less control with the content and the working processes when ICT is used. He adds that there is a possibility that the theme or topic will end up in the periphery of what is actually the plan for the work. Susan thinks that it is important

that the pupils know how to use ICT as a tool before the project period starts (Questionnaire, Appendix 6E, p. 395).

When I asked the teachers about what premises made the foundation for a teacher team function well, Sarah quickly replied: " No one dares answer that." One of the other teachers mentions that you have to be flexible and that you need to have the skill to co-operate. Another teacher mentions that you need to feel safe and that it is an advantage to be creative. Sarah adds to this: "I also think that it's important that there are different types of people. What you can do together is surely better than what you can do alone. And then we have to be different types of people. Then you have to accept that your own solution perhaps is not the best one" (intteam 120500). Sarah also thinks that the teachers need to dare loosen their grip on the reins on the pupils, otherwise the teachers will direct the work too much, she says, adding:

> *The starting point is the teachers' attitudes to other people, in a way your philosophy, and I think that you have a humanistic approach, but you have to practice it too. You have to respect the others as equal partners, you see, this opinion I think is the main premise. And the best of all is that a team is composed of different people, then you can take different strengths into account, and then you can get a good result. Otherwise I think it's a premise that the teachers in the team involve themselves, but then again we are speaking of different types of people. What is involvement? Perhaps my definition doesn't coincide with others, and then you're on thin ice again, I think. But these factors are important to get a team to function. In addition, you're placed in a team, and I think that part of our job is to make it work well (intinf 041200).*

Sarah says that I was a resource person during the team meetings because the questions I asked made them reflect more than they usually do. She adds that they perhaps should have continued that process even more because she thinks that the team could have been more co-ordinated on the pedagogical view or philosophy (Appendix 1B, p. 359).

In one team-meeting the teachers plan for the coming project period, using experiences and reflections from a completed project as their planning basis. The overall theme for the coming project period has been decided. It is to be: "Norway". Sarah starts the dialogue:

> *Sarah:* *I look forward to beginning with the topic. I like things when they're in order. I know from experience that it's difficult for the pupils to make questions. I suggest that during the first two weeks of the project period we teach the pupils some basic knowledge about the theme. We have to define some goals for the project, and we have to make criteria for the assessment process so that the pupils know what is expected of them.*
> *Brian:* *Do they choose the topic themselves in the project then?*
> *Sarah:* *Yes, yes from the material we have presented to them.*
> *Deborah:* *In earlier project periods they have also made the question themselves, and we let the pupils make a priority list regarding topics they wanted to work on. We established interest groups on the basis of their lists.*
> *Sarah:* *I've never done it that way before, it could be interesting to do it like that.*

Deborah: (Reading from a document). During the last project the pupils didn't attain the various subject goals, but the use of ICT functioned well. The groups put together by the teachers worked better than self-composed groups. The pupils made nice Power Point presentations, and they had to make appointments with their teacher for advice and guidance, but there has to be some content.
Sarah: And it has to be something they are wondering about (obsnot team 103100).

Sarah thinks that project work is similar to "learning by doing". She believes that pupil activity together with the increased motivation and interest raised by the pupils' own questions will enhance the learning processes. She reflects on how much time teachers have used to motivate the pupils. During project work she thinks that the pupils in a way motivate themselves. Therefore she deems project work to be a valuable work method. She says that during project work the pupils have to make up their own questions and solve them in their own way, perhaps with some guidance from the teacher. Sarah continues:

> *Think of the work process when the pupils plan to make a film, plan to make a presentation and work it out so just the main things are addressed, imagine how much learning that lies implicitly in a process like that, an incredible amount, I think: They have to pick out the most important aspects, they have to know how to present it, they have to learn it, lots of things that are of good use for them (intinf 120400).*

There are many aims for the pupils' learning, Sarah thinks. She believes that it is important that they learn some basic knowledge in the school subjects so that they have the necessary tools to progress in their educational career. She adds that if they do not have this knowledge basis, they cannot master the requirements they will meet after completing lower secondary school. She also thinks that it is important for the pupils to acquire a sense of belonging in the school community, and that they learn to know what a social milieu can give them and how they can contribute to their social environment themselves. Sarah concludes that action competence is a result of both subject and social qualifications (intinf 120400).

The Norwegian National Curriculum (1996) is a regulatory plan, but Sarah does not feel that it directs her work too much. The main purpose is to interpret it and arrange it to give the best possible adaptation to the pupils' needs. Thus you do not need to apply for an exemption from this plan, she says (intinf 111300). Sarah thinks it is important that the pupils' thoughts and needs are in focus and that they are listened to. She says: "I have always said to my pupils that 'thank God you're asking questions'. In this world adults are not supposed to think the same as youths, if they did we would never improve life, so I'm glad the youths are cleaning up the mess we've made" (intinf 112800).

There were forty-five pupils, thirty-one girls and fourteen boys, at the eighth grade level that I was observing. In class 8B for which Sarah was the form teacher, there were

fifteen girls and nine boys. Class 8A and 8B did not always have their project lessons at the same time, so it was natural that I mostly observed the one class, 8B. Sarah, my key informant, tells me that the pupils have been in the same class since they started in the first grade, and that they therefore know each other very well. Last school year some pupils in the class felt that they were picked on and were afraid to speak in class. The class atmosphere has improved according to Sarah, and the conversations she has had with the pupils also confirm that everyone is enjoying the class (Questionnaire, Appendix 6E, p. 395): “Now they act as if they're members of a large family" (intinf 111300). The ICT group at the school has given courses for the classes at the school, including the pupils at the eighth grade level. Sarah says that they have learnt to cut and paste. When they find some interesting topics on the Internet they know how to copy and paste pictures and texts into their own documents before they print them out. They have also learnt to present their material as Power Point presentations (intinf 111300). The pupils are placed in groups in their work area. Sarah says that her aim is that all the pupils can work together and co-operate. They usually change the groups once a month, and the first time this year the pupils chose the composition of the groups themselves. The next time Sarah formed the groups, and the last time they changed, the pupils were allowed to state their preference for two pupils they wanted to work with. Sarah took the pupils’ wishes into account when she grouped them (intinf 120400).

The Project Period

The teachers have planned a project period of six weeks with eight school lessons a week dedicated to project work. The overarching theme for the work as decided by the teachers was “Norway”, which was a central topic in social studies at the eighth-grade level. The project period was divided into three different parts. The two first weeks the teachers had planned to introduce basic knowledge about the theme to the pupils. During this introduction phase of the project work there was a clear “division of labour” between the teachers. They presented issues that they thought could be interesting for the pupils to work on, and most of these topics were chosen from the National Curriculum. In this first part of the project the pupils worked together in the eleven basic groups in class, which had four pupils at the most. Sarah thinks that four pupils in a group are suitable (intteam 120500). During the two next weeks the pupils chose a topic from the basic course and work with that, and the last two weeks were allocated for the pupils' presentations.

The Introduction Phase

When the pupils were introduced to the plans for the project, both classes were gathered in the school's auditorium, which was adjacent to the pupils' work area. Sarah starts to talk to the pupils:

> *Now we're in the introduction phase of a long project period. And I'm really looking forward to this, I must say. We're going to concentrate on Norway in many ways. And now I'm going to tell you how we're going to work on this. That's why I asked you to bring your project plan with you. I'll go through this plan together with you so that everyone knows what it's all about (trec 110600).*

Sarah tells the pupils about the different parts of the project period, that the first two weeks would be like a basic course, the next two weeks would be for working on their project where they are by and large on their own, and that in the third part they will present their findings, which they are responsible for themselves. So the three parts are: teacher directed, more pupil directed and mostly pupil directed, Sarah explains. Then Sarah moves on to the goal of the project work.

She says that the first consideration is to learn some subject knowledge. The work during the project period should increase their knowledge about the themes listed up in their project plan. The teachers have decided which subjects are going to be integrated in the work processes (project document, trec 110600). These subjects are social studies, religious and moral education, Norwegian, home economics and arts and crafts. In connection with the various subjects the teachers have also made a list of topics that are going to be worked on during the project period (project document). Sarah goes on to inform the pupils that in addition to content knowledge they will learn that it is important to collaborate, which is a skill in itself she says. "When we've finished this project we'll be better collaborators," she adds. She wants them to understand that collaboration is a very good and productive way of working, and they will experience that to collaborate and learn from each other is extremely useful. Sarah adds that the pupils will then have a positive attitude to project work as a work method. "These are our 'goals'," she says. Then she moves on to talk about assessment of the project. She asks the pupils:

Sarah:	*So your work is going to be assessed. What is meant by assessment? What is assessment about? Do you know what assessment is?*
	John? (he is raising his hand)
John:	*How we've worked and stuff like that.*
Sarah:	*Yes, and how do we usually perform the assessment in school?*
John:	*Marks.*
Sarah:	*With marks, that's right.*

Sarah: *And here you can read what we'll assess (the project document). These are the things we'll assess. And it's important to be aware of this even now. You have to know that you have learnt some knowledge, both from the basic course and from your own projects. Besides you are going to learn from the others' projects. When do you learn from the others projects? Julie?*

Julie: *When they present their work during their presentation.*

Sarah: *Exactly. And you'll have a test at the end of the project period. We'll assess your knowledge about all the topics, your skill and will to collaborate. And we'll focus on how you manage to present your own project so that others can learn from it. So you'll be assessed in content knowledge, your skill to collaborate and the clarity of your presentation, ok? (trec 110600).*

Sarah talks to the pupils about the topics they are going to work on, and also motivates the pupils to ask parents and grandparents about the topic "buildings" when they are ready to start working on that. Sarah says that after each introduction of each topic the pupils will receive handouts on the topics they have talked about, both information papers and some exercises. She suggests that they put all the handouts in a folder on which they write the name Norway. The first topic Sarah introduces to the pupils is about "Norway's geography".

The Basic Course

Sarah tells the pupils that they are going to talk about their country and where people live, why there are mountains, lowlands and fjords. Sarah uses the pupils' textbook in social studies when she talks about this topic. She lectures for about thirty minutes before the pupils get a handout with exercises related to the topic. This introduction was before the pupils' midday break. After this break they have a lesson on the political system, democracy and organisations.

Sarah starts this lesson by writing the word democracy on the board. The pupils are then encouraged to brainstorm around this topic. Some pupils are very eager to take part in the dialogue, others listen passively to their classmates' suggestions. After the brainstorming session Sarah presents a developmental perspective regarding the history of Norway, from the Vikings and up to the present. In this connection she also mentions both the American and French revolutions, and tells the pupils that it is important to remember the dates for these historical events. After this introduction the pupils also receive some exercises to work on (trec 110800).

The next theme the teachers present to the pupils is about Norwegian culture, literature, art and music. Susan is responsible for this topic, and she also presents a historical perspective to the pupils, from the Norse era and until Romanticism. Susan ends the lesson by playing "Fanitulen" by the Norwegian composer Edvard Grieg. After this lesson the pupils receive a handout that summarises what she has talked about (summary note, obsnot 111300).

The next topic that is presented to the pupils is called Norway today. Deborah leads the pupils through this process. She writes the topic on the board and encourages the pupils to associate with the theme. This process ends with a brainstorming mind-map on the board. Deborah gives the pupils an exercise. She says:

> *We're going to have a group activity in the regular groups. We're going to imagine that we're taking part in a Nordic contest, and the aim is to present our country the best way possible, and it's therefore important that the presentations come across well. And the work must be informative, and clear. There must be some information that shows that you have knowledge about Norway, and the information must be correct. You have to have more than just goat's cheese, national costumes, mountains and fjords, that's not enough. You'll get as many sheets of paper as you need (trec 111500).*

The pupils are given an exercise which will end up as a cartoon made of sheets of paper. One of the groups of pupils decides to work on the topic culture and music. They ask the other pupils in the class what kind of music they like, and if they try to dress like a particular pop star or if they have any other role models. The dialogue rendered below is from a discussion in the group after they have compiled some information in the class.

Benny: *The next question was about clothes, wasn't it? (the pupils are writing down questions they have already asked their classmates).*
Janet: *No.*
Benny: *Where do you have anything about clothes? (looking in Janet's papers).*
Janet: *There (pointing).*
Benny: *Clothes, and that was?*
Janet: *If they had a role model.*
Benny: *An idol. Next?*
Janet: *If anyone wanted to be a famous person?*
Benny: *We have to write this neatly on the computer. We have to do that, we can't use this as part of our presentation (trec 111500).*

Another girl in the group is busy in the computer corner trying to find some pictures of pop groups on the Internet. A girl sitting next to her has found something about the Norwegian national day on the Internet. One boy is searching for information about oil, another for data on the Vikings. Two girls sitting in front of the same computer screen are trying to find some facts about Norwegian chocolate. During this lesson there is intense activity in the ICT corner, and all the pupil groups are using the Internet as an information source for their exercise (obsnot 111500).

Deborah takes the pupils on a trip through the history and development of religious thought and groups to the situation in Norway today after the midday break the same day. Some pupils volunteer to dramatise the events when she talks about them in chronological order. After the introduction, the pupils receive a handout that summarizes the content and has questions on the topic.

The next common topic the pupils are to learn about is buildings and settlement in their local community. Sarah guides the pupils through this task and she starts the work process by explaining the exercise to them. She says:

> *It's a study of the houses here, what type of houses and where the various types are, how it is to live here, how it was to live here before and things like that. There's lots of work here, but we'll divide it between the eleven groups. And we're going to do this pretty fast, that means that we're not going to work on this topic in depth, and this way of working is typical for the work we're doing now. We're just going to present a lot of topics now, but when we start the real project work, you can decide which topic you want to study more thoroughly. You'll have a long period to work on that, so be happy. This in-depth period will start soon. First I'm going to hand out these group exercises to you. We can look at them together although they are a bit different (trec 112000).*

Each of the eleven basic groups in the class are assigned a part of the neighbourhood to study. One group is going to study blocks of flats, another row houses. Other topics are detached houses, older buildings, school buildings, office blocks and how it was to live in this area and how it is now. One group will be studying the surrounding areas, which areas the community borders on, another is going to make a theme-map of the area. A sports arena that lies nearby is the focus of study in one of the pupil groups (teacher's planning document, obsnote 112000). During this group activity the pupils also use the Internet as a central source of information. Two girls in the group working on the sports arena are in front of the computer trying to find some pictures about their topic. The rendered dialogue below shows that the pupils have found the pictures they were looking for:

Janet:	*Here, good. Oh, look (excited). Oh, we'll take that.*
Ina:	*It worked! (comes with a picture that she has printed out).*
Janet:	*Oh, how nice it is (looking at the picture).*
Janet:	*Which other ones do we want?*
Ina:	*Maybe we should look at another page too.*
Janet:	*Are we, we could search for something else? Here's a flag (looking at the same page).*
Ina:	*Scroll further down then.*
Janet:	*Yes, but we don't need to use all this.*
Ina:	*No, but then you have to save the image.*
Janet:	*Should I take this one, you can do it, I don't dare.*
Ina:	*Should we press control c then?*
Janet:	*Shouldn't we right click on the mouse?*
Ina:	*Yes, I could do that.*
Janet:	*Maybe there's some text about it too, maybe we could print it out, all of it, should we do that?*
Ina:	*That could mean a lot of paper but…*
Janet:	*Yes, but that doesn't matter, we have to have pictures, don't you think?*
Ina:	*Now we probably have enough.*
Janet:	*Yes, I think so (trec 112200).*

When the pupils have worked on all these presented themes, just the topic on Norwegian food is left. This theme turns out to be a private study. The pupils are given some pages they have

to read before they answer a list of questions. Sarah comments: "We had planned to make waffles, but we didn't get enough time. Typically, really the most enjoyable activity" (intinf 112800). When all the themes have been worked on, it is time to start the more pupil-directed part of the project. The pupils are given the opportunity to choose a topic from the themes they have worked on during the introduction phase of the project.

The Choice of Theme Phase

The pupils in both 8A and 8B are gathered in the school's audio-visual room (the AV-room). Sarah has made a Power Point presentation that shows and reminds the pupils of the themes they have worked on. She says that they probably know more about these themes now than before the project work had started. This lesson the pupils are going to choose a topic from the list of themes and work in depth on their chosen topic. Unfortunately, due to technical problems, Sarah cannot use the Power Point presentation, and she has to use the board instead (trec, vrec 112400).

Sarah reminds the pupils that they have to choose a topic they have worked on during the basic course. She tells them that it is important that they choose a topic that they are interested in and want to work more on. If the pupils choose a topic outside the listed themes they have to rethink their choice. The pupils are encouraged to find subtopics for the theme they choose. After a while Sarah asks the pupils if they have found a topic they want to formulate questions for. She reminds them that they have to have questions to ask to find out something (trec, vrec 112400). When the pupils have no more topics to suggest and Sarah has explained the requirements for the project work, they all go to their places in their work area where they write down their choice of topic. With these preferences in mind, Sarah establishes the pupil groups, seven in all, with these headings: animals, fashion, fashion and media, music, good food, sweets and national dishes (trec 112700).

Sarah thinks that the pupils' choices are too simple and that they are not up to the level of what the pupils have produced during the basic course. She blames herself and the teaching situation for this: "I don't think it was such a good idea to put both classes together during the brainstorming process, and it was a pity that I couldn't show them the Power Point presentation. I think that this presentation would have inspired them to choose other topics" (intteam 120500). Sarah also thinks it has been more difficult because the other form teacher, Deborah, who teaches class 8A is on sick leave and will not return before the project period has ended. Sarah says that this is in no way a reflection on the supply teacher, but she feels that she and Deborah are on the same page when it comes to involvement and taking

responsibility (researcher's log 121300). The next project day the pupils are told which group they are in.

The Planning Phase Including the Forming of Questions

Having placed the students in their groups, Sarah informs them that they will have a guide for their work and that it is time to start the planning phase of the project. She points out the importance of proper planning and gives the pupils a planning document for their work. Before they examine this plan together, Sarah reminds the pupils that they will get a grade on the test in social studies. Furthermore, the group work they are going to do and the portfolio they will make at the end of the project containing the overview papers and the answers to the lists of questions will also be graded. Their collaboration skills will also be assessed, but without a mark being assigned. She tells the pupils that the presentation will be assessed according to their oral skills, and that they thus will get a mark in oral Norwegian (trec 112700).

The planning document that guides the pupils' work during the planning phase contains several items that the pupils have to consider. First they have to agree upon a question for the work and how this work is to be presented. They have to decide upon which information sources they will use and how they will divide the work between the members of the group. They have to plan when each part of the work is to be finished, and when they will meet in their group to inform each other about their work process and their progress. After the pupils and their guide have gone through the planning document together, the teacher also decides which other subjects in addition to social studies and oral Norwegian the pupils can naturally integrate in their work and thus be assessed in. When the groups have finished this planning, they sign the document together with their guide. At the bottom of this planning document is a reminder of how to use the guide to apply for permission to work outside the school’s premises. The pupils have to inform their teacher when they are planning to do the work, what persons will be performing this work, and where this work is to be done (pupils' planning document).

The pupils working on the theme “National dishes in Norway" are sitting in their group planning their project period with the planning document as the starting point for the discussions. There are two girls and two boys in this group, and one of the boys starts the dialogue rendered below:

Ron: *We have to agree on what national dishes we're going to have.*
Jenny: *Lamb is good.*
Lisa: *Yes, but that's a dish they eat in almost every country. We can't call that a national dish.*
Harry: *Yes, but we could search for dishes on the Internet.*
Ron: *Yes, I could do that.*
Lisa: *Yes, but first we have to…*
Ron: *Find out what we're going to do.*
Jenny: *What are we going to have then?*
Lisa: *We could search on the Internet and see if we find different dishes.*
Jenny: *The question is, what are we actually trying to find out then?*
Lisa: *We can find out…*
Jenny: *Which ones that are the national dishes in Norway?*
Ron: *Which ones are the most popular.*
Lisa: *And we have to find recipes and things like that.*
Jenny: *Yes, and then we make the food.*
Ron: *Yes, and then we eat it.*
Ron: *What did we decide?*
Jenny: *What national dishes are the most popular, and perhaps some recipes.*
Ron: *Ok, and then someone has to search on the Internet, I can do that.*
Jenny: *Yes, but perhaps someone else wants to do that too (trec 112700).*

The pupils structure their work in this way: they make their question, plan what to do and divide the work between them. Sarah guides the pupils when they make questions for their work. She says: "A good question is a question that starts with how and why. It shows an inquisitive attitude. You want a question that you can really work with at the same time as it restricts your work" (intinf 112800). She guides one group of pupils working on the topic "sweets" to change their question. Their first question was: "What kind of sweets are the most popular?" Sarah asks the pupils what group of people they are thinking of, and she also asks them if they could think of starting their question with the word "why" as, she says, that would make it more interesting. The group reconsiders their question, and ends up by putting the word "why" behind their first question (trec 112700).

The Realization Phase

In the realization phase of the project work all but one group uses the Internet as one of their information sources in both 8A and 8B (Table 9, p. 403). The teachers usually put some relevant links on the school's homepage before a project periods begins. This time they had actually forgotten to find such links, but it seems that the pupils manage to find the information themselves. Sarah comments that the only thing they need to do is to give some URL addresses or provide some tips about how to search and where to search (intinf 112800). The pupils gather information in other ways as well, using encyclopaedias, newspapers, magazines, TV, books and interviews as sources when compiling their data material (Table 9, p. 403). During this phase of the project work the teacher's role is to advise the pupils. Sarah also reflects on the teacher's role. She says:

Some groups need very little guidance, you see, at least in connection with the collaboration processes. But, generally the guidance focuses on the question and if the pupils are answering this question. That's often difficult for them. And then you have to help them to use different information sources, and help them to plan their work process so that they are finished in time. How often you need to help the pupils varies of course" (trec 111300).

Sarah has tried to make a structure that encourages the pupils to co-ordinate their work during the work process. She included an item in the pupils' planning document where they had to decide when they were going to have different group meetings. “We have to work more on this,” Sarah says, “but it's an attempt to help the pupils collaborate on and co-ordinate their answers to their main question” (intinf 112700). Working in the group with the theme “fashion and media”, Jill says to the others that they have to remember that they are going to have a meeting soon. At one o’clock they all gather at their cluster of desks and Jill starts the meeting.

Jill: *What do we have, and what are we lacking now?*
Janet: *We have to interview some people at a shop, because then we can get some information about what the fashion was years ago.*
Jill: *Yes, and we have to finish this poster about media. Then we have actually everything settled then.*
Cindy: *You told them which day we have decided to do the interview then? (She asks Kevin. He had just rung the shop where they were going to hold the interview).*
Kevin: *Yes, tomorrow at ten o’clock (trec 112900).*

After this meeting Janet takes the fashion poster they have finished and shows it to Sarah. Sarah comments:

Sarah: *Mmmmm, it's very nice.*
Janet: *We have two posters, and then Jill is going to record an interview, and then we have the film.*
Sarah: *Oh, great (seems satisfied with the pupils’ work) (trec 112900).*

During the realization phase some of the groups also use the video camera and try to edit a film. A teacher responsible for the AV equipment was brought in to help one group edit their film so they were capable of finishing their film on their own. Sarah also asks these pupils to share their newly acquired expertise to help another group edit their film (trec 120400). During the filming processes the pupils discover that only one of the school’s two video cameras is functioning, which means that some groups have to wait for it, or decide not to use it. Some pupils decide to use the digital still-photo camera to take some pictures of the people they are interviewing instead of filming them. The pupils in this group also have problems when they are trying to transfer the pictures to the computer and print them out because the

printer is not working (trec 120400). One group that has prepared a Power Point presentation could not show this either due to technical difficulties (trec 121300).

Sarah writes in her log that the equipment became a greater problem than she had imagined. The ICT equipment functioned well during the basic course, but at other times, perhaps when it counted most, it often did not work. Transferring the pictures and printing them out was also difficult or to be more correct, impossible, she writes. This was terribly irritating and had an inhibiting effect on the pupils' work process, Sarah adds. It is especially irritating she says, because the ICT office at the municipal level controls the ICT equipment, so it is difficult for the teachers at school to make any corrections or adjustments, nor was she aware that the video equipment at the school was that bad. "I could have checked it out beforehand, but I was not prepared for the large number of pupils who wanted to use the video cameras," Sarah says, admonishing herself. "It is sad," she continues, "that we have such a short supply of proper equipment because that restricts the choice of presentation forms, and it can force the pupils back to traditional writing again." She adds that before the next project period she plans to learn simple editing techniques because she does not want to be dependent on others all the time. She ends this section in her log by saying that she will encourage the school to buy some new video cameras (informant's log).

The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase

During the realization phase two groups work at the home of one of the group members. One of the groups is working on the theme "National dishes", and these pupils bake a chocolate cake, which they bring to school and serve to the others. The other group working on the theme "What is good food?" makes both a main dish and a dessert at one of the pupils' homes. These pupils film the work process, and after they have edited the film, they show it to the other pupils and their teachers as their project presentation. After the presentation the pupils assess each other's work. Sarah encourages the pupils both to remark on what is good and what they think can be even better. She comments first that she thinks the presentation was really good. One pupil says that he thinks that the film was very well made. Another says that she liked the way they poked fun at each other, and that the film was both funny and serious. One pupil criticized the unsteady camera (trec 120400).

Before the project period has come to an end all the pupils have presented their work and commented on each other's work. During the project period the pupils have also written a log during the work processes. Sarah starts one lesson by saying: "Before we continue the

work today, everybody is going to write a log. We're doing this because we'll give you the opportunity to reconsider your work. And you can discuss the log in your groups” (trec 120400). During the assessment phase of the project after each presentation, the pupils write each their own log. When one of the pupils asks Sarah what she should write about, Sarah tells her to give her personal opinion, and to write about the collaboration processes in the group, about the division of labour and about what she thinks about their work: "You're going to write down just what you think yourself, and therefore it is important that you write alone," Sarah concludes. Sarah also uses the logs as documentation, and together with her observations they form the basis of her assessment of the pupils’ work processes (trec 121300). Sarah instructs the pupils to write down two questions from their presentation, and afterwards she gathers these questions on a list that makes the basis for a group competition. She says: “This competition was in a way an activity to collect the pupils' work, and when they make questions, they also have to reflect on what they have presented " (trec 131200). When I ask the teachers in the team about their own evaluation of the project period Sarah says. “The project period did not turn out exactly how we planned it. We actually intended more pupil activity also during the basic course, among other things we had planned to make waffles, but time is short, so many things happen that change our plans. But I think it has turned out very well" (intteam 120500).

A Summary of the School Visualized in the Activity System

The various factors influencing the learning processes in the school are visualized in the Activity System below.

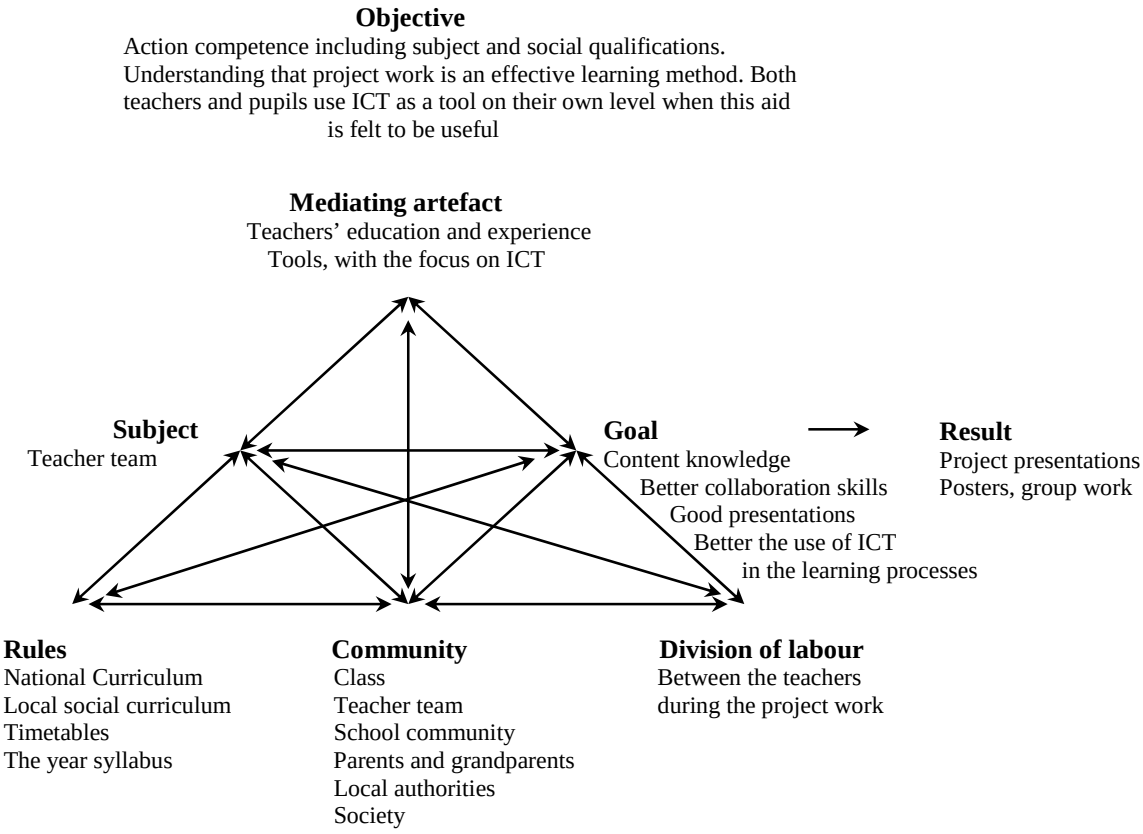

Figure 9: A summary of Bridgeford School visualized in the Activity System

As with Applebee School, the teacher team is looked upon as the acting subject with their experiences and their education in theories of learning and knowledge as factors that assist them in their teaching processes in the classroom. In addition to the teachers' experiences and theories, I have also placed ICT as a mediating artefact that can help the teachers to create supportive and structured learning situations for the pupils. In connection with the factors, the rules, the community and division of labour that form the context for the work and thus lay the premises and also possible limitations for the actions, I have listed various issues that were prevalent at Bridgeford School.

Chapter 7
Description of Cooper School

The Context

Cooper School was built in a rural district in 1973, and now houses a total of 203 pupils. The children are from thirteen to sixteen years of age, so this school is a lower secondary school. The pupils in Cooper School work in ordinary classrooms, and there are forty teachers guiding the pupils during their school day.

The school community has different factors as their joint basis: well-being, confidence and solidarity, ICT integrated in various subjects and assessment. The school has decided to concentrate on the first-mentioned issue (well-being) because some pupils still suffer from eating disorders and some even have suicidal tendencies. The integration of ICT in school subjects has been advocated as an important tool in the National Curriculum (1996) and in the municipal plan as well, and therefore the aim is that it should be a central artefact at the school as well. In the National Curriculum (1996) holistic assessment is emphasized, not just assessment of the content knowledge. In the Curriculum plan portfolio, observation and logs are mentioned as ways of assessing the pupils. With this in mind the school community is focusing on developing its assessment practice.

One of the school's objectives is to combine active pupil learning and thorough content knowledge in subjects with well-being and a sense of belonging. Another objective for the school practice is to create an equal and adapted education for the pupils' needs. A third objective is to help the pupils develop basic knowledge, bring cultural heritage to life, and stimulate and inspire the pupils to be active and productive. The school also has a plan regarding social enterprises in the school community. Teachers in the different classes use the neighbourhood during a camping trip to lay the foundation for the development of the pupil's subject competence both in natural science and physical education, and to develop their social skills. The school also aims to give all the pupils a safe class and school community without any kind of mobbing or bullying. One effort in this connection is to try to improve the way the teachers and the parents work together (the school's activity plan).

The teachers at the school have taken a three-day further-education course in project work as a work method. "But we have no teachers who have taken credits in that subject area," the headmaster states (inthead 110200). The teachers were actually using the project-oriented approach before the last National Curriculum (1996)."We have a long tradition of

working this way, but before 1997 we called it an "integrated day," Ben, a teacher in the observed team, explains (intinf 091400). Even though the teachers have integrated some subjects and let the pupils work in groups for a long time, group work is not used very often outside the lessons planned for project work. "In the other lessons we do have some pair work. For example, pupils turn around and work together with the classmate behind them. We don't have project-work learning situations during these lessons," Marion, the key informant, says (intinf 112300). The headmaster explains that he and the deputy head guide the teachers during school seminars to help them learn to use ICT as a tool in school subjects. He further tells that the teachers can ask the deputy head to help them give the pupils some basic skills in using ICT as a tool. The school has no progression plan in the use of ICT, neither at the teacher nor pupil level. "But we intend to draw up such plans during this school year," adds the headmaster (inthead 110200).

The school received its first computer to be used in the teaching processes way back in 1985. The school now has two PC's in each teacher team room or workplace. Usually four teachers work in such a team room. "We have two computers at our workplace, a dinosaur and a newer one," Ben says laughing (intinf 140900). There is one PC lab at the school with twelve computers, a projector, a screen, a scanner and a printer. Nearby this computer lab is also a classroom with an ICT corner containing ten computers. The library has six PCs, and each classroom has two PCs. This means that there are altogether fifty PC's that the pupils can use and twenty to thirty that the teachers can use. "So, that's between seventy and eighty PCs, and we buy used computers from the private sector," the headmaster says (inthead 110200). Otherwise the school has one analogue video camera and two digital still-photo cameras (intinf 091400). The teachers at Cooper School think that the equipment should be placed nearby the pupils' classroom so that it is easily accessible. One of the teachers at Cooper School also mentions that some of the equipment should be placed in computer labs (Questionnaire, Attachment 6E, p. 395). The headmaster is responsible for the technical system, and the deputy head is paid to use four hours a week on the support and use of ICT (inthead 110200). "He uses this resource on one-day school seminars and short courses that he holds for the teachers. And we can ask him when we need some help. He can plan to teach a skill to a whole class or to smaller groups. We can use him as a resource person," Ben says (intteam 110900).

The information I have presented above constitutes some of the context for the actions that take place during learning processes in the classroom. This context establishes both the premises and the restrictions for the actions during the observed project work. Together with a

description of what is actually going on, I present the teachers' articulated goals, the rules for their work, how they divide the work between them (division of labour) and how ICT is used during the learning processes. First of all I will present the teachers in the teacher team that is guiding the pupils throughout the project period.

There are three teachers in this teacher team. My key informant, Marion, teaches the class in social studies, religious and moral education, English, Norwegian and some pupils with special needs in mathematics and natural and environmental science. She has a degree from the teacher training college, but has also taken some extra credits in English, social studies, home economics and Nordic studies, and she has studied social pedagogy for two years. Marion has been a teacher at this school since 1983. Ben has worked at this school since 1980. His degree is in arts and crafts, but he also has undergraduate studies in physical education and art history. He teaches the class in physical education, arts and crafts, social studies and religious and moral education. John has worked as a teacher since 1978, and at this school the last six years. He has a bachelor's degree in history, social studies, Nordic studies and mathematics. He teaches the class in mathematics, Norwegian and natural and environmental science. Marion says that he is the team's expert on computers (Questionnaire, Appendix 6E, p. 395).

Project work as a work method starts with a question, according to Marion. This question is made on the basis of the pupils' interests, what they want to find out. She adds that project work ends with a presentation or a concrete result. Ben sees project work as a work method in which the pupils can work alone or in groups on a problem or a question which they have formulated themselves. The teacher motivates, scaffolds and takes part in the assessment process, he says. John defines project work as a work method in which the pupils appropriate knowledge and understanding through a process which involves initial planning, collecting data material and planning how to present the information. During the work the pupils have to formulate questions or define problems. These questions or problems can be formulated at an early stage in the pupils' work, but the teachers must expect that these can change during the project period (Questionnaire, Appendix 6E, p. 395).

Marion thinks that the teacher’s responsibility in his or her traditional role is to transfer knowledge to the pupils, while during a project period the teacher is more an advisor and a person who arranges a learning situation in which the pupils can develop their own knowledge. Ben also says that the teacher's role is to advise the pupils and arrange the environment for learning situations. John thinks that the teachers work as errand boys for the pupils, but also as advisors. He adds that the school has rules that do not take the pupils' needs

into account, for example when it comes to the lack of free entrance to the library and to the computer lab. The teacher has to accompany the pupils if they want to find a book or use the computer to search for something on the Internet (Questionnaire, Appendix 6E, p. 395).

The following dialogue took place when the teachers were asked to name the factors that constitute a well functioning framework for a team:

Marion: *In the first place I think that the teachers have to be different as persons, then I think you have to be educated in different subjects. You also have to have a person who is creative in your team if you teach project work. We need patience, tolerance, just what we expect from the pupils, and we need to have the same interest in what we're going to do, that we invest the same effort. And in this project I feel that we're doing that, and that's very positive. John is skilled in ICT, and he's very interested in genealogical research.*

John: *And the team members need to participate, to feel responsible.*

Ben: *Yes, that's very important, but if a team is too one-sided, it helps if you have some specialities, so that together you can make an extensive platform.*

John: *Yes, that we have different strengths, and that we exploit them.*

Marion: *Yes, I think if we're too alike as persons, and don't have discussions we can't get further.*

Ben: *Yes, and then you're at a standstill. So when you have such a platform and such an attitude, it works (intteam 110900).*

Marion has many ideas about what the school's main task is, but she thinks that the most important is to make the pupils independent and contributing human beings. She adds that striving to make young people self-confident, helping them to arrange and do their work well and helping them to acquire good self-esteem are the most important tasks for school. She goes on to say that it is crucial that the pupils feel that they succeed. Hence, during this project she says: "I think and hope that the teacher can withdraw, that the pupils can take the lead themselves" (intinf 110200).

There were forty-four pupils, twenty-three girls and twenty-one boys between fifteen and sixteen years of age in the 10th grade I was observing. These pupils were divided into three different groups with Marion, Ben and John the form teachers for one group each. They have been the pupils' form teachers since they started in the eighth grade. During the project period the pupils established groups across these class borders so that my observation was focused on all three classes. Some pupils also decided to work individually:

> *I think that some have decided together with their parents that they want to work alone because then they can work more in a more concentrated way. Others are working alone because they have decided to co-operate with some of their relatives to find out more about their distant relations. I know that one family decided from the very beginning that the pupil should work together with his grandparents, Marion says (intteam 090600).*

The atmosphere in the class is very good and there is a wide range of different types in the class, according to Marion. She finds that this means that a teacher has to pay attention to

everybody's needs and whims. Ben thinks that the milieu in the class is fine, and John comments that it is very good without any great deviations (Questionnaire, Appendix 6E, p. 395). Marion says: "I think that I probably have another attitude than my male colleagues because I think the atmosphere is very good and we have worked quite hard to make it what it is, but we have different tolerance levels. For me, the social milieu is the most interesting aspect because I have studied social pedagogy, so for me it means a lot" (intinf 090700).

During their first year at this lower secondary school the pupils took a course in Microsoft Word taught by the deputy head. John says that the pupils have also had some instruction and training in how to use ICT as a tool when they have needed to use it, “but we haven't been clever enough to give the pupils the basic courses in the eighth and ninth grade, we haven't done that," John laments (intteam 110900).

The Project Period

The observed project period was meant to be the final project in the class. The National Curriculum (1996) states that during their tenth grade year pupils must have a final project. At first it was decided that the pupils should have the assessment written in their school leaving certificate, but the directives have been changed, so now just the theme the pupils worked on will be written on their certificate. The pupils are not going to be marked on each project, but the pupils’ work will count in connection with the different subjects that are naturally integrated into the project (rules).

The project was started in the classroom one Thursday late in August. After nine Thursdays at school with three lessons each day, the project work ended with presentations at a "cultural evening" in the middle of November arranged by the pupils in co-operation with the local historical association (teachers' plan for the project period). Actually it was this local association that approached the school to hear if it wanted to participate in a project on Norwegian emigration. Thus the title or the overarching theme for the project work became "Emigration" (intteam 090600).

The Introduction Phase

The introduction phase actually started in the spring the same year when the pupils were still in the ninth grade. Then they went on a school trip to a historical site in their neighbourhood where a member of the local historical association lectured on emigration during the second half of the nineteenth century. In addition to this school trip the teachers also held a parent meeting during which they informed about the coming project period. "So both parents and

pupils already knew about the project this spring. We also told the pupils that we had imagined those who had grandparents living a long way from their own home could work on their project during the summer break. So they were not restricted to write about relatives just emigrating from their home place, but also from other places in the country," Marion says. Ben also states that on midsummer night a local theatre group dramatised a play about emigration from a place in their rural district, but just a few of the pupils were there. He also says that there have been local weekly events at this place, and that emigration was the theme of one of the evenings. The town hall has also had an exhibition, where letters and suitcases from America were shown. "We have really emphasized motivating the pupils and the brainstorming phase," Marion says (intteam 090600).

The Choice of Theme Phase

The first project day the pupils have the opportunity to brainstorm around the theme "Emigration". They have lots of associations, and the board is crowded with ideas.
The teachers inform the pupils about the time limit for the project period and that it will end as a cultural evening where everyone will be welcome. The pupils have altogether twenty-seven hours at the school to work on their project and they are also expected to work on their project at home. The pupils are reminded that their parents and relatives are important resources during this project period. "For this project we said that their parents and their grandparents were their best resources," Marion says (intinf 110200). During the lessons earmarked for project work at school the pupils also have the opportunity to go home and work there (intinf 110200).

The pupils work on their project for three lessons one day a week. Two of the social studies lessons and one of the religion and moral education lessons are borrowed from the timetable for the project work, but the teachers feel free to manage things their own way: "Because the same teachers are involved in this most of the time, we can adapt the timetable to our activities," Marion says. The teachers have previously tried to hold project work over an entire school day, but they have found that six hours is too long and that three or four hours are a suitable time for such work processes (intinf 091400). "The road is the goal" for this project period, Marion utters. When I ask her if they have specified any goals, what the road is, Marion and Ben start to reflect out loud on my question.

Marion: *What we want? (she thinks out loud).*
We want the pupils to learn something about project work as a work method. We want them to be able to compile information on their own and to be independent, and perhaps to present their findings.
May Britt: What about working in groups? (I continue to ask questions about their goals).
Marion: *Yes, that's a very important factor, and division of labour and collaboration.*
Ben: *And that this work will increase their interest in their roots, their background.*
Marion: *Yes, I think that's the most important thing.*
Ben: *And perhaps contribute something to the school and to the local environment and to their family (intinf 091400).*

During this conversation the teachers did not mention what the National Curriculum (1996) lays down as directives or rules for school practice. The teachers talked together with the pupils in the introduction phase about what their contribution to the local environment and to their family could be, but the pupils were never explicitly told the goals (intinf 091400). On the planning document for the project which the parents and pupils received this spring, one indicated goal was that the pupils should be motivated to find their roots both far away and in their local environment. Another intention was that they would acquire an understanding of the concepts of identity and cultural heritage, and learn about living conditions for minority groups and therefore develop respect and tolerance.

The next project day the pupils are introduced to certain aspects about America by a person born and raised for the most part in the USA. She talks to them about the Statue of Liberty, Columbus and Leif Eriksson. The pupils are focused and listen to what she has to tell them. After this information and motivational contribution Marion talks to the pupils about the question or the problem that is to be the starting point for their work (obsnot 083100).

Marion tells the pupils that it is difficult to formulate good questions. Ben says: "If you make a question or an approach that you can answer at once, then it's just one question that's easy to answer. But the question has to be worded in such a way that you actually can think of more than one solution or answer" (intteam 110900). Marion goes on to ask the pupils if they have decided which topic they want to work on. Some of the pupils raise their hands, but some are obviously still uncertain about what they want to work on. The teachers start to make titled columns on the board on the basis of the pupils' interests. The pupils are then put under one of the columns on the basis of their expressed interests. At the end of this lesson the names of five pupils are not on the board because they still do not know what to do. Marion tells them that they will be put into groups in the next lesson (obsnot 083100). The next lesson the pupils group themselves in accordance with their common interests listed on the board. The teachers are not involved in this grouping process, but they try to help the

pupils who still have not decided which topic to work on by getting them on a constructive track. Marion says to one of the pupils:

Marion: *What would you like to do?*
Edward: *I haven't got a clue.*
Marion: *Ask yourself, what do I want to find out?*
Edward: *Yes, but could I go to the computer lab?*
Marion: *You can't just go to the computer room when you have no plans for your work. You have to know what you're looking for (obsnot 083100).*

The Planning Phase Including the Forming of Questions

The teachers talk with all the pupil groups during the following planning process and when the pupils write a contract. The pupils have to write down which persons are in their group, what their question is and how they are going to present their answer. The pupils also need to decide where they are going to find the information and put this in writing in their contract (contract, obsnote 083100). The teachers' planning document for the project also contains some suggestions on which sources could help the pupils find the necessary material. The teachers suggested interviews, the Internet, Church books, folk narratives, the Public Records Office, records about the local district, their relatives, letters from America, presents from America, clothes, things that one would take on a journey, literature about emigration and film/videos of present interest (the teachers' plan for the project).

The teachers decided that the pupils had to get their approval on their project question to help them structure their work situation before they moved on to research and realization of their project. Some of the pupils also had to revise their question before they started to gather information to answer it. Two pupils, David and Michael, worked together and made several questions. They are advised to find out which question is the most important for them and make sub-questions based on this one (obsnot 090700). David says to Michael: "We have to decide which question is the most important" (obsnot 090700). The topics the pupils decided to work on during the project were: relatives in America, food in Norway 150 years ago, living conditions in Norway, Indians, web page on emigration to America, the Statue of Liberty, clothes and sailing to America. Several pupil groups worked on the topic relatives and two pupils also formed a group that intended to make a film of the work process. The pupils formed altogether twelve groups of two to five pupils, and eight pupils worked alone (the pupils' self-evaluations). In the planning phase Marion suggests that the pupils can “steal” ideas from each other. She also arranges the classroom processes so that it becomes possible to exchange ideas. She asks each group to read their main question and sub questions to the

whole class. Then the pupils are given the opportunity to use each other's ideas. Marion also shows the pupils that she is impressed by what some of them have agreed on. When pupils in a group have made eighteen sub-questions, Marion says that she is overwhelmed (obsnot 083100).

The third project day the class is gathered in the classroom. Marion seems to be very involved and starts to talk to the pupils. She says:

> *I'm excited today (she sinks her voice). Ben has brought an overhead and now we're going to talk about the coming work, in what direction you're going. We've collected and made an overview of what all of you are working on. Some of your questions are gigantic. Today you're going to make a time frame for your work. You've to divide the work between you. You'll also be given a logbook that we will collect after each work session. This is important if your work is to be good. It's important that you're satisfied. It's your motivation that drives the work, you decide. Not all of you can go to the computer lab at the same time, we've to be tolerant and find a way to use the lab (obsnot 090700).*

Marion uses the overhead to show the pupils a paper they will use when they plan and divide the work between themselves. This sheet of paper also gives them the opportunity to assess their work each day; what turned out well and what could be done better. Marion also puts a paper on the notice board in the classroom as a reminder of the structures for the different work processes. This paper also states that the pupils have to apply for permission on a specific form to work outside the school during school hours (obsnot 090700).

The Realization Phase

The forth project day the teachers tell the pupils that they agree about the aim of the project, but not about how to reach this aim. They tell the pupils that they feel they are loosing the control over the situation, and that the process they are in is not structured enough. The teacher Ben commented to me: "You observed at the end of the project lessons the last time. You saw that they wanted to go to the library and the computer lab, and then we felt that we almost lost control. They just flapped away without exactly knowing what to do. So I think it was smart to stop them and help them structure their work a bit more" (intteam 090600). Marion thinks that they have to accept that they will lose control, and she adds that she believes that all the teachers have proper plans for the next project day, but not for the whole project period (intteam 090600). Furthermore, Ben says to the pupils that several of them forgot to make their logbook entries and to fill in the assessment paper the last time, and they have to take up this problem now. Marion says that it is important that the pupils write a plan for their work and also a log so that the teachers can both assess and help the pupils throughout the process. She reminds the pupils that they can write more thoroughly in the

logbook than on the sheet of paper, and emphasises that if they have decided to work at home they have to take the logbook with them and bring it back the next day. Ben uses the overhead to show the pupils how many days they have left to work on the project. Marion ends this information sequence by saying that it is important that they arrange meetings so that they will not have the same problem again as when the teachers lost the control and could not find some of the pupil groups (obsnot 091400). At the end of the project period Marion says that having both an assessment paper and log book represented an unnecessary doubling up of the work and states firmly that she will not make the same mistake again (intteam 110900).

During the project work ten of the twelve groups and five of the eight pupils that worked alone used the Internet as one source of information. Otherwise the pupils used books, pamphlets, encyclopaedias, the teachers and their relatives (Table 10, p. 404, the pupils self-evaluations). In one of the project lessons a boy says: "I want to go home to continue my work. What I need now is my grandmother, and she's not on the Internet" (obsnot 090700). Marion says that she thinks that it would have been just as useful for some of the groups to use the library instead of the Internet to find the information that they needed. She continues: "But it appears that the pupils feel the Internet is the most important information source" (intinf 090700). Nevertheless, it would appear that the pupils do not always find what they are looking for on the Internet. David is trying to find some relatives on the Internet when he gets some help from the teacher John:

David: *John, do you now about any pages where you can find relatives from America?*
John: *Yes, I know about some. I suggest that you write relatives.no, that's a gateway.*
David: *Nor?*
John: *No, for Norway you know.*
David: *I thought you said nor (the page shows up).*
Should I just write the name here then? Should I just write the last name?
John: *(nodding, as he goes to help another pupil).*
David: *Here, I guess you could say I found a lot (he finds nothing he is looking for)*
(trec 090700).

Before they start their web searches John gives the pupils addresses of pages they can try to search on. Marion says: “Most of the pupils have learned to search on the Internet by themselves, or got some help from the teacher when they needed it. And in this project they have some URL addresses, so it's easier for them to find what they're looking for” (intinf 110200). When the pupils are allowed to go to the computer lab during the realization phase of their project, John is there to help them. All the twelve computers are being used, and almost all the pupils want John to help them when they are searching on the Internet. John says to the pupils: “I can’t manage to teach people on twelve computers all at once. I will

teach two now to be experts, and then they can help others afterwards" (trec 090700). In this way the pupils receive help to find some of their data material.

About one third of the pupils (fourteen pupils) worked at home during the project period, some of them almost every lesson, others more sporadically. Six of the pupils stated that they worked at home because they got help from some of their relatives. One of these also claims that the school has bad equipment. Eight of the pupils worked at home because they think they had better working conditions there. They say that there are too few computers at the school, and that they thus have better computer access when working at home (Questionnaire 2, Appendix 6D, p. 394). Ben also says that some of the pupils have much better equipment at home (intinf 091400). Marion admits that they lack a colour printer, and that they also have problems printing out the pupils' work in general (intinf 092800). Marion also says: "We can't be too inflexible either, because that must be the ideal, because they have resources at home. It's not me and Ben that are the resources for this project, you see" (intinf 091400).

Some of the pupils work at the school because they are not connected to the Internet at home. David and Michael are two of these. They make a web site on emigration to America. They work at school because they want to use information they find on the Internet as their data material. The dialogue rendered below is a conversation between the teacher Marion and David. Michael was absent when this dialogue took place. Marion invites David into the dialogue by asking if someone needs some help:

Marion: *Does anyone here need some help?*
David: *Yes, I have to change the topic.*
Marion: *Are you going to change the topic?*
David: *I can't find anything about my relatives (he has been searching on the Internet). At any rate I want to make a web site, and I think I'll write some general things about emigration.*
Marion: *Do you have a computer at home?*
David: *Yes, but I'm not connected, but I'll make a web page.*
Marion: *Yes, you'll manage that. I think this seems reasonable. You don't need to do it at home, you can search for some information on the Internet at school.*
David: *Yes.*
Marion: *I recommend that you use Kvasir [a Norwegian search engine] and try to search for emigration to America there.*
David: *Do we spell it with just one m? (spells emigration, and asks:)*
Like this?
Marion: *Yes.*
David: *Wow, here I found a lot (excited). Emigration from America to Norway (reading).*
Marion: *You have to write in your own words, David. Then scroll down the page and look at all the information that's there.*
David: *Is it possible to find any information in the encyclopaedia?*
Marion: *Do you know about that, and Norwegian history books then? Do you have some sources at home?*
David: *No, I'm not connected to the Internet at home.*

Marion: *No, I mean some books and encyclopaedias?*
David. *No (trec 091400).*

David works on the Internet and searches for information. He reads and talks to himself about how many people have emigrated to America. Marion comes up to him and asks him how he is progressing. David says that he is working well now. He adds that he will make a table on his web page to show how many Norwegians emigrated. He reads loudly from the computer screen and he suddenly says eagerly and loudly: “Now I've found it,” and he reads about all the people who left Norway and why they left (trec 091400). Marion states that David is keenly interested in ICT, and she thinks that it is good that he can work with it. It is the computer that motivates him, she adds. She also observes dryly that otherwise he would never sit in so concentrated a manner for three lessons. She continues: “ICT really motivates that boy. And when people are motivated, then you can see they are willing to do quite a lot” (intinf 110200).

When Michael and David work together they also discuss what this work is worth with respect to marks. David says to Michael:

David: *I think we can get an extra plus because we make a web page.*
Michael: *Oh, spelling wrong too (talks to himself when he writes).*
David: *I think we can get a good mark on this work.*
Michael: *Yes, if we manage to make it the way we want it (trec 092800).*

During their work David and Michael get help both from the teacher John and from the deputy head. The pupils try to put the page on the web, but find that it is impossible to install a file transfer protocol programme on the computer. "No entrance," they read on the screen. John tells them to ask the deputy head for help with this problem. The deputy head helps them to solve their problem, and tells them about HTML codes because the pupils have made their web page in the front page express programme without taking these codes into consideration (trec 110200).

Throughout the project period the pupils work on various tasks. One group makes a model of the Statue of Liberty, about one and a half metres high, made of chicken wire and papier-mâché. The pupils in another group bake thin wafer crispbread. Others are making pamphlets and collages of their material. Fourteen days before the cultural evening, Marion gathers the pupils and tells them that they have to think of how they want to present their work. She informs them that it is their result that will be shown, and that the pupils are the ones who will be most focused during the coming evening. She also reminds the pupils about

the time limit they have and that she thinks there will be some work to finish at home (trec 110200).

The Product Presentation Phase and the Teachers' Reflections

Before the cultural evening starts, all the pupils have been eagerly involved in making a proper exhibition. Some have put posters and pictures on the walls. Others have brought a suitcase typical of the journey to America and put suitable contents in it. One group has made dolls with old clothing, and others a cartoon about the boat trip across the Atlantic. The group that has worked on old-fashioned cooking and food has samples for visitors to taste. The Statue of Liberty is placed beside the entrance to wish people welcome. In one corner of the exhibition area two walls are raised and decorated to represent a kitchen for a family that has emigrated. One of the walls has a window, and behind the glass a painting that shows horses with wagons riding across the prairie. The other wall is full of papers telling about a pupil's relative who emigrated to America. Another boy uses a Power Point presentation to tell about his relative. David and Michael sit in front of two PC's ready to help people who want to look at their web page. The local historical association is also exhibiting some pictures this evening.

After all the pupils have their work in place, but before the exhibition is open to the public, Marion and Ben sit at a table reflecting on what they see.

Marion: *Haven't we given them high enough demands? I don't think this is good enough. I'm quite sure it's not. We should have had more dialogues with them. I think we can blame ourselves a lot. I think that some have a really "thin" result. The guidance, I think that has been too bad.*

Ben: *We've been available for the pupils. We should have insisted that they bring their work with them, so we could see what they had done.*

Marion: *In such a project some need much more guidance than others.*

Ben: *We should have directed them much more in the beginning and made them think of different ways to present their material. I think we were too eager not to conduct the process. We can lead the pupils more on their way, I think.*

Marion: *We have to structure the work processes more.*

Ben: *We have to have better dialogues with the pupils and give them more expectations and demands.*

Marion: *But we must let them take responsibility themselves also for what they're going to present. Perhaps we should let the pupils make up their opinion about which subjects they're going to be assessed in? (obsnot 111600).*

Throughout the project the teachers had different roles (division of labour). Ben helped the pupils with practical activities, especially the group making the Statue of Liberty. John helped the pupils in the computer lab, and Marion was an all-rounder as she describes it herself (Questionnaire, Appendix 6E, p. 395). They had planned to divide the scaffolding work between them, but Marion says:

> *We feel that we were fairly divided with the pupils' assessments of themselves, with the planning document for the work and the log, but the question is, I imagine, that each of us has to take responsibility for some of the groups. I think that we have to plan that already for the next project lesson (intteam 090600).*

Even though the teachers planned for this at the beginning of the project, they never really achieved such an arrangement. Marion says that they did not manage to guide the pupils and assess the process in the way they had hoped to do. Then the pupils could not have worked at home, she states (intinf 110200). The teachers feel that they have not planned how to structure the whole process from the very beginning and Marion adds: "We feel that we have made the plans for tomorrow, but we also know that we have to use more time to plan the other project lessons" (intinf 090700). Towards the end of the project Marion says that she thinks the teachers have to structure their work better and adds that they should have organized more planning meetings where the project was the only item on the agenda. She explains that when they have planning meetings they have to discuss a myriad of other things, so the problem is finding enough time (intteam 110900).

Even though Marion has not had a plan for how to observe the pupils, she has noticed things throughout the process. For example, one boy she observed simply opened a key page about the topic and cut and pasted material into his own word document and printed it out. She says that she then became aware that the pupils had not only learnt about the emigration, but also about how to "use" the Internet. John confirms that he also thinks that several pupils have become more accustomed to using the computer as a tool (intteam 110900). Marion adds that this process has also changed her attitude to the use of computers and the Internet. She believes that without the Internet during such a project they have just conducted, the work would have been heavy going; "There's a lot of information on the Internet," she mentions. John comments: "I also think they have become more realistic with regard to what they can find on the Internet. Earlier when they didn't find what they were looking for, there was something wrong with the computer." Ben continues: "They see that the Internet has its limitations. And we have also told them that it's not just to cut and paste and say that this is my work. But they have to rewrite and adapt the material so that it in a way becomes their work, that they have a personal relationship to it." Marion wishes that they had a big library at the school so that books do not become the forgotten tool and feels that it is much easier with computers because they are right there (intteam 110900).

The teachers' plan was that the pupils should write a report about the process and their work at the end of the project. Marion tells the pupils that it is not to be assessed, but it should

be a document of about one to three pages on what they have done. She thinks that it is best that they write this report at school and that they perhaps could sum up the process orally together with the pupils before they sit down and write on their own (intteam 110900).

The Complementary Work Phase

A day after the exhibition the pupils are gathered in the classroom together with their teachers. The headmaster and a representative from the local historical association are present during this summing up session. Marion starts the lesson by telling the pupils that she has received feedback from several people who feel the cultural evening was a success. During this session the pupils comment on their project. She asks the pupils if they have learned about genealogical research during this project. One pupil answers that he has found out that it is quite difficult to find information about one's relatives. Marion also asks one of the other pupils:

Marion: Tom, you got busy at the end of the project. Could you tell us about your experience?
Tom: Yes, I sent a letter two weeks before our exhibition, and I got the answer the day before.
Marion: And what helped you to be successful, what tool did you use?
Tom: The Internet. I got an answer to my e-mail (trec, vrec 112300).

Three of the thirteen pupils who worked on the topic relatives found information on the Internet that helped them. The boy who made a Power Point presentation about some emigrated relatives says in front of the whole class that he is satisfied with his project result (trec, vrec 112300). The next lesson the pupils write their report.

The Product and Process Assessment Phase

The report is a form made by the teachers. The pupils are to give a short summary of their work, stating which topic they chose and why. They are to include their project question and how they worked during the project. They have to answer a question about which information sources they used. The next part of the form gives the pupils the opportunity to assess and reflect on the process. They are to write about their own and other pupils' efforts during the work phase. The pupils are allowed to suggest which subjects could be assessed in connection with their work, and they also assign themselves marks, both for the product and the work process. They are asked about their experiences and asked to suggest something they could have done in another way. They are to assess their result and give their opinion about how the cultural evening turned out, and how they think they were guided throughout the project work. They are asked to sum up what they have learnt about project work as a method, and why they think project work is interesting or not. They are also asked to write down what

should be done with the products. With a summary of these reports and a closer look at the pupils' products the teachers end this working phase with an assessment dialogue with each pupil (the pupils' assessments, trec 120700).

During the project period the pupils are invited by a teacher from the local primary school to present their results or product. David and Michael accepted the challenge and said they could also help other pupils make their own web page. Marion says to them:

Marion: It'll be fun to be a teacher, David?
David: Yes, but Michael will be there too.
Marion: Yes, but you're the expert, aren't you, isn't that so, Michael?
Michael: Yes, it is, but I think he has taught me a lot (trec 110900).

Marion says that this project has given them the opportunity to see pupils get involved (intteam 1100900). On the day of the exhibition lots of pupils are gathered around Marion asking questions about the coming evening. Then Marion comments: "They're so cute, now and then I understand why I'm a teacher" (obsnot 111600). After the project period was over Ben reflects on whether he has learnt something from this project himself. He says: "I haven't got that much knowledge about emigration, but I think about project work as a method, arrangements and solving problems along the way: And we have gained a lot of experience, experience that we can use in future projects" (intinf 112300).

A Summary of the School Visualized in the Activity System

The various factors affecting the learning processes in the school are visualized in the Activity System below.

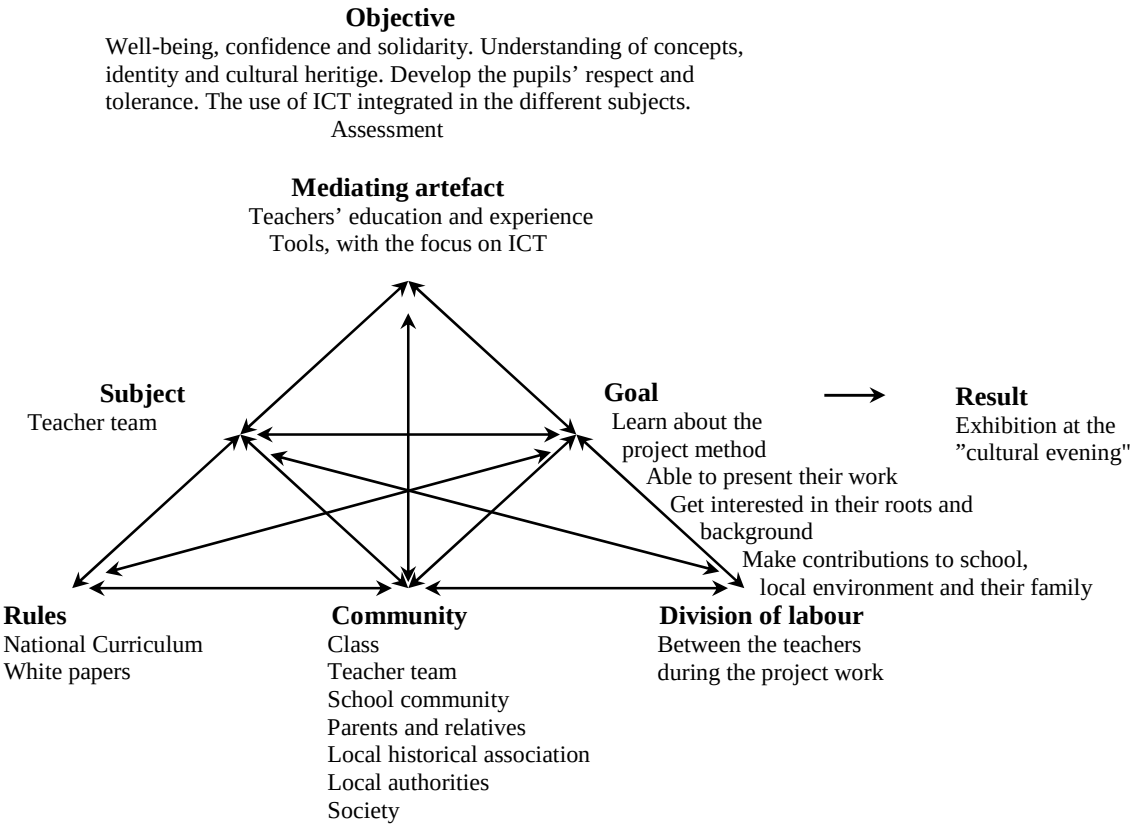

Figure 10: A summary of Cooper School visualized in the Activity System

As with Applebee School and Bridgeford School, the teacher team is looked upon as the acting subject. The teachers' experiences and their education in theories of learning and knowledge are looked upon as factors that assist them in their teaching processes in the classroom. In addition to these issues, I have placed ICT as a mediating artefact that can help the teachers create fruitful learning situations for the pupils. Under the factors, the rules, the community and division of labour that form the context for the work and thus lay the premises and also possible limitations for the working situations, I have listed various issues that is representative for Cooper School.

In this part of the text chapter I have given descriptions of each school. In the next four chapters (8-11) that constitute Part 3 of the text, I will present dialogues from these described activities. These illustrations will be analysed with respect to how ICT as a mediating artefact affects the learning processes and the teaching practice in these schools. But first of all I will

start the next section with a presentation of Vygotsky's and Bakhtin's concepts on language, dialogue, learning and understanding.

Part 3:

Dialogue;

Analysis of Dialogues to Understand Teaching and Learning

Introduction: Vygotsky's and Bakhtin's Concepts on Language, Dialogue, Learning and Understanding

Both Vygotsky and Bakhtin believed that semiotic mediation was the main medium by which individuals could form their consciousness. Vygotsky (1986/2000) believed that progress in thought and speech is not parallel, but claimed that at the age of two, these two lines of development meet and initiate a new form of behaviour. He maintained that there is also a pre-speech phase of thought. He described a child's babbling, its crying and its first words, as stages of speech development that are not at all connected with the development of thinking. The time when speech begins to serve intellect and thoughts are spoken, can be recognized among children. The child starts to ask what things are called and thus rapidly increases its vocabulary. In this way there is a close connection between speech and intellectual thought. Vygotsky found that the words that are spoken in social relations turn inward and become part of the person's thinking, and called this the process of moving from social to egocentric and to inner speech. When the social language has been internalized, the words are not audible, the speech structures that the child masters have become the basic structures of his or her thinking.

Vygotsky described inner speech as a speech for oneself and external speech as a speech for others. Inner speech has been studied by using the genetic method of experimentation. While egocentric speech is perceived as a stage of development preceding inner speech, egocentric speech has been studied to understand inner speech that has the same function and structure. Vygotsky claimed that egocentric speech was a phase in the development from social to inner speech, a pattern that Vygotsky meant was common for all higher psychological functions (Vygotsky 1978, Vygotsky 1986/2000,). Egocentric speech represents a transition from speech for others to speech for oneself. It has the function of inner speech, but it still has the expression of social speech (Vygotsky 1986/2000).

Inner speech is not speech minus sound, but an entirely separate speech function that differs from social speech. Vygotsky also claimed that inner speech appears disconnected and incomplete, and that it is the evolution of the child's egocentric speech step by step. Vygotsky further claimed that the development of thought is determined by both the linguistic tools of thought and by the sociocultural experience of the child (Vygotsky 1986/2000, p. 94). He stated that when children have developed inner speech and verbal thought: "*the nature of development itself changes*, from biological to sociohistorical" (Vygotsky 1986/2000, p. 94, italics in original). This means that the social context children grow up in will impact their

thought processes and development. Education and how this is organized will thus also play a part in children's development. Vygotsky stressed the importance of formal schooling, and introduced the concept of the zone of proximal development (ZPD) (thoroughly described in Chapter 8 Scaffolding, p. 158), meaning that children can manage to do more with the help of adults or more capable peers (Vygotsky 1978). In these processes language or words play a prominent role.

Vygotsky (1986/2000) believed it was wrong to analyze word and thought as parts of a whole. He compared this with the analysis of water as a product of hydrogen and oxygen, neither of which separately possesses the properties of the whole, as with word and thought. Vygotsky maintained that the analysis should rather be of units of elements, and found the unit of verbal thought to be word meaning. He also believed that the meaning of a word represents an amalgam of thought and language and that it is hard to decide if it is a phenomenon of speech or a phenomenon of thought. There is a constant movement from thought to word and from word to thought, and during the process the relation between these two entities changes, a change that can be regarded as development in the functional sense: "Thought is not merely expressed in words; it comes into existence through them" (p. 218). Vygotsky further stated that we give every word content, and thus a word can undergo changes. A word acquires its meaning in the context in which it appears, and it will change in different contexts. Vygotsky also stated that "it is not merely the content of a word that changes, but the way in which reality is generalized and reflected in a word" (p. 213).

To understand the relation between thought and word and between thought and speech it is necessary, according to Vygotsky, to understand the psychological nature of inner speech. Abbreviation is not an exception but a rule in inner speech, and this inner speech often consists of predicates only. With this structure, inner speech functions as a draft both in written and oral speech. Vygotsky described dialogues between people who are psychologically close, and further showed how these people converse in an abbreviated manner. These people share the context of the talk and it is not necessary to say everything. In inner speech this "mutual perception" (p. 243) is already present, therefore wordless communication is the rule even for the most complicated thoughts (Vygotsky 1986/2000).

A word in inner speech stands for a number of thoughts and feelings, thus this speech cannot be translated into ordinary external speech. The transition from inner speech to external speech is not a simple translation from one language into another. It is a process in which language for one self is translated into intelligible language for others, but thought does not have its automatic counterpart in words. It is the task of the speaker to give his thoughts

meaning through the use of words. Thoughts thus pass through meanings and thereafter through words. According to Vygotsky, to completely analyze an utterance we must also understand a person's words and also understand the thoughts of the speaker and his motivation. Thus the language always has a subtext or a thought behind it (Vygotsky 1986/2000). In this way thoughts, and thus learning, can be reflected in the language of learners, even though we know that all "thought will not enter words" (Vygotsky 1986/2000, p. 249). Vygotsky (1986/2000) claimed that the relation between thought and word is a living process, and that thought is born out of the word, from the outside to the inside, from verbal speech to egocentric speech, to inner speech or inner dialogue and to verbal thought (Vygotsky 1986/2000). It is through language that thoughts realize themselves. Vygotsky (1978) also claimed that "children solve practical tasks with the help of speech, as well as their eyes and hands" (p. 26).

Even though Vygotsky felt that various forms of mediated actions were affected by historical, cultural and institutional settings, he did little to show the links between these settings and mediated actions. Vygotsky for the most part studied intermental processes or interaction in adult-child dyads (Wertsch 1991). Hence we must turn to Mikhail Mikhailovich Bakhtin,[36] who developed Vygotsky's ideas. He emphasized relations and believed that everything is in a dialogue or in relation to something else. Bakhtin's starting point is Kant's argument that there is an unbridgeable gap between mind and world, but then he departs from Kant's belief that there are things in themselves, rather finding that there are relations between them, mind cannot exist without the world and vice versa. The non-identity of mind and world is also the foundation for dialogism, a term that is not used by Bakhtin himself, but by others referring to Bakhtin's ideas. For Bakhtin, "self" is not a self-sufficient construct. He claimed that self is always in relation to something else, it is dialogic. Self and other are entities that have no meaning in themselves. The self and the other have meaning just by the fact that they are both present, they exist in a relation. Bakhtin maintained that the relation was never static, but dynamic; it was always in the process of being made or unmade. He

[36] M.M.Bakhtin (1895-1975) belonged to various intellectual schools during his early career. In the 1920s a reading and discussion circle was created to study texts by contemporary German philosophers. In addition to Bakhtin, this circle included, among others, the then musicologist Valentin Voloshinov and the then journalist and organizer of literary events Pavel Medvedev. These two names have also been mentioned in relation to Bakhtin's works due to disputes over the authorship of several texts. In 1929 Bakhtin was arrested for political crimes, the nature of which was never made clear. Because of his chronic illness, he was not sent to the harshest of the camps, but after this he could often not dare to publish his writings under his own name. Therefore Voloshinov and Medvedev are listed as authors of texts that are believed to actually present Bakhtin's thoughts and ideas (Holquist 1981, Clark & Holquist 1984). In my own writing I treat the content in these texts as Bakhtins's own writing.

believed that the key to understanding all artificially isolated dualisms is to understand the dialogic relation between them, as between the self and the other. According to Bakhtin, nothing can be perceived except against the perspective of something else. The structure of the mind is so that the world is perceived according to the contrast as described by the figure/ground relationship. Dialogism is thus not the name for a dualism, but for the multiplicity in human perception[37] (Holquist 1990).

Bakhtin looked upon the world as activity and further defined existence as an event. He also said that the event of existence has the nature of dialogue and that existence is an utterance. He explained that a dialogue is composed of an utterance, a reply, and a relation between the two and he contended that the relation is the most important of these three because without it the other two would have been without meaning. The event, he maintained, is something that is shared. Thus to be, is always a co-being. You are always in relation to something or someone. Bakhtin claimed that we are always in dialogue with human beings and our natural and cultural surroundings. We have our place in this world, we are addressed by our surroundings and are answerable for the response that we give from the unique place we occupy in existence. In our place we are also looked upon as active and constructive persons, not as passive receivers. At the highest level of mental life nothing means anything until it achieves a response, according to Bakhtin (Holquist 1990).

Life is expression, and that expression means to make meaning, according to Bakhtin. At all levels of existence something exists only if it means something, a meaning that is mediated by signs. As mentioned above, Bakhtin maintained that everything is in relation to something else. The self does not coincide with itself, and thus the experience a person (the I) is undergoing only exists for this person in the material of signs (the other). Meaning comes about for both the individual psyche and for others in the shared social experience. There is always a relation between the "I" and "the other", and "the other" "can range from other individuals, through neighbourhoods, classes, professions, and so on, all the way up to other cultural systems" (Holquist 1990, p. 50). Bakhtin also claimed that the individual's thoughts are not just speech, but inner dialogue. Natural language is only one of several ways dialogic relations are exposed in the larger dialogue, which is seen as the event of existence. He conceived our existence as a kind of a book, or more explicitly as a novel or several novels.

[37] By 1918 Neo-Kantianism had been the dominant school in Germany for about fifty years. One feature of Kant's thoughts that Neo-Kantianism attacked was his formulation of the mind/body relation. Bakhtin did not passively follow the thoughts of Neo-Kantianism with respect to the oneness they allotted the mind/world entities. He resisted the all-encompassing oneness. Bakhtin instead believed in a dialogue between mind and world, and said that these two factors, just as all other phenomena, are in relation to each other (Holquist 1990).

He also believed that the novel's relation to everyday talk is especially significant because it is the constant reminding of otherness in speech that makes up the novel's characteristic subject and also its formal features (Holquist 1990).

Stylistics treated verbal art as something cut off from social life, just representing a "private craftsmanship" (Bakhtin 1981, p. 259). Bakhtin (1981) disagreed with their view on artistic work, where they saw it as being a closed authorial monologue that presumes only passive listeners beyond its own boundaries. He rather believed that words should not be studied from the point of view of ancient languages, but from the point of view of the speaker, and thus the social context became a relation to the speaking subject (Bakhtin 1986, Holquist 1990). Bakhtin (1981) also believed that a written novel has to be looked upon as a text in which several languages make up its language. Language is stratified and has a heteroglot form that carries its meaning. Literature may, for instance, be presented as in oratorical, newspaper and journalistic genres and the genres of low and high literature (speech genres). Bakhtin (1986) described speech genres not as just a form of language, but also as combinations of these forms. He believed that the better we know different variants of the genres, the more freedom we obtain because then we can choose between variants in given situations. In addition to this generic stratification of language, there is also stratification into languages that are socio-ideological: languages of social groups, the languages of generations and the language of professions and so forth. This could be the language of the lawyer, the doctor, the businessman and the politician. Heteroglossia is created because of the differences between various social languages. These forms of language may both coincide with or depart from the stratification into genres (Bakhtin 1981).

According to Bakhtin (1981), all words have a "'taste' of a profession, a genre, a tendency, a party, a particular work, a particular person, a generation, an age group, the day and hour" (p. 293). All words thus have contextual overtones. In this way language also lies on the border between people, and the word in language is half someone else's. "It becomes 'one's own' only when the speaker populates it with his own intention, his own accent, when he appropriates the word, adapting it to his own semantic and expressive intention" (p. 293). These words have to be taken from others' mouths and then be made into one's own. Thus people have to choose their language in an active process.

The utterance was in Bakhtin's (1986) view the real unit of speech communication. Every utterance is a link in a very complexly organized chain of other utterances. The boundary of each utterance as a unit of speech communication is determined by a change of speaking subjects, a change of speakers. Any utterance has an addressee, and the responsive

utterance of the addressed person could be merely silence or an active responsive understanding or also a responsive action based on this understanding. According to Bakhtin (1981), every utterance is part of the "unitary language" at the same time as it is part of the social and historical heteroglossia. This means that Bakhtin also considered the authentic environment of an utterance and described this as anonymous and social as language, accented as an individual utterance. Every utterance, he said, has taken shape in a particular historical and social environment, and "the social atmosphere of the word, the atmosphere that surrounds the object, makes the facets of the image sparkle" (p. 277).

Bakhtin described the extraverbal context, which was comprised of three factors: the common spatial purview of the interlocutors, the interlocutors' common understanding and knowledge, and their common evaluation of the situation. This also means that the utterance is not merely what is said, and it does not passively reflect the context or situation that surrounds the language. According to Bakhtin, the utterance actively resolves the situation and brings it to an evaluative conclusion or extends the action into the future (Holquist 1990). The social context thus played a central role in the meaning making of language, according to Bakhtin.

A text was not an authorial dialogue in Bakhtin's opinion. He rather believed that any text had dialogic overtones and that all discourse had a dialogic orientation. As mentioned above, he also maintained that there is an inner dialogism of the word, an inner dialogue. He believed that every rhetorical form is directed at an answer, an answer that it anticipates. It is also shaped by what has already been spoken (Holquist 1990). Bakhtin believed that meaning is created for the individual, and it is also shared in a social experience by means of the mediation of signs. Understanding thus comes about in response to a sign with signs. Thus every sign is a link in a never ending chain of signs. "And nowhere is there a break in the chain, nowhere does the chain plunge into inner being, nonmaterial in nature and unembodied in signs" (Bakhtin in Voloshinov 1973, p. 11). In connection with internal dialogism, it is the subjective system of the speaker and listener in one person that can come into dialogue with the uttered word. In social speech, various social "languages" come into contact with each other. Responsive understanding is a fundamental force, and this active understanding means that discourse can be enriched by sensed resistance or support (Bakhtin 1981). In this way the present living dialogue is influenced by the past, the present and the future.

Bakhtin (1981) said: "In the actual life of speech, every concrete act of understanding is active: it assimilates the word to be understood into its own conceptual system filled with specific objects and emotional expressions, and is indissolubly merged with the response,

with a motivated agreement or disagreement (...) Understanding comes to fruition only in the response. Understanding and response are dialectically merged and mutually condition each other; one is impossible without the other" (p. 282). In Voloshinov (1973) he added: “If one end of the bridge depends on me, then the other depends on my addressee. A word is a territory shared by both addresser and addressee, by the speaker and his interlocutors" (p. 86).

In school there are two basic modes that are recognized for the appropriation and transmission of others’ words when verbal disciplines are taught. These two forms that operate simultaneously are reciting by heart and retelling in one’s own words what is taught. This second mode, retelling in one’s own words, includes a series of forms for appropriation within it. What form of appropriation that is happening while transmitting another’s words is dependent upon what text is to be appropriated and the pedagogical environment in which this is going to happen. In this connection Bakhtin (1981) introduced two different concepts, authoritative discourse and internally persuasive discourse. Typical to the first concept could be the authoritative word of a father, adult or teacher, and this word does not know internal persuasiveness. It is the word of religion, politics and morality. The authoritative word is like a compact and indivisible mass. It does not allow the spontaneous creative stylizing of variants in it. Its semantic structure is finite. The authoritative word permits no interplay with the context that frames it, and it is not surrounded by dialogic life. Because you cannot change it, you must either totally affirm it or totally reject it.

The internally persuasive word has no authority: “It is affirmed through assimilation and tightly interwoven with one’s own word" (p. 345). The internally persuasive word is half our own and half someone else’s. One can retell a text “in one’s own word, with one’s own accents, gestures and modifications" (p. 424). It is creative and productive because it creates new and independent words, and it helps us to organize masses of our words that belong to ourselves. In this way the internal persuasive word does not remain isolated and static. This internal persuasive discourse is “freely, developed, applied to new material, new conditions, it enters into interanimating relationships with new contexts, (…) and it enters into intense interaction, a *struggle* within other internally persuasive discourses" (p. 345-346, italics in original). The semantic structure of the internally persuasive discourse is open, not finite as in the authoritative word. The internal persuasive discourse can also reveal ever newer ways to mean in connection with new contexts that dialogize it (Bakhtin 1981). Intonation is also a way of giving an utterance a special kind of expression (Bakhtin 1986, Holquist 1990). It can be described as the "material expression of the shaping role the others play in the speech production of any individual self" (Holquist 1990, p. 61). It is the struggle and dialogue of

these two categories, the authoritative word and the inner persuasive word, that forms or determines the individual consciousness (Bakhtin 1981).

The words or the utterances all have the same pre-existing restraints. The Bakhtinian utterance is dialogic because every aspect of it in some way or another is in a dialogue between the speaker's needs and the global requirements of the language as a generalizing system, in which speech genres and the speaking practices developed by different groups are a part. An utterance is never in itself original. According to Bakhtin it is always an answer, and it is thus conditioned by the utterance that has preceded it (Bakhtin 1986, Holquist 1990). Thus the norms that control the utterance are similar to other social norms. The individual will therefore be affected by the particular group he is a part of. In this way the utterance is on the border between what is said and what is not said, and the speakers of a group will take for granted that the community they are a part of have some shared values (Holquist 1990).

Bakhtin believed in the idea of inner speech, which he also called "inner dialogue" (Holquist 1990). In this he agrees with Vygotsky, who also talked about inner speech and inner dialogue. Vygotsky believed that tutoring was necessary for children to develop a higher consciousness, and much like Bakhtin, he saw that the social environment in which the child was unfolding shaped the determining aspects of growth. These aspects were not only shaped by genetic directives, but also by the people in the community in which the child lived. Thus for both Bakhtin and Vygotsky, the direction for development is not from the individual to the social, but from the social to the individual. As both believed in social speech as a first step to inner dialogue and thought, they placed significance in the social factors and education. Vygotsky's development of the concept of the zone of proximal development (ZPD) made tutoring possible through conversations. Thus Vygotsky believed that language imparts a unique quality to human thought, and further that language provides a medium for teaching and learning. Dialogism treats the gap between the higher and lower levels of consciousness as a zone of proximal development: "a distance that may be traversed (at least partially) *through the pedagogical activity of the parties in a dialogue simultaneity relating to each other in time"* (Holquist 1990, p. 83, italics in original).

In dialogism there is a constant struggle between the chaos of events in real life and the ordering ability of language. Language reduces the range of happenings which are endless to a restricted number in understandable relations that can be perceived and processed. This means that an utterance is always more ordered than what happens in life outside it. Meaningless chaos is put into meaningful patterns afforded by words and sentences (Holquist 1990). When words and sentences are written down, they provide a way of seeing the world.

When dialogues from a classroom are written down, they give an ordered glimpse of what is happening in situations where such dialogues play a part. Thus we can see the actions of the world in the classroom in reduced, finished and consummated categories that can give meaning to the endless chaos, and the dialogues thus function as an artefact that can mediate understanding. According to Bakhtin, languages or dialogues also must be understood in their context to make proper meaning (Holquist 1990).

The following four chapters present categories that are representative of the actions that took place in the classroom. Each category contains dialogues between pupils or between pupils and teachers, and utterances from teachers in dialogues with me are also presented. Bearing in mind Vygotsky's theory on language and thought, and Bakhtin's theory on dialogue and understanding, the conversations between the participants in the classrooms are looked upon as tools for creating an understanding during the learning processes throughout the work. Each category is also meant to give the reader a deeper understanding of what was actually going on during the observed processes.

Chapter 8
Scaffolding

The term "scaffolding" Wood, Bruner and Ross (1976) used to create an image of an adult helping a child to carry out a task or achieve goals the child could not reach without this help. What distinguishes man as a species is not only that human beings can learn, but also that they are able to teach (Wood et al. 1976). Interactive teaching takes the situation and the pupils into consideration during the teaching and learning process (Tharp & Gallimore 1988). In their book *Rousing Minds to Life* (1988) Tharp and Gallimore state that: "Teaching must be redefined as assisted performance. Teaching consists of assisting performance. Teaching occurrs when performance is achieved with assistance" (p. 21). During project work the teachers' and the pupils' roles change compared to their traditional roles in school. As we can see in the definition provided by Berthelsen et al. (1987), the teacher's role is to get things started, to be an inspirer, a person who sets the rules and functions as an advisor and consultant. Dewey (1902, 1916, 1938) also said that the teacher's role was to guide the pupils towards a goal and thus function as a leader of group activities.

During project work pupils use different mediating artefacts to help them in their work. In the following text I will present dialogues in which the teachers give advice to pupils during their use of information and communication technology (ICT). The dialogues (re)-present conversations between the pupils and teachers in front of the computer when some of the pupils are searching for information. I also present dialogues which show pupils receiving advice while learning different programmes and using external equipment. Other dialogues render conversations between the teacher and pupils when the teacher is helping them to make presentations. During all these conversations the ICT equipment is present in the processes in one way or another, but it is more prominent in some dialogues than in others. The presented dialogues are typical illustrations of what was taking place during the conversational processes. Before coming to the illustrations, I will examine theories as a framework for analysing what is said in the dialogues. At the end of this chapter I will comment on the analyses and put them in a wider context. In this connection I will discuss the teacher's role when pupils use computers in project work.

Theoretical Framework

The Zone of Proximal Development

Vygotsky (1978) introduced two concepts that are vital to understanding his view on learning and development. These concepts represent two developmental levels that have to be determined if one is to understand the child's learning possibilities. Vygotsky's view has consequences for both the assessment of the pupils' development and evaluation of instruction[38] (Rogoff & Wertsch 1984, Wertsch 1985, Wertsch & Stone 1985, Wells 1999). Vygotsky (1978) defined the zone of proximal development (ZPD) as "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). This potential level in the ZPD thus involves social interaction or functioning on what Vygotsky (1981b) called the intermental plane, between mind and world. The actual developmental level defines functions that are developed, whereas the ZPD defines the functions that have not yet fully developed or matured. These functions could therefore be termed "the 'buds' or 'flowers' of development rather than the 'fruits' of development" (Vygotsky 1978, p. 86). The social activities that constitute the zone are part of the socio-cultural origins in which these activities are embedded. "When cognitive change occurs not only *what* is carried out among participants, but *how* they carry it out appears again as an independent psychological function that can be attributed to the novice (Newman et al. 1989, p. 61, italics in original)." According to Smagorinsky (1995), the ZPD concept incorporates the three themes that are central in Vygotsky's theoretical framework: reliance on genetic or developmental method, the social origin of consciousness and the fact that mental processes are mediated by tools and signs. Newman et al. (1989) claim that the child's appropriation of cultural tools takes place through involvement in culturally organized activities in which the tool is integrated.

A real understanding of the ZPD concept will result in a new appreciation of the role of imitation. Traditionally the child's independent activity, not imitating activity, has been a measure of its mental development. During assessment of mental development, the focus has been on solutions to problems that the child has solved independently, without any help from others, without modelling and supporting questions from others. "Imitation and learning are thought of as purely mechanical processes. But recently psychologists have shown that a

[38] The Russian word *obuchenie*, which is translated as instruction, is meant to cover both the teaching and learning processes (Rogoff & Wertsch 1984).

person can imitate only that which is within her developmental zone" (Vygotsky 1978, p. 88). This means that children may imitate a great many actions that go beyond their actual developmental level. With imitation, a child gains the competence to accomplish more in joint activity and when guided by an adult or more capable peer. This view will influence the traditional understanding of the relationship between development and instruction. Based on the traditional view, instruction has been adapted to the child's actual developmental level. Teaching that is directed at developmental levels that have already been reached is ineffective for the child's total development. Vygotsky (1978) also contended that "´good learning´ is that which is in advance of development" (p. 89). Bearing this view in mind, he placed a great deal of emphasis on instruction in the ZPD (Rogoff & Wertsch 1984). Using Vygotsky's theory, the tools and techniques of a society will be introduced to children and practised in social interaction by more experienced members in the children's ZPD (Rogoff & Wertsch 1984). The social interaction with people defined as experts in the use of material and conceptual tools thus functions as a "cultural amplifier" to expand the children's cognitive processes (Cole & Griffin 1980). All the same, it is important that both the learner and the expert are involved in the activity. The learner must actively take part in the problem solving for which the expert offers guidance along the way (Rogoff & Gardner 1984).

Another way of thinking of the ZPD is when learners work with educational activities that are of interest to them and thus seem meaningful to them. This can be done, according to Wells (1999), when teachers invite the pupils to take the initiative with the teachers to decide aspects of a class topic. This is also what happens during project work. The pupils are given the opportunity to decide which topics they want to work on according to an overarching theme the teacher has presented. When the pupils formulate their questions, they find themselves in their ZPD. They formulate questions about something they wonder about, something they want to inquire about and thus obtain an answer to.

Vygotsky has been criticized because he has given prominence to cognitive development and thus neglected the social, affective and motivational dimensions. In his book *Thought and Language* (1986/2000) Vygotsky gave the impression of a much more balanced conception of development than is usually ascribed to him. He described consciousness as a "sphere" that includes our needs, interests emotions and motives: "Behind every thought there is an affective-volitional tendency (...) A true and complex understanding of another's thoughts becomes possible only when we discover its real, affective-volitional basis" (p. 252). With Vygotsky's ideas that the whole person is involved in activities in mind, I will treat interactions in the ZPD as involving all facets of an individual's personality. The traditional

view of the ZPD concept defines the expert as an adult or more capable peer. The adult or more capable peer helps pupils in their learning activities. This view indicates that the expert adult knows what is to be learned and thus does not change during the activities. According to Lave (1996), both the teacher and the pupils are participants in the on-going practice, and the teaching can thus affect the teacher as well as the pupils. The ZPD concept can be used when examining a teacher helping one pupil, groups of pupils or the whole class.[39] Within an activity setting, teachers often need to help pupils working on tasks. This is my focus in this chapter. To understand what happens during these and other interaction settings as well, I introduce the concepts of situation definition, intersubjectivity and semiotic mediation.

Situation Definition, Intersubjectivity and Semiotic mediation

Wertsch (1984) laid the groundwork for his critique and extension of Vygotsky's concepts and development of the ZPD in his concept of *situation definition*. Wertsch states that persons operating in a situation actively define the way the setting or context is presented. To exemplify this he compares a fifth-grader and a first-grader who have been presented the same problem, but understand the context in such different ways that they are not really doing the same task at all. Wertsch also shows that these two pupils are guided in qualitatively different ways. He argues that the process of giving up an existing situation definition and instead choosing a qualitatively new one is the major change a learner[40] undergoes in the ZPD. Thus progressing in the ZPD involves a shift in the child's basic understanding of the objects and the events in a setting. The adult or more capable peer does not necessarily have the same situation definition as the one that corresponds to the potential level of the child. The tutor and the tutee can collaborate on the basis of a third situation definition, but to do so requires *intersubjectivity*[41] between the participants.

Intersubjectivity exists between two persons who act in the same task setting when they share the same situation definition and they know that they share it (Wertsch 1984). Rommetveit (1979) defined intersubjectivity in a way that corresponds well with Wertsch' definition:

[39] I will examine teachers helping to create shared knowledge in class in Chapter 10 "Shared knowledge".
[40] Here I say that a learner undergoes change in the ZPD. Throughout the text I often name the learner the child or the pupil, at the same time as being consciously aware of that this learner can be both a child and an adult.
[41] Trevarthen (1979) presented two forms of intersubjectivity. He named shared attention "primary intersubjectivity" when a mother and infant in interaction focus on each other. When the focus for their shared attention is an object, he named it "secondary intersubjectivity". A third kind of intersubjectivity is called "tertiary subjectivity", which means that the focus is on ways others approach a problem (Tomasello et al. 1993).

> *A state of intersubjectivity with respect to some state of affairs `S` is attained at a given stage of a dyadic interaction if and only if some aspect `A (i)` of `S` at that stage is brought into focus by one participant and jointly attended to by both of them (p. 187).*

According to Wertsch (1984), the interlocutors in an interactive setting can actually have a different situation definition, but need to share a common one if they are to interact in the ZPD. To make this possible, intersubjectivity has to be attained at different levels. When the interlocutors' intramental situation definitions are or become identical, there is no need for the adult or more capable peer to give more assistance. To attain intersubjectivity, the joint situation definition can correspond to the child's actual developmental level, but often this shared situation definition requires the child to change its understanding of objects and events. This change may involve the child assuming the situation definition of the adult or a viewpoint somewhere between. The teacher cannot lead a learner toward understanding of new information unless the context for the interaction is intelligible to the learner (Rogoff & Gardner 1984), and the effectiveness of interactions within the ZPD also varies as a function of the interpersonal relationship between the participants (Stone 1993). But how can the interlocutors in a task setting come to the same situation definition? This happens through semiotic mediation (Wertsch 1984). Vygotsky (1981b) looked upon semiotic mediation, mediation through signs and speech, as the key to all aspects of knowledge co-construction. Wertsch (1984) also claimed that intersubjectivity is often created by language or other non-verbal signs. Language can be used in different ways to reach a joint situation definition and intersubjectivity. By representing objects and events in speech, the adult attempts to negotiate a new level of intersubjectivity. The child thus has to change its understanding of the situation. By using speech the child negotiates new levels of intersubjectivity during the interplay so the adult can give impetus to further change and development.

The Scaffolding Metaphor

The "scaffolding" metaphor is used to give a picture of an adult helping a child to solve a task or reach a goal the child could not achieve without this support (Wood et al. 1976). This notion is closely related to the ZPD[42] (Rogoff &Wertsch 1984). Vygotsky claimed that what

[42] Griffin and Cole (1984) argue that the "Zone of Proximal Development" concept is more extensive than the "scaffolding" concept. They allude to theorists such as Vygotsky and Dewey, who they say use the scaffolding metaphor and look upon the discovery of new goals as a vital part of the process of development. To find out how the adult's understanding of goals structures the sequence of activities, they argue that architects and foremen have to be engaged in the building process that the scaffolding indexes. Building, they claim, "has to begin with all the scaffolding in place, and it would have to include work starting at the uppermost reaches of the roof as well as the basement" (p. 47). Then the adult's or teacher's role during instruction in the ZPD is much more than just to scaffold the pupils. The scaffolding devices are made and ready to be used when they are needed (Griffin & Cole 1984). Bearing this in mind, I nevertheless use the term "scaffolding" as an overarching term or metaphor including all assisting processes.

distinguishes primitive humans from animals is the fact that human beings use tools and signs to mediate interactions with nature and each other (Scribner 1985). During the tutoring activity the children can become aware of the goals and the means to get there, and thus become capable of accomplishing the actions alone without any assistance (Wood et al. 1976). Dewey (1938) said that guidance given by the teacher to the pupils is an aid to freedom. When pupils understand which means they can choose to reach a desired goal, they are free to act without any need of assistance. There are two theoretical models the assistor has to take into consideration when scaffolding a child (Wood et al. 1976). The tutor has to have a theory about the task or problem and how this may be completed, and the tutor has to have a theory about the performance qualities of the tutee. It is also provided certain criteria for the relationship between the tutor and the tutee (Crook 1994). The tutor has to have a sensitivity to the longer-range history of what the pupil knows at the same time as he is sensitive to the task in progress. The tutee or pupil must interpret the tutor's interventions as a contribution to what they are trying to achieve.

Six tasks of a tutor when helping children during goal-directed action are presented by Wood et al. (1976). These functions of the scaffolding process are also in a way included in project work as a work method at the same time as they can be used throughout the work processes structured by the activity. The first trait of the tutoring process is *(1) recruitment.* The tutor's first task is to become aware of the child's interest and adherence to the task. The teacher in a classroom has to get the pupils interested in the task, and keep this interest. By interest, Dewey (1916) meant both a person's results or goals that are foreseen and wanted and the person's emotional inclination. He also defined interest as a state when an object attracts the person. As we have seen, the pupils in Applebee, Bridgeford and Cooper Schools were given the opportunity to draw associations with the overall theme that was presented to them. After this brainstorming process the pupils worked in interest groups. As the pupils had the opportunity to manage their choice of topics, the interest and motivation for the work could be sustained throughout the entire project period. The starting phase of project work can thus be understood as phase one in the scaffolding process.

Phase *(2) reduction of freedom.* This phase involves simplifying the pupils' task to conduct their exercise. The task is not made easier, but the amount of help is adapted to the pupils' skills. The starting point for the pupils' work during a project is the problem formulation or question the various groups have made. The goal is to find answers to this question. In addition to this academic goal, another aim for the pupils during project work is to develop their social, aesthetic, methodological and learning competencies (Postholm et al.

1999, see Appendix 8, Figure 17, p. 411). The activity setting that the project work constitutes lays the premises for these competencies to grow and develop. At Applebee and Bridgeford Schools, the pupils were closely scaffolded throughout the basic courses and then were left more on their own devices, but then also scaffolded, when managing their "own projects". At Cooper School, the pupils more or less did not have their "freedom reduced", something the teachers also commented on at the exhibition night when they said that they should have given the pupils more expectations and demands during the project period (descriptions of Applebee, Bridgeford and Cooper Schools, p. 85, p. 107, p. 127 respectively).

Phase *(3) direction of maintenance.* This phase indicates that the teacher's task as a tutor is to guide the pupils in the direction of particular goals. A good question to work with during project work is a question that is precise, interesting and gives direction to the various actions that are to be carried out (Koritzinsky 1997). If the pupils are given some advice on how to formulate a good question, this can also direct their actions throughout their work. Thus the method itself can structure and support the pupils' work. At both Bridgeford and Cooper Schools the pupils receive help in formulating their questions. At Applebee School, the teachers discuss what the problem formulation for their activity is. The teachers ask the pupils what they would like to present from their “own town” and their “own school”. The teachers use these questions to try to motivate and direct the pupils' work (descriptions of Applebee, Bridgeford and Cooper Schools, p. 85, p. 107, p. 127 respectively). The problem formulations or questions that are made at the beginning of a project period also in a way move the pupils in their ZPD. The teachers ask them about something they want to find out, something they wonder about.

The goals for the work also appear to maintain the pupils' interest and motivation. In addition to working towards articulated goals, the pupils also strive to arrive at a concrete result or presentation. The pupils at Applebee School are going to make two films on the web, the pupils at Bridgeford School are going to make group presentations and the pupils at Cooper School are organizing an exhibition (see the Activity Systems p. 105, p. 125 and p. 143). According to Dewey (1916), a foreseen end will direct an activity when this activity is rooted in the pupils' interests. What is required of the teacher is that he has conceptions both about the aims and the pupils' abilities or possibilities so he can scaffold them on their way (Wood et al.1976).

Phase *(4) Marking critical features.* The tutor uses different scaffolding devices to stress what is relevant for the task. The teacher can build scaffolds in various ways for the pupils during their project work. The teacher or key informant at Bridgeford School made a

planning document with various items which the pupils had to consider when planning their work process. At Cooper School, the pupils also received a document which was intended to help them structure their processes. In addition to this document, the pupils were also asked to write in their logbooks to make them reflect on the conducted processes. At Applebee School, all the teachers regularly gathered with the pupils to reflect on and discuss problems they had run into, and to plan and help the pupils foresee future actions (descriptions of Applebee, Bridgeford and Cooper Schools, p. 85, p. 107, p. 127 respectively).

Phase *(5) frustration control.* This means that problem solving is less stressful with a tutor than without. The danger is that the pupils may become dependent upon the teacher to solve problems. During project work the teacher's role is to advise and support the pupils in various ways (Berthelsen et al. 1987). The teacher's role is not to be a sage on the stage, but a guide on the side. As one teacher said to one of the pupils at Applebee School: "We're not going to help you by telling you how to do it, we can help you by giving you some advice" (trec 100300). The challenge for the teachers during project work is thus to give the pupils a suitable amount of guidance so that they reach their goal while also making an effort in their ZPD.

Phase *(6) demonstration.* Demonstration or modelling of a task involves more than simply performing it for the child or pupil. Often it involves an idealization of the act that is to be performed, and the modelling may even include a completion or even explication of a solution performed, in part, by the learner himself. In this way the scaffolder is presenting an idealized form of an action he thinks the learner is trying to do so that the learner has a model to imitate to conduct the task in a satisfactory or appropriate manner. During project presentations the pupils present their work to each other, and during these performances the pupils can come to think of different possibilities or strategies they can use to present their own result. In this way these presentations may function as models for how pupils present the answer to their questions the next time they work on a project. The project presentations can thus demonstrate or provide examples of solutions for how pupils can give appropriate presentations of answers to project questions or problem formulations in future projects.

This shows how the project method itself can help both the teachers and the pupils structure and support the learning processes. When teachers organize the learning environment as, for example, in Bridgeford School, by giving the pupils planning documents to discuss, they have to take the pupils' skills into consideration. Rogoff (1986) talks about structuring situations. This means that situations with regard to tasks, accessible tools and material represent features of assisting performance. The arrangement in the classroom

requires the teachers and pupils to have the same situation definition of project work as a method. This creates a common focus on the learning activity that establishes intersubjectivity between the participants in the classroom (Matusov 2000). This means that the organization of the social function in various structuring situations can be expected to lead to differences in how individuals function at the intramental level (Rogoff & Wertsch 1984). Perkins (1985) cautions against the opinion that “the opportunity does the teaching itself” (p. 13). The teacher's task is to create communication that forms a common focus for the classroom community (Crook 1994). Having a joint situation definition is also a fundamental assumption when teachers scaffold the pupils face to face during the learning processes. The teachers have to take the learner perspective or gain intersubjectivity with the pupils to give the support that is needed. Tharp and Gallimore (1988) have formulated a theory about scaffolding processes, and this theory deserves closer examination here.

Tharp and Gallimore’s Scaffolding Methods

Tharp and Gallimore (1988) have developed a model that presents their view on how actions develop before they are appropriated by an individual. Their thoughts are visualized in Figure 11 below.

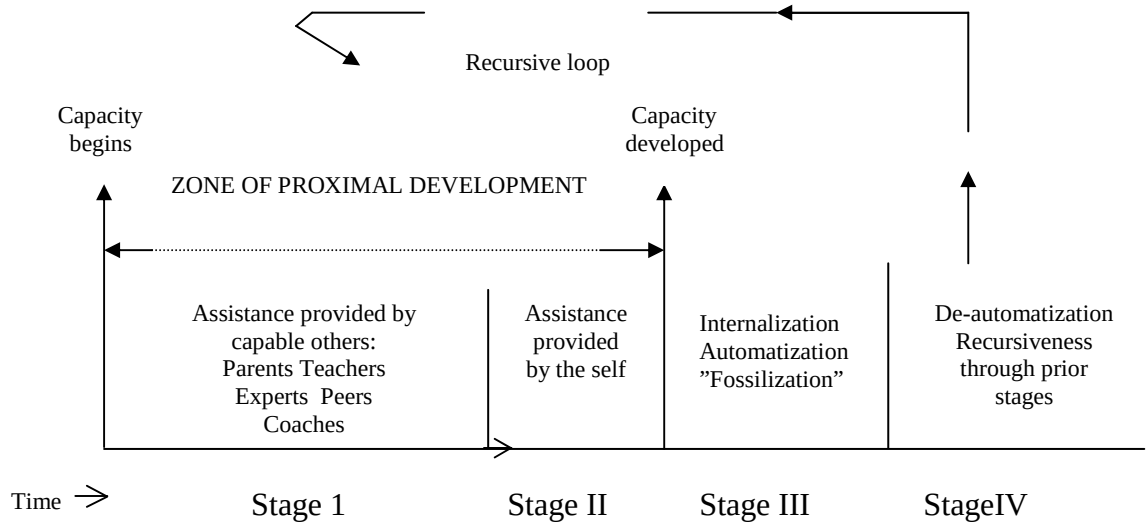

Figure 11: Genesis of performance capacity: Progression through the ZPD and beyond

During Stage 1 the learner, who could be either a child or an adult, may not think of the goal of the activity in the same way as the assistor does. During the conversation, goals and sub-goals can emerge and change as the participants in the activity work together. Both the goal of

the assisted person and the assisting person will change according to their growing intersubjectivity. This adaptation of goals to achieve intersubjectivity with the learner requires a profound knowledge of subject matter on the part of the teachers who are trying to assist the learners' performance. During Stage 1 the learner gradually takes over the responsibility for the task, while the assistor's responsibility correspondingly declines. The developmental task of Stage 1 is to move the learner away from other-regulation to a state of self-regulation. When the learner asks what part he is to do next, the learner has begun to influence the level of help provided.

During Stage 2 the learner conducts tasks without assistance from others, but this does not mean that the performance is fully developed or automated. During Stage 2 the relationship between language, thought and action undergoes a high degree of change. What the assistor said has now become the words of the actor to control the situation on behalf of himself. According to Vygotsky (1978), once learners begin to guide their own actions with their own speech, an important stage has been reached in the transition of a competence through the ZPD. This is indeed true of the process throughout lifelong learning. This is what happens when adults talk to themselves when performing an activity. They scaffold themselves by using language to conduct the actions.

Stage 3 illustrates a state where the learner has emerged from the ZPD into the actual developmental stage for the task. The performance is then developed, automated and "fossilized" (Tharp & Gallimore 1988). Fossilized behaviour refers to actions that are performed without the learner being conscious of his or her movement from the zone in such a way that it has become automated or "fossilized" (Vygotsky 1978). Assistance from a more capable person is no longer needed. Assistance at this developmental level would be disruptive, and this stage of development is beyond both self-control and social control (Tharp & Gallimore 1988). Vygotsky (1978) described this stage as the "fruits" of development. For any individual there will be at any time a mix of other-regulation, self-regulation and automated processes, due to the fact that we have different proximal zones for different activities (Rogoff 1982). Moreover, people forget in different situations, so that they need assistance to perform activities that earlier were automated. According to Tharp and Gallimore (1988), de-automation and recursion occur so regularly that they constitute a Stage 4 of the developmental process.

Stage 4 thus represents a stage in which de-automation may be a consequence of slight environmental changes or individual stress. When restoring competence, making self-speech external is a form of effective recursion. During recursion, the reconjuring of the voice of a

tutor is an effective self-control technique. In some cases self-regulation is not sufficient, and therefore other-regulation in these situations is required to exit the ZPD and move to a new automation.

Scaffolding during the learning processes is contingent on and responsive to the learner's level of performance (Tharp & Gallimore 1988). The more the learner can do alone, the less the assistor helps the learner during actions (Rogoff & Wertsch 1984). When the learner manages to conduct the activities alone, assistance is comprehended as interference. Bearing this in mind, Tharp and Gallimore (1988) define teaching as the assisting processes in the ZPD, the processes that requires assistance. This means that teachers or assistors have to be aware of the learners' different ZPDs, and thus the learning abilities of the learners. Teachers have to take into account the curriculum's goals and must also have competence in guiding the pupils in their ZPD. This means that the teachers base their authority on professional competence, not on power (Sutter & Grensjø 1988). This professional competence thus includes knowledge of the curriculum, the pupils' ZPDs and different ways to assist the pupils in their proximal zones. This curriculum plan as a guide or "instructive" for the work is what distinguishes teachers' work from parents' and others helping novices in everyday activities (Mercer 1995). Tharp and Gallimore (1988) have developed a theory of teaching that includes six ways assistors can scaffold learners in their activity. In the following I will use the teacher and pupil as examples of the assistor/learner relationship.

Tharp and Gallimore's Six Means of Assisting Performance

(1) Modelling is a process that gives the pupil a model or behaviour for imitation. This process is also in accordance with Vygotsky's ideas on development and its basis in interpersonal situations. Imitation is probably the principal learning method before language maturity is reached. The development of language itself is also affected by imitation. In traditional and pre-technological cultures teaching is, for the most part, based on modelling. The children learn basically by participating in everyday activities and imitating grown-up models. In our Western culture language is central in the teaching and upbringing of children (Tharp & Gallimore 1988).

All in all, learning also takes place through modelling in the Norwegian school, both in physical education and during language learning when reading in chorus, to mention two examples. In physical-education classes the teacher shows how various actions are to be conducted. The teacher, for instance, shows the pupils techniques they are to develop when high jumping. In foreign-language classes words are often learnt through the strategy whereby

teachers at first pronounce words and the pupils afterwards repeat them in unison. The teacher can also show the pupils which strategy they can use to learn to write new words. This meta-cognitive competence then becomes a part of the pupils' cognitive development (Postholm et al. 1999). In addition to the fact that modelling is an assisting method in developing the pupils' motor and cognitive skills, modelling can also have great influence in the development of abstract or rule-governed behaviour. During observations, the pupils or children become socialized into the culture they already are a part of (Bandura 1977). Modelling is often looked upon as a mechanical process that takes place without the acting subject choosing and imitating different models. Vygotsky (1978) claimed that children just imitate what is in their ZPD. In this way the pupil or child is regarded as an active participant even when imitating models.

(2) *Contingency management* is a strategy that supports a performance or an action with a reward or punishment, depending on whether it is wanted or not. Praise and encouragement, material reinforcement and other privileges, together with various kinds of evidence of recognition or tokens, are examples of positive reinforcement. Punishment has been restricted to a loss of something that is wanted. Reinforcement, in the form of praise in the classroom given to one pupil, may also be a motivating factor for the other pupils as they then try to behave as required. When real praise is given, it may create a calm and productive atmosphere in the classroom. Even if contingency management is a vigorous tool for supporting behaviour in the ZPD, this scaffolding method cannot shape new behaviour. This aspect separates reinforcement from the other scaffolding methods (Tharp & Gallimore 1988).

(3) *Feedback* is the third way to support the pupils. This means that pupils are given a response to their actions or performance. In school this feedback could be marks or an immediate comment provided by the teacher in a conversation on a task or problem the pupil is trying to solve. Written comments that pupils receive on their exercises and assignments may also be perceived as a response. Such a response is related to a standard, and the actions are assessed according to this. The pupil needs to know about the goals so that he or she is also able to understand the response and the gap between the performance and the desired goal. Models can also present such standards. The teacher may model different standards, or the pupils may function as models for standards when they are praised for good work. This corresponds to Tomasello's, Kruger's and Ratner's (1993) concept of "tertiary subjectivity" which means that the focus is on ways others approach problems. Instructions may also set the standards for work to be performed.

(4) *Instruction* is a scaffolding method that is especially linguistic in nature. Instruction is often used in everyday activities. The instruction method is usually used on two different occasions, when an exercise is given and in connection with disciplinary problems. Thus instruction as a scaffolding device calls for specific action, but if instructions become too authoritarian, they can provoke opposition. To make this method effective, it has to be used in combination with other scaffolding methods, especially contingency management, feedback and cognitive structuring, a method I will describe after the fifth scaffolding method, questioning.

(5) *Questions* may also help pupils in their learning process, and lead them further in the ZPD. In school, pupils often have to answer questions. Questions are posed to find out if they have done their homework, or they may be given in tests to make the pupils reproduce what they have read. Such questions capture the pupils' actual developmental level. Teachers can also ask the pupils questions to make them think further to gain a better understanding. Questions may be a vigorous scaffolding method because they trigger mental activity. The pupils have to give a linguistic or cognitive response, which in turn may awaken new thoughts. Then the questions can guide them in their proximal zone. Thus questions can be divided into two categories: assessment and scaffolding questions. By using assessment questions, the teacher may be able to ascertain a pupil’s actual developmental level. Scaffolding questions are asked to start mental activity that the pupils are not competent to accomplish alone (Tharp & Gallimore 1988).

(6) *Cognitive structuring* gives a structure both to actions and thought processes. Cognitive structuring does not call for a specific response, but it provides a structure for organizing elements in relation to one another. All actions and mentations have a structure with which we both regulate our own lives and the lives of others. In play, cognitive structuring is established through the rules in the same way as everyday life is structured by rules. They regulate both our own and others' lives. Some of the rules are universal; others are created by the local culture. Cognitive structures can be both conscious and unconscious. This means that some can be put into words, others cannot. They can be automated and occur without any form of attention. They disappear from the ZPD and become in this way a part of one's intra-mental processes. There are two types of cognitive structures. These are structures of explanation and structures for cognitive activity. The first type serves to organize perception in new ways. The teachers may have explained that molecular activity increases with temperature. As a result of this explanation, ice and steam can become part of the child’s science structure. Structures for cognitive activity operate similarly, but the content of this

structure is mentation. The pupils may be given structures for how to remember, for recall or rules for accumulating evidence. Such a rule could be when you are reading and come upon a word that is new to you, you first look for clues, then you put these clues together with what you already know about the word and decide what the word means. Finally, you check if that meaning fits with the content of the rest of the sentence (Tharp & Gallimore 1988). This form of cognitive structuring can thus be called metacognitive competence (Collins, Brown & Newman 1989), because it provides a strategy for how to proceed in the learning processes.

Other Ways Assistance is Provided in Learning Processes

Intersubjectivity demands mastery of rules for communication. Such ways of conversing are mainly a part of Grice's (1975, 1978) four maxims or rules for communication. These maxims are: "quality", "quantity", "relevance" and "manner". Together these maxims contain the principles for collaboration in "everyday language". Quality means that all the participants have to agree that all utterances are to be true so that the conversation is conceived and understood by all participants. The utterances also have to be informative and no more comprehensive than necessary (quantity). Relevance means that the utterances must be to the point and expressed in a clear and unambiguous way (manner). These maxims are valuable tools for understanding intersubjectivity because they recommend procedures that interlocutors can use to create an understanding that goes beyond the semantic content in the words that are used. The intersubjective space that children create together with their parents or teachers thus is both the foundation for the dialogue and is also created by it. Through dialogue with others children learn the principles for collaborative interaction and strategies for finding out what people mean during talk. During dialogue as described by Grice (1975, 1978), children learn to take an active part in the co-construction of knowledge (Ochs 1990). The inferences children make will be different than these that will be established through formal, deductive argument.

In traditional teaching in school, pupils usually learn one way of conversing that contradicts the maxims of Grice. In school pupils might be given the following mathematics exercise. "Peter has one blue car and a red car, how many cars does he have altogether"? When solving this exercise the children learnt that the answer to this task is 2, 1+1=2. This is looked upon as the correct answer if the exercise was given deductively. According to Grice (1975, 1978), this task can be interpreted in different ways. The answer could be as above, that Peter has two cars, or it could be that he has more than two. This means that there are two answers: two cars or at least two. Exercises in school are usually defined as having one

correct answer, and thus Grice's maxims do not fit the thinking in the traditional school. In the traditional classroom pupils have to distinguish between two forms of interpretation, a collaborative everyday discourse and an authoritative academic discourse (Dore 1985). These to forms of discourse can be grouped together with inner convincing and authoritative dialogue respectively (Bakhtin 1981). The inner convincing dialogue fits well with Grice's (1975, 1978) four maxims, but the authoritarian dialogue can be looked upon as a form of conversation based on absolute truth. If the authoritarian dialogue is conspicuous in a classroom, there is little room for the pupils to create knowledge and understanding in a dialogue with their teacher.

The most suitable way to scaffold pupils is not necessarily to tell them what is maximally informative. The most helpful remarks could be those that are incomplete or otherwise imperfect. This can help the learner to think more about the problem s/he is trying to solve. Thus the apparently laudable and precise patterns of feedback, correction, diagnosis and demonstration that ITS[43] designers strive to achieve are not representative of what expert tutors actually do (Lepper, Woolverton, Mumme & Gurtner 1993). Crook (1994) recommends that learners should be provoked rather than assisted, but he is also aware that this type of help could be viewed as a more cognitive account in the traditional sense because provocation emphasizes the elicitation of private cognitive processes. As a significant addition, he claims that the processes are prompted by social participation.

Prolepsis is another form of instructional dialogue (Rommetveit 1979, Stone & Wertsch 1984, Crook 1991, Crook 1994). This term indicates that communication requires some grasp of the speaker's presuppositions, which means understandings that are not completely explained. Thus such messages may be said to be underspecified or richly presupposing. The use of presuppositions creates challenges for the listener. When the listener is challenged he tries to construct a set of assumptions in order to make sense of the utterance. The communication becomes successful only when the listener's assumptions recreate the speaker's presuppositions (Rommetveit 1979). This situation of course creates some tension, but this tension can encourage activity that is intended to solve the "problem" that has been given to the listener by the speaker. Rommetveit (1985) has some remarks on speaking and listening in the process of defining intersubjectivity. He says: "encoding and decoding are complementary processes. Encoding always contains a component of anticipatory decoding

[43] The more advanced versions of CAI, Computer Assisted Instruction, are sometimes called ITS or "Intelligent Tutoring Systems". Computer programmes offering intelligent tutoring intelligently implement an individualized tutorial dialogue based on an intelligently diagnosis of the learner's needs (Crook 1994).

and decoding takes the form of reconstructing fragments of an intended message" (p. 25). According to this, the teacher's role will be to encode in a way that makes the decoding process of the pupil enriching.

In his book *The Guided Construction of Knowledge* (1995) Mercer focuses a great deal of attention on how teachers ask pupils questions. He also believes that the traditional IRE (initiation-response-evaluation) communication procedure may be useful in a classroom when pupils are viewed as active participants. He says that guiding techniques have to be evaluated in their context, taking into account what is being talked about. He claims that it is only when questions are considered in a context that they can guide the pupils in their work. Mercer adds that when pupils are asked questions, they not only gain new knowledge, but they are also given the opportunity to check, refine and elaborate on what they already know. Moreover, the teacher can be aware of what the pupils know and can do, and he can thus adjust his teaching strategies accordingly. Mercer also appears to think of two types of question: questions that focus on what the pupils actually know (their actual developmental level) and questions that can help pupils in their learning processes, in their ZPD. Mercer also draws attention to the fact that the patterns of communication in any classroom are defined by the teacher's own style of teaching. He claims that the ways teachers and learners talk will be shaped by the cultural traditions and by the specific institutional settings in which they act. He adds that there is often a mis-match between how things are taught and how and what the students are expected to learn.

In the following text I will present scaffolding dialogues between teachers and pupils, both when the teacher helps pupils in a one-to-one relationship and also when he scaffolds small groups of pupils working on task. As mentioned in the introduction of the chapter, these dialogues are illustrations of different situations in which the observed pupils were guided by their teachers.

Illustrations of Scaffolding Processes in Activities Using ICT

Information Searching

The dialogue below is from Cooper School. The pupils have been searching the Internet for information on their relatives. John (teacher) comes to the pupils' classroom and asks if anyone is having trouble finding data material for their project. Two pupils go with him into a classroom next to the one they were working in. John wants to give them some advice on how to search for information. He invites the pupils into a dialogue.

Illustration 1

(1) John: I think lots of pupils have found something about their relatives on the Internet, but I also think that some of you haven't found anything. I recommend that you use "genealogy books from rural districts". But can we find such books, and which districts have them?
(2) Tommy: Maybe we have a book like that at home.
(3) William: I'm trying to find a man from Aafjord.
(4) John: I can help you find your relative (John gives the boys a sheet of paper which lists various information sources. Different libraries are mentioned, a library in the nearest city where most "genealogy books from rural districts are to be found, the Public Registry, the Latter-Day Saints' library and Norwegian and foreign URL addresses are listed. John explains what he has listed to the pupils. He continues).
(5) John: I also have the URL address for the Mormons, and all the church registers in Norway are photocopied, and these are the people who have done this type of research. By the way, are you connected to the Internet at home?
(6) Tommy: Soon.
(7) William: Some of us already are, you know (rather proudly).
(8) John: You could also search by using different names in Kvasir (a Norwegian search engine). For example, I wrote my last name, and it actually showed up. Try, using your imagination. You'll find out that there are a lot of coincidences when you use the Internet. I remember saying to someone that God didn't create the Internet. You can't find everything there, nor is everything you find there true. What are you going to do the next fourteen days? Perhaps you could also use other sources than the Internet? I suggest that during the next fourteen days you use "genealogy books from rural districts", talk to people, you might get as much out of them as from the Internet. And be generous with any good advice you get. Tell the others if you have found something, and to me too, not the least (Cooper School, obsnot 091400).

In utterance (1), John describes the situation in the class. Lots of pupils have found some information, but some have failed to find anything about what they were searching for on the Internet. In this way John tells the boys about the situation in the class, and the conversation following this then has a context in which it can be understood (Mercer 1995). The participants in this dialogue have a joint situation definition. Two boys wanted advice from John, obviously from among those who were searching for information about relatives and had failed. John says that they can use books written about people from rural districts to try to find information about their relatives *(suggestion, cognitive structuring, direction of maintenance).* He then asks the boys if they know where these books can be found *(questioning).* The teacher wants to find out what the pupils actually know about such books. One of the boys answers (2) that they probably have a book like this at home. The other boy says (3) that he is trying to find a relative from Aafjord (a rural district in the same county as the school), and thus informs John that he needs some information about this place. In utterance (4), John assures William that he will help him find this relative. John was obviously able to answer the question he asked the pupils in utterance (1) himself. When they have talked about how to find books, John gives the pupils a sheet of paper with lots of information about where to find the data material they are looking for. In this way, the

handout can function as a mediating artefact to help the pupils structure their information-searching processes. Several URL-addresses have been listed written on this sheet of paper *(cognitive structuring, direction of maintenance).* In utterance (5) John goes on to *inform* the pupils that he has a URL address they can use, and he goes on to *tell* them about the church registers. He ends this utterance by asking if the boys are connected to the Internet at home *(questioning).*

With this question the teacher probably wants to find out if the pupils have the possibility of using this tool at home. The boys could have answered just yes or no to this question, but they choose other answers. Instead of saying no, one of the boys says "soon" (6), and in this way also apparently tells the teacher that he is looking forward to getting such a tool at home. The other boy confirms (7) rather proudly that he already has such a possibility at home. In utterance (8), John *tells* the boys about one of his experiences when searching on the Internet when he searched his own name and actually obtained hits. At the same time he *informs* the pupils that he has told someone that there are limitations to what you can find on the net and that the information you find there is not necessarily true. In the middle of this utterance John asks the pupils what they are going to do the next fourteen days *(question).* The pupils have a day off the next project day, so it will be fourteen days before the next time they work on their project at school. John does not wait for the pupils to answer the question, rather answering it himself by *suggesting* what the two boys can try to do the next two weeks. He says that they could get as much information from books and by talking to people as by using the Internet. At the same time he also tells the pupils that searching on names can be a useful search strategy *(cognitive structuring, marking critical features).*

The boys have failed to find information on the Internet. In this dialogue John gives them a new strategy to use to find information on the Internet while also recommending other information sources. This also seems necessary because the pupils are now going to work at home for fourteen days, and one of them does not have the possibility of using the net as an information source. The teacher assures the pupils that they can find as much information by using the other recommended sources as on the Internet. He at last tells the boys to share anything they find with the others. He is probably thinking of good sources or important information. He also wants them to inform him about their findings. In this way he is letting the pupils know that he also needs to develop his competence with respect to searching for information.

Illustration 2 below is from Bridgeford School during a session when they are searching for information. A boy is sitting in the ICT corner trying to find a local map on the

Internet. He is working on the group exercise about buildings and areas near the school during the introductory course. He wants to find a local map on which he can write down the information he has collected. Sarah (teacher) comes up to him and starts to give him some advice.

Illustration 2

(1) Sarah:	*I know about another place it's a good idea to go to, Dennis. If you find something you're looking for there, then it's ok. Did you find that? (At the same time she's asking, a map shows up on the computer screen). This map is actually a finished map, really.*
(2) Dennis:	*Yes.*
(3) Sarah:	*Where did you search?*
(4) Dennis:	*I searched on Trondheim.*
(5) Sarah:	*Where did you find that then?*
(6) Dennis:	*Under Trondheim city.*
(7) Sarah	*Did you find Trondheim city on the school's web site?*
(8) Dennis:	*Yes. No, I don't know.*
(9) Sarah:	*There, yes, that page, yes, (looks at the URL address), did you search on maps?*
(10) Dennis:	*Yes.*
(11) Sarah:	*Oh, yes I was searching yesterday evening to find that page, but it didn't show up on the screen. It was probably because the server was down. But on the school's web site you can also find some maps, and on the school's page you can also search on Trondheim, and find a lot (Bridgeford School, trec 112000).*

In the first utterance Sarah shows (1) that she knows about an URL address the pupils can search on to try to find maps. Almost at the same time as she asks (1) Dennis if he has found something *(question)*, a map pops up on the computer screen. She comments that this is a finished map, which Dennis also agrees (2) on. Then Sarah asks (3) Dennis where he was searching to find this map *(question)*. Sarah apparently asks because she wants to know where the site is, she is not asking a question she already knows the answer to. When Dennis answers (6) Trondheim city, Sarah has (7) a follow up question *(question)*, but Dennis obviously does not know (8) how he has got there. Then Sarah looks at the URL address and apparently recognises it. She then asks (9) if he had searched on the word "maps" *(question)*, and Dennis confirms (10) this. In the last utterance Sarah shows (11) that she has tried to find some sites on the Internet that could give the pupils some help in their work before she gave the pupils the exercise. In this last sentence she informs Dennis that he can also find a lot of information on the school' s web site.

As a helping device, in the past the teachers at Bridgeford School have connected several links to the school's web site so that the pupils can find information more easily. During this project the teachers had actually forgotten to connect such links to this web site. Throughout the work Sarah suddenly realises this, but at the same time concludes that the

pupils apparently have become used to the search procedures, so this helping device is not that necessary any more (intinf 112800).

The teachers use different means to assist the pupils. Sarah and John (teachers) both ask several *questions* in Illustration 1 and 2. These questions are asked to find out about practical issues, such as if they have books, if they are connected to the Internet and what address has been used to find the information on the Internet. These questions also help the teachers to understand or become aware of the pupils' situation. In this way the pupils and the teacher also obtain a common situation definition and intersubjectivity that helps them discuss and plan together. Otherwise scaffolding devices such as cognitive structuring, direction of maintenance and marking critical features are given to the pupils through various artefacts such as URL addresses and procedures for how to find information. John also gives the pupils a lot of advice through suggestions and by telling them or giving them information that supports their coming actions. Suggestions also function as a kind of cognitive structuring because they give the possible ways of performing actions.

Learning Programmes

The pupils at Applebee School are learning to use the I-movie programme. Steven (teacher) walks around and helps the pupils while they train to use this programme. The pupils are sitting in pairs, and have been encouraged to work together when solving exercises given to them on sheets of papers (description of Applebee School, The Basic Course, p. 93). One of the girls wants some help from Steven. Sheila (pupil) talks to him and asks him if he can stand beside her while she finishes a task.

Illustration 3

(1) Sheila: *I need some help while I do this.*
(2) Steven: *Mm.*
(3) Sheila: *No, like this, I have to delete this (deletes a name).*
(4) Steven: *Mm.*
(5) Sheila: *No, I've deleted everything.*
(6) Steven: *Yes, yes.*
(7) Sheila: *The people who are taking part, here (she thinks of the persons taking part in the movie).*
(8) Steven: *Mm.*
(9) Sheila: *At first we choose the first line.*
(10) Steven: *Mm.*
(11) Sheila: *Then we write like this, ok?*
(12) Steven: *Yes.*
(13) Sheila: *Maddie, like this?*
(14) Steven: *Yes?*
(15) Sheila: *Oh, there. And the third, how do I get it so that I can see the third word myself then?*

(16) Steven: Yes, let's see, if you jump over one line. You jump over this line, and then you start on the next one.
(17) Sheila: And then, what am I going to write there then?
(18) Steven: Yes, what can you read on your paper? (Applebee School, trec, vrec 092600).

Sheila invites (1) Steven into the dialogue by saying that she needs some help while she is conducting an exercise. Steven confirms (2) that he can do that by saying "mm"*(feedback).* He does not interrupt Sheila in her thinking process, but lets her be the active part in this exercise. Sheila talks to herself while reading the written instructions, and it is obviously enough for her that Steven gives feedback on her comments and actions (*frustration control*). In utterance (3) Sheila talks to herself and gets feedback from Steven. He says (4) "mm" *(feedback).* In utterance (5) Sheila surmises that she has deleted everything, and Steven confirms (6) with the words "yes, yes" *(feedback).* The dialogue continues in the same vein from utterances (7) to (14). Sheila is reading the instructions on her paper out loud, then performing the task and getting feedback from Steven.

In utterance (15) Sheila asks Steven a question. In this way Sheila is the one to take the lead in the scaffolding and learning process. When she lets Steven stand in front of her computer screen observing her solving the tasks at the same time as she asks questions, Steven has a unique possibility to find out how Sheila is performing the task. According to Tharp and Gallimore (1988) the learner has begun to influence the level of help provided when he or she starts to ask questions. Sheila is in phase 1 (Tharp & Gallimore 1988) of development in accordance with this programme, but presumably in the last part of it. She regulates her actions by talking to herself, just needing confirmation from her teacher. In this situation Steven has an opportunity to gain intersubjectivity with Sheila during their shared focus on the exercise, and thus he also obtains a good opportunity to guide her in her ZPD. In utterance (16), Steven tells Sheila how to solve the task she asks about *(instruction, marking critical features).* In utterance (17) Sheila again asks Steven about what she should do. Steven then answers (18) Sheila with a *question* hinting at the instructions written on her task paper *(marking critical features).* Steven has obviously decided during the scaffolding process that Sheila is able to conduct the exercise by herself just with the written task and the computer as helping tools. Steven wants the pupils to be self-regulative. As he says to the pupils: "I'll be in this room, but try to do it by yourself first, before you ask me" (trec, vrec 092900). He wants them to use the instructional exercise to direct their work. He does not give Sheila help that is maximally informative (Lepper et al. 1993). He obviously thinks that the quantity and the relevance of his advice is given in such a manner that she will continue her work (Grice 1975, 1978). In Illustration 3, the teacher uses scaffolding in the form of feedback, frustration

control, a question and also by making critical features when giving instruction, which is a scaffolding device used when exercises are given, according to Tharp and Gallimore (1988).

Using External Equipment

The pupils in Applebee School are given a task that involves putting a camera on a tripod. Steven (teacher) gives the pupils some instructions before they start.

Illustration 4

(1) Steven: *Then you can do what you were told (Steven has given the pupils some exercises written down on paper, and the pupils have been told to carry out some of them). You are to put the camera on the tripod and make it work, and you're going to work through those pages jointly in your groups. Read some of it and then try to do what you've read together.*
(2) Brian: *I've tried this before.*
(3) Steven: *Yes, that's good, then you're the expert who can help the others (Applebee School, trec, vrec 091500).*

In utterance (1) Steven tells the pupils that they are going to do what they had talked about. He encourages the pupils to read and work together. Because of his clear *instructions* (*reduction of freedom)* before the exercise, a structure or organization of the work has been created that also helps the pupils during the work process *(cognitive structuring, direction of maintenance)*. One of the boys says (2) that he has tried to put a camera on a tripod before. Steven answers (3) that it is good that he has some experience *(feedback)*, and suggests that he than can be the expert pupil and help the others. Steven shows through this utterance that he wants the pupils to help each other and that he values this. He seems to appreciate that he has expert pupils in the classroom who can help their peers develop in their ZPD.

During this exercise Steven walks around the classroom talking to the pupils while they work. He also gives them advice when it is necessary to do so. During the dialogue rendered below the pupils are working with the camera. Steven goes up to one group and starts a dialogue with them.

Illustration 5

Sequence 1:

(1) Steven: *You see, Sheila, that wasn't too difficult. Don't you agree?*
(2) Sheila: *Yes.*
(3) Steven: *Good.*
(4) Mia: *I could do some things with the camera beforehand, because we've almost the same camera at home.*
(5) Steven: *Yes, that's great. Here you can reverse the same way as …*
(6) Sheila: *Is it possible to reverse the film and record a new shot if we want to?*
(7) Steven: *Yes, ok. And these are the things I want you to find out yourself, because then I think you'll remember them. If I just stand here and tell you things, then you'll just forget them (Applebee School, trec 092800).*

Before this exercise one of the girls said that this exercise would be too difficult for her, but while they work through this task Sheila seems to get by very well (obsnot 092800). Steven has obviously observed this too, because he tells her that this work was not too difficult, and asks (1) for her agreement *(frustration control)*. Sheila also confirms (2) his request positively with a "yes", which Steven again replies (3) to with the word "good" *(feedback)*. In this way he encourages her in this work, while at the same time he signals to her that he has observed that she has done a good job. Mia, another girl in the class, says (4) she knows how to use a camera like the one they have because she has one like it at home. Steven replies (5) "that's great" *(feedback)* to this utterance, and starts to explain the camera's reverse function. He is then interrupted (6) by Sheila who follows his thoughts with a question about new recordings. He confirms (7) her question at the same time as he says that they can try to find solutions to such things themselves. He also gives the pupils reasons for his requirements for the activity. Steven tells them that he thinks they remember and learn more when they practice and try the things they are to learn. In this way he does not just give the pupils instructions on what to do, but he also tries to give them an understanding of the learning process and thus metacognitive competence for their learning. In this way he also shapes a social context around the pupils' work (Crook 1994).

Steven also talks to another group working with the camera. He comments:

Sequence 2:

(8) Steven: Very good, great! Then there's just the rest left (Applebee School, trec, vrec 092900).

Steven comments on one group of pupils, showing that he observes that they are working very well. He does not interrupt their processes other than to confirm that they are doing a good job, and that they just have to try to finish the rest. In this way he encourages them to work more without giving them too much information. According to Crook (1994) one way of helping the pupils is to *be provocative* rather than giving help. The pupils do not show that this utterance provokes them (obsnot 092900), but he obviously consciously does *not* tell the pupils what is *maximally informative* (Lepper et al. 1993). This utterance could be understood as a message that requires the pupils to have some grasp of the teacher's presupposition *(prolepsis)*. The pupils probably remember the teacher's initial dialogue with them in the beginning of the lesson when they talked about what exercises they were going to work on (description of Applebee School, The Basic Course, p. 93). They can thus interpret the

teacher's utterance in this dialogue as a context for understanding the message. The pupils also continue to finish the work (obsnot 092900).

Steven (teacher) also gives the pupils some advice when they are ready to go outside to record their first film. He says:

Sequence 3:

(9) Steven: *Now you're going to practise what you did during the exercises. You don't need to know more. Now you can go outside. Take the exercises handout with you. I want you to make a film of about five minutes' duration. You can film what you want to, the things that you suddenly find out that you want to film, you see? And then you have to use the tripod at least half the time. Do you think that's ok? (Applebee School, trec, vrec 092900).*

Steven has decided what the pupils need to know and do before they go outside to film *(marking critical features)*. Steven seems to have clear ideas about what the pupils need to know before they do this filming. He also seems to have made up his mind about the scaffolding processes, reflections he also shares with his students. He observes the students during the activity and thus has the opportunity to find out if they need some help. Steven has organized the classroom so that scaffolding is prominent at various levels. He gives the pupils instructions written down on paper as a helping device during the activity. He organizes group work so that the pupils can work together, and he also gives the pupils advice when it is necessary. An assistor has to take both the problem of the task and the tutee's performance qualities into consideration during scaffolding processes (Wood et al. 1976). "You don't need to know more," Steven says to the pupils, and gives an impression that he has considered both the factors Wood et al. (1976) focus on.

During this filming process the pupils are asked to make a film of five minutes' duration. Steven probably puts this limitation on the pupils' filmmaking so that they can become aware of how much time one and a half minutes is, and thereby acquire a sense of how long the final film or product is going to be. In the beginning of the project period Steven also showed the pupils a film about themselves (description of Applebee School, The Basic Course, p. 93). Steven told them that he had used the I-movie programme, the programme they are going to use to edit their own films. The film Steven shows at the beginning of the project period thus also functions as a *model* or a *demonstration* for how a film product can be produced with the help of the computer as an editing tool.

The teacher uses scaffolding devices such as frustration control, instructions, reduction of freedom, feedback, cognitive structuring, direction of maintenance, and also a model or a demonstration for the actions when the pupils learn to use external equipment. By using a

model or a demonstration he seemingly also motivate the pupils for the task *(recruitment)*. He also tries to make the pupils understand why he scaffolds them the way he does (metacognitive competence). During the dialogues between the teacher and the pupils the teacher also uses prolepsis by not giving the pupils maximum information. As mentioned earlier, Steven wants the pupils to think for themselves.

Making Presentations

Steven (teacher) talks to all the groups before they are going to record sequences for the film the pupils will edit to make their film on the web. One group of pupils sits together with Steven on a sofa in the school corridor. Steven starts the dialogue with the pupils by asking them a question:

Illustration 6

(1) Steven: *So, how's your work going?*
(2) Wendy: *Very well actually.*
(3) Steven: *So, now I want you to tell me, imagine that I'm sitting in a cinema, like, and you're allowed to show me thirty seconds of what you've made. What things will I be watching?*
(4) Wendy: *You'll see the cathedral.*
(5) Steven: *Uh huh.*
(6) Wendy: *And you'll see the old town bridge. And you'll see…*
(7) Louise: *A row of wharves. And you'll…*
(8) Wendy: *See the old part of the town.*
(9) Steven: *Am I going to see all this in thirty seconds?*
(10) Louise: *We're going to cut the film like, and you know...*
(11) Steven: *Okay, are you going to make commentaries for some of these sequences?*
(12) Wendy: *Yes, we are.*
(13) Steven: *I think this sounds exciting. Okay, now I want you to make the most of each others' qualities, what you're good at. That's important. I'll make sure that all of you participate in the process. What we've to find out is if you need to make appointments with someone in town (Applebee School, trec 100400).*

In the first utterance Steven asks (1) a general *question* of the pupils. He invites them to inform him about their work. With this question the pupils can share their situation with the teacher and in this way they can gain intersubjectivity. Their answer (2) is very short, so Steven has to be more specific to make them inform (3) him about their work. He apparently tries to put them in a real situation in which they can imagine what their finished film will look like. He also makes them think in terms of the thirty seconds that will be their recording time. Then two of the girls tell him about the ideas they have (4, 6, 7, 8). They interrupt each other, with Steven commenting (5) along the way. Then Steven asks (9) a *question,* probably to make the pupils think of the time they have at their disposal. This question reminds the pupils of the short amount of time they have and it can also trigger new thoughts *(cognitive*

structuring). The pupils answer (10) that they intend to cut the sequences they have recorded. Steven follows up (11) with another *question* about commentaries. This question can also remind the pupils of what they have talked about earlier and also probably makes them think more about this task. Wendy answers (12) this question in the affirmative. In utterance (13), Steven gives *feedback* on their work. He thinks they have planned their work well. It seems exciting, he says. He also encourages the pupils to contribute what they are good at to the group. He tells them that he will be watching to see if everyone is participating in the work. He then informs the pupils that they have to find out if they need to make appointments with people who are responsible for places they are going to visit and film.

During this dialogue Steven is able to learn about the pupils' thoughts, about what they are going to do. Instead of giving the pupils instructions on what to do, he asks questions. In this way Steven learns what the pupils have been thinking, and at the same time he probably also stretches them further in their planning activity. By using questions the pupils also probably feel that they are managing their own work. The aim of these questions is not to make them conduct different actions, but they are indirectly encouraged to do so. In the last utterance (13), Steven appears to be more controlling by saying that he will be checking to make sure they are all participating and doing their best.

When all the groups have recorded their films, two groups of pupils have the job of editing them. The two editing groups both contain two girls and one boy (description of Applebee School, The Realization Phase, p. 100). One of the editing groups has encountered a few problems and asks Steven for some help.

Illustration 7

Sequence 1:

(1) Molly:	*Hey, Steven, do you know what?*
(2) Steven:	*What?*
(3) Molly:	*Now the sound has suddenly disappeared. The only sound we can hear is when Mary is doing the talking.*
(4) Steven:	*Let's see if we can't find it. Try now. Here, you separate the different tracks.*
(5) Molly:	*Oooooh! (excited).*
(6) Steven:	*So, if you now try to play the track, we'll see what happens (the pupils and the teacher watch the film and they also hear the audio) (Applebee School, Group 1, trec101200).*

The pupils get the help they need from Steven. When he tells (4) them that they can separate the different tracks, Molly seems to remember what they should have done from instructions in the basic course when she expresses (5) an "oooooh". Then the pupils watch the film together with Steven, and the audio is perfect.

Sequence 2:

(7) Molly: *Now we've really finished, no not completely finished.*
(8) Steven: *What are you going to have at the end of the film?*
(9) Molly: *Rolling credits or?*
(10) Steven: *Yes?*
(11) Molly: *What are we going to write there then?*
(12) Steven: *You can take anything that's usually written after films.*
(13) Molly: *Which persons have made it? Are we going to write that?*
(14) Steven: *What year? Which school?*
(15) Molly: *Yes, but how do we do that then?*
Was it good or? (asks Steven).
(16) Mary: *What do you think about the film?*
(17) Steven: *Oh, I think it's great.*
(18) Molly: *Mm.*
(19) Jack: *Then we have to go to…*
(20) Mary, Molly: *Rolling credits (saying it enthusiastically together).*
(21) Steven: *Yes, and now we move to the end of the film. Then you're going to use the keyboard. Mm. There you can see the writing as it is. What I wonder about, hmmm? Yes, there it is. We can add some or take some out.*
(22) Mary: *What?*
(23) Steven: *Add more lines.*
(24) Molly: *Yes, but you should be able to roll it.*
(25) Steven: *Yes, yes, but I thought of the keyboard. There it is.*
(26) Mary: *Are we?*
(27) Molly: *Oh, yes, there it is.*
(28) Steven: *You see?*
(29) Molly: *Yes.*
(30) Mary: *Mm (Applebee School, Group 1, trec 101200).*

When they have fixed the sound, Molly thinks for a moment that they have finished, but at the exact moment she has said this, she suddenly thinks (7) of something they still have to do. Steven also asks (8) them what they are going to have at the end of the film *(question)*. Molly answers (9) with a question to make sure she is thinking of the right thing, if they are going to make rolling credits. Steven answers (10) in the affirmative at the same time as his tone indicates that he wants them to think more *(feedback)*. Molly continues (11) to ask Steven for information. Steven does not give her a direct instruction, but gives (12) her a *model* or a *demonstration* that can guide her thoughts. He makes her think of real films. Molly again asks (13) Steven a question. She wants confirmation about what rolling credits might contain. Then Steven responds (14) to her question with more *questions*, hinting that her suggestion is right and that other things also could be a part of the rolling title, like what year and which school. Then Molly obviously has imagined what the content will be, because her next problem seems to be how they are going to make it (15). Molly suddenly stops her thinking process about the making of the rolling title, and asks (15) Steven what he thinks about the film they have made. She obviously wants some comments on their work from their teacher. Mary also asks (16) what he thinks about the film. Steven gives (17) the pupils *feedback*, he thinks it is great. Molly hears his comment and responds (18) "mm". Then Jack obviously

wants to continue the work. He says (19) that “we have to go to”, but is interrupted by the girls saying (20) "rolling credits" enthusiastically in unison. They are both apparently eager, because they now know what they are going to do. Steven also confirms (21) this with a "yes". Then he gives (21) the pupils further *instructions (marking critical features)* on what they are to do. The utterances interchange between the teacher and the pupils until the pupils know exactly what to do (22-30). The pupils smile recognizably at the lines they have used during the basic course to make rolling credits. Now they seem to have appropriated how to use this device. They start to write who has made the film, which class and school and so on. When they have finished, they play the whole film with the rolling credits. Mary talks to Steven and asks him to have a look.

Sequence 3:

(31) Mary:	*Steven, you have to look here now.* *Look, it’s very professional now. Look!*
(32) Steven:	*Okay (leans towards the computer screen).*
(33) Molly:	*Norway.*
(34) Mary:	*Where? Below Apple Distinguished School.*
(35) Molly:	*Yes.*
(36) Steven:	*You could maybe have more space between that.*
(37) Mary:	*Okay.*
(38) Molly:	*Try it once more then (they look).*
(39) Mary:	*Yes, and then what year is it? Below that too (eagerly) (Applebee School, Group 1, trec101200).*

The pupils seem very excited about their result so far. Mary says (31) to Steven that it looks very professional now and that he has to look. Molly and Mary talk to each other when they see the credits scrolling down the screen (33-35). Steven *suggests* (36) that they could have more space between what they have written *(cognitive structuring, marking critical features)*. Mary responds (37) "okay", and makes more space. Molly suggests (38) that they should watch the credits once more, and they do. Then Mary makes (39) a comment in just the same way as Steven did. She wants them to write the year in the credits.

During this editing work Steven also encounters some problems when he tries to help one of the editing groups. The pupils in the group are sitting together with Steven in front of the computer screen. He says:

Illustration 8

(1) Steven:	*Hmmm, just wait a little bit, I’ve got a problem that I have to solve first (the pupils in the other group ask Steven for help).* *Hmm, now I’m at a bit of a loss here. No, I can’t solve this right now. That’s strange (he is trying to delete a sound).* *I think we’ll have to make a deal. We can let the sound be there for now, and I can try to work it out for tomorrow.*
(2) Julie:	*Should we continue then?*

(3) Steven: *Yes, you can go on with the other things, you know, then I'll fix the problem with the sound. Is that a fair deal?*
(4) Julie: *Mm (Applebee School, Group 2, trec 101200).*

Steven says (1) he was at a bit of a loss when he tries to delete a sound for the pupils. He adds that he cannot solve the problem then and there. He *suggests* that he'll try to fix the problem for the next day *(cognitive structuring, direction of maintenance).* Julie, one of the girls in the group, then thinks (2) they have to stop working, but Steven assures (3) them that they can work on other things instead. He *asks* the pupils if they think it is a fair deal if he works on fixing the problem for the next day *(question).* Julie confirms (4) that she thinks this is a fair deal with a "mm".

Two pupils in Bridgeford School are sitting in the ICT corner planning to make a Power Point presentation. They are sitting in front of the computer screen. One of the pupils asks Sarah (teacher) what they are going to do.

Illustration 9

(1) Rose: *Sarah, what are we going to do with this stuff?*
(2) Sarah: *You see, this material, you also have to present it to the other pupils in the class. You can tell everything you have written to the others, but when you make a Power Point presentation, then it's important to just write down some key words, and then you fill in more details around the key words when you are making your presentation, because otherwise it will be a bit boring if people just read what you have written, don't you agree?*
(3) Rose: *Yes, but could we have notes to help us remember?*
(4) Sarah: *Yes, of course, you can have notes, but the very best is that you can remember what to say when you see the key words.*
(5) Rose: *Yes.*
(6) Sarah: *But you could also have notes to help you, but you don't need to be completely correct about dates and things like that. Think for yourself what could be fun to listen to. The most important thing is that you tell it in a way that is easy to remember.*
(7) Rose: *Yes.*
(8) Sarah: *So then, pick out some key words here now, the ones you think are important, and then you learn what to say. Divide the different keyword between you and talk to each other, or you can do it another way, this was just a suggestion, okay? (Bridgeford School, trec 120400).*

Rose asks (1) Sarah what they are going to do with the data material they have collected. In the next utterance Sarah supplies (2) an *explanation.* She tells the pupils that they can write just key words, and she also explains why she thinks this is smart. Rose is obviously afraid that she will forget what she is supposed to say and asks (3) Sarah if they can use notes to help them remember. Sarah confirms (4) that she can have notes, but also *recommends or suggests* that she should try to manage without such notes, just using the key words in the presentation as her cues for what she is to say *(cognitive structuring, marking critical features).* Rose seems to agree (5) with Sarah when she responds with a "yes". Sarah then

goes on to comment on (6) these notes, saying they can use them as a helping tool during the presentation, but also *suggesting* that the pupils should not make a fuss over trifles. She tries to get the pupils to think of what they would have found interesting to listen to *(cognitive structuring, direction of maintenance).* In utterance (7) Rose answers with a "yes", while Sarah goes on to conclude (8) what they have talked about. She adds that it is possible that they can do it other ways, and that she was just making a *suggestion (cognitive structuring, direction of maintenance).*

In Cooper School, two boys are working together to make a web page about emigration. They have problems downloading a programme from the Internet they want to use to transfer the page they have made for the net. David and Michael (pupils) are sitting in front of a computer in the computer lab. David asks John (teacher) to come to their workplace to help them.

Illustration 10

1) David:	*I don't think we can do it on this computer.* *I can't install it, I have no access.* *You, (talking to John). We can't install the programme we' re going to use to put our homepage on the net.*
(2) John:	*You can, what's it called?*
(3) David:	*Cute ftp. It says no access.*
(4) John:	*If you want, you can ask Bill about it (Bill is the deputy head).*
(5) David:	*Yes, I think I'll have to go and ask Bill (Cooper School, trec 110200).*

David first concludes (1) that they cannot install the programme they need. He then asks (1) for his teacher's help. John then asks (2) David a *question* to obtain information about the situation. Then the teacher can gain intersubjectivity with the pupils. David informs (3) the teacher about the name of the programme and also tells him that they have no access. John obviously understands (4) that he cannot give the pupils any help himself, the only help he can give is to inform them that they can ask Bill, the deputy head, for help. David responds (5) that he will do this.

The boys receive some help from the deputy head. He shows them HTML codes and uses the school's homepage as a model when he introduces the codes. He also shows them how to copy codes from one page to another. Bill also helps them to put the page on the web. The pupils continue after he had withdrawn from the situation to work on and develop their web page. John (teacher) also comes up to the group again when they are sitting in front of their computer working on their page. He starts the rendered dialogue below with the two boys.

Illustration 11

(1) John: *What are you working on now?*
(2) David: *I 'm beginning to make it myself now.*
(3) John: *Yes, yes.*
(4) David: *Now, I'm just trying different things.*
(5) John: *Yes, great. What about you Michael?*
(6) Michael: *I don't understand the thing with…*
(7) David: *I understand it now (eagerly) (Cooper School, trec 110200).*

John wants (1) to know how the work is going. David answers (2) that he is beginning to make it himself, and thus shows that he has learned throughout the process. John answers (3) him with the words "yes, yes" *(feedback)*, and in that way tells David that he has understood that he manages things by himself. David informs (4) John that he is just trying different things. John gives (5) him positive responses on this *(feedback)* at the same time that he asks Michael how he is doing. Michael's utterance shows (6) that he does not understand all of it, but he is interrupted (7) by David who eagerly wants to tell John that he can do it now.

John understands that the pupils need some guidance in how to make HTML codes. When the next project day starts he has brought a small handout he has made himself. This handout contains some codes that he presumably thinks will be useful for the pupils to know. David has seen this handout and also finds out that it can help him. He says to John:

Illustration 12

(1) David: *Where do you have the handout, John?*
(the piece of paper about how to use HTML codes which John made for the pupils).
(2) John: *It's on the desk there (pointing).*
(3) David: *I've forgotten about the mailto thing (Cooper School, trec 110900).*

David asks (1) John where he can find this handout. John tells (2) him where it is, and David informs (3) John that he has forgotten the HTML codes for how to put his e-mail address on the page. In this way John's handout becomes useful.

When the pupils make presentations, the teachers help them by asking questions, by giving feedback and cognitive structuring and instruction by marking critical features and giving direction of maintenance. In addition Steven (teacher) give the pupils a model or a demonstration for guiding their actions. The conversations taking place between the teachers and the pupils when the pupils give their presentations also characteristically involve the teachers giving suggestions and recommendations to the pupils. In this way the pedagogical environment in these classrooms makes living dialogues possible, and thus the pupils can make decisions on their own while they are receiving the guidance from the teacher (Bakhtin 1981).

Discussion

After the conversation presented in Illustration 1, the pupils at Cooper School are going to work at home on their project for a period of fourteen days. Usually on project-work days they are given the opportunity to work at home. Most, but not all of the pupils can choose between working at school or working at home. At Cooper School, all but two pupils say they have a computer at home. Eight pupils say that they are not connected to the Internet at home (Table 2, p. 397). This means there are a few pupils who cannot choose between working at school or home. Marion (teacher at Cooper School) feels that the pupils staying at school have a better opportunity to be scaffolded when so few are present, but at the same time she concludes that the teachers lose their opportunity to give the pupils that work at home close scaffolding during the working process (intinf 110200). In this way the teachers cannot help the pupils to structure the process as much as if they had been present all the time, and they also lose the possibility of creating expectations that could have helped the pupils achieve a better result. Nor do the teachers have clear aims with respect to the pupils' presentations at the exhibition. Marion concludes when she looks at the pupils' presentations at the exhibition that they should have had more advising dialogues with the pupils (description of Cooper School, The Product Presentation Phase and the Teachers' Reflections, p. 139).

During this project the pupils are encouraged to work at home on their topics as part of their homework. This expectation also creates clear dividing lines between the pupils. As we have seen, most but not all, had a computer and access to the Internet at home. What could actually have been done with this difference in work opportunities? Giving the pupils the opportunity to work in the computer room at school in the evenings could have been one device to help eliminate the differences between the pupils. The pupils are also encouraged to work together with their relatives during this project. This could be one criterion for letting the pupils stay at home to work on their project when necessary. One of the pupils at Cooper School comments on a day when almost all the pupils want to go to the computer room to search for information. He says that it is of no use for him to go to the computer room. This is because "he can't find his grandma on the Internet", and he thus go home to work on his project (description of Cooper School, The Realization Phase, p. 135). It seems that most of the pupils have an exaggerated faith in finding needed information on the Internet. John (teacher at Cooper School) clearly tries to moderate this by reminding the pupils that God has not created the Internet, and he also says that all the information on the net is not always true. At the same time that he encourages the pupils to use books, he also gives them several URL addresses and a technique for using names as a scaffold to search for necessary information.

Illustration 2 shows that Sarah (teacher at Bridgeford School) has prepared for the project and found addresses of pages she can advise the pupils to go to when they want to search for information. The school where Sarah works, has a homepage which the teachers use actively during projects by placing links there that they think may be useful for the pupils when they are working on their topics. These links help the pupils in the information-search process to find the material they are looking for. It is possible that this device can restrict the pupils in their search process as it may limit them to using only these pages. But this does not seem to be the case. The pupils are allowed to use whatever browser and search engines they want to search on the World Wide Web. On the other hand, by connecting various links to the schools' homepage, the teachers can manage to ensure the quality of this material.

Illustration 1 and 2 show that when pupils work on a project, where they are using the Internet as one of the information sources, teachers are important resources, helping the pupils on their way. Teachers preferably should know several URL addresses and information-searching strategies if they are to give the necessary help to the pupils. If they want to connect relevant links to the school's homepage, they in addition need some knowledge about HTML codes or programmes making such codes. It is also very helpful for the pupils that teachers can advise them about when they should use the Internet as an information source and when other sources are useful or even more useful than the Internet. The teachers thus need to have some clear ideas about which information is qualitatively good and which information is of no or minimal use for the pupils. As John said, not all information is even true. The teachers also have to give the pupils advice on how they will work with or make the information on their own, thus giving an answer to their question. At Cooper School, the pupils are expected to write the information in their own words, and thus they are not allowed to just cut and paste (intteam 110900). Sarah states that they have been through the process in which pupils printed a lot of information from the Internet without working with it. But now she says, they have clear instructions on what they want the pupils to do with the material (intinf 111300).

Illustration 3 shows that Steven (teacher at Applebee School) has clear thoughts about his pedagogical practice. He wants the pupils to be self-regulated. He gives them a handout with an instructional exercise to direct their work, and in this way he does not tell the pupils exactly what to do. He is not maximally informative (Lepper et al. 1993). This shows that the teacher has to have reflected on his role when advising pupils on how to learn to use a software programme. He also has to have clear ideas about other helping tools that are relevant for the pupils to use. In this observed activity they are given instructive exercises to follow, but this does not mean that the teacher is neglecting his responsibility to know how to

use the programme. He has to have this expertise if he is to help the pupils when the instructive exercise seems to be too difficult to follow. During this sequence Steven also gives Sheila (pupil) an instruction that tells her how to solve the task.

The teacher's role as a guide or a pedagogical leader is also obvious in Illustration 4 and 5. Steven gives the impression that he wants the pupils to collaborate and that it is good that one of them has first-hand competence, and by virtue of his being the expert, he can help the others (Illustration 4). In Illustration 5 he explains to the pupils why he structures the learning process the way he does. He thinks that they learn more when they work out problems for themselves. His thoughts about learning are also evident when he tells the pupils "then there's just the rest left". All the same, he also gives the pupils clear instructions by marking critical features on what to do when they are about to go outside and do some filming (Illustration 5, sequence 3). In addition Steven gives the pupils positive feedback when they say or do something that he appreciates. In Illustration 6, Steven shows that he actively tries to help the pupils structure their process when he advises them during the planning phase before the filming.

The pupils work actively together, getting help from Steven when needed during the editing process that is illustrated in dialogues 7 and 8. Steven lets the pupils work mostly on their own without interrupting their collaboration processes, but he is always available when the pupils call for him. In this way it seems that Steven thinks that the teacher has to be available during the whole working process. During this editing process Steven also shows the pupils that he has some problems. He cannot give them immediate help, but tells them that he will work on the problem. This indicates that the teacher has to think of himself as an active learner, and that he also dares to communicate this attitude to his pupils.

Sarah gives the pupils some advice on how to use a Power Point presentation in Illustration 9. She tries to make the pupils think of their audience and of what they would like to hear. In this way she gives the pupils a thinking device for how to pick out relevant information. She tells the pupils that they can use keywords to help them in their presentation. In this way she teaches the pupils some learning competence on how to extract relevant information in a learning situation. This illustration also shows that the teacher has to have clear pedagogical intentions when pupils are using tools in their learning processes.

John shows that he is not able to help the pupils with their work on their web page in Illustration 10. He recommends that they ask the deputy head for some help. The teachers at Cooper School have complementary competencies, and John is looked upon as a computer expert (description of Cooper School, The Context, p. 127). During the activity making a

homepage the deputy head is also needed to give the pupils some guidance. This illustration shows that persons in the school community, other than the teachers in the responsible teacher team, can function as advisors in situations where the teacher team does not have enough expertise. John talks to David and Michael (pupils), asking them how their work is progressing in Illustration 11. In this way he finds out how the situation is for the pupils, and John can thus share the same situation definition as the boys. He recognizes that Michael still has some problems. John makes a handout for the next project day containing HTML codes which he thinks can be of assistance to the boys. Because he talked to the boys when they apparently did not have any problems, he understood that it could be beneficial to make a helping device in anticipation of difficulties arising. In this way John was at the cutting edge of problems, something that was also confirmed when David asked for this handout in Illustration 12.

In the described activities the pupils are active participants in various actions when teachers help and guide them through the process in different ways. The activities in this chapter deal with pupils being on task trying to reach partial goals on their way to a result. During these activities the teachers can be looked upon as mediating artefacts in advising dialogues (by using words as a primary artefact), when introducing various physical artefacts to the pupils and when they organize and structure the learning situation in the classroom. Bearing the Activity System in mind, and thinking of the pupil or a pupil group as the acting subject, the teacher as part of the community can function as a mediating artefact for the pupils by giving them help both with physical and psychological tools so that they can reach their goals. In the processes I have described, in their discussion with the pupils, the teachers give them guidance by using various means. The teachers ask questions, give models and demonstrations, instruct the pupils, and provide feedback, cognitive structuring, provocations and prolepsis when the pupils are working on tasks. Furthermore teachers help the pupils by marking critical features, by frustration control, by providing direction of maintenance and by reducing the pupils' freedom. The only scaffolding means the teachers do not use is contingency management. During these tasks the students are on their way to a partial goal and want feedback from the teachers that can guide them further on their way. Contingency management, as described by Tharp and Gallimore (1988), cannot shape new forms of behaviour. The teachers also appear to use feedback instead of contingency management. Feedback is a response that is related to a standard, and this form of guidance can also give the pupils a feeling of whether or not they are on their way to the goal. During the periods of project work the teachers, some more than others, also structure and organize the activities in

a way that also can function as a scaffold for the pupils. Steven, for instance, has clear ideas about how the filming sequence and the learning of the I-movie programme shall be accomplished, and he also shares his ideas with the pupils. These organizing structures can also be contemplated as "rules" for the different actions throughout the project.

In addition to the dialogues and the organization of the activities, the teachers also give the pupils other tools as helping aids. John recommends that the pupils can use books as mediating artefacts. When the pupils at Bridgeford and Cooper Schools are searching for information on the Internet, they are given handouts with URL addresses (Cooper), they learn search strategies (Cooper) and they can use the school's homepage to find links that are relevant for their work (Bridgeford). Sarah has also searched for information on the web to be prepared to give the pupils URL addresses that can be of interest. The pupils at these two schools have also learned strategies for how to work out the material they found on the web. When the pupils at Applebee School learn to use the I-movie programme, they are given written instructive tasks to guide them during their work. When Michael and David at Cooper School are working on their homepage, they are given a handout with HTML codes to help them, and the deputy head at the school also give them some help. The pupils at Bridgeford School also learn how a Power Point presentation can be a useful tool for presentations.

The teachers in the observed teacher teams are the main teachers for the observed classes. The teachers in all three schools think that a qualification for a team to function well is that they have complementary competencies, and that they are different kinds of people (descriptions of Applebee, Bridgeford and Cooper Schools, The Context p. 85, p. 107, p. 127). When teachers have different strengths, they can also divide the various parts of the work between themselves. John helps the pupils when they use ICT as a mediating artefact. He finds that his competence is not enough, and he therefore advises the pupils to ask the deputy head for some help. This example shows that it is important to use the competence available in the whole school community to help the pupils reach their goals. Before a project period starts up at a school, it could therefore be useful to find out what expertise there is at this particular school and how this can be used. The scaffolding processes at Applebee, Bridgeford and Cooper Schools when the pupils are preparing and working on tasks can be presented in the Activity System as below.

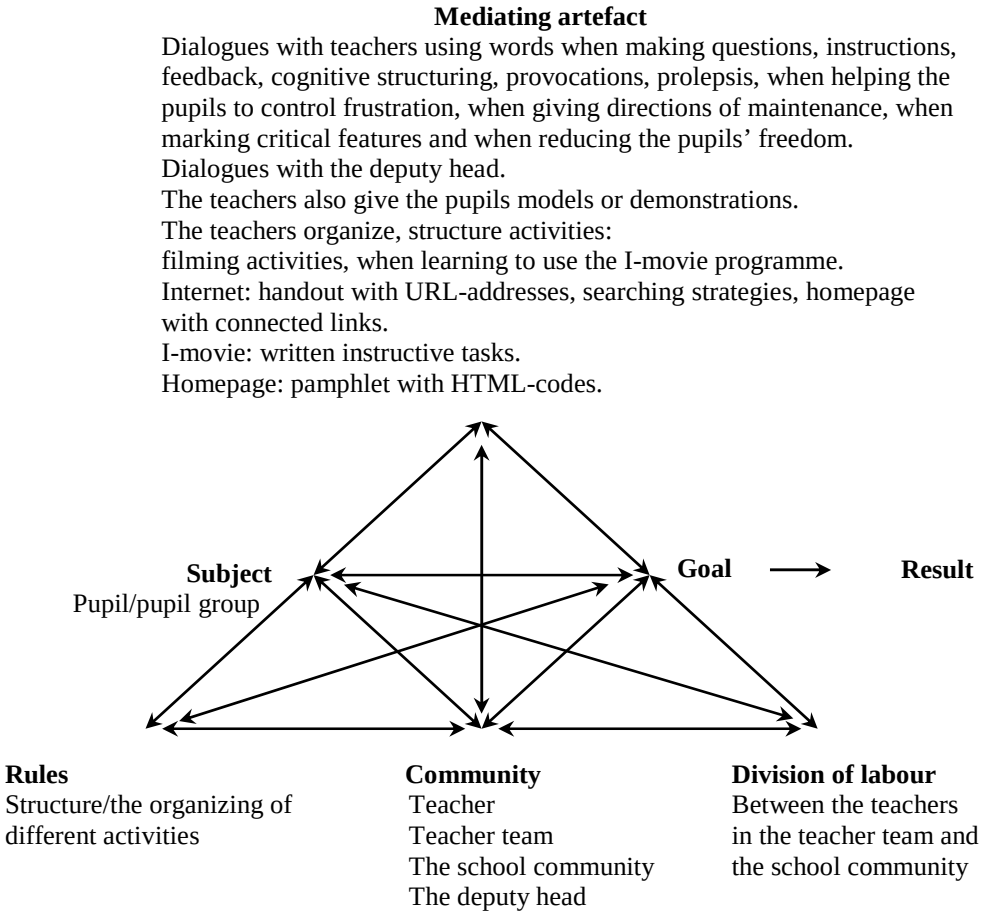

Figure 12: Scaffolding processes visualized in the Activity System

The assistor has to take two factors into consideration when scaffolding a child. The assistor has to have a theory about the task or problem and about the performance qualities of the pupil (Wood et al. 1976). Teachers also need to know about different ways of scaffolding pupils (Tharp & Gallimore 1988). This does not appear to be sufficient when scaffolding pupils who are using computers during project work, where the pupils are looked upon as active, constructing their own knowledge in social interplay. This means that the teacher's ways of helping the pupils must coincide with an epistemology of social constructivism. Guiding pupils when they are using ICT as a mediating artefact also implies that the teacher is familiar with this tool. The computer is not as a simple tool as an overhead projector or a book the pupils intend to use. When you open a book you know how to leaf through it and you can gain an overview of the contents in fairly quick order. The computer is a far different case. It is not just using the computer as a machine, but also all the possible ways of using the software. Teachers have to help the pupils when they surf for information. The amount of information is also so enormous that it is difficult to gain an overview of it. The pupils may

use different software programmes that the teacher will need to know how to use, he or she will have to know how to write, send and receive e-mail and about different ways of using the computer as a presentation tool, to mention just a few ways of using ICT. This means that the help the teacher can give the pupils also depends on the performance qualities of the teacher. It is not enough to know about the problem or task, the performance qualities of the pupils and ways of scaffolding. The teachers must also be familiar with ICT as a tool to give pupils satisfactory guidance. This means that the ICT tool offers a range of possibilities, but at the same time it places great demands on the teacher. Even though the dialogues in this chapter illustrate the teachers' guidance on tasks, the presented illustrations do not show the teachers controlling the pupils' activity at the micro level. The teachers also try to organize the learning environment so that this will also structure and help the pupils during their work. This means that the teachers emphasize self-regulation while also seeing the environment, with themselves as a prominent aspect, as a decisive factor for creating such regulated pupils. The next chapter deals with how pupils also can help each other throughout the working processes.

Chapter 9
Pupil Collaboration

One of the effects of computers is that they have fuelled the interest in collaborative learning among developmental psychologists. The benefits of group work have been advocated long before the computer was introduced into classrooms, but the computer has made pupil interaction more visible, and the situation with pupils seated around the computer has become an attractive focus of research on collaboration. By studying collaborative settings such as this, the researcher will grasp what the pupils talk about in this restrictive situation. At the same time, the pupils' experiences and the school and classroom culture are not necessarily taken into consideration when studying pupil interaction in front of the computer screen. Often, the conversations in connection with the use of ICT equipment are not understood with any reference to the broader social context. It is argued that the productivity of interactions within ICT activities is created in situations outside them, in circumstances that comprise a broader social context (Crook 1999).

Various terms are used to talk about different ways to look upon learners and their collaborative interaction: interaction "at", "around" "through" and "in relation to" computers. Interaction at computers means two or more learners collaborating by using the computer to solve a problem together. Interaction around computers means that a loosely-knit group of people are sharing workstations placed in the same room. The conversations between them are casual and impoverished as a consequence of both the social and physical setting. Interactions through computers are made possible when the social organisation is asynchronous, meaning that partners are separated in both time and place. The final type of interaction, in relation to, means that interaction may occur after the learners have used the computer. The computer then mediates interaction that is not dependent on current interaction with the technical equipment, rather the learners talk about experiences that were previously shared at the computer (Crook 1994, 1999).

In the dialogues I present in this chapter, we find both "interaction at" and "in relation to" computers.[44] The broader context in which the illustrations below take place is found in the description of each school, and this context will also play a part in the analysis of these

[44] I understand the term interaction to include collaborative activities that can be conducted both with and without the use of language. In this chapter the focus is mostly on dialogues and thus on conversational processes.

dialogues. Interactions can only be fully understood within the context of the institutional setting (Littleton & Häkkinen 1999). This is because institutional settings may both afford and constrain opportunities for interaction. The particular setting in which the dialogues take place will also be described in the introduction to each dialogue. Even though most of the conversations take place in front of the computer screen, the experiences the pupils bring with them to this activity will affect the dialogues, at the same times as these dialogues will also play a part in future experiences. Future actions will also be affected by the experiences at the computer if teachers organize common talk that can bring these experiences into focus.[45]

An important issue when examining the pupils' collaboration is the relation between language use in front of computers and language use in similar situations off computers. As mentioned earlier in connection with relateded research on ICT, (p. 44), some studies show that language use is sustained during computer work (Hill & Browne 1988, Shooter et al. 1993). The question one then may ask is if the talk between the pupils in front of the computer screen is the same as in other similar situations, and if not, what talk is mediated in these settings.

Theoretical Framework

Collaboration

The focus of Vygotsky's studies was for the most part adult-child dyads (Wersch 1991). Even though he mentioned in his definition of the concept zone of proximal development (ZPD) that more capable peers can help other individuals in their problem solving, it appears that in his research he did not address the idea that development can be a social and dialogical construct. His focus was on the individuals receiving help either from an adult or a more capable peer, and what they were learning (Vygotsky 1978). Bakhtin, on the other hand, believed that everything is in a dialogue or in relation to something else, and that meaning is created in the relation between an utterance and the reply to it, that is to say that individuals are "co-beings". Thus meaning is developed both for the individual and for others in a shared social experience (Bakhtin in Volosinov 1973, Bakhtin 1981, Holquist 1990). Hence, all the participants are developing, not just individuals who receive help in their ZPD. Vygotsky's concepts are taken further to explain what happens in collaborative situations in which

[45] In the next chapter, "Shared Knowledge", I will present and analyse dialogues in relation to experienced actions with computers and other ICT equipment.

collaborators think together. Wegerif and Mercer (1997) claim that Vygotsky treats language as a mediating artefact in individuals' learning and development. While remaining within the broad socio-cultural paradigm, they follow Bakhtin's concepts that claim that no utterance can have a meaning in itself, and that meaning is created in dialogues that include and interanimate different voices and different perspectives. In this way they think of language as a means of attaining a joint intellectual activity, and thus language can be defined as a social mode of thinking (Mercer 1995, Mercer & Wegerif 1999). A socio-cultural perspective on collaborative learning focuses on the quality of the observed talk and the mediation of meaning in the processes (Mercer 1996). The discussions during collaborative work may enhance learning in various ways. Ideas and concepts can be clarified through articulation and discussion because the learners are able to draw upon the rich potential of each other's ideas and perspectives. When learners express their ideas and views, they have the opportunity to compare their own ideas with their classmates. In this way they might then develop their thought and understanding by using language in collaboration with other peers (Vygotsky 1986/2000, Holquist 1990). When the pupils talk to each other they also need to take into account the other persons, what they know and do not know. In this way the communication process becomes an activity in which mutual knowledge can be established (Bakhtin 1981, Holquist 1990).

There are three features of social action that are important if a successful collaboration is to be created. The first feature is that the pupils have to have a communal purpose. The collaborators have to have some experiences and understandings in common, and thus share the same situation definition and know that this state of mutuality exists (see Chapter 8, p. 160). The second feature is that collaborations are likely to depend upon the quality of the relationship between the participants that has already been established before the collaboration process commences (Crook 1998). Friendship is looked upon as an important factor that enhances the collaboration processes (Azmitia & Montgomery 1993). The third feature is that the chances of productive collaborative situations being created, are likely to be improved by the resources the context supplies. New technology, and thus computers, can optimise the chances to establish an environment that creates good collaborative situations (Crook 1998).

Computers in schools are mostly used by pairs or small groups of pupils rather than by individuals (Wegerif & Schrimshaw 1997). This pattern is probably shaped by resource constraints (Jackson et al. 1988, McMahon 1990, Blaye et al. 1992, Hoyles et al. 1994, Fitzpatrick & Hardman 2000), but it is also obvious that teachers feel that interacting pupils

using computers as a mediating artefact is a productive way of learning (Light & Littleton 1999). It is a widely held belief that the clearest benefits of classroom computer use are shaped by the collaborative modes of using the ICT equipment (Crook 1994). When using computers, many forms of collaboration are also possible (Underwood & Underwood 1999). The pupils can work on an exercise in front of the computer screen and come to an agreement on how this exercise could be solved. On the other hand, the computer could be just one of the artefacts the pupils agree to use when solving a task. Technology may enhance education by helping to reach traditional goals in both mathematics and science more efficiently (Pea 1993), but technology can also shift the goals of education (Walker in press), as has been shown by the use of the calculator. The calculator has shifted the focus away from the mechanics of the arithmetic operations themselves and onto the meaning of operations. Co-operative[46] work with technology can also create new goals for the education process. For example, rather than writing an individual essay for the teacher, pupils may make a multi-media presentation involving graphics, sound and text (Underwood & Underwood 1999).

The effects of having a partner or partners may be considered on a number of levels (Light 1993). Partners may make the task more fun, or less threatening. The pupils might also pick up ideas from each other, and also help each other to remember things. In addition, arguments and also just talking about the problem might help pupils to think more clearly. Arjava et al. (2000) summarize the effects of collaborative work in a Vygotskian soundboard and state that such work settings help students to “discover, construct and become aware of their thinking processes" (p. 456).

As implied, language is a central mediating artefact in the pupils' knowledge construction in collaborative settings. Below I present methods that give directions for how dialogues in collaborating pupil groups can be analysed. We find methods that have predetermined codes that do not take the collaborative setting into consideration. There are methods that analyse language use at different levels that also bring into focus the context and the mode in which the pupils meet each other in the particular setting that is analysed.

[46] Underwood and Underwood (1999) distinguish between co-operative and collaborative learning: Co-operative learning refers to leaning environments in which small groups of pupils work together to achieve a common goal. In achieving this goal the pupils may take responsibility for each their own sub-task to reach their common goal. If they collaborate, the pupils work together on all parts of the problem. I also use this definition. In the processes I describe from the observed project periods, the pupils work on sub-tasks to reach their common goal, that is to find an answer to their thesis question, and thus they work co-operatively. In this chapter I describe actions in which the pupils for the most part work together on all parts of the problem. I therefore name these working processes “pupil collaboration”.

Analysing Data Using Predetermined Codes

Various methods have been used to analyse talk and interaction. One way to do this is to categorise the data according to predetermined codes. The number of categories varies according to the focus of the research study (Mercer & Wegerif 1999). A study of collaborative learning conducted by Teasley (1995) is an example of this method. Each utterance by the children was attributed to one of fourteen mutually exclusive categories. A count of categories of talk in each group was correlated with the outcome measures. This was done to find out which of the utterances were promoting effective learning. In other research, measures of the length of the utterances, as well as pragmatic functional categories, have been used to investigate variables that can affect the success of collaborations in connection with computers (King 1989).

However, the use of coding methods in the study of talk has been seriously criticized (Mercer & Wegerif 1999). There are several problems that coding methods encounter when applied to language in use. First, utterances are often ambiguous, so that the coding work will be difficult. Second, utterances often have multiple functions and they are often not recognized by coding schemes. Third, the phenomena that are of interest may be spread over several utterances. In this way no coding scheme based on single utterances as the unit of analysis will capture such phenomena. Finally, meaning will also change during the ongoing conversation (Draper & Anderson 1991). Coding methods may show a statistical relationship between two events, that event B generally follows from event A, but this method is not sensitive to context and to the temporal development of shared meanings between collaborators. Webb, Ender and Lewis (1986) observed a group of pupils from eleven to fourteen years of age who were taking a basic course in programming. All the pupils worked in pairs, but were individually tested at the end of their work. The researcher found that pupils who could give and receive explanations, who received answers to questions and verbalized aloud when typing at the keyboard, were the ones who scored best on the programming test at the end of the course. On the other hand, the mentioned categories did not capture the interaction between the pupils because the researcher only counted how many of these utterances each pupil received or produced.

The methods described in the text below that serve as tools for analyzing the collected and transcribed dialogues are based on detailed classroom observation and interviews with teachers, which means that the processes are studied in a naturalistic way.

Tools for Analysing Dialogues in Naturalistic Studies

There are various levels of collaboration both at the discourse and the action level. Analyses of these levels not only give indications of successful task performances, they may also help us to understand the processes by which dialogues facilitate the group's solutions of the tasks. Bales (1950) has developed an Interaction Analysis schedule that breaks discussions between children into four main types. This schedule has been developed for pupils collaborating away from computers. The types are: group agreement, offers suggestions/answers, asks for suggestions/answers and group disagreement. Within each of these four main categories we also find three subtypes, so that there are altogether twelve possible statement categories. These statements are:

(A) Positive socio-emotional comments:

(A1)-shows solidarity (e.g. offers a reward, raises status of others, gives help, rewards)
(A2)-shows release of tension (e.g. jokes, laughs, shows satisfaction)
(A3)-agrees (e.g. shows passive acceptance, understands, concurs, complies)

(B) Task-specific help

(B1)-gives a suggestion (e.g. direction, implying autonomy for others)
(B2)-gives an opinion (e.g. evaluation, analysis, expresses feelings, wishes)
(B3)-gives orientation (e.g. information, repeats, clarifies, confirms)

(C) Task-specific requests

(C1)-asks for orientation (e.g. requests information, repetition and confirmation)
(C2)-asks for opinion (e.g. requests an evaluation, analysis, expression of feeling)
(C3)-asks for a suggestion (e.g. requests possible ways of acting, direction)

(D) Negative socio-emotional comments

(D1)-disagrees (e.g. shows passive rejection, withholds resources)
(D2)-shows tension (e.g. withdraws from field)
(D3)-shows antagonism (e.g. deflates others' status, defends or asserts self)
(Bales 1950, p. 177-195).[47]

These speech acts show that Bales did not treat each sentence as an analysing unit, but in much the same way as Bakhtin (Bakhtin in Volosinov 1973, Bakhtin 1981, Holquist 1990) he claimed that an utterance had to be treated in relation to other utterances and to the context the talk takes place in.

[47] The letter and number combinations (example A1) are used in the analyses of the dialogues to distinguish between the various statement categories.

Language is as mentioned, described as a social mode of thinking (Mercer 1995, Mercer & Wegerif 1999). When studying children working together with the computer as a mediating artefact, Mercer (1995) has also typified three distinct types of talk. These types of talk represent ways in which pupils orient themselves to each other during conversation. Each type of talk represents a way pupils in dialogues can engage in the joint construction of knowledge (Wegerif & Mercer 1997). These types of talk are: “disputational talk”, “cumulative talk” and “exploratory talk” (Mercer 1995).

Disputational talk is characterised by disagreement and individualized decision making. Pupils that use such a type of talk seldom offer constructive criticism of suggestions or try to pool resources. Some characteristic features of this type of talk are short exchanges that consist of assertions and challenges or counter-assertions. Participants in disputational talk treat interaction as a competitive game in which all participants have their own interest and which everyone tries to win. What each individual says is motivated by the desire to defend or promote one's own interests and to compete with the others. Cumulative talk is a mode of talking in which speakers build positively but uncritically on what the other has said. During discourse, partners construct common knowledge through a process of accumulation. The cumulative discourse mode is characterised by repetitions, confirmations and elaborations. During cumulative talk group harmony is pursued instead of such issues as personal ownership or the development of ideas. Exploratory talk is talk in which partners engage critically but also constructively with each other’s ideas. In this mode of talk statements and suggestions are jointly considered. These statements or suggestions may be challenged and counter-challenged, but the challenges are justified and other alternative hypotheses are presented. Exploratory talk can lead to competition between ideas instead of between people, that is, finding the argument that is considered to be the best, with it winning over the other arguments. In this mode of talk knowledge is made more publicly accountable and the reasoning is more visible in exploratory talk that in both disputational and cumulative talk (Mercer 1995, Wegerif & Mercer 1997).

As mentioned above, types of talk may be distinguished by the ways participants in a dialogue orientate themselves towards each other. This means that collaborators in conversations may use different “ground rules” to select what speech acts they will use. Cultural norms and experiences will help pupils in their choice of what to say. In schools, pupils will learn that there are norms for how language can be used to construct knowledge (Wegerif & Mercer 1997). The cultural norms thus help the pupils and teachers to make up the “ground rules” in the classroom. It is not the intention to separate all the observed speech

into three categories based on disputational, cumulative and exploratory talk, because language is inevitably resistant to neat categorization (Mercer & Wegerif 1999). All the same, the three types of talk make up analytical categories that can be used as a frame of reference for understanding talk among school children and how they think together when they collaborate.

Explorative talk is used to describe a communicative process for reasoning through talk in contexts in which participants take part in joint activity. The persons who take part in explorative talk offer reasons for assertions and expect reasons from others as they work towards their common goal. When pupils use explorative talk as a mode of talk, the proposal best supported by reasons is likely to be the most accepted by the group members. It is therefore important that all participants recognize each other's rights to participate and also respect each other's statements. This means that such a mode of talk has implications for the social order in the collaborative group. Furthermore, exploratory talk is characterised by critical thinking, and it is therefore essential for people to successfully participate in educated communities of discourse. There is more to participating in educated discourse than using talk in an exploratory way, but all the same, this mode of talk is important (Mercer & Wegerif 1999). Littleton, Light, Messer, Joiner and Barnes (1992) and Light and Littleton (1994) have found that symmetrical pairs of groups reason better together and also produce better results than asymmetrical groups. Friendship is also stated as being an important factor that supports explicit reasoning in groups (Azmitia & Montgomery 1993). Teachers have to simulate a situation of symmetry when they model and coach exploratory talk in the classroom (Mercer & Wegerif 1999). It is also argued that the ground rules for rational debate must be based on mutual respect and equal rights to participate (Habermas 1984, Rorty 1991). Wegerif and Mercer (1996) argue that this could be a factor that helps to explain the results of the studies of collaborative activity as reported by Littleton et al. (1992), Light & Littleton (1994) and Azmitia and Montgomery (1993).

To capture the nature of the types of talk, they have also been analysed at four different levels. At level one the focus is on talk as a social mode of thinking and how participants in a dialogue orientate themselves towards each other in the joint construction of knowledge. At level two the focus is on the ground rules that govern the production of appropriate utterances, which means speech acts that are suitable in various situations. At level three the attention is on the specific speech acts or utterances and their function in their apparent context. At level four the actual, particular words that are recorded and transcribed are considered (Mercer & Wegerif 1999).

As mentioned above, Bales (1950) has developed an Interaction Analysis Schedule that divides discussions between pupils into four main types. The Bales (1950) Analysis Schedule can, in my opinion, be looked upon as a corresponding scheme to the third level described by Mercer and Wegerif (1999), dealing with speech acts and their function in their apparent context. In Bales' Interaction Analysis Schedule we can say that speech acts are defined by four levels, with three subtypes for each of them. These twelve types of language use can thus be of help when we are focusing our analyses on level three, speech acts, as defined by Mercer and Wegerif (1999). Furthermore, Bales' main categories are also comparable with the three types of talk developed by Mercer (1995). The negative socio-emotional comments are speech acts that can be used during the disputational mode of talk. Positive socio-emotional comments are speech acts likely to be used during the cumulative mode of talk, whereas both task-specific help and requests represent speech acts that are well-suited when pupils orientate themselves to each other in both cumulative and exploratory modes of talk. When pupils give an opinion, they probably also will reason and argue for their ideas. Thus it is the B2-statements (see p. 200) that most obviously can be followed up with an argumentation.

The basic structure for classroom discourse is postulated as having the form I-R-F (or I-R-E), which stands for Initiation by the teacher, Response by the pupil and Feedback or Evaluation from the teacher (Sinclair & Coulthard 1975). This is a communication feature that is representative when education is teacher directed, which means that the teacher directly shapes and controls the pupils' learning (Edwards & Mercer 1987, Mercer 1995). Some interaction with computers can be compared to the communication processes between teachers and pupils in the traditional manner (Crook 1994). The argument that some discussion between pupils on what to do is necessary before they press a key when responding to computer initations (Fisher 1992), led Wegerif (1997) and Mercer and Wegerif (1999) to develop the traditional communication feature. They developed the structure I-D-R-F, which stands for Initiation by the computer, Discussion between the pupils, Response by the pupils acting together and Follow-up by the computer. This structure combines the traditional I-R-F structure and a structure that gives the pupils much more freedom to direct their own process. When the pupils discuss, they are active participants in a group that finds answers they want to test on the computer. In this case the computer is reduced to a passive element in the learning environment and thus it acquires the role pupils play in the traditional education genre. This means that the teacher has to find software programmes that have the potential to create pupil interaction.

Exploratory talk between children in groups is most prominent when teachers teach pupils effective ways of talking away from computers at the same time as they are given the opportunity to use software programmes that encourage discussions (Mercer 1994). This also means that the input of teachers is important for pupil discussions in front of computer screens. Other research studies support the finding that the most effective ways of using computers in the learning processes in school are through classroom activities that integrate an instructional and supportive involvement of the teacher, and through a software programme that elicits discussions and gets the pupils to work together without the constant supervision of the teacher (Crook 1994, Light & Littleton 1994, Mercer & Wegerif 1999). The pupils need to have conversation partners, technology will never replace the need of learners to take part in conversations about shared interests and commitments. Technology will not replace such a communication, but rather become a resource that supports it (Säljø 1999).

It is developed descriptions of levels of discourse (Packer 1985) and co-operation (Parton 1932) away from computers. Discourse practices can be differentiated into three modes: the practical, the reflective, and the theoretical. The most basic mode is the practical or ready-to-hand mode. A group of pupils are, for example, filming their school, and they are all helping so that the group can finish their activity. The reflective mode or unready-to-hand mode occurs when a problem arises. This could be disagreement about the appropriate course of action in an activity. The pupils may, for example, disagree as to whether they should use the tripod or not when filming a sequence. This problem can be solved by one pupil explaining his definite opinion and why he has this opinion. If the other pupils in the group accept this pupil's reasoning, they return to the practical mode. The theoretical mode, or present-at-hand mode, as Packer calls it, occurs when people detach themselves from the ongoing practical activity to use general and abstract tools, such as logic, to solve a problem (Packer 1985). In the mode of talk which Mercer (1995) calls exploratory talk, reasoning is looked upon as a social process of thinking. Much that is meant by cognitive development can be looked upon as learning how to participate in exploratory talk, in other words to reason together with others. Thus knowledge is not something that is just stored in the brain, but something that can be used in social activity (Wegerif & Mercer 1996).

It is evident that the reflective mode presented by Packer (1985) coincides with exploratory talk. In both the reflective mode and in exploratory talk, arguments or reasons for a statement are important. This happens when people disagree about solutions or ways of solving a problem. Packer describes the practical mode as the kind of talk used when

individuals are working on a joint task. Mercer (1995) divides this mode into two parts which he calls disputational and cumulative talk, with disputational talk representing disagreement and cumulative talk agreement. The theoretical mode presented by Packer, the one which detaches talk from practical actions, is absent in Mercer's categorization of language. As his three modes of talk represent talk when pupils collaborate in front of the computer screen, they are not separated from practical activity.

The concept "in relation to" relates to conversations after the pupils have accomplished tasks "at" the computer (Crook 1994, 1999). This means that this conversation is not separated from the practical activities the pupils have just accomplished, but comprises reflections on these actions. In this way there is an interaction between mind and world, which is the epistemological view of social constructivist theory in which knowledge is not conceived of as abstract and logical, but closely related to social activities. The educationalist cognate of rationality is to assess reasons and their ability to justify claims that can be defined as critical thinking (Siegel 1988). It is unsuitable to describe educated discourse as abstract and decontextualized because this draws attention from the historical, cultural context which generates and sustains such discourses (Wegerif & Mercer 1996).

The Interaction Analysis Schedule developed by Bales (1950) and Mercer's (1995) and Packer's (1985) modes of talk deal with language as a collaboration tool. Parton (1932) has studied procedural interaction and found that this also can be identified at three levels. These levels are the parallel, the associative and the co-operative level. These approaches represent three qualitatively different approaches to the sharing of ideas and the division of labour. During parallel procedural interactions, pupils share materials and exchange comments about the task. Nevertheless, they make few if any attempts to monitor the work of the others or to inform the others of their own thoughts and actions. It could be said that the pupils are acting beside rather than with the other pupils. During the associative procedural level there is an overt recognition by the group members of their common activity, and the conversation also concerns this activity. The pupils try to exchange information about some of the actions or plans each one has selected. However, at this level no attempt is made to co-ordinate the roles of the two partners, and thus there is no division of labour. When pupils move to the co-operative level, they constantly monitor each other's work and play co-ordinated roles in performing the task procedures. Thus there is a division of labour between the group members.

Talk is not the main focus in Parton's (1932) levels. Rather he focuses more on how the group members act in relation to other individuals and how they orientate themselves in

accordance to the others. Under the definition of the associative level he also examines talk and mentions that conversation at this level is also about the common activity. It seems that although Parton is interested in how groups work, he is also focused on the language the pupils use during the activity. On the associative level of interaction, individuals may encounter each other in a disputational, a cumulative and an exploratory mode of talk, and thus also at the practical and reflective level. These concepts are developed from situations when pupils collaborate (Packer 1985, Mercer 1995), which means that they are expected to work on all parts of the problem together and not on each their sub-task during their work. During the associative level the group members are aware of their joint activity, and these terms can therefore also be used in connection with this level. Figure 13 below compares Bales' (1950) Interaction Analysis Schedule, Mercer's (1995) and Packer's (1985) modes of talk and Parton's (1932) theory of procedural interaction. It also shows how these theories are related to each other.

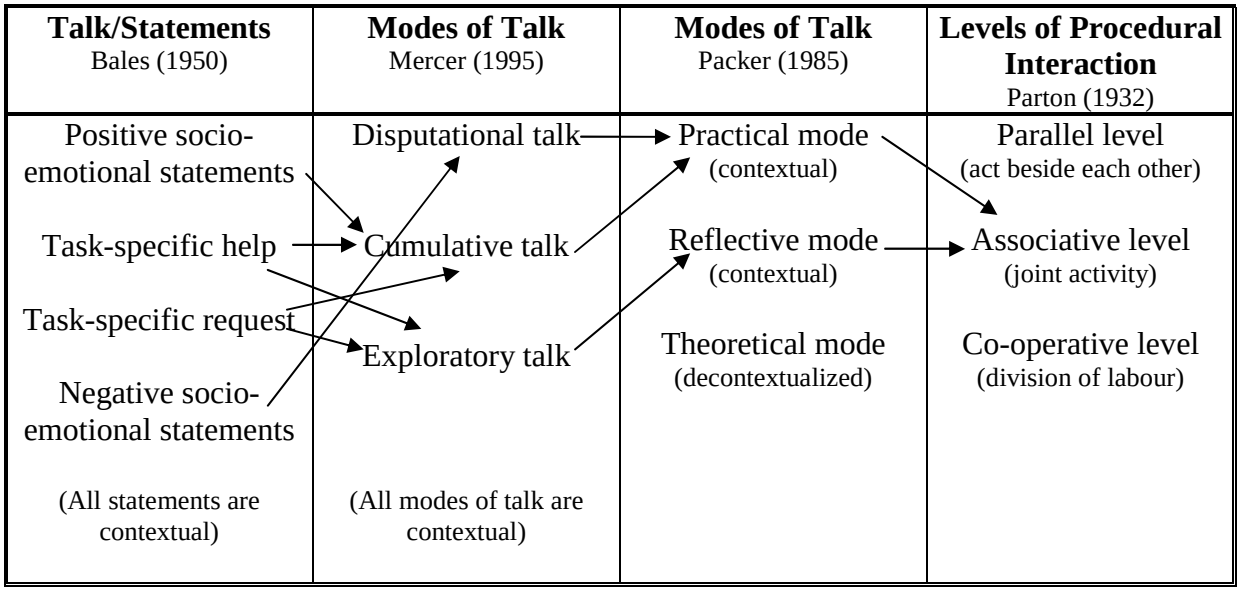

Figure 13: An illustation of Bales' (1950) Interaction Analysis Schedule, Mercer's (1995) and Packer's (1985) modes of talk and Parton's (1932) theory of procedural interaction, showing the relation between them

Teachers have to take advantage of the experiences the pupils bring with them to school. Pupils come to school with an existing repertoire of discursive capabilities. It is the task of the teachers to let the pupils use their repertoire for school purposes (Crook 1999). Such a practice coincides with the philosophy of project work that brings the pupils' experiences and interests into focus. Dewey (1902, 1916, 1938) also emphasised the interaction between the knowledge developed by the older generation and thus the goals of

the curriculum and the interests or internal states of the pupils. A challenge for the educational practice is then to create continuities between the issues that interest pupils when they enter the classroom and the tasks teachers want them to reason together about in the classroom. In this way continuities in learners' experiences have the possibility of being exploited. Collaboration thus makes the pupils mobilise their natural capacity for building joint knowledge in the group which is directed towards a purpose that is defined by the educational setting (Crook 1999).

Review of Results from the SLANT Project[48]

In this section I present research that has focused on talk when pupils work together in connection with computers. Phillips and Scrimshaw (1997) have paid attention to talk around adventure games called Concept Kate, Wizard Revenge and Viking England. Adventure games usually present a fantasy world, but we also find games that simulate realistic situations, though very simplified. Playing the game in this world the children can decide where to go and what to do. In the Concept Kate game, one of the games in the Concept Kingdom series, the children have to help the eponymous Kate escape from the country in which she is trapped. She has to travel over hazardous terrain collecting helpful items along the way. The problems the pupils have to solve are the sudden threats Kate encounters during her endeavours. The pupils can decide which of the roads they think is best for Kate to take, but they cannot plan what route they will help her through because the players do not know anything about the potential threats that might arise along the way. Phillips and Scrimshaw found that the talk consisted primarily of imperatives that would lead to action that solved the immediate problems. Thus the constructed conversation consisted of short and easily identifiable exchanges. The conversation between the pupils was primarily structured by quickly closing instruction exchanges. They concluded that the majority of the discourse was characterised by short exchanges and repeated closure, and that exploratory talk was almost completely absent. During the game, the pupils' talk is often centred on the physical mechanics of pressing keys.

The game called Wizard's Revenge is also an adventure game involving a quest and a journey through a strange landscape that is inhabited by gnomes and witches. The various

[48] The research studies that are referred to here have been undertaken in the SLANT (the Spoken Language and New Technology) project. This project looked at how primary school children in twelve schools in south-east England talked and worked together at the computer. These were naturalistic studies in which researchers collected the data material by observing and recording the talk of the groups of children engaged in activities at the computer (Wegerif & Scrimshaw 1997).

locations are linked to the function keys so that to move to a new location the pupils have to press another key. However, not all the locations are connected to each other. Often the pupils are not allowed into a new location because they need to have been somewhere else first, or they have to solve a specific problem before they can continue to this new location. This programme requires some holistic planning, but the pupils in the study did not discuss this in the observed session. Instead the language is broken down into a number of discrete sequences rather similar to the extracts of talk when pupils played with the Concept Kate game. The talk contains short exchanges, but the children do not refer explicitly to the physical mechanics of key pressing to the same degree as the talk during the Concept Kate game did. This is probably because they are more familiar with the programme, and thus they concentrate more on the problem itself. In this game the pupils also offer individual solutions to the shared problem, which means that exploratory talk was completely absent.

Viking England is a different type of game that attempts to create an imagined reality based on other times, places or cultures. This programme is as open-ended as possible, the only constraint being that all subsequent decisions are contingent upon the first one. The programme offers the players the opportunity to explain why they make their choices and to enter this into the game. When playing this game, the pupils need to undertake holistic planning, first, because they need to decide what choices they will make because the choices are contingent on their actions, and the pupils thus need to think of what the outcome might be. Second, as the story develops it also creates a more complex context for the events that take place later in the narrative. Thus the pupils have to plan well ahead, and therefore they also have reasons for explaining their choices to each other. The game also provides some scaffolding for the pupils by presenting the children a visual version of the whole that can be a map of the territory. The pupils thus have the possibility of moving back and forth between the immediate situation and the overall context. In this way the players may also consider alternatives before performing the action. After the players have considered a special course of action, the programme also raises questions that may have to be reflected on if that option is proceeded with. In this way the pupils have the opportunity to consider alternatives. On the screen the pupils can read phrases containing words such as “possible courses of action” and “preference”, modalities such as “might” and “seem”, and the programme may ask for “reasons”. The “world” in the Viking England game is fully contextualised both visually and textually. The game also invites the pupils to undertake strategic planning, and this game emphasises decision-making rather than decision-taking processes. As different actions also lead to different consequences, the game provides a motivation for collaborative discourse.

Studies of pupils using this game also show that their talk is exploratory, with emphasis on planning and reflection upon the possible outcomes their choices might have. This shows that programme structure may be an important determinant for the talk that is created among the collaborators when working on the programme.

It is argued that the discourse that accompanies highly structured programmes conforms well to the I-R-F structure (Sinclair & Coulthard 1975). The programmes then direct the pupils' actions in the same way as teachers in a traditional classroom. Discourse that is created by more open-ended software is more varied, and the pupils rather than the computer take the initiating role. The I-R-F structure is very useful to describe the talk when pupils use "closed" or directive programmes such as adventure games.[49] When pupils use an open-ended software programme like paintspa, which they can use to make drawings, the computer only has a minimal role in transforming what they do, and the pupils can move from disputational to a cumulative mode of talk (Fisher 1997).

Analyses have been done of a study of pupils using a story-writing programme called Mystery Island. This programme offers the pupils a series of ten pictures outlined, to which they can add characters and objects. The pupils are required to write a text in a story-form with the help of these pictures. When analysing the pupils' talk as they use this programme, it is found that they use both cumulative and exploratory talk. It is concluded that when the computer's role is confined to a direct, non-transformational response to the pupil's input and thus to a more restricted role, the context in which exploratory talk can occur is provided. Both the structure of the programme and the nature of the task for which the software is being used will also play a crucial role. This also means that the teacher has an important role, both in making the tasks for the pupils and in his or her choice of software made available to them (Fisher 1997).

Analyses has also been done of a study in which pupils were using a word processor (PenDown) and a task set written on a sheet of paper by their teacher. The activity in the task, entitled "Pioneers", was to describe moving to a new town. It was found that in addition to cumulative and exploratory talk, the pupils used a mode of talk that they called "tutorial talk". In this mode of talk the relationship between the pupils is not seen as an equal one because one of the pupils is accepted as an expert relative to the others. In this mode of talk one of the

[49] Fisher (1997) argued that directive programmes such as adventure games make contexts for restricted opportunities for exploratory talk between the pupils. Wegerif (1997) used a quantitative study that found that the Viking England game created much more exploratory talk than was expected of such games. The Viking England game was introduced to the pupils after they had been taught oral skills by the teacher. The hypothesis proposed by Fisher, that directive software limited discussion, was expressed before the experiences with the Viking England game shifted the focus from the role of the software to the role of the teaching.

pupils assumes the role of a tutor and directs and corrects the work of the others. At the outset, tutorial talk does not seem to fit disputational, cumulative and exploratory talk because in these modes of talk the pupils are perceived as having equality of status and of assumed knowledge. In tutorial talk, on the other hand, there may be a pupil variant of teacher talk that can range from directive and expository forms to scaffolding adapted to the understanding of the learner (Scrimshaw & Perkins 1997).

Bearing in mind the SLANT–project findings, it is claimed that the expectations of the pupils are the most important factor and that they lead the children to adopt a particular style of interaction. The most effective way teachers can plan for the expectations of the pupils is to set up situations in which they can exercise with co-operative and exploratory styles of work before they start to use the computer. Mastering of complex interfaces is a common problem when using open-ended software. Such a problem may also cause the pupils to focus more on mechnical, procedural matters rather than on task interpretation.[50] In this way the interface is a hindrance to the pupils' activity with the task (Wegerif 1997). Results from the SLANT-project studies also show that teachers have to discourage the pupils from taking decisions in turn, physical turn-taking, because such an arrangement may hinder the talk between the pupils. The problems the pupils are going to solve should be both complex and holistic. This means that the decisions the pupils are making will have consequences not just for the next step in their activity, but also for the process as a whole. Pupils will always work together with expectations of how to proceed. These expectations may be shaped, among other things, by the climate of the classroom, which is the main factor that can form the foundation for the pupils' assumptions (Wegerif 1997).

In the text below, I present dialogues between the pupils when they search for information, when they learn to use a new computer programme, when they use external equipment and when they make presentations. I will start with a dialogue that take place when two pupils are sitting in front of the computer screen trying to collect information on the Internet.

[50] In this text I distinguish between mechanical procedures and procedures or strategies the pupils use to solve a task. The procedures the pupils use when solving a task may include the information sources the pupils choose to use, and how they decide to collect the data material (methodological competence).

Illustrations of Pupil Collaboration Processes in Activities Using ICT

Information Searching, at the Computer

Jenny and Harry (pupils) at Bridgeford School are sitting together in front of a computer trying to find some information about national dishes, which was the topic for their project. Just before this activity, Jenny, Harry and Lisa (pupils) have tried to find national dishes and recipes in books. At that moment another pupil Ron is searching the Internet trying to find information that will be useful for the group's topic, but he fails to find anything. Now they all want to give it a try. Lisa has found a place together with Ron, and these two pupils are sitting beside Jenny and Harry in the computer corner where each pair of pupils has a computer. Ron starts the dialogue.

Illustration 1

(1) Ron:	*Nothing's possible here. That's strange. Everything about meat, frequently asked questions (reads by himself from the computer screen). Wasn't it national dishes we were supposed to find out about?*
(2) Lisa:	*Yes.*
(3) Ron:	*Yes, but help me to find something here, Jenny? Frequently asked questions, meat today (reads by himself on the computer screen again).*
(4) Jenny:	*Ron, we've opened the page food.no*
(5) Harry:	*What are we actually trying to find?*
(6) Jenny:	*Food.no.*
(7) Harry:	*Traditional food, perhaps we should try that?*
(8) Jenny:	*Should we just wait to see what shows up on the screen?*
(9) Harry:	*Veal fricassee, try that, we can get the recipe for that. Print out that one (they see a link with the name veal fricassee).*
(10) Jenny:	*Okay, there we've got it (the recipe appears on the screen).*
(11) Harry:	*Yes, print it out (Bridgeford School, trec 112700).*

Ron has been sitting a while at the computer trying to find some information. In utterance (1) he claims that there is nothing to find. Then he asks for information (C1)[51] to confirm whether he is working on the right task or not. Lisa answers (2)"yes", and thus assures him that he is working on the right topic (B3). Then Ron asks (3) Jenny for help on moving ahead in his work (C3). Jenny tells (4) Ron what web page they have opened (B3). Then Harry also enters the dialogue and asks (5) what they actually are trying to find (C1). Then Jenny just answers (6) with the name of the page, "food.no" (B3). Harry suggests (7) that they can try to find traditional food (B1). The pupils have already tried to find national dishes and recipes in books. During the conversation around these books it became evident that the pupils were not

[51] The letter and number combinations are explained on p. 200.

sure what dishes were typical to Norway.[52] In the next utterance Jenny suggests (8) that they should just wait and see what shows up on the screen (B1). Harry obviously accepts Jenny's suggestion because when a link to veal fricassee appears on the screen, he proposes (9) that they can obtain a recipe for this dish and also suggests that they print it out (B1). In utterance (10) Jenny confirms that they have found it (B3), and Harry repeats (11) that they can print out this recipe (B1). This is also what the pupils do (obsnot 112700).

The pupils in this dialogue build positively but uncritically on what the other group members have said. They give and ask for suggestions and orientations (B1, B3, C1, C3), but they give no arguments or opinions for their thoughts and decisions so they are not using an exploratory or a reflective mode of talk. Nor do they disagree during the conversation. This means that the pupils use a cumulative, practical mode of talk during this dialogue. When it comes to co-operation, these pupils collaborate at the associative procedural level, not dividing any of the work processes between them.

The pupils at Bridgeford School, also searched for information on the Internet when working on various topics during the basic course at the beginning of the project period. When the pupils work on the topic "buildings and settlement in their local community", some of them try to find a map of the area they are working on. Rebecca, Jenny and Lisa (pupils) are working in the same group during this task. In the rendered dialogue below the pupils are sitting in front of the computer screen trying to find a local map. Before this brief extract, the pupils have been trying to find maps for a while. Rebecca starts the section below.

Illustration 2

(1) Rebecca: *Tour-map, write, scroll to the top again. Tour-map + Trondheim, you write.*
(2) Jenny: *No, it doesn't work (Jenny has done exactly what Rebecca told her to do, but no map shows up on the screen).*
(3) Lisa: *There has to be a tour- map for sure.*
(4) Rebecca: *Do you know what? We've used a lot of time just to find a map.*
(5) Lisa: *Yes, but when we've found it, them we have it, you see. Try to write "Statens vegvesen" [Public Road Administration]+ map.*
(6) Jenny: *Okay (she sounds a bit resigned, but writes the words that Lisa has suggested).*
(7) Lisa: *You have to write Trondheim then, there's a "Statens vegvesen"[Public Road Administration] in all municipalities.*
(8) Rebecca: *I'll go and look in an atlas (she gets up and walks away from the group).*
(9) Jenny: *Oh, it's so difficult to find maps, then (they have still not managed to find a map). Do you know what, we can draw one (Jenny has tried Lisa's suggestion, but fails to find a map) (Bridgeford School, trec 112200).*

Rebecca suggests (1) that they should try writing "tour-map". She also tells Jenny another search word to write down when performing the search (B3). Jenny does what Rebecca tells

[52] A dialogue that took place between the pupils while they checked books for national dishes is presented as Illustration 3 in this chapter.

her, but she still does not find (2) a map. Lisa tries to encourage her group mates (A2) by saying (3) that there has to be a map. It appears as if she is trying to stimulate her co-pupils to continue their search. Then Rebecca utters (4) an evaluation of the situation. She thinks that they have used a lot of time on trying to find this map, and appears to be indicating that she thinks they have used too much time (B2). Then Lisa again tries to motivate (5) her classmates to continue (A2). She says that when they have found one, they will have it (B2). She probably means that when they have managed to find a map on the net, they can just print it out and they do not need to write or draw anything on it. It will be completely finished. Then Lisa suggests (5) other word combinations they can try for their search (B1). Jenny responds (6) "okay" to Lisa's proposal (A3). Then Lisa again gives (7) Jenny task-specific information (B3). She tells Jenny that she has to add the name of the town to her word combination, and she also tells her why she has to do this: because there are Public Road Administration Offices in all municipalities, she explains (B2). In this way she shares her ideas and her opinion with the other pupils as to why she thinks that they ought to add the name of the town. Immediately after this Rebecca says (8) that she will try to find the map in an atlas and gets up and leaves the group (B3). Jenny also appears to give up trying to find the map they need on the net when she suggests (9) that they can draw one (B1).

During this conversation the pupils work together trying to help each other. According to Mercer (1995), they are working at both the cumulative and exploratory level, which corresponds to Packer's (1995) practical and reflective mode of interaction. The pupils make suggestions that they share with each other, and they inform the others in the group about different ways of conducting their search (B1, B3). One of them also tries to encourage the others to continue the work, and in addition argues for how they should continue their search for information (A2, B2). In this connection Lisa also gives reasons for their action and thus meets the other pupils in an exploratory or reflective mode of talk. Rebecca and Jenny do not directly disagree or argue over Lisa's suggestions, but they both suggest other ways of trying to solve their problem (B1). Rebecca will try to look in an atlas, and Jenny will try to draw a map. In this way the pupils suggest various procedures to try to solve their problem, hence a division of labour is established between the pupils. They thus are working at a co-operative level on their task. All the same, the pupils end up drawing a map together (obsnot 112200).

Information Searching, off the Computer

The same pupils presented in Illustration 1 are sitting in a group with a large number of books in front of them. They are grouped around four pupil desks that have been placed together to

make a large table. The desk tops are filled with books containing recipes. Ron is sitting in front of the computer searching for information while Jenny, Lisa and Harry try to find recipes in the books. Jenny starts the dialogue.

Illustration 3

(1) Jenny: *Do you know if corned salmon is a national dish?*
(2) Lisa: *Yes, I think we can say that, because we have a lot of salmon in Norway.*
(3) Harry: *There's one thing I wonder about, reindeer and elk and so on, are they …*
(4) Jenny: *Yes, I think we can write down reindeer, yes, I think so. Reindeer meat and corned salmon (talking to herself when writing down these words on their list).*
(5) Harry: *And elk and caribou.*
(6) Lisa: *Wood grouse. Write that down too.*
(7) Harry: *Look how delicious this looks then (looking at a plate full of food).*
(8) Jenny: *Wafer cone, that's very Norwegian too, isn't it?*
(9) Harry: *I'll find something, sour-cream waffles or something like that. Wafer cones I also think I saw in this book. Griddle cake (looking at a recipe in the book), isn't that Norwegian then?*
(10) Jenny: *Yes (Bridgeford School, trec 112700).*

In utterance (1) Jenny asks the other pupils in the group if salmon is a national dish (C1). She obviously does not know what dishes can be put in the category national dishes. Lisa confirms (2) Jenny's suggestion and also explains why she thinks it is a national dish (B2). In utterance (3) it seems that Harry also wants the other pupils to confirm if reindeer and elk are national dishes (C1). Jenny interrupts (4) Harry obviously aware of the fact that he intends to ask if deer and elk actually are such dishes. She says "yes", and goes on to tell them that she thinks that they can write down these dishes. She talks to herself when she writes down reindeer meat and corned salmon on their list of national dishes. In utterances (5-6) Harry and Lisa go on to suggest things Jenny should write down as examples of national dishes (B1). In utterance (7) Harry also comments on a picture, saying how delicious the food looks (B2). Then Jenny again directs (8) a question to the other pupils and asks if a wafer cone is Norwegian (C1). This obviously reminds Harry of waffles because immediately after Jenny's question he says (9) that he will try to find sour-cream waffles or something like that (B3). He also informs (9) the others that he thinks that he has seen wafer cones in the book (B3). Harry continues to look through the book and finds a cake. He asks the others in the group if it is Norwegian (C1). Jenny just answers (10) "yes" as a confirmation (B3).

In this group activity the pupils are looking through cookery books trying to find national dishes. For the most part the pupils are building uncritically on each other's statements (B1, B2, B3, C1), but obviously the pupils wonder about what dishes can be considered as national dishes. In one utterance (2), one of the pupils explains why a dish may be defined as an example of a national dish (B2). Otherwise the pupils suggest various dishes

which they uncritically write down on their list of national dishes. There is no division of labour between the pupils sitting in front of the books, because they all collaborate mostly on the associative level trying to find national dishes. During this collaboration they for the most part meet each other in a cumulative mode of talk, whereas exploratory or reflective talk is present in one of the utterances (utterance 2).

Learning Programmes

One third of the pupils at Applebee School are sitting in the computer lab trying to learn to use the I-movie programme. All the pupils have placed themselves together in pairs in front of the computers.[53] Molly and Sheila (pupils) have planned to work together. Steven (their teacher) has explained to the pupils that it is important to work together on a task like this. He tells them that they have to read all items one by one on the sheet of paper on which the instructions are given, and discuss them and try to find solutions (description of Applebee School, The Basic Course, p. 93). When the pupils have found their seats, it is clear that one computer, the one beside Molly and Sheila, is vacant. The teacher agrees to let Molly and Sheila work at each their own computer when they promise to work together on the task (trec, vrec 092600). In the dialogue rendered below, the two girls are trying to make scrolling credits. Molly starts by telling Sheila what to do.

Illustration 4

Sequence 1:

(1) Molly:	*Write down the persons who are acting in the film in the third text file.*
(2) Sheila:	*Third? (wondering).*
(3) Molly:	*Yes, here (pointing at the screen).*
(4) Sheila:	*Oh, yes there.*
(5) Sheila, Molly:	*Write our dirty dog in the fifth text file (the girls are eagerly reading in unison).*
(6) Sheila:	*I don't know what's what here (still uncertain).*
(7) Molly.	*One, two, three, four, five, okay, here (pointing to the screen, showing her).*
(8) Sheila:	*Two, three, four, where? Where is it then?*
(9) Molly:	*You have to count (Applebee School, trec, vrec 092600).*

In utterances (1-4) Molly helps Sheila to find out what to do. Sheila asks for information (C1), and Molly gives Sheila information about what to do (A1). In utterance (5), the two girls really show that they work together by reading the next instruction on the sheet of paper together. Then in utterance (6) Sheila again asks Molly about what to do (C1). She has obviously not understood how to accomplish this task. Molly shows (7) Sheila what to do,

[53] Steven lets the pupils establish the groups themselves, but he says that he will change the groups if pupils that he thinks will not work together well end up in the same pair (intinf 092900).

telling her where to write while she is also pointing at the screen (A1). Again Sheila has to ask (8) Molly, because she apparently does not understand what she is saying (C1). Molly again answers (9) her, and says that she has to count to find out which lines she has to write the various names on for the scrolling credits (A1). The discussion continues in this manner until Molly has finished almost the entire process. She reads the last exercise and tries to carry it out.

Sequence 2:

(10) Molly: Click on, let's see click on resolution chart (reads and executes the instruction). (Now Molly can see the finished scrolling credit on the screen). Oh, cool, did you see that Sheila? (excited).

(11) Sheila: No, just wait a little bit. The ninth (she is reading to herself, concentrated on the task she is doing) (Applebee School, trec, vrec 092600).

In utterance (10) Molly is talking to herself. She reads the instructions and does what she is supposed to do. Molly has managed to finish the task and is obviously satisfied with the result. She shares her excitement with Sheila (A2) and asks if she saw the credits scrolling down the screen. Sheila answers (11) no, and adds that she has to wait a little bit. She is obviously so busy with her execution of the task that she does not have time to look at Molly's screen just then. This means that Sheila has also understood what to do and is eagerly trying to finish her task. On the other hand, Sheila also shows solidarity (A1) because she indicates that she wants to look at Molly's result when she has finished what she is trying to do.

During this activity the two girls are taking part in the joint activity to make scrolling credits. The pupils are working at the associative level, as we can see that information about the actions or plans they have selected is asked for and given (A1, C1). However, this information seems to go in one direction, from Molly to Sheila. Molly seems to tackle this task more confidently than Sheila. In this mode of talk there appears to be an expert pupil helping the other to perform the task at the practical level. In this way Molly functions as a tutor for Sheila, and therefore this dialogue is conducted in the mode of talk called "tutorial talk" (Scrimshaw & Perkins 1997).

Using External Equipment

Before the pupils at Applebee School start working together on trying to put the camera on the tripod and learn to use the most important function buttons, Steven (teacher) informs them that they must work together. He tells them that they are not finished before all of them can do the job (description of Applebee School, The Basic Course, p. 93). The pupils establish the

groups themselves and start to work in them after they have received the needed information from Steven. The pupils make up all-girl and all-boy groups. In the dialogue rendered below, four boys are working together trying to be more familiar with the video camera. Jeff, one of the pupils, starts the dialogue rendered below.

Illustration 5

(1) Jeff: *Where should we put it? (they are trying to put the camera on the tripod).*
(2) Eric: *Here.*
(3) Jack: *Does it fit well?*
(4) George: *Yes it does (George holds the camera and checks if it is firmly placed on the tripod. Now they have managed to put the camera on the tripod).*
(5) Jeff: *There's no battery! We have to have that (eagerly to the others).*
(6) Jack: *How clever we are (rather ironic). (They all hurry to the camera case to find the battery. Then Jeff tries to put the battery on the camera).*
(7) George: *It should be placed here (pointing).*
(8) Steven: *Are you helping each other? (Steven comes up to the group after he has observed it for a couple of minutes).*
(9) Jack: *Yes.*
(10) Steven: *That's good (he then leaves the group again) (Applebee School, trec, vrec 091500).*

Jeff has the camera in his hands and wants to put it on the tripod. He asks (1) the other pupils where he should fit it (C1). Eric answers (2) by telling Jeff where he should put it (B3). Jack also wants to take part in the discussion and asks (3) if the camera fits well (C1). George confirms (4) this after he has tested how the camera is placed (B3). Then Jeff notices that there is no battery on the camera and says (5) this to the others (B3). Jack makes (6) a playful comment on the situation: "how clever we are" (A2), and all the boys hurry to the camera case where they find the battery. Jeff grabs it and they go back to the camera again. All of them are around the tripod when Jeff tries to put the battery on the camera (trec, vrec 091500). George gives (7) Jeff a helping hand by pointing to its place (B3). Then Steven comes up to the group and asks (8) if they are working together (C2). Jack tells him (9) that they are (B3). Before Steven leaves the group, he confirms (10) that it is good that they are helping each other (B3).

The pupils are working at the practical level trying to put the camera on the tripod. They ask for and give orientation about what to do (B3, C1), and thus help each other during the activity without actually critically building on each other's suggestions. Hence, the pupils meet each other in a cumulative mode of talk, also trying to make a cosy atmosphere in the group (A2). Furthermore, it seems that all the boys eagerly want to help the group without dividing different parts of the work between them. Thus the pupils are collaborating at the associative level.

Making Presentations

Three pupils in Applebee School are sitting in front of a computer in the computer lab editing the sequences each film group in the class has recorded. In this lab there are just two groups of pupils, one group working on the topic "Our town" and the other on the topic "Our school". These pupils have been chosen by the teachers on the basis of a set of criteria. The teachers want the pupils who are going to edit the films to be conscientious, good collaborators, responsible and capable of taking the lead in a group (description of Applebee School, The Planning Phase, p. 98). The three pupils who were selected to work on the topic "Our school" are from each of the three groups that filmed various topics related to their school. One of the groups filmed inside the school and the outside area, another group filmed various activities at the school,[54] and the third group had tried to make a film of the school as a mixture of different nationalities and thus different cultures (description of Applebee School, The Introduction Phase, p. 96). During the dialogue rendered below, group one has just started, so they are in the planning phase of the editing work. They are watching the film sequences, trying to find out how long each of them should be. As mentioned in the description of Applebee School (The Project Period, p. 93), the pupils in the two groups are restricted to making a film with a duration of one and a half minutes. Jack, the boy in group one, starts the dialogue below.

Illustration 6

Sequence 1:

(1) Jack: *I filmed this (they are looking at the various film sequences).*
(2) Mary: *We start there, there we start, and we stop there. We could show this for about five seconds (she sounds eager).*
(3) Molly: *Yes, five, yes. What commentary are we going to have for this then?*
(4) Mary: *Yes, we should comment on the pictures. Here we can start.*
(5) Molly: *What should we say about this sequence? (wondering).*
(6) Jack: *Yes, we planned to say something, sure. Tommy, has this sheet of paper (another boy in the class).*
(7) Mary: *This garden is situated in the centre of the school, something like that.*
(8) Molly: *Now the long sequence is coming (they are looking at the screen).*
(9) Mary: *What's that, the auditorium?*
(10) Molly: *Yes, it's the auditorium.*
(11) Mary: *But we don't need to have everything in the film?*
(12) Molly: *No.*
(13) Mary: *We can start there.*
(14) Molly: *Yes we can, and then we cut this? (Applebee School, Group 1, trec 101200).*

[54] The group that had the theme "pedagogical grouping" did not want to do this task. They rather decided to film various activities at the school, both activities that were finished and activities that were going on when they were filming. This group of pupils also filmed the posters in the school's auditorium as a substitute for all the theatrical performances that had been shown there over the years (see description of Applebee School, The Realization Phase, p. 100).

In the first utterance (1) Jack informs the other pupils that he has filmed the sequence they are looking at (B3). This seems to show that the pupils feel that they are responsible for some part of the product, and thus they will probably also feel that they have made their part of the finished result. In the next utterance Mary suggests (2) where they can start to cut this sequence. She eagerly proposes that they can show this sequence for about five seconds (B1). Then Molly enters the conversation (3) and supports Mary's suggestion (A3). They obviously remember what they agreed on in class. They were supposed to comment on each of the film sequences. They were either to write or record their commentary during the editing work (trec 100900). Molly continues, asking what commentary they are going to have for this film sequence (C1). Then Mary just confirms (4) that they are going to make a commentary, without giving any suggestion as to how it could be written or said (A3). Molly challenges (5) the others to suggest what the commentary should be (C3). Jack then remembers that they have worked out the commentaries in their teams in class. He says (6) that one of the boys in this team has written their commentary (B3). Instead of suggesting that Jack shall go and find this commentary text, Mary proposes (7) a comment she thinks is suitable (B1). None of the pupils comments on this suggestion, yet it is exactly this commentary that is used in the finished film (obsnot 101300, trec 101300). This shows that Jack and Molly probably agreed with Mary's suggestion (A3). While the pupils watch the screen, Molly comments (8) that the long sequence is coming (B3). Mary does not immediately recognise the pictures and asks (9) if it is the school's auditorium (C1). Molly confirms (10) this (B3). Then Mary suggests (11) that they do not need to have the whole sequence in the finished film (B1). Molly seems to agree with Mary when she supports (12) her suggestion (A3). Mary proposes (13) where they should start (B1). Molly agrees (14) with her (A3), and then suggests where they should cut this long sequence.

On the other hand, it seems that throughout the dialogue Molly tries to "defend" her group's contribution because several times she tries to convince the other two pupils in the editing group that they need to have a sequence from the auditorium. This was one of the sequences Molly's film team produced (obsnot, trec 101100). Jack and Mary want to cut most of the film from that sequence, but Molly tries to argue that they should keep it. Jack starts the dialogue between the pupils below.

Sequence 2:

(15) Jack: *So, we just cut it then (talking about the sequence of the posters in the auditorium).*

(16) Mary: *We've to have something from the auditorium too. We can just take this one (they are looking at one of the posters in the auditorium).*

(17) Jack: *Yes, that seems ok.*

(18) Molly: We can't cut all that, because it's like each poster is a symbol of a performance (Applebee School, Group 1, trec 101200).

In utterance (15) Jack suggests that they should cut the entire sequence from the auditorium (B1). Mary does not agree with Jack straight away, as she suggests (16) that they have to keep one of the pictures in the film (B1). Jack answers (17) "yes" to Mary's suggestion and obviously agrees with her (A3). Molly, on the other hand, has another view. She argues (18) that they cannot cut so much from the sequence because all the posters are in it (B2). It appears that the pupils feel a sense of ownership for the sequences they filmed. Jack also comments in utterance (1) in Illustration 6 that he had filmed the sequence they were watching on the screen, obviously thinking that it was worth mentioning. Therefore it also appears that it means something to him. In this work process in which the pupils are to co-ordinate the work from the three groups into one joint product, it looks like the pupils feel responsible for each their part at the same time as they intend to make as good a result as possible.

At the outset, the pupils in the film teams work on the various sequences that are going to make up the class' two joint films. There is a clear division of labour between the work teams. At the end of the project work the pupils in the two editing groups are collaborating, trying to make a common result out of the various group-work sections. During the editing work the pupils in these two groups in a way have two roles to address. Each pupil represents his or her group, but is also interested in making the editing work a good joint result for the whole class. In this way the pupils are working both on the associative and the co-operative levels simultaneously.

During the process the pupils meet each other in different modes of talk. Most of the time the pupils are working on the practical level using the cumulative mode of talk while trying to edit the film. They ask for and give suggestions and orientations (B1, B3, C1, C3), and agree on what it uttered (A3). However, when the school's auditorium is brought into focus, Molly argues that they should have included more than one poster in the film because all the posters are there, and with that indicating that they all represent a different performance. In this way she gives her opinion and also argues why she asserts it (B2). In this way the reflective or the exploratory mode of talk is brought into the pupils' conversation when there are different opinions in the group. The pupils try to defend or promote their interests as in disputational talk, but the task, making a joint video film also demands that they pool their interests together. This means that they can articulate their opinions and thoughts and produce arguments for them, but these interests also have to be coordinated.

During the editing process the pupils encounter various problems. In addition to having to make joint decisions, these decisions also involve mechnical problems. Jack also introduces the dialogue below.

Sequence 3:

(19) Jack:	*Let's save the project, then we save. Then we find what we've already saved. When we need it, then we just find it (Jack moves as he wants to start to save their work).*
(20) Mary:	*But how can you be so sure it's like this?*
(21) Molly:	*I've seen Steven (teacher) use the undo button.*
(22) Jack:	*I've done that too.*
(23) Mary:	*But, we can ask later then, maybe? It's so silly, that if you think it's an important file, and then you do it, and then it's wrong.*
(24) Jack:	*Yes, but…*
(25) Mary:	*And that you couldn't have undone it.*
(26) Jack:	*The only thing…*
(27) Mary:	*That would have been stupid.*
(28) Molly:	*I think Steven is here some place.*
(29) Mary:	*Yes, we've got to ask him (Applebee School, Group 1, trec 101200).*

Jack suggests in utterance (19) that they should save the project (B1). He also states that they are going to save it, almost confirming his own statement (B3). He then goes on to argue why they should save the work (B2). Then Mary enters (20) the dialogue, apparently uncertain as to whether they know how to do this (C1). Molly then assures (21) her that she has seen Steven use the undo button. It thus appears as if Molly is trying to calm down her anxiety (A1). Jack confirms (22) that he also has seen Steven use this button to reassure them that they are taking no risk by doing this (B3). Mary does not seem convinced by their argumentation (23) because she proposes that they can ask Steven (teacher) (B1), and she also argues about why they should do so (B2). Then Jack again tries (24) to take part in the discussion, but he is interrupted by Mary who continues to argue (25) that they need to ask Steven before they can do anything at all (B2). Jack again tries to say (26) something, but is again interrupted by Mary who still has (27) an argument (B2). In utterance (28) Molly also seems to agree with Mary because she turns her thoughts towards Steven and not towards the saving activity at the computer (B3). Mary also seems to conceive (29) Molly's utterance as agreement with her concerns because she answers "yes" to Molly's statement, and then concludes this conversation by saying that they have to ask Steven (B3).

During this sequence the three pupils discuss whether they should take a chance or ask Steven for help. They give and ask for suggestions and orientations (B1, B3, C1). During this conversation they also argue for their statements (B2). Mary seems to have the best argument because they finally settle on asking Steven to help them with their problem. Thus these pupils meet each other in an exploratory or reflective mode of talk during this process when they plan the procedure for their work. During this process there is no division of labour

between the pupils because they work collaboratively on the same problem, and thus on the associative level.

The pupils need to plan and take decisions continuously throughout the editing process. When they are almost at the end of the work, they also have to plan and find out what to do. Molly says:

Sequence 4:

(30) Molly: *Are we going to have scrolling credits at the end?*
(31) Mary: *Yes, are we going to write who's in the film?*
(32) Molly: *Who has made it and things like that? Yes, I think so (Applebee School, Group 1, trec 101200).*

In utterance (30) Molly asks if they are going to make scrolling credits at the end of the film (C1). Mary confirms (31) her question positively (B3), but Molly's question seems to make her think of what they should have in their credits, and Mary thus follows up with another question (C1). Molly answers this question and suggests (32) what persons should be included in the scrolling credits (B1). In this dialogue the pupils also collaborate on the same problem, building uncritically on each other's suggestions in their planning activity (B1, B3, C1). Thus the pupils are working at the associative level, meeting each other in a cumulative and practical mode of talk.

The dialogues in front of the computer screen do not only show that the pupils plan and discuss their work, they also indicate that the pupils have learned something during the editing process. One of the groups is almost at the end of the process and they are going to watch the whole film yet again. Jack starts the dialogue rendered below:

Sequence 5:

(33) Jack: *Let's watch it.*
(34) Mary: *Yes, try now, try now (excited). (The pupils watch and listen to the film).*
(35) Molly: *Yeah, it was okay.*
(36) Mary: *Yuhuuuuu (excited).*
(37) Molly: *There was very nice music at the end (they had added some music to the sequence). Have you watched any films and noticed if there was anything we could use in our film? I've not done that.*
(38) Mary: *I didn't watch any films yesterday.*
(39) Molly: *Is there anything else we should do, Mary?*
(40) Mary: *What?*
(41) Molly: *Should we watch the whole film once more, we have to see if there's any misspelling or anything like that (they have written commentaries on some of the sequences).*
(42) Mary: *Yes, okay (they start the film).*
(43) Mary: *Oh, that's good, it fits really well, wow! (they watch the pictures and listen to the accompanying music). It's really cool. Do you know what, this is really good (is excited).*
(44) Steven: *Did you think it would be this good?*
(45) Mary: *No, I didn't think I was capable of doing this.*

(46) Molly: No (agreeing and confirming Mary's statement) (Applebee School, Group 1, trec 101300).

Jack suggests (33) that they should watch the film (B1), something Mary eagerly gives (34) her consent to (B2). After the pupils have watched the film, Molly confirms (35) that it seems okay (B3). Mary is obviously very satisfied with the result, as she gives (36) an excited outburst as a comment (B2). Molly comments (37) that the film ends with very nice music, something that she also seems to evaluate very positively (B2). Then she asks (37) the other pupils if they had watched any films at home to see if they could pick up any ideas they could use in their film (C1). Steven (teacher) encouraged the pupils the day before to watch films to find out how credits looked at the end of a film (obsnot, trec 101200). Mary informs (38) Molly that she did not watch any films (B3). Then Molly asks (39) if there is anything else they can do (C1). Mary apparently does not hear what Molly is saying because she answers (40) with a question (C1). Molly obviously has something in mind, but apparently wants to ask the others before she proposes her ideas because in the next utterance she suggests (41) what they can do when the invited responses from the others just result in a "what" (B1). Mary confirms (42) that she supports Molly's suggestion (B3) and then the pupils start the film yet again. In utterance (43) Mary gives an evaluation of the film and also argues why she thinks it is so good (B2). She thinks that the pictures and the music fit well together. Then Steven comes up to the group and asks (44) them if they believed that they could achieve a result like this (C2). Mary answers (45) that she never even thought she was capable of doing this work. Molly also confirms (46) Mary's statement with a "no" (B3). In this way the two girls also express that they have learned something during the work process, that they have learned to use the software programme to edit the films.

During this sequence the pupils are taken up with the result of their work. They watch the film together and mostly meet each other in the cumulative or practical mode of talk (B1, B3, C1, C2). They express feelings (B2), but do not give any arguments that support their way of feeling. On the other hand, when Mary utters that she thinks the film is good, she also put forward an argument (B2). In this way the conversation moves towards the use of exploratory or the reflective mode of talk when the pupils collaborate at the associative level during this rendered sequence.

At Bridgeford School, the pupils in one group are working on a Power Point presentation as part of the presentation at the end of the project. They are sitting in the ICT corner writing down various points they want to introduce to the rest of the class during this presentation. This group consists of three girls, but one of them is absent this day, so just two

of them, Fanny and Rose, take part in the dialogue below. The dialogue starts with Fanny asking Rose a question.

Illustration 7

(1) Fanny:	*Why don't we use all this then? (pointing to pieces of papers full of written text).*
(2) Rose:	*We've to choose some of it and just write that bit. And then we've to practise on presenting it (says this to Fanny). Sarah told us not to use this so religiously (the teacher). (She points to the sheets of papers they have written on). We should rather use some more time on trying to explain what we've written.*
(3) Fanny:	*Take more time when we explain it, what do you mean by that?*
(4) Rose:	*Use the time to explain what we have written instead (Bridgeford School, trec 120600).*

Fanny is unsure and asks (1) why they do not include everything in the Power Point frames. She appears to think that they should include everything they have worked on in their presentation (C1). Rose then tells (2) her that they should only use some of their material in their Power Point presentation. She explains that Sarah, their teacher, has told them to do it this way. Rose proceeds to tell Fanny that they should rather try to explain what they present (B3). Fanny obviously does not understand what Rose means because she asks (3) what she means by "explain" (C1). Rose then tells (4) Fanny that they should use the presentation time to explain what they have written on the Power Point presentation instead of just telling everything that they have written down on their sheets of papers (B3).

In this dialogue the two girls are discussing how the Power Point presentation should be made. The dialogue contains questions and answers that tend to move towards reflective or exploratory talk (B3, C1). In utterance (3) Fanny asks Rose what she means by "explain", but Rose does not really answer this. She just repeats what their teacher said earlier, that they should explain what they have written. It seems that she just repeats the Sarah's words without giving reasons for what they should do. Rose obviously does what Sarah says without making it her own choice based on an understanding of what they are to do. She knows or masters how to do it, but she does not yet understand why so she can explain it to the other girl (Wertsch 1998). Thus the pupils meet each other in the cumulative or practical mode of talk when working at the associative level collaborating on the joint task.

At all three schools the pupils are working towards a presentation at the end of the project work. Michael and David (pupils at Cooper School) are working on their presentation, a web page. The dialogue below is recorded after the pupils have received some help from the deputy head. Michael starts the dialogue.

Illustration 8

(1) Michael: *The codes then, I'll try to learn them.*
(2) David: *I'll show you.*
(3) John: *(The teacher) I learnt a few things too when I watched what you were doing the last lesson (referring to the lesson the deputy head helped the two boys).*
(4) David: *This is the main page, the menu, the text and the links here (showing Michael what is what on the screen).*
(5) Michael: *Mm.*
(6) David: *The frame is cus. Cus, right?*
(7) Michael: *It's the frame isn't it?*
(8) David: *Yes (Cooper School, trec 110200).*

Michael says (1) that he will try to learn the codes (B2). He utters a wish and in the next utterance (2) David says that he is willing to show him (A1). This indicates that David is the expert pupil in this group. He also says in a dialogue rendered in Chapter 8 (Illustration 11, p. 187) that he understands how to work out a web page with a frame and links by using HTML codes after the deputy head had helped them. Now it is obvious that he wants to help Michael to learn this. John (teacher) also enters the dialogue by saying (3) that he also has learned something when the deputy head showed the pupils how to do it (B3). In this way he does not give the impression that he is above the pupils, but indicates that he can also learn together with them (A1).[55] In utterance (4) David starts to show Michael what to do (B3), and Michael confirms (5) that he has listened and heard what David has told him with an "mm" (B3). Utterance (6) shows that David goes on to help Michael (A1), and Michael shows (7) that he actively listens to David and obviously wants his help (C1). He asks (7) David for confirmation when he hears David mention the word "cus" (the name of a page), and he says that he thinks it is the frame (C1). In utterance (8) he obtains David's confirmation (B3).

Already in the two first utterances (1-2) we find out that Michael wants to learn (B2) and that David wants to show him (A1), but Michael does not argue why he wants to learn the codes. Throughout the dialogue David also gives Michael help as he has promised (B3, C1). Thus the pupils collaborate at the practical, associative level, where a tutorial mode of talk is used.

Discussion

In Illustrations 1 and 2, the pupils are trying to search for information on the net. In Illustration 1 the pupils appear to be very focused on doing their search. They concentrate on the mechanical way of searching and talk about it. This is similar to the way the pupils used the Concept Kate game. This game made the pupils use short exchanges referring explicitly to

[55] In the next chapter, Chapter 10, I write about learning communities in which both pupils and teachers construct knowledge together.

the physical mechanics of key pressing. Phillips and Scrimshaw (1997) found that the pupils were unfamiliar with the programme. The pupils in this group strive to find out how to search for the material they need. During the work at the computer the talk between the pupils is about the search process, the pupils never come far enough to discuss what dishes to choose, the task they are to solve. The pupils have had training in finding information on the net (description of Bridgeford School, The Context, p. 107), nevertheless, they are struggling to find the material they want. When the pupils at last manage to find a recipe, it also appears that they uncritically decide to print it out, content to at least have found something.

On the other hand, when the pupils sit in front of their cookery books (Illustration 3) the conversation between them is about national dishes and the pictures they have every opportunity to look at. In this activity they have no problems finding recipes so they talk about the content of the task. The conversation also moves towards exploratory talk so that the pupils have the opportunity to learn and develop their insight from each other's statements and arguments. From this comparison it seems that the group's activity off the computer is the setting in which the pupils can use talk to enhance their learning processes with respect to the topic of the task. All the same, this does not mean that collaboration at the computer during information searching generally constitutes an environment that gives less opportunity for exchanges of views than the setting around books. However, this appears to be the case for this group working with exactly this task at exactly the moment they were being observed. On the other hand, it seems likely that pupils need to find material that is about their task before they can move from a conversation about mechnical issues and procedure to talk about task and content.

Illustration 2 also shows that the pupils strive to find the information they are searching for. If the pupils cannot manage to find what they are looking for, this illustration gives the impression that they give up and use other methods to find or make up the needed material. The pupils in this group actually decided to draw a map. On the other hand, the pupils in this group had the opportunity during the search process to motivate each other and to argue for their opinions. Thus, in this activity the pupils learn not only about the topic they are working on, but also about planning and taking decisions together. In this way the pupils can develop their methodological competence as part of their holistic development, a process that includes gathering information.[56]

[56] As mentioned in connection with the theory of project work, the aim of such a work method is holistic development. This means that the pupils can develop their academic, social, aesthetic, methodological and learning competence during the work process (Appendix 8, Figure 17, p. 411).

In Illustration 4 Molly and Sheila (pupils) are working together to learn how to use the I-movie programme. During this exercise they are given the opportunity to place the recorded video sequences in the order they want. They can make commentaries for these sequences, both written and oral commentaries, and they can also add sound tracks for the various sequences. At the end of the film they try to make scrolling credits. The task the pupils are given is written on several sheets of paper given to them one by one (description of Applebee School, The Basic Course, p. 93). This means that the written exercises, the teacher's request for collaboration, the software programme and the pupils' expectations constitute the premises for the pupils' activity in front of the computer screen. When the pupils do the exercises, they have several options to choose between with regard to both the order of the video sequences, and what sounds and text to include. This means that the pupils have an extensive opportunity to discuss, plan and make decisions together. This situation is like the one described in connection with open-ended software programmes, as reported by Fisher (1997). When using such programmes, the pupils can develop both a cumulative and an exploratory mode of talk. In the rendered dialogue (Illustration 4) one of the pupils functions as a tutor for the other, helping her to execute the required operations. It seems that this process is useful for Sheila, and the dialogue also indicates that she learns how to use the programme through the process. At the end of the conversation she is so engaged in her actions that she has no time to look at Molly's screen when she asks her, nor does she ask for her help. This illustration also shows that the teacher's organization of the exercise has profound implications for the collaborative processes at the computer. The pupils could have conducted this exercise alone with no talk between them. When the pupils work together on such a task it is obvious that help and guidance from a classmate are useful. Molly obviously gives Sheila help in her ZPD (Vygotsky 1978), and the understanding of how the programme is functioning is created in the exchanges of utterances between Sheila and Molly (Bakhtin in Volosinov 1973, Vygotsky 1978, 1986/2000, Bakhtin 1981, Holquist 1990).

The pupils also collaborate to solve a joint task in Illustration 5. The pupils are told to help each other and the goal of the exercise is that everybody will manage to do the task on their own, in other words, that they can master putting the camera on the tripod and using the most important function buttons (description of Applebee School, The Basic Course, p. 93). Steven (teacher at Applebee School) also talks to the pupils and asks them if they manage to collaborate. The pupils seem to be aware of the teacher's expectations when they work together, and they answer in the affirmative. Steven evidently tries to build a collaborative atmosphere in the class, both when the pupils work at the computer and in activities related to

computer work. This practice is obviously based on Steven's belief in collaboration as a medium for learning, therefore he structures the learning activities as collaborative group work whether the tool the pupils are using is a computer or a camera. Before the pupils start to work with the camera and try to put it on the tripod they are given Steven's expectations (Illustration 5). Thus the pupils know how they are to proceed during their work. According to Wegerif (1997), the most decisive factor for successful collaboration between pupils consists of the expectations shaped, among other things, by the classroom climate. Steven follows up his expectations when the pupils are working on task by both observing the pupils (trec, vrec 091500) and also asking them if they help each other. Thus the pupils are reminded of Stevens's expectations throughout the work, and thus probably also understand that it is important that they collaborate. When some of the pupils at the end of the project work edit the films the pupils have recorded, this activity is also structured as a collaborative process.

The pupils have already tried the I-movie programme during the basic course. In the editing process the pupils are to use the computer and the software programme as a tool to edit their own film recordings (Illustration 6, sequences 1-5). During this process they have to reach many decisions together. The pupils have to agree on which shots they want to have in the film. They have to decide how long each sequence is to be and they need to agree on how the sequence is to be edited. They have to find out what sequences they want to record background music for and they have to agree upon which colour and size the written text is to have. They also have to agree on the content of the scrolling credits at the end, and not least, they have to help each other to operate the I-movie programme so that they can use it in an effective way. As Illustration 6, sequence 3, shows, the pupils also have to agree whether they should try to carry out their work by themselves, and thus take a risk, or if they should ask the teacher for help. All these issues comprised the foundation for the talk, in other words, the pupils need to argue for their opinions if their suggestions are to be taken into consideration during the work process. The restrictive duration of the films also forces the pupils to move between the specific situation and the whole when they edited the films. When they decide how long one of the sequences is to be, this will have immediate consequences for the duration of the other sequences in the film and thus the whole product. In this way the structure of the task forces the pupils to think holistically, in other words, the realisation that one decision will have consequences for the process as a whole (Wegerif 1997). Illustration 6, sequence 5, also reflects the pupil's learning with respect to the use of the I-movie programme. Molly and Mary both claim that they master the software programme.

The aim of the activity in Applebee School this year is that the pupils will learn to use different tools. Steven says that the pupils are in their "training phase" (intteam 101300). This means that the aim of the teaching during the project lessons is mastery of tools that the pupils can use as mediating artefacts in later work. Thus the content of the task during these activities is precisely to learn how to use and thus master various tools, and therefore the aim is to “know how” and not to “know what”. The pupils can of course also learn more about their town and school during the project, but this does not appear to be the main aim. In this project the pupils are to learn how to produce knowledge, the focus is not on what they produce.

One of Sarah's aims (teacher at Bridgeford School) is that her pupils shall learn about the topic “Norway” during the project work. The work during the project period should increase the pupils' knowledge about the themes they were to work on (description of Bridgeford School, The Introduction Phase, p. 115). She also tells the pupils from the outset of the project work that they will be assessed during this work period. One of the criteria is how the pupils manage to present their own project so that the others in class could learn about it (description of Bridgeford School, The Introduction Phase, p. 115). When the two girls, Fanny and Rose, are working on their Power Point presentation, Sarah also advises these two girls to just write down key words and to concentrate on explaining things in connection with these words (Illustration 9, Chapter 8, p. 185). This shows that Sarah is focused on the content of the task. The Power Point presentation can thus be used as a mediating artefact in the knowledge-constructing processes in class. At the same time, the Power Point presentation may be a tool that helps pupils to internalize how to extract the most important issues from a text and put them into key words. This is also a skill the pupils can use in similar situations where they need to summarise and pinpoint the most important content. This means that there will be an effect from the process of making a Power Point presentation that indicates that the pupils can develop both their academic and learning competence (see Appendix 8, Figure 17, p. 411).

In Cooper School, the aim is that the pupils shall learn about the topic "Emigration". David and Michael (pupils) seem very interested in making the web page (Illustration 8). The discussion between these two, like the pupils in Illustration 1 in this chapter, is for the most part about mechanical problems rather than procedure and topic matter. This indicates that it is necessary to learn to master the tool, to move the talk between collaborative learners from talk about mechanical issues to decision-making and decision-taking processes and then to the content of the task. This means that the actions when using the tool have to be moved from

the action level to the operation level, and thus accomplished automatically (Leontèv 1981). In this way effort can be directed to others aspects than mechanical problems. The talk between David and Michael can also be assessed as being at a another level than the talk between the pupils at Applebee School when they are editing the recorded films (Illustration 6). If they had learnt how to make a web page before they decided to use such a page as a presentation tool, they could have moved their talk away from the mechanical level, and could have talked about how they wanted to design their page, how the frame should be placed and look like, what fonts they could have used, what images they could have inserted and what text they could have written in connection with these images. In this way the pupils had the opportunity to argue and thus present reasons for their opinions. Thus the talk could have moved from a tutorial mode to cumulative and even exploratory talk, which means that the relationship is as an equal one, and in this case means that both pupils master the making of a web page. Once released from focusing on mechanical problems, the pupils' mental abilities could be concentrated on the content of the task, which in this case was the topic of emigration.

From the observations of the pupils' work in front of the computer screen, it is fair to say that some of these settings enhance learning that is useful in similar situations. I am especially thinking here of the planning and decision-making processes when the pupils are using the I-movie programme (Illustration 6). It is probable that the pupils develop a methodological and a social competence that is useful in situations when they work together with other persons constructing knowledge on the basis of their collaboration processes. However, it once again appears that it is absolutely necessary that the pupils master the ICT equipment before talk can move from a mechanical level to a level that deals with procedure. When the pupils have found out how to proceed with their work, they can also move into discussions on the content of the task or the thesis question. Thus they can also internalize an understanding of the content matter.

In this discussion I have presented various levels of talk, but this is not to say that there is a hierarchical relationship between these levels of communication. It could be that the methodological competence that is constructed is at least as important as academic competence. Knowledge is to be conceived of as a "fresh good", it is not something that is detected, but something that is constructed and continuously transforming. This means that it is important to know how to gather information by using tools and also how to process this material together in a working team. Another premise appears to be that you have to master ICT equipment to secure a future job. Thus academic competence, further methodological

competence and the mastery of tool use, including computers, all appear to be skills that are a necessity in our ever changing technical society.

Exploratory talk is essential to successfully participate in educated communities of discourse. It is obvious that reasoning and thinking critically are skills that are necessary for participating in such talk (Mercer & Wegerif 1999). Thus an exploratory mode of talk is a way of meeting people that is the same across similar situations. This also means that such a mode of talk can be transferable to other situations similar to the one in which it is practised and learned. From the observed settings in the classroom it appears that several factors affect the mode of talk the pupils are using. Which programmes the pupils are using is important, but at the same time it also appears that the teachers' roles and their way of structuring the activities at and in relation to the computer has at least as much a role to play in deciding which mode of talk will be conspicuous between the pupils. The teachers' organization of the process will also shape the pupils' expectations, while the thesis questions they create themselves may also stimulate them to work and talk together.

When the pupils make up the thesis question for the project period, the teachers also play an important role in how they advise the pupils to make these questions. Most of the thesis questions at the three observed schools start with the word "what". Sarah tries to advise a pupil group to change their question so that it starts with a "why" instead of "what kind of". It is more exciting, she says to them. Sarah thinks that a good question starts with "how" or "why" because this shows that the pupils have an inquisitive attitude (description of Bridgeford School, The Planning Phase Including the Forming of Questions, p. 120). Nearly all the pupils' thesis questions thus demand a descriptive answer. Questions starting with "why" are looking for an answer that provides explanations and also shows an understanding of the relation between various factors. Descriptive questions may be perceived as too simplistic, but it is claimed that pupils preferably can answer such questions before they move on to work with "why" questions. It is most likely that critical thinking and thus exploratory talk are more prominent in groups that work with "why" questions (Koritzinsky 1997). This means that the teachers have to take the developmental level (ZPD) of the pupils into consideration when they advise them in the making of questions, at the same time as he reflects on what mode of talk the various questions will trigger.

The terms "effects of" and "effects with" are used in connection with computers (Salomon 1990, 1992, Salomon, Perkins & Globerson 1991, Salomon & Almog 1998). The expression "effects with" takes into account the activities the computers enable the individual to do while working with the tool. In this way the computer or the ICT equipment could be

looked upon as an extension of the individual (Prawat 1996). At Applebee, Bridgeford and Cooper Schools the computer enables the pupils to conduct various activities. The pupils use the Internet to search for information, they use it as a typewriter, they make Power Point presentations, they scan pictures, they make a web page, they send e-mails, they use it in connection with video-cameras and digital still-photo cameras and they edit films (Table 1, p. 94, Table 11, p. 405, Table 12, p. 405). It also appears from the pupils' own utterances that the group work with the use of ICT as a mediating artefact has had some effects beyond the specific context in which it was learned ("effects of"). With regard to the learning and the use of the ICT equipment as a mediating artefact, most of the pupils seem to find it useful in several situations. The most frequent answer given by the pupils at Applebee School is that they have learnt to use the video camera and the I-movie programme. At Bridgeford School the most frequent answer is that they have learnt to copy pictures from the Internet to their own document. Two of the pupils say that they have learnt to adapt the data material to their own needs, while two others mention that they have learnt to edit a film. At Cooper School the most frequent answers are connected to the information search process. Seven of the pupils say that they have improved the way they search for information, and three pupils say that they have found that there is a great deal of information on the net (Table 13, p. 406, Table 14, p. 407, Table 15, p. 408).

It appears that during the observed project periods the pupils have in a way internalized a meta-knowledge about the use of ICT, but just a few report that they have learned something about the use of ICT that is not unambiguously positive. One pupil at Cooper School reports that it is not easy to find information on the net. At Bridgeford School, one of the pupils also says that it is difficult to find what you are searching for, another pupil at the same school states that he has learned that material can be lost, and a third says that you can not always manage to do what you want at the computer (Table 14, p. 407, Table 15, p. 408). This knowledge of computer use is an effect the pupils will likely bring with them beyond the specific situation or context in which they learned it. Perhaps as a consequence of this, the next time one of the pupils needs to find some information, he or she will decide to search in books instead.

The pupils also seem to have some opinions about what can be an advantage with group work. The most frequent answer from the pupils is that they have found that it helps to collaborate, followed by the answer that it is fun to work in groups during project work. The next most frequent answers are that the pupils find that group work takes effort from everybody and that the work helps them to be better collaborators (Table 16, p. 409). This

could be looked upon as an effect of the group work during the project directed work processes.

The observed actions and their contextual factors during the group work can also be visualized in an Activity System. This is shown in Figure 14 below.

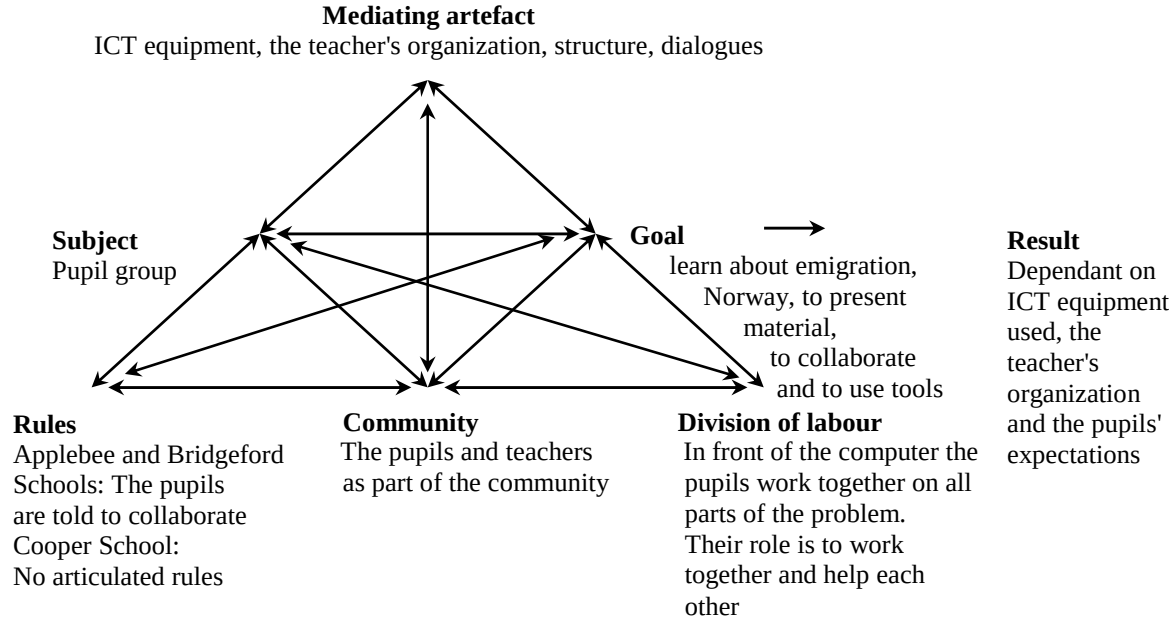

Figure 14: A pupil group as the acting subject in the Activity System

During the actions that take place when the pupils work together, they use different mediating artefacts to help them reach their goals. During these actions they also have different rules that guide them throughout the process. The rules the pupils have to follow also function as goals they have to aim to reach (as an example see description Bridgeford School, The Introduction Phase, p. 115). They are told that they have to collaborate and that the intention is that they learn to collaborate well. Thus there is no distinction between means and goals. The results of the project periods appear to be dependent on factors such as tool use and thus computer programmes, the teacher's role and how the pupils look upon their role during in the community during the work processes.

Crook (1991) claims that we run the risk of believing that events inside the collaborating peer are the only source of discourse material relating to the social quality of learning. He believes that teachers and researchers will be making a mistake if they segregate computer-based learning from the rest of classroom life. Teachers must instead help pupils to appropriate a shared body of understanding. In this way classroom discourse, with all pupils

and teachers as participants, will be the medium to create this common understanding. In the next chapter the focus is on processes that can function as a social context for a common understanding.

Chapter 10
Shared Knowledge

Teachers have traditionally been the persons doing most of the talking in classrooms. They have presented information to the pupils, so subject matter has been treated like a package of information to be handed over to passive recipients, the pupils. In this way the pupils are given no opportunity to construct knowledge of their own interest and thus gain some ownership of its meaning. Wenger (1998) argues that the primary focus in classrooms must be on the negotiation of meaning and not on the mechanical transmission and acquisition of knowledge. While the "mechanics of learning" have to be present in processes such as the perception of memory, development of automatisms and skills, accumulation and information processing, structuring of activities and changes in behaviour, he does not believe that they have to be the primary focus of education. Wenger claims that we learn to speak a language so successfully because we are focused on the experience of meaning rather than on the mechanics of learning.

During project work the pupils are given the opportunity to work in interest groups and find answers to their own thesis questions. During this work they may use various artefacts to reach their goals. Successful use of computers is dependent on changing the practice in the classroom. Both pupils and teachers have to be learners in a classroom characterized by intense activity on behalf of the pupils (Koschmann in press). The teachers' role is to scaffold the pupils through the processes where they also have every possibility to learn themselves. The setting in the classroom described by Koschmann (in press) is in many ways similar to the project method presented by Berthelsen et al. (1987). This means that the pupils can work on various thesis questions or try to find answers to various questions that point to an overarching theme presented by the teacher. In this way there will also be an “interaction of the planned and the emergent” (Wenger 1998, p. 267) with the curriculum and the pupils' interests (Dewey 1902, 1916, 1938), and the pupils, together with the teachers, will be responsible for knowledge production in the classrooms. In socio-cultural theory, learning is defined as a process in which one masters to use artefacts for thinking and action (Wertsch 1991, Säljø 1999), or in other words as the "appropriation and mastery of communicative (including conceptual) and technological tools that serve as mediational means in social practice" (Säljø 1995, p. 91). But how can all the pupils in the class learn about all the examples of the overarching theme and also the various ways of using artefacts to gain and

understand this information? This chapter focuses on how knowledge is shared in classrooms, and what the teachers' and pupils' roles mean for this knowledge-construction process.

In project work, phase six is called the product presentation phase (Berthelsen et al. 1987). In this phase the pupils are expected to present their work to each other in one way or another. Usually the content matter is the focus in these presentations. Learning to use artefacts is a major part of the learning process (Wertsch 1991, Säljø 1995, 1999), but how can this learning become shared knowledge in the classroom community? In this chapter I will also demonstrate how the teachers' conversations with the pupils and the organization of the classroom processes can help the pupils gain shared knowledge. In Chapter 8, “Scaffolding”, I presented dialogues between pupils and teachers when pupils were working on task. In this chapter I will present dialogues between pupils and teachers when the pupils have finished a work sequence, and when the whole work period has come to an end, in other words, when they talk about their presentations. The pupils' experiences and learning are expressed through these conversations and the constructed knowledge can thus be shared by all the pupils in the class.

Theoretical Framework

The Zone of Proximal Development

Computers should be considered as an artefact in the joint activity in the zone of proximal development (ZPD). This means that most computer applications are experiences in a context of a social exchange. This social context must be taken into consideration when defining the success or failure of computer use. In this context, learning is seen to be happening in socially organized settings. The failure or success of computer use is therefore evaluated in terms of the interactions around or in relation to technology, rather than with it. The teacher's responsibility will thus be to bring the pupils' experiences into the discourse of the learning community. Computer work will then be a topic of the classroom discourse and the experiences can thus become part of the shared understanding gained by the participants. In this way the computer activity will not be isolated from the mainstream work of the class. Pupil collaboration is thus not the only source of discourse material that relates to the social quality of learning, but the pupils' experiences will also be made a body of shared understanding through a class discourse conducted by the teacher (Crook 1991).

In educational settings, intersubjectivity may be considered from two different perspectives. In one perspective, intersubjectivity resides in the talk between pupils and

teachers in instruction-in-progress or in the moment-to-moment scaffolding when working on task. In the other perspective, intersubjectivity resides in the talk and actions that serve to create what is held in common, and also known by the participants to be held in common (Crook 1994). During project work students may present their work to each other in a number of ways. Examples of such presentations are Power-Point presentations, web pages or collages. Artistic performances, such as dance, role play and singing, may also function as expressions of the pupils' answers to their thesis questions. All these modes of representation function as tools for thinking (John-Steiner 1987), and when presented to all the pupils, they can also become part of the shared understanding developed in class. As described in Chapter 8, "Scaffolding", Vygotsky tended to talk of the ZPD concept in terms of individual assessment and instruction. This approach to the concept has been criticized by others who want to expand it to include not simply speech, but also a wide range of mediational means, not simply dyads in face-to-face interaction, but also collaborative participation in communities of practice.

The concept ZPD has been interpreted in many ways that can be placed under three categories. The first interpretation is the one presented in Chapter 8 "Scaffolding". This interpretation finds that the ZPD is the difference between the problem-solving abilities the learner has on his or her own and the abilities he or she has when assisted by an adult or more capable peer (Vygotsky 1978). This means that the learner at first needs some assistance and later manages to perform the action alone (Wood et al. 1976, Greenfield 1984). A second interpretation of the concept finds that the ZPD is the distance between the cultural knowledge provided by a sociohistorical context and everyday experiences (Davydov & Markova 1983). This interpretation is based on Vygotsky's distinction between everyday and scientific concepts, and that a mature concept is reached when the scientific and everyday concepts have merged (Lave & Wenger 1991). In both these interpretations internalization is looked upon as an individualistic acquisition as a result of social interplay with the surrounding context. In the third interpretation, Engestrøm (1987) defines the ZPD in a collectivist or societal perspective, claiming: "*It is the distance between the present everyday actions of the individuals and the historical new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in the everyday actions"* (p. 174, italics in original). In this way the shared knowledge developed in a class can be interpreted according to Engestrøm's definition. Through discussions and retellings the learner can create a joint understanding that affects both the individual and the social community.

Learning in a social practice does not need to mean development of special skills. It means that the learner becomes a full participant in activities that have meaning in a broader system, a system of relations between persons in a social community. In this way learning also involves the construction of identities. The learning concept does not just include persons, but also the social communities. This means that there is a change both at the individual and community level (Lave & Wenger 1991). Thus the community does not present a predetermined structure for learning, but develops itself in the ongoing activities.

Situated Learning through Apprenticeship in Communities of Practice

In Lave and Wenger's (1991) theory of situated learning, learners are perceived as apprentices. This means that a master-novice relationship is often related to this kind of learning theory. In such learning situations apprentices are given structure through work practices rather than being in the asymmetrical relationship between master and apprentice. Engagement in practice may well be a condition for the effectiveness of learning, and observation and imitation are not the only means for acquiring the specifics of the practice that are going to be learned about. Participation is the right way of learning, and such an involvement gives the learners a general idea of what constitutes the practice of the community and also opportunities to make the culture of practice their own. This means that the structure for school practice also may function as a structure for pupils acting in various activities.

A distinction is made between a learning curriculum and a teaching curriculum (Lave & Wenger 1991). A learning curriculum consists of resources in everyday practice viewed from the perspective of learners, whereas a teaching curriculum is constructed for the instruction of newcomers. A learning curriculum is essentially situated and thus characteristic for a community. In Lave and Wenger's view, learners may make different contributions to an activity, and participation at multiple levels is the situation in a community of practice. In such a practice, they find relations between persons, activities and world, and participation in the cultural practice is thus the epistemological principle of learning. Productive activity and understanding are not separate, but dialectically related. Thus learning and understanding are created through learning by doing and not through learning by abstraction. In this connection language and thus talk within practice have a prominent role to play, because in a community of practice the talk is not about practice, rather it accompanies the actions that take place.

Learning is defined as the increased access of learners to participating roles in expert performances. Learning is also looked upon as a way of being in the social world and not a way of coming to know about it (Lave & Wenger 1991). Learning is thus an integral and inseparable aspect of social practice (Hanks 1991). Legitimate peripheral participation is a concept developed by Lave and Wenger (1991) to describe the participation status of novices. This concept highlights the learning processes in which newcomers become a part of the community and thus belong to it. The feeling of belonging is not just an underpinning of learning but also an important part of the learning process itself. The novice can gradually move from legitimate peripheral participation to full participation by taking part in the activities in the community.

A common misinterpretation of this theory is to see it as having connotations of parochialism, particularity and the limitations of a given time or task (Lave & Wenger 1991). Transparency of a learning context cannot depend on features of the context alone, as the preparedness and flexibility of the learner are also important (Hanks 1991). The generality of any form of knowledge always lies in the power to renegotiate the meaning of the past and future in constructing the meaning in present circumstances. Learning is not merely situated in practice, it is also an integral part of generative social practice in the lived-in world. Appropriation takes place through situated negotiations and renegotiations of meaning in the world. Thus understanding and experience are in constant interaction and are mutually constitutive. Persons, actions and the world are implicated in human thought, and in our speech, knowing and learning. Hence learning implies that a person develops due to the possibilities enabled by these systems of relations. Therefore learning involves the construction of identities. Legitimate peripheral participation is an analytical viewpoint on learning, and thus a way of understanding this process (Lave & Wenger 1991). In Lave and Wenger's (1991) view learning can take place both with and without intentional instruction. Language is by Lave and Wenger treated as a means for acting in the world. Bearing this in mind, it is important to investigate retellings and discussions that take place around actions and also talk between the learners. Retellings and discussions are also reflections around practice, and this communication can thus create common knowledge in the community. Talk is thus not a substitute for legitimate peripheral participation, but learning to talk in the actual practice is the key to legitimate peripheral participation (Hanks 1991).

In school practice there is a tendency to focus more on the person and try to changing him than on putting focus on the process of increasing participation. Thus the identity of the learner becomes an explicit object of change. Learning has to be understood with respect to

practice as a whole, and learning and identity have to be treated as inseparable aspects of the same phenomenon. Learning is looked upon as something more problematic than merely the transmission of knowledge or the acquisition of skills. The process of learning is not just the process of learning by the newcomers, but also the reciprocal relation between persons and practice. Thus the move from legitimate peripheral participation to full participation is not a development in a static context, the practice itself is also in motion (Lave & Wenger 1991). In this way the interpretation of the ZPD constitutes a potential for learning that is created in the interaction between participants acting in a particular activity together. There is no upper limit for what the participants are able to learn from the task-related interaction, this depends on the development of the interaction as much as an estimate of the participant's current potential. In this way the ZPD emerges in the activity as it proceeds, and learning in the ZPD is not conceived of as just skills and knowledge, but involves all aspects of the learner and thus leads to the development of identities (Resnick et al. 1997, Wenger 1998, Wells 1999, Daniels 2001).

Learning is the construction of identities, which means the development of the whole person. Participation is defined as being more than just participation in local events in certain activities with certain people. Participation means being active in practices of social communities, and identities are constructed in relation to the participation in these communities. During participation, processes such as doing, talking, thinking, feeling and belonging are included so that participation involves the whole person, including body, mind, emotions and social relations (Wenger 1998). In school this means that pupils can be engaged in meaningful practices and that they are given access to resources that enhance their participation. Furthermore, they can be involved in actions, discussions and reflections that may open their horizons and also make a difference to the community they value. According to Resnick et al. (1997), the thinking process and identity construction go hand in hand: "To think or to reason well in a situation is, by definition, to take on the forms as well as the substance of a community of reasoners and thus to join that community. Much of discourse, and thus of cognition serves to situate an individual with respect to others, to establish a social role or identity" (p. 9).

The concept "activity" allows for a reformulation between the individual and social and cultural development. It is unrealistic to assume that development takes place on one plane and not on another (Rogoff 1995a, 1995b). A transformation of the learner also involves transformation of the community the learner is a part of (Wells 1999). The mutual relation between artefacts and community is also shown in the Activity System when a line is drawn

across the triangles to connect these factors (see Figure 3, p. 19). This means that changes in artefacts will affect the community and visa-versa. The three concepts of apprenticeship, guided participation and participatory appropriation are introduced in connection with socio-cultural activity. The word apprenticeship is used as a metaphor for activities on the community plane (Dewey 1916, Rogoff 1990, 1995a, 1995b, Lave & Wenger 1991). The metaphor involves individuals participating with others in a culturally organized activity, one of the main aims of which is to develop mature participation in the activity by the less experienced individuals. This concept includes situations far beyond expert-novice dyads, as it includes systems of interpersonal involvement and arrangement in which apprentices become more responsible partners. Guided participation refers to involvement between people as they communicate and co-ordinate effort when they participate in cultural activities (Rogoff 1990, 1995a, 1995b, Rogoff & Gardner 1984). This concept does not only include face-to-face interaction, but also side-by-side joint participation. This means participation that is frequent in everyday life and also more distal arrangements that do not require co-presence. Guided participation also means that persons are guided by cultural and social values as well as social partners. Guided participation refers to observation and to hands-on involvement in activities.

Participatory appropriation refers to how people change during involvement in activities and thus become prepared for participation in related activities. The term "participatory appropriation" or just "appropriation" are used to refer to the process in which people transform their understanding. The basic idea of appropriation is that people are changed and in this process are prepared to engage in similar activities. By participating in activities, people make ongoing contributions both in specific actions and in their attempts to understand the actions and ideas of others. Thus participation is in itself the process of appropriation. While guided participation is an interpersonal activity, participatory appropriation is the personal process in which persons change and handle a later situation in ways that were practised or prepared for in the previous situation. This situation is described as a process of becoming rather that acquisition. In guided participation, processes of communication and co-ordination of efforts are important. New members of a community try to make sense of the activities so that they can take part in them. Communication and co-ordination with other members of the community stretches the understanding of them all when they try to find a common ground of understanding (the same situation definition) to enable them to proceed with the activities at hand. When these people search for a common ground and also try to extend it, they need to make adjustments (gain intersubjectivity) to

acquire a common understanding (Rogoff 1995a). As Dewey (1916) said: "Men live in a community in virtue of the things which they have in common; and communication is the way in which they come to possess things in common" (p. 5).

Practice is defined as the source of coherence of a community. In this connection three dimensions of practice is described: mutual engagement, a joint enterprise and a shared repertoire. In a community of practice, people have dense relations of mutual involvement organized around what they are there to do. Practice exists because people take part in actions whose meaning they also negotiate to each other. What defines a community is membership in a community of practice and its mutual engagement. A requirement for being engaged in a community's practice is being included in what matters. Maintaining the community also requires effort from the community members. Even though the participants have much in common, the co-ordination necessary to do things together requires constant attention. Mutual commitment and collaboration create differences and similarities. Members specialize and develop shared ways of doing things. Each participant in a community of practice finds a unique place and gains his or her own identity, which will be further developed while working in the practice. The participants' identities will be both interlocked and connected to one another through their mutual involvement. All the same, the identities do not fuse and the mutual relations of involvement give rise to both differentiation and homogenization. Through mutual engagement the participants can learn from each other's competencies, and their actions function as complementary contributions. Even though mutual involvement creates homogeneity, it creates relationships among people. These relationships may be peaceful, but there may also be disagreements and conflicts between the participants (Wenger 1998).

In their joint enterprise the participants feel mutual accountability. The joint enterprise is the result of the collective process of negotiation that reflects the full complexity of mutual engagement, and it is defined by the participants in the very process of pursuing it. The joint enterprise is not constituted on the basis that all the participants believe the same thing, but on the basis that it is communally negotiated. The participants' communities of practice are not a self-contained entity, rather historical, social, cultural and institutional contexts influence them. Nonetheless, the members of the community produce the day-to-day reality with their responses to the conditions they act in. Therefore it is the participants' enterprise, but at the same time their community is part of a broader system that influences it.

Over time a shared repertoire is shaped among the participants in the community. Their joint enterprise creates resources for negotiating meaning, and it is these shared

resources that form a shared repertoire. The repertoire combines two characteristics that shape it as a resource for the negotiation of meaning. First it reflects a history of mutual engagement, and second it remains inherently ambiguous. The inherent ambiguity makes the community of practice dynamic and thus open for the generation of new meanings. In this practice a co-ordination of perspectives is a source for new meanings at the same time as it is also the source of obstacles, which in turn need the co-ordination of perspectives to be overcome. The key to making communities of practice work is thus to make social arrangements that put both history and ambiguity to work. The repertoire of a community of practice includes such things as routines, words and physical tools, and, furthermore, ways of doing things, stories, gestures, symbols, actions or concepts the community has produced or adopted during its existence and which have become a part of its practice. With respect to the learning concept there is a major difference between a lesson that is about the practice and takes place outside it, and explanations and stories that are a part of the practice and take place within it. Building social relationships around meaningful activities requires very good practices in which taking charge of learning becomes the enterprise of the community. Communities of practice then become the resources for the organization of our learning as well as the contexts in which learning is manifested through an identity of participation. Learning in the communities of practice can also be affected by the use of new artefacts, ideas, terms, concepts and images (Wenger 1998).

Cognitive Apprenticeship

In cognitive apprenticeship, conceptual and factual knowledge are exemplified and situated in the contexts in which they are used. This means that knowledge is not abstracted from the contextual use, and thus not just handed over from the teacher to the learner. In this way the educational problem of inert knowledge can be solved, but to give guidance processes that are carried out internally need to be externalized. The way most subjects are taught and learned in school does not give teachers and learners the opportunity to see how they solve the task or problem as an expert or a novice. Cognitive apprenticeship teaching methods are intended to bring these processes out into the open. Another aim of cognitive apprenticeship is to encourage the development of self-correction and self-monitoring skills. Two basic means of fostering these metacognitive skills are defined. The first is to encourage reflection on the differences between the novice and the expert performance. The second means of encouraging the development of self-monitoring is to draw attention to the fact that the problem solver

must use various cognitive activities when he or she carries out a complex task (Collins et al. 1989).

The traditional view in apprenticeship is that a product made well means well-earned profit. In cognitive apprenticeship it is necessary to find other incentives for participation that will lead to progress (Collins et al. 1989). Project work in which the work is directed by the pupils' interests and experiences may thus be a setting or work method in school that maintains the pupils' activity. In cognitive apprenticeship the aim is also to develop knowledge that can be used in different, but similar situations. The teacher's task is to create situations in which the pupils' knowledge can be used. This is not contradictory to the view of Lave and Wenger (1991) who, according to Hanks (1991), believe that the portability of knowledge is dependent on the preparedness and the flexibility of the learner. Reading a book and listening to a lecture are important ways of learning, but not as much will be learned as in cognitive apprenticeship because the pupils will have to use their knowledge in practical situations. Work methods similar to the apprenticeship method are used in school. Students are expected to learn to solve problems they encounter when carrying out complex tasks, and when they undertake projects guided by an expert, they need to use their textbook knowledge actively. When working in a project-directed way, pupils learn to find a problem and then solve it (Collins et al. 1989).

Two methods that can help pupils consolidate their knowledge are "articulation" and "reflection". Articulation is a method that encourages the pupils to articulate their knowledge, reasoning or problem-solving processes in a domain. The teacher could ask the pupils questions that lead them to talk about the processes they have been through and also talk about the findings they have made. The teacher could for example ask why one way of using the computer is better than another, and also why some of the pupils have used a camera just the way they have done. In this process the pupils start to reflect on the actions they have accomplished. They are led to compare their problem-solving processes with those carried out by experts. The reflection may be enhanced by various recording technologies, such as video and audio recorders and computers. In this way the pupils can watch or listen to their activities and try to reflect on what is good and what could have been done better. In this context the teacher will play an important role by giving the pupils suitable questions, where "suitable" means adapted to the pupils' performance levels (Collins et al. 1989).

The Idea of Shared Knowledge

The subject matter knowledge and the context in which talk takes place are focused on in a study conducted by Edwards and Mercer (1987). They treat dialogue in the Bakhtinian way, in that they attach importance to the context of dialogues (Bakhtin 1981, 1986, Holquist 1990). Furthermore, they are aware that joint understandings take place in power relations between teachers and pupils. The teacher represents the intentions of the wider culture or society that is presented in the curriculum. The pupils come to school with interests and experiences, and there is no guarantee that their interests are concurrent with the topics and goals of the curriculum. In the tension between the interests of the culture and the interests of the child it is decisive how the teachers play out their role in the classroom. Dewey (1902, 1916, 1938) believed that the content of education could be created through an interaction between knowledge already developed and the interests or the internal states of the pupils. This means that the teacher has to listen to the pupils and let their interests be heard in the classroom.

In the classroom, language provides the medium for teaching and learning. Language is also one material from which the child builds its thinking (Bakhtin 1981, Vygotsky 1986/2000, Holquist 1990). Thus language affects learning in two ways, as a medium for conversation and as a tool for thinking. The concept “handover” is used to describe the process in which learners, after some scaffolding, control the process themselves (Bruner 1983). Edwards and Mercer (1987) ask rhetorically where this handover takes place, and wonder why so many pupils apparently fail to achieve the competence of teachers. This leads to the final question: are the pupils really meant to achieve this competence? Often teachers are concerned with maintaining control of the content of the topics and the discussions in class (Edwards & Furlong 1978), but if the pupils’ interests are to be heard in the classroom, the teacher also has to let pupils introduce their topics without leading them in the direction he or she wants them to go, rather, according to Dewey (1902, 1916, 1938), opening for an interaction between the two poles of interest. Two of the questions I examine in this chapter are how knowledge is shared in classrooms, and what the teacher’s and also the pupil’s roles mean in this connection. In the traditional view knowledge is transmitted to the pupils, while the opposite epistemological view states that knowledge is constructed by individuals independent of the cultural, historical and social context. Shared knowledge is in a social constructivist view created in the interaction between the individual and the context. The teacher’s dilemma is then “how to get the pupils to learn for themselves what has been planned for them in advance" (Edwards & Mercer 1987, p.130). However active the pupils

are, we cannot assume that they can reinvent culture through their own activity and experience.

Most of the teacher's questions are not aimed at obtaining information, but teachers may use questions to ascertain what the pupils know, their actual developmental level, to control the topics of the discussion and to direct the pupils' thoughts and actions (Edwards & Mercer 1987). With this in mind, we can see that one competence pupils learn in school is to answer these questions appropriately to please their teacher. For most learning situations the goals or purposes for the activities are not revealed to the pupils. This means that pupils undertake the action they do because the teacher wants them to. One way of helping pupils come up with the answer the teacher already knows is to give the pupils hints or use body gestures and demonstrations, or "cued elicitations". Questions that asks for information and facts seldom reflect the everyday life outside school. Thus the pupils also have to think of questions as hypothetical, as "what-if" questions (Edwards & Mercer 1987). This clashes with Dewey's theory and social-cultural theory, which both maintain that everyday experiences not only must be used in school, but also that the knowledge or experiences the pupils gain in school must be of use in their life outside the school building. The pupils should be working on real problems, and thus not leave their life situations at the door when they enter the school. When they bring their interests and experiences to school, their life situations will thus also be part of the context for the actions that take place in school. Thus activities in school also can have a meaning for their life in their leisure time.

Context is defined both as a linguistic and non-linguistic entity. The linguistic context is the speech or the text that precedes and follows any given utterance. The non-linguistic context includes the time and place, the social action, the persons taking part in the activity and their behaviour and gestures. Physical contexts of joint activity may serve as a shared mental context of experience and learning. When pupils and teachers have been through demonstrations and developed an understanding of how to talk about it, the joint activity and the discourse of the past can become a shared mental context of the present. In this way it is not just the words and verbal expressions that count for the shared understanding, but also the context of the shared experience and activity. Teachers try to develop a shared understanding in classes by arranging recaps and summaries. Recaps and summaries for the most part are given at the beginning of a lesson when the teacher usually introduces what is to be done, while also connecting this with work that has previously been done. In this way continuity links are established between the coming and the finished work. Thus common understanding between teachers and pupils is built on the basis of a continuity of experience and talk which

also becomes the context for the meaningfulness of further activity and talk. In dialogues between teachers and pupils, teachers also tend to shift from the "I" to the "royal we" to give an overt expression of the knowledge or understanding the teacher is trying to make common. In this shared knowledge building "spontaneous contributions" offered by the pupils are the ways of communication least controlled by the teacher (Edwards & Mercer 1987).

Information is treated as both "given" and "new". These concepts indicate what is already known and what is unknown to listeners. The norm is for given information to precede new information. An example can be the sentence: "John paid for the meal *with his credit card*". The attribute at the end presents the new information. Everybody knows that John has paid for the meal, but how he paid for it was unknown to them. The added words, "with his credit card", provide new information about how the food was paid for. Thus the shared knowledge for the listeners is expanded or developed (Edwards & Mercer 1987).

Communication connected to a software programme or pupil-computer interaction in general rarely offers a rich interaction on its own (Crook 1991). Most computer applications at school are experienced in a context of social exchange. Computer experiences have a context that encompasses events outside the computer interaction itself. This could be when all the pupils in the class talk about experiences they have had in connection with searching for information. In this process they might have used various tools, among others ICT. In the class conversation these experiences will be shared with all the pupils and teachers, and the experiences will thus become shared knowledge for all of them (Edwards & Mercer 1987, Crook 1991). "Computer work must become a topic of classroom discourse such that the experience can be interpreted and blended into the shared understanding of the participants" (Crook 1991, p. 87). This classroom discourse may also help to prevent computer use from being isolated from the mainstream of classroom work, which is often the case when computers are placed physically in another room than the one the pupils usually work in, or the computer is used in free or additional activities when pupils have finished the work they have to do.

Communities of practice are by Scardamalia and Bereiter (1996) considered as a practice in which shared knowledge is created in class by collective commitment. To illustrate this they compare the success of a knowledge-building community with the performance of a Swiss watch. After close inspection, a watch will be found to contain lots of irregularities and imperfections so that one would consider it unlikely that it managed to keep perfect time. They believe that if schools are to be transformed into effective knowledge-building communities, the major challenge is to explain how the Swiss watches work so well in spite

of their imperfection, and next try to change the schools so that they function in much the same way. They suggest that the work pupils do has to be made visible to all pupils in class so that they can become a part of the knowledge-building activity. It is also expected that the participants give each other a constructive response. Important factors needed to make such a community are to create a climate and desire to advance understanding rather than promoting brilliant displays by individuals. To create understanding they think that the work process should be focused on problems rather than on categories of knowledge or on topics (Scardamalia & Bereiter 1996). Problems or questions as a device to build knowledge are also stressed in the theory of guided discovery in communities of learners (Brown & Campione 1994). This also coincides with project work as a method in which thesis questions guide the work (Berthelsen et al. 1987).

In a knowledge-building discourse more knowledgeable others also learn, and such communities are therefore other information sources than teachers, for example, who have usually transmitted knowledge to the receiving pupils. It is the nature of the discourse that decides if it is a knowledge-building community or not. All participants in a community, teachers as well as pupils, can discuss and comment and respond to each other. Both oral and written language can function as a medium in this discourse. As a tool for writing documents available through a computer network can function as a meeting point for participants in a knowledge-building community. All the same, technology in itself can not bring about the preferred change in school, but teachers have an important role in the creation of strategies that get the pupils involved in collaborative knowledge building, where technology may be an important factor (Scardamalia & Bereiter 1996).

In the text below I illustrate how knowledge can be shared in classrooms. The knowledge I am thinking of can be defined on three levels. The first level comprises the content knowledge pupils learn during the project period. The second level comprises the methodology or the strategy the pupils learn for how to carry out the work. I define the third level as the mastery of tools, and focuses especially on ICT equipment. Language is important on each of these levels. The first illustrations are from the topic information searching.

Illustrations of How Knowledge Is Shared in Classrooms

Information Searching

In the class I observed at Applebee School, the pupils took the same basic course regardless of what they could do beforehand. Steven (teacher) told the pupils that it was very important that

they move together towards their goals so that they would not destroy the feeling of community (intinf 102500). During the project work in Applebee School, the pupils were to make links to the two films they were producing as additional information (description of Applebee School, The Planning Phase, p. 98). In this connection one of the pupils asks the teachers if they can use the Internet to find some information about the topics (trec 100300). This pupil obviously understands that the Internet would be a useful tool during this work. Anne (teacher) answers the pupil's question. She says:

Illustration 1

> *You can't use the Internet because you haven't learned to use the information-searching strategies yet (Applebee School, trec 100300).*

Anne also has clear thoughts about why the pupils could not use the Internet to search for information. She says:

Illustration 2

> *The pupils will learn effective search methods, to cut out, for instance, a short paragraph from a web page that they have found. In this way we're trying to stop the pupils from printing out information that they haven't processed (Applebee School, intinf 102500).*

This dialogue with the pupil shows that the teachers at Applebee School believe that it is important that all the pupils receive the same training. The pupil who asks this question probably knows how to use the Internet, as he understands that it could be useful during this work, but the teachers have decided that all the pupils must receive the same training before they start to use the web as an information source. This could be due to the fact that the teachers knew that as many as eighteen of the thirty-nine pupils were not connected to the net at home (Table 2, p. 397), which means that a lot of them could not get this training outside school other than at homes of friends or relatives. Another reason to consider was organizational logistics. If some of the pupils were to search for information on the net, a teacher would have to come with them to the computer lab. This would then mean one less teacher in the work area where the whole class was gathered. This could have been one reason for the teachers' decision that all pupils should go through the same introduction conducted by one of them, but it is also evident that the teachers are convinced that a joint introduction is important for the community and that every pupil should be given the same information or guidance towards mastery. In this way, computer work, that is searching for information, is detached from the mainstream work in the class (Crook 1991), but the training courses at this

school are meant to train pupils in the mastery of the ICT equipment as a tool precisely to attain natural integration in later projects. This year the pupils' training course will give them competence to both carry out “assignments” during the second year and “self-elected activities” the last year at this school (intteam 101300).

At Bridgeford School the practice is different. During the observed project period the pupils in the 8th-grade class at this school do not receive any special training in how to search for information on the Internet, but Sarah (teacher) helps pupils when they experience problems during the work process as described in Chapter 8 “Scaffolding” (Illustration 2, p. 175). In a dialogue with me, she says that the pupils have already had some training in how to search for information on the Internet. She adds:

Illustration 3

> *In the ICT group we have offered the pupils courses in various ways of using the ICT equipment. And on this level I have been asked for advice several times. We taught the pupils to cut and paste, that means to find information on the net, cut and paste pictures and texts in their own documents, which they edited before they printed them out. I actually repeated this together with them three weeks ago. Otherwise we haven’t had much joint training, but we do give help to pupils who need it (Bridgeford School, intinf 111300).*

Sarah informs me that the pupils have practised finding information and using this in their own documents. They have also repeated this a few weeks before they started on the project. Help is given to pupils who need it by the ICT group, and the teacher for each class is responsible for finding out which pupils need this help (inthead 120400, intinf 111300). It is also possible for the pupils to enrol in a course on their own volition (intinf 111300). Thus the whole class does not partake in the same training courses in the use and mastery of the ICT equipment. The help is adapted to what they can do beforehand and to what they can develop to master the task together with a teacher under his or her guidance. Thus the activity arranged by the teachers will help the pupils to develop in the use of ICT. Hence an activity has been created that can help all the pupils to make use of the equipment to find information, but at Bridgeford School there is a practice that takes into account what the pupils know and can do beforehand. Seven of the twenty-four pupils in class 8B are not connected to the net, (six pupils out of twenty-one in 8A), (Table 2, p. 397), so this also means that the pupils have different possibilities at home to learn how to search for information on the net. At Bridgeford School there is thus a culture to help pupils who need assistance so that they can develop a shared knowledge on web search techniques. In this way the whole class becomes a learning community in which all pupils can move from novice towards expert knowledge on how to

search for information. How the pupils learn to compile information at Cooper School differs from both Applebee School and Bridgeford School.

When many of the pupils at Cooper School are compiling information in the computer room they all want some help from John (teacher) at the same time. All the twelve computers are being used. John says to the pupils:

Illustration 4

> *I can't manage to teach people on twelve computers all at once. I'm going to teach two of you to be experts, and then you can help others afterwards (Cooper School, trec 090700, description of Cooper School, The Realization Phase, p. 135).*

In the computer lab there is no arrangement for a joint introduction in information-searching techniques. The teacher has every possibility of doing this as he has both a projector and a screen in the lab. But he would rather guide two pupils who can then help other pupils afterwards. He calls these pupils expert pupils, and we can see clear parallels to the process Vygotsky called guidance in the ZPD (Vygotsky 1978), whereby more competent pupils help others to develop. All the same, there is no structure or plan for how these pupils will help the others, and the teacher's intentions more or less came to nothing (trec, obsnot 090700). The pupils have had some common courses with the deputy head in the 8th-grade class in connection with the use of Microsoft Word, but John informs me that they have not given the pupils enough basic courses in the eight and ninth grade, as perhaps they should have (description of Cooper School, The Context, p. 127). Nor do the teachers in this team give the pupils the opportunity to take courses if they themselves think they need it, even though eight pupils out of forty-four are not connected to the net at home (Table 2, p. 397). Marion (teacher) comments on how the pupils' learn to use the ICT equipment:

Illustration 5

> *Most of the pupils have learned to search on the Internet by themselves, or got some help from the teacher when they needed it. And in this project they have also been given some URL addresses, so it's easier for them to find what they're looking for (Cooper School, intinf 110200, description of Cooper School, The Realization Phase, p. 135).*

Marion states that she thinks that most of the pupils have learned to search for information on the Internet themselves. She comments that John has given some pupils help when it is needed, and that the provision of URL addresses has been helpful for them. All the same, John thinks that there are still some girls who need help to find information on the net (intteam 110900).

At Applebee, Bridgeford and Cooper Schools we can see that there are different practices on how to teach pupils to search for information on the net. At both Applebee and Bridgeford Schools the teachers aim to give the pupils shared knowledge on how to master the Internet as an information source. At Applebee School, they want to give the pupils the same training, while at Bridgeford School the training is adapted to the pupils' needs. At Cooper School the guidance is more random. All the same, seven girls and four boys say that they have learnt something on how to search for information at Cooper School. At Bridgeford School, four girls and two boys think they have learnt something on how to search for information on the net during their project work (Table 14, p. 407, Table 15, p. 408).

Learning Programmes

The pupils at Applebee School are introduced to the I-movie programme. Steven (teacher) is giving the introductory lesson to one-third of the pupils in the class. All the pupils will receive the same introduction, but just one-third at a time, as there is not enough room for everyone in the computer lab. Steven says to the pupils:

Illustration 6

(1) Steven:	*Okay, good morning. There are a few rules and routines in connection with this room I want to tell you about first. All of you know why we're going to use the I-movie programme. You know what we're going to work on for the next few weeks? (looks at the pupils).*
(2) Willy:	*Yes.*
(3) Steven:	*And what is it?*
(4) Willy:	*Making a film about the school.*
(5) Steven:	*Exactly. Yes, and because of that, you're going to learn about various tools you can use. We hope that this will help you in the process when you're deciding what to use for the topics "Our town" and "Our school". I'm going to put you in pairs. This is a typical collaborative exercise, I feel. For the first lesson, we're going to look at the rules and procedures, and also watch a little of the film about the school trip we took. I have started to edit using the editing programme to find out what possibilities it has. It's easy to use, so I thought that in the next lesson we could start on an exercise about how to use the I-movie programme. One thing that's very important, is that we're working together towards our goal, no one is allowed to run ahead of the pack. Later when you have learnt more about the programme you can work at your own pace. But in the beginning, we want everyone to come along. That's important. Then I'll give you a paper with some tasks, when everybody has finished them, you'll get a new sheet of paper. Does that sound okay?*
(6) Pupils:	*Yes (Applebee School, trec, vrec, 092600).*

In the first utterance Steven gives (1) the pupils some rules and procedures. In this way they acquire shared knowledge on how to work in the computer room. He then continues to tell the pupils that they are going to use the I-movie programme and then asks (1) them what they are going to work on for the next few weeks. This is of course a question that Steven knows the

answer to, and the exchange between the pupils and the teacher in utterances (3, 4, 5) can be defined as a traditional IRE (initiation-response-evaluation) communication (Sinclair & Coulthard 1975). He evaluates (5) with the word “exactly”, thus indicating that it was just the answer he was looking for. At the same time he also apparently asks the pupils to see the connection between using the I-movie programme and working on their topics as in utterance (5) he goes on to talk about these two issues. He tells the pupils that he will be showing them a film from their school trip, and informs them that he has used exactly the same programme they will be using to edit the film. Then the teacher lets the pupils know that he has only just started to work with the editing programme to find out what possibilities it has, in other words that he is also in a learning process together with the pupils, just one step ahead.

More knowledgeable others are not outside the learning process (Lave & Wenger 1991, Scardamalia & Bereiter 1996). The move from legitimate peripheral participation to full participation is not a developmental process just allotted to individuals. It is also a developmental process that includes the practice itself, which is in motion (Lave & Wenger 1991). This means that all participants develop, also including the more knowledgeable others, such as teachers. More knowledgeable others in knowledge-building communities are not outside the learning processes, as teachers often are. It is the nature of the classroom discourse that determines whether the classroom functions as a knowledge-building community or not (Scardamalia & Bereiter 1996). In this dialogue, Steven shows that he is also in the process of learning the programme. This was also evident during the editing process when Steven was unable to assist the pupils the moment they needed help, but had to work on the problem before he could help them (Illustration 8, Chapter 8, p. 184). Steven also talks to the pupils on an equal level, asking them if his suggestion is a fair deal. He says (5): “Does that sound okay?”. He is not afraid of showing the pupils that he has something to learn too. It goes without saying that this attitude appears to create an atmosphere for learning practices in which the aim is understanding rather than giving brilliant answers to the teachers’ questions (Scardamalia & Bereiter 1996).

In utterance (5) Steven also tells the pupils that it is important that they progress together and that no one should run ahead of the pack. He explains to the pupils that when they have learned the programme, they can work at their own pace. Steven has clear reasons for only giving the pupils one instruction page at a time when learning to use the I-movie programme. He says:

Illustration 7

> *It was to ensure that everybody was coping. He says that he could have destroyed the feeling of community if he had given them the whole bunch of papers at once (Applebee School, intinf 102500, description of Applebee School, The Basic Course, p. 93).*

Steven likely wants the pupils to feel that they are mutually engaged in a joint enterprise aiming to build a shared repertoire during this exercise trying to learn to use the I-movie programme (Wenger 1998).

During the observed project periods at Bridgeford and Cooper Schools, the pupils did not learn to use a special computer programme so they did not acquire any shared knowledge as the pupils in Applebee School did with the software programme.

Using External Equipment

Before the pupils at Applebee School start working with the video camera, Steven (teacher) asks the pupils about the last lesson when they worked with the I-movie programme. He has one-third of the class together with him. He asks them if they were comfortable with the activity the last time they worked with the I-movie programme. Some of the pupils respond in the affirmative. Steven tells them that the lessons they have had were only an introductory course in the programme and that more detailed training will come later. Today, he says, they are going to take a step further; they are going to learn to use the video camera. During the fist lesson they are going to work together, but during the next lesson the group will be divided into two groups. (One will continue to work with the video camera, the other group will work on e-mail (see description of Applebee School, The Basic Course, p. 93). Steven says to the pupils:

Illustration 8

> *The last lesson in arts and crafts some of you had some problems putting a still-photo camera on a tripod. The first exercise is to unpack the video camera and put it on the tripod. You'll get written instructions you have to read and work out yourself (the pupils sit quietly and listen to Steven). You'll all get the same instructions (he hands out a sheet of paper to each pupil. Steven continues): The group leader will write down all the points you're going to work on (the sheet of paper they have received lists some items as exercises. The pupils are going to work on some of them. Steven informs the pupils about which items they are going to work on. He says): You're going to work on 285, then on 287, recharging a battery. That's what we're going to work on and discuss. Then we'll move on to page 293, and then 295, automatic focus, I think that'll do. Only work on these instructions because we want to ensure that you can put the camera on the tripod and make a film the right way. And another thing, remember that no one is finished before everyone in the group can do the job (Applebee School, trec, vrec 091500).*

Steven reminds the pupils of the process they have already been through when they learned to put a video camera on a tripod during one of the arts and crafts lessons (trec, vrec 091500). In this way he tries to develop shared understanding in class by using a recap. Steven connects what the pupils are going to be doing with what they have done. In this way he establishes a continuity link between the finished and the coming work. The continuity of experience and talk also create a meaningful context for further activity and talk between teachers and pupils, and also create a basis for common understanding (Edwards & Mercer 1987) and thus shared knowledge. Now, instead of a still-photo camera, the pupils are going to put a video camera on a tripod. The teacher obviously has planned what issues the pupils have to work on when he lists the pages the pupils are to work on. In this way he shows what is necessary for the pupils to master if they are going to make a successful film. The pupils are going to work in groups when they carry out this exercise. Steven also reminds the pupils that no one is finished before all of them can master putting the camera on the tripod, and that making a film the right way means using the most important function buttons (description of Applebee School, The Basic Course, p. 93). This means that the teacher wants the pupils to gain shared knowledge on the use of the video camera.

After this sequence the pupils go out to make the film. When the first group comes back, some of them want to watch their film sequence. Steven tells them that they have to wait for all the groups to be finished so that they can watch the sequences together. Steven tells them to rewind their film so they are ready when the other pupils arrive. Then one of the pupils in the group says:

Illustration 9

(1) Tommy: *Can't we start now?*
(2) Steven: *No, we've got to wait until all the pupils are back and discuss them together (Applebee School, trec, vrec 091500).*

This dialogue shows that Steven wants the pupils to watch the films together so they can talk about and thus "articulate" and "reflect" on each other's film sequences (Collins et al. 1989). In this way they can discuss what has been done in a structured way so they can analyse, criticise and suggest better ways of doing things (Wenger 1998). Then shared knowledge between the pupils can be created throughout the dialogues. The rendered dialogue below takes place between the pupils and the teacher when they are all seated in front of the viewing screen.

Illustration 10

Sequence 1:

(1) Steven:	*I can see that you've used the tripod.*
(2) Chris:	*Yes.*
(3) Steven:	*What do you feel now about the way you move the camera?*
(4) Robin:	*We move it a bit too fast, I think.*
(5) Steven:	*Yes, you move it a bit too fast, yes. Notice that the picture is not in focus. Why do you think that happened?*
(6) Robin:	*Because we're zooming? (a bit uncertain).*
(7) Steven:	*Yes, it could be because you're zooming and moving the camera at the same time. There's something called automatic focus on the camera, it automatically adjusts the focus, doesn't it? And it needs a little bit of time, so if you move it a bit too fast, it can go out of focus (Applebee School, trec, vrec 091500).*

In the first utterance Steven comments (1) that he can see that they have used the tripod. In utterance (3) Steven asks the pupils how they use the video camera. He has obviously something in mind when he asks the question. Robin responds (4) to his question by saying that they move it a bit fast. In the next utterance Steven confirms (5) Robin's statement and also brings the problem of focus into the conversation, asking them directly why the picture is out of focus. The knowledge that they move the camera too fast is shared by all the participants in the dialogue. This information thus becomes "given". Steven also brings "new" information (Edwards & Mercer 1987) into the conversation that the pupils have to consider. He says that the picture is not in focus. Robin again comes (6) with a suggestion. He thinks that it is due to their zooming. Steven speaks again and confirms (7) what Robin is suggesting. But in this utterance he also provides the pupils with some new and additional information about automatic focus (Edwards & Mercer 1987). In the next sequence Steven is commenting on another film in another group:

Sequence 2:

(8) Steven:	*Do you see the automatic focus? It doesn't manage to click in. That's what happens when you move the camera back and forth.* *How could you have done this better?*
(9) Mia:	*We could have kept the camera more steady.*
(10) Steven:	*Yes (Applebee School, trec, vrec 091500).*

In this sequence Steven is also commenting on what they are watching on the screen. They are watching a shot where the camera fails to remain in focus. Steven tells (8) them why their film has turned out this way, because they move the camera back and forth. Then he asks (8) them how they could have done this better. It is obvious that Steven knows the answer to this question. He is most probably asking the pupils this question to make them reflect in the group to attain shared knowledge on how to use the camera. Mia responds (9) to this question and says that they could have used the camera more steadily. In utterance (10) Steven

confirms this statement with his “yes”. In this sequence the traditional IRE communication pattern is also used (Sinclair & Coulthard 1975), but the aim is probably to give all the pupils information they need to make a better film. So this communication pattern also gives the pupils shared knowledge that is important to know for their project.

Steven gives a third group of pupils a much more open question and thus allows the pupils to reflect more freely. He starts the dialogue with the pupils by asking:

Sequence 3:

(11) Steven: If you had the opportunity to go outside and film once more, what would you have done then?
(12) Emile: Made a better film.
(13) Steven: What do you mean by better?
(14) Emile: I would have used a tripod.
(15) Steven: A tripod yes, why would you like to use that then?
(16) Emile: Because we would avoid moving the camera back and forth.
(17) Steven: Yes, then we could have seen much better what you wanted to show us. Now there was a lot of grass in the frame (Applebee School, trec, vrec 091500).

Steven asks (11) them what they would have done if they had the opportunity to make their film again. In utterance (12) Emile answers quite generally “made a better film”. Then Steven challenges him and asks (13) what he means by “better”. Emile replies (14) by suggesting that he could have used a tripod. Steven agrees with his suggestion (15), but again challenges him and asks him why he now wants to use a tripod. Emile replies (16) that he could then have avoided moving the camera back and forth, meaning that it would have been more steady. Then Steven rather ironically adds (17) that if they did this they might actually have seen what they intended to show, which was definitely not the grass that appeared to dominate their film. In this dialogue the pupil shows that he uses the criteria that have been introduced in the conversation earlier. He suggests unsolicited that he should have used the tripod and also explains why he should have done so. This shows that the issues that have been taken up earlier in the dialogue are being actively used by the pupil and thus have been appropriated and understood by him. This also shows that reflections around a specific issue performed in a group can be made common and thus shared by the participants.

Some of the pupils at Bridgeford School have taken some pictures with a digital still-photo camera during the project period. When they are trying to download the pictures on to a computer they encounter some problems and Sarah (teacher) says:

Illustration 11

> *Use what you have printed out already, use the best of it. Instead of the others, you can just write about them. Use the pictures you already have, and perhaps use small pictures instead of the pictures that are missing. It's not your fault that things didn't quite work out, you've really worked well (Bridgeford School, trec 112200).*

The pupils have problems downloading these pictures. They cannot find the right cable, and thus they cannot use the pictures they have taken. The pupils have already printed some pictures from the net, and Sarah tells them to use these pictures instead. She also tries to assure the pupils that it is not their fault. Sarah says that the technical problems were much greater than she could have ever imagined (teacher log). The pupils at Bridgeford School are also using video cameras, but they did not receive any training in how to use either the still-photos camera or the video camera. The pupils also had some problems with the video cameras. Sarah says that she had had no idea that the video cameras were as bad as they actually appeared to be. "I could have checked beforehand," she says, but adds that she was not aware that so many pupils would want to use this equipment during the project period (teacher log).

At Cooper School two pupils has also used the video camera during the project to make a film of the process. At the end of the project period the teachers acknowledge that the pupils have not been able to make a film. Ben (teacher) comments on the process these pupils have been through:

Illustration 12

> *The pupils had too little training and too little support in how to use the video camera. They also received too little help in finding out what to film (Cooper School, trec 110200).*

He obviously feels that the pupils have been given too little training and support during the work process. As an afterthought he also mentions that they should have received much more help in finding out what they should have focused on when filming. The aim at Cooper School is not that the whole class should make a film, and there is no reflection on the idea that all the pupils in the class should use such a tool as a joint repertoire, but it seems that the two pupils who were aiming to make the film should have received much more instruction in how to use the camera as a tool.

The work processes at both Bridgeford and Cooper Schools show that a great number of pupils can choose to use still-photo cameras and video cameras during project periods. If all the pupils as part of their shared repertoire learned to master how to use these tools they

would also have had more equipment to choose between when collecting and presenting their information during project periods. Sarah (teacher at Bridgeford school) also reflects on the fact that the pupils may be forced to go back to traditional writing when the equipment does not function well (teacher log).

Making Presentations

At Applebee School, all the pupils learn to use the I-movie programme which is the presentation programme they are going to use during the project whereby they will present the two films as their product. All the pupils in the class thus are given the opportunity to master this programme at an elementary level. Six of the pupils are also picked out to edit the films the pupils have made (description of Applebee School, The Realization Phase, p. 100). During this project Mary and the other pupils in the two groups have moved from legitimate peripheral participation towards full participation in the targeted practice of the community (Lave & Wenger 1991). They have managed to learn some of the teachers' competencies through their guidance. The learning development exists first on the external plane, in the communication processes between the pupils and the advising dialogues between the teacher and the pupils. Then the competencies are appropriated by the pupils, and the practical knowledge is adapted by the individuals on their internal plane.

After the project period has ended the pupils in Applebee School are gathered in the school's auditorium. One of the pupils asks Steven (teacher) if they had finished the films. Steven addresses his answer to the entire class:

Illustration 13

> *One of you asked when I came in here if we had finished the films. I want to underline, it's the class that has made these films, it's we who have made them. This is a class project. Sometimes maybe only some of us will finish the work. Everyone cannot finish the work together. The next time it will be others who finish the work. I know there are several persons here who can do that. (Applebee School, trec, vrec 101300, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 103).*

Steven wants the pupils to feel that the project and the films are the whole class's mutual undertaking. "We" have made them, he asserts, and uses the royal we to overtly express the fact that all of them, both teachers and pupils in the class community, have made these two films together (Edwards & Mercer 1987).

The pupils are also encouraged to comment on the finished films when they watch them in the school's auditorium. Steven thinks that their work is good and reminds the pupils

of the first films they made when they practised using the video camera: "I think that back then you used the camera in a different way." Then he asks the pupils:

Illustration 14

(1) Steven: *Do you see any difference?*
(2) Pupils: *Yes.*
(3) Steven: *What are you thinking of Sam?*
(4) Sam: *The camera is much more steady.*
(5) Steven: *Yes. Other things?*
(6) Tom: *I think the sequence with "the coastal steamer" was a bit short (this pupil has actually made the film sequence of this boat.)*
(7) Steven: *Yes, it was a bit short. But the film had to have a limit of one and a half minutes, that was the limit. Anybody else want to say anything?*
(8) Richard: *At the end of the film the guitar playing, it went a bit fast?*
(9) Steven: *Yes, it was a bit fast at the end. What do you think, Richard, what's difficult when you have that short a time?*
(10) Richard: *What we have to edit out?*
(11) Steven: *Yes, you do have some choices to make. You want to include most of all the sequences everybody has made, and that's a hopelessly difficult task (Applebee School, trec, vrec 101300).*

In this dialogue many of the pupils answer (2) "yes" when Steven asks (1) if they see any difference in how they have used the camera after they have had some practice. Sam answers (4) that they have managed to hold the camera much more steadily when Steven asks (3) for some specific examples of what the difference is. Then Steven asks (5) if any others have comments. Then the conversation turns in another direction. One of the pupils thinks (6) that the sequence involving the "coastal steamer" has become too short. All the pupils have worked in groups that have contributed to these two films about "the school" and "the town". The conversation during the last few utterances (7-11) is focused on the time limit and that some sequences have been cut quite short. Steven tries to explain the reasons for this to the pupils and he talks about the time limit. The pupil asking about the "coastal steamer" has worked in the group that made the film sequence about this boat. He obviously feels that he has contributed to this film, but is also disappointed because he thinks their contribution has been cut too short, but all the same, when the pupils watch the films they can see that all of them are involved. Thus they have every possibility to feel mutual involvement in a joint enterprise (Wenger 1998).

Steven also thinks that the film has a unifying effect on the pupils:

Illustration 15

The films bring the class together. They become a common goal. It's not an individual goal you are supposed to attain while competing with others. What I think is important is that they can support each other and feel that they succeed (Applebee School, intinf 102500).

During the project period the teachers at Applebee School also emphasise that the entire work is something they are doing together. Anne (teacher) says:

Illustration 16

> *It‘s very important to remember that we’re together on this work as a class. And it won't be a finished product if just the pupils who are working on the films or the pupils who are working on the texts finish their work. Both groups have to do their job so that we can attain a good result. It‘s very important that everybody pulls his/her weight here (Applebee School, trec 100300, The Planning Phase, p. 98).*

Anne focuses on the fact that all the pupils are involved in the enterprise. She uses the royal “we” (Edwards & Mercer 1987) when she talks about this to the pupils. She ends her utterance by saying that everybody has to pull his or her weight if they are to attain a good result. Steven adds:

Illustration 17

> *If we take a look at how we've arranged this, we see that first we started with training so that you could learn about the various tools. Second, everybody had to make suggestions on how to make the two films, what the topics should be. And third, we divided you into teams so that you could work out proposals for what the team could work on. So the whole class is responsible for this work, and you all have your share of the product (Applebee School, trec 100300).*

Steven tries to make it clear to the pupils that they have all been through the same process together. He lists what phases they have worked through and concludes that each member of the class has their share of the product. Steven also uses the royal "we" (Edwards & Mercer 1987) to explicitly express the mutual involvement in this joint enterprise.

Later after the project period had come to an end, all the pupils had the opportunity to work on the sequences they had filmed (description of Applebee School, The Product Presentation Phase, the Assessment Phase and the Complementary Phase. p. 103). In this way they would probably feel that they had been through the same processes as the pupils who were picked out to edit the films during the project period. Nevertheless, the pupils had the possibility of moving from legitimate peripheral participation to full participation (Lave & Wenger 1991) with respect to the mastery of the editing programme.

In Bridgeford School, one of the groups was also making a film. Sarah (teacher) comments that some pupils learned to edit films:

Illustration 18

> *It's okay that some pupils both in A and B can edit films, because then they can teach this to other pupils in the classes (Bridgeford School, trec 120400).*

The pupils in the group receive some help from a teacher responsible for the AV equipment to help them to edit the film (description of Bridgeford School, The Realization Phase, p. 121). Sarah obviously thinks that it is okay that pupils receive some training and thereafter can help other pupils who also want to edit a film. Sarah talks to one of the expert pupils later that day.

Illustration 19

> *(1) Sarah:* *Benny, it would be nice if your group could teach the editing technique to another group.*
> *(2) Benny:* *Yes, that's okay.*
> *(3) Sarah:* *Mm.*
> *(4) Benny:* *Very easy to do, really.*
> *(5) Sarah:* *Yes, that's good (Bridgeford School, trec 120400).*

In this dialogue Sarah encourages (1) Benny to help another group. Benny also confirms (2) his willingness to do this. He also tells (4) Sarah that it is very easy to edit films, and Sarah (5) responds: "That's good". Nonetheless, Sarah intends to learn how to edit films before the next project period commences so that they will not be dependent on other people all the time. Sarah has also decided to press the school to buy new video cameras (teacher log).

In Applebee School, all the pupils were introduced to the I-movie programme, while in Bridgeford School, the pupils who wanted to use a video camera in their work were given some help to carry out the editing process. This means that not all pupils at Bridgeford School had the opportunity to learn to master such a computer programme to make presentations. On the other hand, all the pupils at Bridgeford School had learned to make a Power Point presentation and Sarah also states that they have been through such a process some time ago:

Illustration 20:

> *Three weeks ago I repeated how to make a Power Point presentation. And we also had a long sequence talking about how to present information to others. Then we made a little Power Point presentation (Bridgeford School, intinf 111300).*

At Bridgeford School all the groups presented their work to each other in one way or another at the end of the project period. After each presentation the pupils commented on each other's work. The dialogue rendered below is a conversation between pupils who have made a presentation and their audience. The presenting group, two girls and two boys called Jenny,

Lisa, Ron and Harry, has worked on the topic "national dishes". Sarah (teacher) both leads and takes part in this conversation.

Illustration 21

(1) Sarah:	*Yes, and we've to thank this group for their presentation. Do you have any comments? First positive criticism.*
(2) Benny:	*It was quite funny.*
(3) Sarah:	*Yes, May?*
(4) May:	*It would have been better if they all had said something.*
(5) Sarah:	*Yes, for us in the audience it would have been an advantage if all of you had participated, I agree with that, but you surely had planned this?*
(6) Jenny:	*They chose it themselves (she is talking about the two boys who have chosen to stand behind two large collages they have made about national dishes).*
(7) Sarah:	*They chose it themselves.*
(8) Ron:	*It would have been a bit stupid if some of us stood in front of the collages. It would have been difficult to look at them then.*
(9) Sarah:	*Yes, you wanted someone to hold the collages.*
(10) Lisa:	*Yes.*
(11) Sarah:	*Okay, mm, other things that you think were lacking?*
(12) Julie:	*There were no pictures?*
(13) Sarah:	*No, there weren't any, but I think you have an explanation for that (looking at the presenting group).*
(14) Harry:	*No, we didn't manage to print them out (they had some technological problems).*
(15) Sarah:	*Didn't manage to print them out, no.*
(16) Harry:	*We had a lot of pictures, but we couldn't make it work.*
(17) Sarah:	*Did you find any information on the net?*
(18) Harry:	*Yes.*
(19) Sarah:	*Were there any pictures there then?*
(20) Ron:	*Yes.*
(21) Sarah:	*Then you could have copied them into your document, you could have done that. Anyone else who wants to say something?*
(22) May:	*I didn't get any cake (the pupils had made a cake and given the pupils a piece each, May was absent that day).*
(23) Sarah:	*Oh no, May didn't get any cake (rather humorously). It will be fun to look at your recipes, you must put them on the wall so we all see them (Bridgeford School, trec, vrec 121300).*

In the first utterance Sarah invites (1) the pupils to comment on the presentation. Benny says (2) that he thinks that it was quite fun, and May comments (4) that it would have been better if all of them had said something. In utterances (5-10) the talk centres on why the pupils presented their material the way they did. The pupils did not want to stand in front of the posters while they presented the recipes that had been written on computers. In utterance (12) Julie introduces another issue in the conversation. She asks why they do not have any pictures, with the obvious implication that there should have been some. This group had taken some pictures, but could not use them due to technical difficulties (this was the group that Sarah excused, as it was not their fault, (trec 112200). The dialogue focuses on this issue from utterances (13) to (22). Then May gives the dialogue a humorous tone. She says (22) that she did not get any cake. The pupils had served some homemade cake as part of their

presentation. Then Sarah hints (23) about the pupils' recipes probably thinking that they can make such a cake themselves if they want to.

During this presentation the pupils receive such critical comments as “it’s quite fun", “it would have been an advantage if everyone had said something” and “there were no pictures”. Such comments can help the commenting group see what is good about their presentation and also what could have been done better. When the whole class is gathered they all have every opportunity to take part in the common reflection (Collins et al. 1989, Wenger 1998). In this way the pupils can acquire shared knowledge on the project presentations. Furthermore, the pupils can also obtain shared knowledge on the content that is presented as parts of the overarching theme that was presented by the teachers in the beginning of the project period (Berthelsen et al. 1987).

Ben (teacher at Cooper School) has some thoughts about the exhibition evening. It is during this evening the pupils can show the result of their work. He is afraid to put too much emphasis on this exhibition so that the climax of the work will be on that evening, because lot of the work has been done before and will not be seen there. He is thinking of the pupils who have worked a lot, but had trouble achieving a very good result due to problems they encountered along the way (intteam 110900). After the exhibition evening the pupils at Cooper School had some assessment conversations with the teachers. The dialogue rendered below is between a girl who worked on the topic “the boat trip” and Ben. The group of three girls made a cartoon with a text illustrating the journey from Norway to America. Ben starts the dialogue with one of the girls in the group and asks her:

Illustration 22

(1) Ben:	*You've learned a lot from this work, but you think the presentations could have been better (Ben reads from the assessment form Wendy has written).*
(2) Wendy:	*Yes, perhaps all the groups could have presented their work in turn, got some attention all of them (she is thinking of the exhibition day).*
(3) Ben:	*You mean you should have presented to the whole audience, all the groups one after another?*
(4) Wendy:	*Yes, just a short time in the beginning, so that all the groups could have presented a little bit of their work. And then everyone could have walked around and taken a closer look at the work afterwards.*
(5) Ben:	*Yes, that’s an interesting idea. That’s a good idea. It would have taken some time, but…(Cooper School, trec 120700).*

Ben starts (1) by referring to the assessment form the pupils have filled in (description of Cooper School, The Product and Process Assessment Phase, p. 141). Wendy has written that the presentations could have been better, suggesting (2) that all the groups should have had time to present their work to each other. Then Ben probes (3) to find out if he has understood

her suggestion correctly, that all the pupil groups should present to the audience. Wendy confirms (4) that he has understood her intention and adds that this presentation would not have to be long. Furthermore, she proposes that they could have taken a closer look at the products after this short presentation. Ben admits (5) that this could perhaps be a good idea. Wendy obviously feels that the pupils should have talked with each other about their products. It is also evident that the pupils in this class did not know much about each other's work. Just one pupil mentions that he had learnt something from another group (Questionnaire 2, Appendix 6D, p. 394). During this presentation phase the pupils could also have told the others about things they experienced during the process and then they could also have had the opportunity to explain why their work turned out the way it did. Then the audience would have learned why some products appeared to me much more "rich in content" than others.

A week after the exhibition the pupils are gathered in the classroom during their project lesson. The headmaster and a representative from the local historical association are also present during this summary session. The pupils are asked to comment on their projects and whether they had learnt anything about genealogical research. Most of the pupils are not eager to answer and give short comments, which preclude the others in the class from obtaining a good overview of the other projects from this dialogue (description of Cooper School, The Complementary Work Phase, p. 141). It was also after this summary session that I asked the pupils the last questions (Questionnaire 2, Appendix 6D, p. 394), which showed that just one pupil mentioned something that another group had worked on.

When I asked the pupils at the three schools what they had learnt during these project periods, most of them mention issues related to the topic they were working on in their own group. Just a few mention issues that other groups had worked on. At Applebee School, six pupils mention that they had learnt that there are pupils from many nationalities at the school. At Bridgeford School, altogether ten pupils in 8A and ten pupils in 8B mention issues from other topics (Questionnaire 2, Appendix 6B, p. 392, Appendix 6C, p. 393). From the processes carried out in these three classes, it appears that when pupils are given the opportunity to present, reflect and comment on each others' work, they have the best possibility of creating shared knowledge on a topic in the class. The headmaster at Applebee School says that the aim of their project work is something more than the learning of the receiver:

Illustration 23

> *It is not the recipient's learning we are concerned with, it's the learning of the individuals who are making the presentation we're most interested in. If the presentation only produced learning for the listeners, then the teachers could just as well have done it. But it's the group that's presenting it that we're focused on. This is the same if the product is a sculpture, a painting, or a film or video, you see? It's not the listeners' time, this is the time when the individuals use this type of expression to process their knowledge (Applebee School, inthead 100900).*

It is also obvious that the pupils in the class at Applebee School do not remember much of what was presented by the other groups during the short film sequences.

It is positive that pupils can learn from what they are working on at the same time as they also obtain an understanding of the topics the other pupils are working on during the project. If the pupils at Applebee School have been given time to finish the planned information links in connection with the film (description of Applebee School, The Realization Phase, p. 100), and to talk about their work with each other, this verbal presentation in connection with the films, could have started a dialogue between the presenting pupils and the pupils making up the audience, so that shared knowledge could have been created through the dialogue. Why should not pupils, as well as teachers, present to pupils in the class. Then they could learn more from their own topic and also gain some insight into what the others have been working on.

Sarah (teacher at Bridgeford School) asks the pupils when they think they can learn from the others' projects. One of the pupils answers "when the pupils are presenting their work". Sarah responds to this answer by saying "exactly". She also underscores for the pupils that how they present their material is one factor that will be assessed in this project period (description of Bridgeford School, The Introduction Phase, p. 115). It is clear that Sarah has some ideas about the topic the pupils are going to choose and work on. She thinks that the pupils' choices are too simple and that they are not up to the level of what the pupils have produced during the basic course. She blames herself for this, and says that putting both classes together during the brainstorming process was not a good idea. She also thinks that the Power Point presentation that was not shown due to technical problems could have inspired them to choose other topics (intteam 120500). At the end of the project Sarah also makes a competition out of the pupils' presentations. She says that the activity is to collect the pupils' work (description of Bridgeford School, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 123). In this way the work of each group is shared between all the pupils. The pupils also have to reflect on what they have presented when they make questions (trec 121300). At first the presentations were meant to be a part of

the test, but as the test had to be held earlier, they made a competition instead (intteam 120500).

Discussion

During project work the pupils work on the same overarching theme as a framework for their activity. The pupils at Applebee School worked on the themes “Our town” and “Our school”, the pupils at Bridgeford School worked on the theme “Norway”, and the pupils at Cooper School worked on the overarching theme “Emigration”. During the process most of the pupils work in groups and do their part in a mutual effort. In working towards an answer to their thesis question, they work together, plan, carry out and present their work. In this way they can obtain shared knowledge at different levels during the process. They can develop their academic competence when they work on the various themes, their learning competence when making a Power Point presentation and writing down just the key words, their social competence while collaborating in groups, and their aesthetic competence while working on their presentation. During project periods the pupils are also introduced to the work method and may thus develop their methodological competence. They will learn how to formulate a question, gather information, process the information and make a synthesis of it. This practice involves all aspects of the learner; hence the work process may lead to the development of identities (Resnick et al. 1997, Wenger 1998, Wells 1999, Daniels 2001), or holistic development, which is the aim in Norwegian schools (Stortingsmelding nr. 29, 1994-1995) [White paper no 29, 1994-1995]. This also means that the pupils participating in the class community are apprentices guided by the work method itself (Rogoff 1990, 1995a, 1995b, Rogoff & Gardner 1984). The method creates a working culture or becomes a cultural artefact (Holland & Cole 1995) in the classroom that guides the pupils throughout their work.

During the work processes the pupils also need to use various tools to gather the necessary information and to present their results. As I have described, there are various practices in how the pupils obtain the possibility to master ICT equipment. The learning process in social cultural theory is defined as a process in which one learns to use artefacts for thinking and action (Wertsch 1991, Säljø 1999). As a consequence of this theory it is decisive for every individual’s development to learn to use artefacts, which are even looked upon as extensions of the individual (Prawat 1996). Another issue is whether this competence is going to be shared by all the pupils by giving them the same practice, as in Applebee School, or if they are to receive the relevant training when it is needed by giving some of them courses, as

in Bridgeford School. Another way to conduct this process is to give the pupils the freedom to develop the competence more or less on their own, as in Cooper School.

It is clear that if the pupils are going to work as apprentices during project work with the guidance of teachers, other pupils and the structure of the method, they need to know how to use various artefacts to construct and appropriate knowledge and understanding. In this connection the use of ICT becomes a relevant tool during project periods. How the training with these tools is accomplished is probably dependent on more than one factor. One such factor is organizational: None of the three schools had room to give everyone training at the same time. Another question is how this training is conducted. Steven (teacher at Applebee School) obviously thinks that it is important that the pupils learn to master the ICT equipment together, and that they all learn the most basic operations so that they obtain shared knowledge in how to master programmes. He changes between the use of the screen and papers, because he then can control the process (description of Applebee School, The Basic Course, p. 93). Steven obviously likes to control what the pupils learn and therefore uses methods that can help him to maintain this feeling. Sarah (teacher at Bridgeford School) apparently thinks that they have to take the competence the pupils bring with them to school more into account. She says that it is pointless to plan the use of ICT for a longer period of time. She adds that the pupils are learning more and more about ICT themselves so that it is pointless to make a strict plan for a three-year period (description of Bridgeford School, The Context, p. 107). All the same, it is obvious that both Sarah and Steven think that the pupils need to have basic knowledge in the use of ICT, as well as training and development of academic skills, the traditional aim in school. John (teacher at Cooper School) also appears to acknowledge that they should have given the pupils more training in the use of the ICT equipment when he says that they had not been clever enough to give the pupils courses (description of Cooper School, The Context, p. 127). The training practice the pupils obtain at the three schools is probably connected to how the teachers perceive their own role and the pupils' role.

The teachers at Applebee School obviously emphasise that the pupils shall feel mutual engagement throughout the project when they say to them that they are together on this work (description of Applebee School, The Planning Phase, p. 98). During the basic course at Bridgeford School the pupils are also introduced to the same subject matter. The teachers decide what the content of these introductions is to be, but they also invite the pupils to come up with ideas on what they at the outset already have planned to take up in class. Thus during these dialogues the teachers ask pupils questions that they already know the answers to. The

teachers also have clear thoughts and demands on how the exercises in connection with this presented material are to be solved by the pupils and also what the content is going to be. The pupils are presented a common framework in which both this exercise and similar exercises are to be solved. The teachers have decided beforehand what they want to tell the pupils about the issues they introduce during the basic course, and they also have clear ideas on how the pupils shall carry out the tasks (description of Bridgeford School, The Basic Course, p. 116).

At Cooper School, the pupils are given the same information during the motivation phase when a woman born and raised in America tell them about the Statue of Liberty, Columbus and Leif Eriksson (description of Cooper School, The Choice of Theme Phase, p. 132). In this way the pupils at all three schools are told the same thing at the outset, but through different content and to different extents. But what does this mean for the teacher's role? Is she a person who just guides the pupils throughout the process as the project theory indicates, or does she completely decide what the content should be in the lessons, both with regard to the mastery of ICT and the content studied in the subjects? It seems that there is a dialogue between the pupils' interests and the teachers' aims at the three schools. In this way there is a possibility that scientific and everyday concepts can merge throughout the working process and lay the foundation for development and understanding (Davydov & Markova 1983).

Contrary to the traditional view of the teacher's role, Steven is willing to learn together with the pupils, and he also communicate this attitude to the pupils (Illustration 8, Chapter 8, p. 184). It seems that the structure and intensions of the project work method can thus affect both the pupils and the teachers, and create a ZPD in which the whole community develops (Engestrøm 1987). Steven says that you as a teacher cannot be prepared for all eventualities (intinf 102500), and thus utters that teachers cannot control everything the pupils do or want to do. The projects at both Applebee and Bridgeford Schools also became more pupil-directed when the basic courses were finished. On the other hand, the pupils at Cooper School are told that it is their project right from the beginning (description of Cooper School, The Choice of Theme Phase, p. 132). Sarah also thinks that the proper way to conduct the practice in the classroom is to give the pupils more responsibility and an opportunity to be more active during the work process. "It's when they can work like this that we're doing the right thing," she says when observing pupils collaborating in their group (trec 120400).

Both at Applebee and Bridgeford Schools there are activities that are teacher-directed but also more pupil-directed. The teachers at Cooper School do not have any basic course, not for the topic "emigration" nor for the use of the ICT equipment. At the end of the project the

teachers at Cooper School ask themselves if they have placed enough demands on the pupils. At the exhibition evening when they look at the pupils' work they find that they should have directed the pupils more (description of Cooper School, The Product Presentation Phase and Teachers' Reflections, p. 139). At Applebee and Bridgeford Schools there is first an exchange between the different ways to direct the teaching, from teacher-directed to more pupil-directed. During the more pupil-directed phase there is still an interaction between the pupils' interests and the teachers' interests and thus the goals of the Curriculum.[57]

This shows that a tension is always present between the cultural aims represented by the teacher and the pupils' experiences and interests. The teachers at the three schools appear to solve the tension between the traditional teacher role and the teacher's "facilitator" role in different ways. Traditionally teachers have tried to teach the pupils what the Curriculum plan has listed as common goals for the teaching and learning process, but pupils come to school with their own interests and questions which might not be concurrent with these aims. Even though the teacher's role during project work is defined more as a facilitator, he is also expected to ensure that the topics the pupils work on during their projects cover themes in the Curriculum (Rettleiing L-97, 1998) [Advisory Document for C-97, 1998]. If the pupils' thoughts and reflections are to become knowledge shared by everyone in class, it is obvious that the pupils' solutions to their thesis questions must also come into dialogue with what the teacher and thus the Curriculum aims for. In this way the pupils and the teachers can have convergent goals and work in a joint community to reach them. Such a learning community also creates conditions for the internally persuasive discourse to grow (Bakhtin 1981). The pupils and the teachers work in convergent Activity Systems in which their goals are approximately the same. This is shown in Figure 15 below.

[57] Usually teachers try to attain the goals laid down by the National Curriculum in their teaching. The class at Applebee School has an exemption from following this Curriculum (inthead 100900). This means that the teachers' interests at Applebee School are not necessarily the same as the goals that are given in the Curriculum, but they claim that they do not deviate much from the plan (intteam 101300).

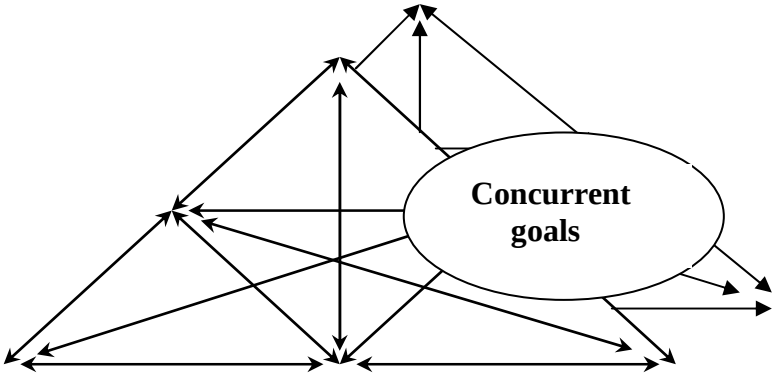

Figure 15: The pupils' and the teachers' convergent Activity Systems with concurrent goals

It seems that it is a challenge for the teachers at Cooper School to connect the pupils' and the teachers' goals, but it is a misunderstanding of the teacher's role during project work to let the pupils more or less direct their own work. As Dewey (1902, 1916, 1938) said, and according to the Advisory Document for the Curriculum of 1997, there should be an interaction between these two interests; they can be merged in a common dialogue where all pupils and teachers are participants. This dialogue should not just be about subject matter, but also about tools the pupils use to gain this knowledge. In this way the use of ICT equipment becomes a topic of the classroom discourse and it can be reflected on and thus shared by all pupils (Crook 1991). This will also agree with the National Curriculum in Norway (L-97) [C-97], which states that the ICT equipment should be integrated in all subjects, with the exception of physical education. This means that the pupils are expected to learn to master this equipment while they also can use it to develop their thoughts and actions (Wertsch 1991, Säljø 1999).

In traditional teaching the normal approach has been to control what the pupils have learned by giving tests. These tests have measured what the pupils have learned regarding content knowledge. This tradition has more or less been upheld even though more pupil-centred activities have been integrated in the classroom practice. In this connection objectives for the school practice have also been integrated more than knowledge on subject matter. All the same, the content knowledge seems to receive the most attention when teachers want to find out what the pupils have learnt. In the next chapter I will examine the practice of pupil assessment in connection with project work.

Chapter 11
Assessment

Sarah (teacher at Bridgeford School) tells her pupils in the beginning of the project period:

> *But when you go to school, you go there to learn things. And you work all the time to learn in different ways. And what you've learned has to be tested, so you can't get away from that, you see. You have to test, in one way or another, how much has been learned (Bridgeford School, trec 110800).*

Assessment in school may have many purposes. One is to rank and certificate pupils, while another is to help individuals in their learning processes. This chapter examines pupil assessment during project work that can have both these purposes, but the focus is most on its effects on learning. During project work the pupils are assessed on how they work throughout the process and how they manage to come to a result at the end of their work. Assessment is one of the major challenges teachers have to deal with, and it is likely that teachers are also struggling with assessment during project work, as this approach represents a new form of teaching and learning for which traditional assessment practice is too limited to include all the learning activities that unfold during such a work process. Traditionally the teacher's task has been to "acquire formal knowledge, find efficient ways of sharing it, and determine whether pupils have learned what was taught" (Cuban 1993, p. 248). During project work in which pupils construct knowledge in collaboration with other pupils and their teachers, this situation is changed quite dramatically. The pupil's role has changed from being a passive receiver to becoming an active learner and producer.

Questions one should ask in all assessment situations and thus during projects are: What is the purpose of the assessment process? For whom are we doing this assessment? What is going to be assessed? Who is doing the assessment, and how should it be conducted? (Franke-Wikberg & Lundgren 1990, Gipps 1994, Calfee & Masuda 1997). Another question could be how assessment can manage to give a picture of all the processes that take place during project work. According to Gardner (1992) pupils must be involved in long-term projects in which they can reflect upon their learning and use their skills in a productive way. In such a practice the pupils will also be included in the assessment processes of the competences they actively use. This is just one way that the "who" question could be answered. In this chapter I will examine all the aspects these questions touch on.

In socio-cultural theory the context in which the child grows up outside school as well as the social contexts of the learning processes in school influence the pupils' learning. This means

that the assessment processes in school also have to be conducted in the social context in which the learning activities take place. In this chapter I will present a description of how the assessment processes at Applebee, Bridgeford and Cooper Schools were conducted. Illustrations from the three schools show that Sarah and the other teachers at the schools use various strategies to find out more about the pupils' learning, and not just test what the pupils have learned.

Theoretical Framework

Assessment Paradigms

The assessment practice has gone through paradigm shifts that also follow the changes in epistemological views. Psychometrics, which has developed from work on intelligence, has followed the behaviouristic tradition that looks upon learning as a linear and sequential process. In such a process it is assumed that a complex competence can be broken down into skills learned separately by developing individual stimulus-response bonds. This is also what is called the building-block model. One cannot move to a higher level before the lower levels have been mastered. Assessment in such a paradigm aims to assess the pupils' separate skills, not each individual's understanding of various phenomena, so the aim of assessment is to decide whether the pupils are ready for the next block. Such an assessment practice will encourage a teaching practice that puts emphasis on isolated components. In this view of learning, each component is also looked upon as decontextualised, meaning that it takes on the same form in all places it is used. To measure what the pupils learn, standardized or normative tests are normally used.[58] These are also looked upon as objective measures of skills across places and individuals (Gipps 1994). The aim of these tests is to measure the pupils' raw ability, in other words they reflect inherent capacities that cannot be changed by external influences or instruction (Gardner 1992, Gipps 1994). Tests both classify and standardize knowledge (Torrance 2000). This means that the tests form a framework for what is "acceptable" as necessary knowledge to be learned. This in turn means that subjects such as history and mathematics, and the pupil who is learning, are defined or judged in accordance with these standards. Hence the tests form the basis for what is to be learned. As mentioned above, assessment practices measure the pupils' inherent capacities, but assessment also aims to find out what the pupils have learned during the work processes. Assessment can also be a

[58] The word "test" can be used about tests that measure the pupils' raw ability or intelligence, and about tests that are used to find out what the pupils have learned during a teaching period. When I use the term test in the text, it has the latter meaning.

scaffold that supports the learning of children while they work. Glaser (1990) believes that we need a much wider assessment practice that takes more into consideration than just subject-matter acquisition and retention. Brown, Campione, Webber and McGilly (1992) claim that ideally, pupils should not be labelled and categorized by assessment, but instead diagnosed and helped.

The way teaching and learning is organised also has consequences for how the pupils manage to use what they have learned in similar but new situations. During traditional and so-called objective tests, the pupils can memorize and answer the questions the right way without necessarily understanding the material they have learned. "Good learning" involves thinking about the meaning of what is being learned (Gipps 1994). When people understand the meaning of what they have learned it is, according to Shepard (1992), easier for them to look upon knowledge as useful because it becomes part of their understanding of how it should be used. Thus it will be easier to transfer this knowledge to similar situations. This also coincides with Campione's (1996) view when he says that the ability to transfer what one has learned in one setting to similar situations indicates that you have understood what you have learned. Such a notion of learning has implications for the assessment practice. Assessment based on an epistemological view like this is not seen as an exact science, and the complexity of the interaction of pupils, task and context is also taken into consideration (Gardner 1992, Gipps 1994). While psychometrics was based on the theory of intelligence and a behaviourist model of learning, assessment today and for the future must be based on the best current theories of learning (Gipps 1994). Social constructivist theories form the theoretical framework for this study. According to perspectives deriving from social constructivist levels of understanding, something more than the recall of facts has to be assessed. Aptitude and intelligence are conceived of as fixed, natural and inherent characteristics. These terms can be replaced by terms such as competence, attainment or achievement that refer to the product of education (Gipps 1994). In these concepts, the attained understanding of different tasks is an integral component of the learning that has taken place. This also highlights the importance of instruction for learning, a conviction that was an important part of Vygotsky's theory (Vygotsky 1978).

Rather than indicating current or past achievement, assessment should support learning and thus stand in a dynamic interaction or be part of the teaching and learning processes (Glaser 1990). Authentic assessment is a term used in the USA to describe an assessment practice in which the assessment task closely matches the regular activities and also takes place in an authentic context. It can be produced in the classroom as an integral part

of the daily work rather than being a specific task for assessment. Details of what the pupils have learned during these actions can be provided by “qualitative descriptors” (Gipps 1994, p. 16). Thorough descriptions are necessary as part of naturalistic assessments to obtain a "full understanding of what the pupils know, understand and can do and in what contexts” (Gipps 1994, p. 168). Such rich descriptions of pupils can be difficult to compare because it is hard to present it in a condensed way. If schools are aiming to develop challenging programmes for the pupils, assessment also needs to encapsulate and test challenging goals (Torrance 2000). To be able to test challenging goals Torrance also suggests that authentic assessment has to be conducted when pupils act with real tasks and challenges. He adds that these tasks should involve enquiry, design, analysis and report writing that demands that pupils use their competence that the teacher can observe in a natural setting rather than the pupils’ knowledge being recalled in paper-and-pencil tests.

An alternative form of teaching could be to have processes in which both pupils and teachers construct knowledge together (Gipps 1994), and thus form a knowledge-building community (Scardamalia & Bereiter 1996). In such a practice the pupils can learn how to learn from the teachers and thus develop their metacognitive competence, a thinking about thinking. Metacognition involves aspects such as planning, monitoring and also controlling one’s own thinking, and therefore this concept also means learning about learning. In this way the pupils learn how to gain knowledge (Brown et al. 1992, Gipps 1994). Metacognition that involves the pupils controlling their own work also implies that the pupils know how to assess their own work. This means that pupils should also gain experience of assessing their work, and in this way acquire an active role in assessment. Metacognition can be gained through guided or negotiated self-assessment, in which the pupils become aware of their learning strategies (Gipps 1994).

In socio-cultural theories artefacts play an important part in people’s actions. Wertsch (1998) thinks “that cultural tools provide the context and standard for assessing the skills of an agent" (p. 45). This means that tools have to be taken into consideration during the assessment process. Learning is also defined as the competence to manage to use mediating artefacts to think and act (Wertsch 1991, Säljø 1999). In this way artefacts are looked upon as having an important role in the learning processes. Gipps (1994) finds that pupils should be allowed to use tools during assessment processes. Such a practice, she believes, could also reduce the focus on memorizing and instead place it on the thinking and problem-solving processes. As a consequence of this, the pupils’ competence in managing these tools and thus

also ICT equipment (information and communication technology equipment) should also be a focus for assessment when such tools are used during the learning activities in the classroom.

It is, not surprisingly, because of the traditional teaching in education that students strive to understand and structure their own learning. On the other hand, there is a growing consensus that learning environments that emphasise interaction and learning as a process of gaining understanding of both the content matter and the procedures used create more insightful and intentional learners. In this connection assessment procedures are affected accordingly (Campione 1996). Static and dynamic assessments are terms that denote distinct assessment practices.

Static and Dynamic Assessment

Static assessment measures what the pupil already has learned. A traditional test after a teaching sequence uncovers selected parts of what the pupils have learned. These tests can measure ability (or intelligence) and content area knowledge. Both these measures have been criticized. Intelligence tests cannot support instruction, and they can also underestimate what the pupil's potential is.[59] Content area tests, on the other hand, are criticized because they can give a too optimistic view of the pupil's progress. A pupil can memorise a few aspects connected to the subject matter without actually understanding the content. Thus this knowledge is restricted. These content tests can also affect the teaching process in that the instruction will be focused on the content the pupils are going to be tested on. If assessment is made a part of ongoing instruction practice, assessment will be ubiquitous, and the assessment practice will not lead the teachers to focus on the content the pupils will be tested on. In this way assessment will serve instruction, not drive it (Campione 1996, Cizek 1997, Broadfoot & Pollard 2000, Torrance 2000).

A conclusion made on the basis of traditional tests is that pupils who get the right answer know what to do, and that children who do not manage to get the right answer do not. The knowledge a pupil shows that he or she has on such tests is also viewed as being a good estimate of the pupil's readiness to learn (Campione 1996). These traditional tests are conducted without any interaction between the teacher and the pupils, and the pupils are thus tested without any support. The static model also assumes that the teacher and the pupils view the tasks in the test in the same way. This is not always the case, and the pupils get the answers wrong because they did not perceive the task in the same way as the teacher. Kragler

[59] Potential is treated as in Vygotskyian terms, not in terms of intelligence. Thus potential is a perception of learning that develops during a setting in which support is given.

(1996) shows this with an example of a child who has teachers as parents. This pupil is asked to put a ring around a person who is working. This pupil marks the picture of a person reading. According to the teacher, this answer is wrong because the picture of a person digging a hole was the answer he was expecting.

On the other hand, dynamic assessment[60] aims at measuring the pupil's assisted performance during collaboration (Dixon-Krauss 1996). In this approach the pupil is not assessed alone, but the social system he or she is a part of together with the teacher is dynamically assessed to find out what the pupil has learned and has the potential to learn. This form of assessment is thus based on an approach that coincides with social constructivism and thus socio-cultural theory. The goal during dynamic assessment is to give descriptions of pupils that reveal what they can do and what they need more help to do. Such a description gives teachers help in designing enriching activities. In this way assessment and instruction are merged effectively (Campione 1996). Gardner (1992) says that assessment should occur "on the fly as part of an individual's natural engagement in a learning situation" (p. 90). Brown et al. (1992) maintain that one should observe the processes "undergoing change right before one's eye" (p. 135). Both Gardner (1992) and Brown et al. (1992) thus indicate that assessment should be part of the ongoing processes. Static assessment measures what Vygotsky (1978) has called fossilized processes or the fruits of instruction. Vygotsky (1978) also uses the words buds and flowers, which means processes that are developing during instruction. These concepts and terms could thus be juxtaposed with static and dynamic assessment respectively.

Assessment should be an ongoing process and thus an indispensable part of reflective teaching. The assessment of the pupils should be based on various factors so that there are multiple indicators of a learner's progress. Formal, informal and constructed response measures, portfolio-based, anecdotal records and journals could be used. Thus the assessment process could be aligned with the context of teaching and learning (Valencia, Hiebart & Afflerbach 1994). During this activity teachers can ask the pupils questions, or may observe pupil activity, or they can assess the pupils' work in a planned and systematic way or in a more ad-hoc way (McCallum, McAlister, Brown & Gipps 1993). In such an assessment practice the focus is on what the pupils understand, and a picture of the pupils' understanding can be given in the pupils' articulations during work (Gipps 1994). This also coincides with

[60] Dynamic assessment is a term initially used by Feuerstein. His theory resembles Vygotsky's theory. Feuerstein (1979) talks about mediated learning, which means that individuals are given help during their learning processes.

the view of the CSCL (computer supported collaborative learning) paradigm in which learning is expected to be reflected in the language of learners (Koschmann 1996). Such an assessment practice reflects the intentions of dynamic assessment that is conducted in an ongoing process. The focus on both product as well as process has also become embedded in the assessment practice called dynamic assessment (Campione 1996).

The teacher can seldom concentrate on just one child at a time in realistic situations in the classroom. The assessment practice called "assessment while teaching" differs in several ways from the usual way of viewing dynamic assessment. In this practice the teacher subordinates assessment to instruction, which means that the focus has shifted from being on assessment as in dynamic assessment and to the teaching process. During the assessment of teaching practice the teachers for the most part interact with small groups of pupils instead of working one to one. In this situation the teacher finds out how the pupils' behaviour matches what is expected of the task. Usually the pupils also choose different ways to arrive at their solutions, all of which are appropriate. This means that the teacher has to be flexible to meet the pupils' various ways of solving problems. This also indicates that it is difficult to give an objective assessment of the work processes (Newman et al. 1989).

The zone of proximal development (ZPD) focuses on instruction as the key to learning, and it thus links assessment to the ongoing instruction or process. To define a person's ZPD it is necessary to focus on the social interaction during the teaching and learning processes.

The Zone of Proximal Development

As referred to earlier, ZPD is defined as the difference between what an individual can do alone and what this individual can do with the help of an adult or a more capable peer (Vygotsky 1978). Vygotsky (1978) introduced the concept of the ZPD to deal with practical issues in education. He felt that an assessment dealing only with a focus on intramental functioning had restricted assessment to a measurement of the child's past accomplishments, or its actual developmental level. Vygotsky argued that to take the growth potential of the child into consideration, an assessment procedure has to focus on the activity in which the child is partaking and in which growth takes place. Hence, the intermental functioning has to be in the focus. In this way Vygotsky proposed that both the child's actual developmental level and its ZPD should be assessed. Such an assessment practice, he believed, would be of vital importance for the planning of instruction and thus the instruction practice. Thus Vygotsky's focus was both on process (the ZPD) as well as product (a new actual

developmental level attained after collaboration processes). Brown et al. (1992) use the term "guided assessment" and say that it has the potential to afford predictions about future performances and also to give outcome measures, which means assessment of the fruits of previous teaching. It was in connection with the gradual internalization of cognitive activities that were at first interactive processes, from other-regulation to self-regulation, that Vygotsky introduced his concept ZPD (Vygotsky 1978). This concept entails the role of language and mediation in addition to the role of the social context. In this way it also became important for Vygotsky to assess the pupils' abilities in situations different from those in which traditional tests were the main assessing measure.

The ZPD concept provides a good alternative to the theoretical framework for traditional tests (Newman et al. 1989). Reduction in the amount of help the pupils need will indicate that the pupils have increased their ability to carry out the task more independently and thus have learned. It is important that the teacher gives appropriate help to the pupils, which means that the pupils work on "the edge of their ability" (…) and that the teachers "pick the children up when they slip over the edge of their competence" (p. 87). When the teacher gives the appropriate help, it is possible to find the pupil's ZPD. The observation the teacher makes of the processes on the embryonic stage can give good estimates of an individual's potential beyond the current competence (Campione 1996). According to Brown et al. (1992) the pupils can learn to be more efficient learners, and they also state that tests should aim to measure the pupils dynamically, which means that they can reveal both the pupils' actual development and also their capacity for growth. In contrast to assessment that tends to measure a change against a preconceived standard, the ZPD concept also paves the way to look at where a student can go with a little help without quantifying the amount of help needed to reach a given endpoint (Campione et al. 1984). Teaching children is a qualitative process in which the endpoint is not clearly known in advance. This means that the teacher's adjustments often are more qualitative than quantitative (Campione, Brown, Ferrara & Bryant 1984). Vygotsky's concern with assessing both the child's actual and potential developmental levels has been a part of the testing philosophy in Russia, a philosophy that has also influenced the literature on assessment in the U.S. (Rogoff & Wertsch 1984).

There are reports from assessment practices in Russia that have been conducted in the frame of Vygotsky's thoughts on learning, assessment and instruction. In these tests the degree of qualitative aid that a child needed was taken as an indication of the child's ZPD. After a solution was reached on one task, the child was presented a new task similar to the original task to find out if the child needed fewer cues to solve the task this time. This would

indicate the degree of transfer and whether the child had learned anything and thus had gained a new actual developmental level. The assessment of the width of the child's ZPD is defined by how much help the child needs before it solves task one, versus task two, versus tasks three and so on. Thus a child that is assessed to have a wide ZPD has reduced the need for help from one task to other similar tasks,[61] and it is then also able to use a new solution across similar tasks (Brown & Ferrara 1985).

Other studies have also been conducted within the framework of Vygotsky's concepts. Brown and Ferrara (1985) found that the IQ measured in traditional, static tests, did not predict the learning speed and/or the degree of transfer for about fifty percent of the pupils. They also found that the process of estimating learning and transfer is the process of mapping the children's zone width. This means that children with a wide proximal zone are more able to transfer solutions across situations. They also found, like Rogoff (1982), that people have different ZPDs related to various domains, at the same time as these zones provide a design that enables educators to assess the children's learning in a dynamic way.

As mentioned in Chapter 10, "Shared knowledge" p. (235), the concept of the ZPD has been interpreted in other ways than in connection with dyads working on tasks. In project work the pupils' interests are taken into consideration during the activity. This means that the pupils' aims and the teachers' aims or the aims of the curriculum meet during the processes. Thus there is a merger between the cultural knowledge presented by the socio-historical context and the pupils' everyday experiences (Davydov & Markova 1983). Like the processes in dyads, this process also takes place on the individual level in which individuals develops their understanding in the encounter between their personal experiences and the experiences they become a part of in school. The collectivist or societal perspective presented by Engestrøm (1987) defines the ZPD as the distance between everyday actions of individuals and the historical new form of the societal activity that can be generated collectively. This social activity also has the intention of changing society for the better. In project work the pupils bring their interests with them to their work, and they work in groups on various thesis questions that are examples of the overarching topic presented by the teacher on the basis of the curriculum plan. In this way the result a class arrives at is also a collectively made product. Earlier the objective for project work was class struggle, but now the focus is moved from that to democracy and self-management (Illeris 1993). However, if the pupils do not create change in society, they manage to create joint results that are new for them and the rest

[61] Brown and Ferrara (1985) talk about similar situations the same way as Greeno (1989), who says that similar situations mean there is a "relation between the knowing agent and the situation" (p. 313).

of society. They have not reproduced processes during the project work, but together created a unique process and constructed a unique product with the use of artefacts. The joint activity thus ends with a joint product that can also be assessed collectively.

The basic underlying principle in dynamic assessment is that the pupils are assessed in a one-to-one relationship (Campione 1996), or in a dyad that also was the structure for Vygotsky's instruction and assessment settings. Like the expansion of the concept of the ZPD that includes both individual and collective aspects (Davydov & Markova 1983, Engestrøm 1987), the term dynamic assessment could also have been widened so that it could include assessment settings at the individual, group and class levels. In this way dynamic assessment could be used about all processes in school in which both scaffolding and assessment are intertwined. Throughout the text I use dynamic assessment as a joint name for all these processes. This also means that dynamic assessment could be juxtaposed with "assessment while teaching", as defined by Newman et al. (1989).

Formative and Summative Assessment

Assessment that emphasises finding out what the pupils know and understand and that aims to help the teacher find out what and how to teach in coming lessons, is called formative assessment. If such a teacher assessment is going to be beneficial for the pupils' learning, it appears that the pupils also need to be involved in the assessment processes. The teachers have to talk and explain to the pupils how they are to continue on their work to improve their understanding (Gipps 1994, Tunstall & Gipps 1996, Torrance & Pryor 1998). It appears that if teachers are to help the pupils, they also have to find various ways of assessing them. Teachers can both observe and interact with the pupils to help them (Alexander, Rose & Woodhead 1992). At the same time teachers have to "combine assessment of work completed with assessment of work in progress so as to understand the pupils' thinking as it happens" (p. 39). Summative assessment is often mentioned together with formative assessment. In the coming text I will examine the difference between these two forms of assessment.

Traditionally formative assessment is conducted during the work processes whereas summative assessment is undertaken at the end of a work period (Scriven 1969). The purpose of formative assessment is to help the pupils during the work process, whereas the purpose of summative assessment is to inform people both inside and outside the classroom how schools and individuals are performing.[62] This information is then also available to the learning

[62] Gipps (1994) defines performance as a term that refers to what is actually done under existing circumstances, and competence as a term that refers to what a person can do under ideal circumstances. These concepts will also

individuals and their parents. Furthermore, this assessment practice may have selection and certification purposes. The distinction between these two forms of assessment practices is not when they are carried out, but what their purpose and effect is. It is argued that assessment that is undertaken during the work processes can also be conducted for grading purposes, and it thus has a summative assessment form, not a formative assessment that aims to improve the pupils' competence (Sadler 1989). A particular assessment can function as a desired instructional event (Cizek 1997). In such instances the assessment process is linked to the formative information the student acquires at the same time. This means that assessing and supporting processes are intertwined. Formative assessment deriving from a social constructive perspective, takes the teacher-pupil interaction into account, and such an assessment is seen as having an impact on the pupils' learning, as well as on the product (Torrance & Pryor 1998). Usually assessment at the end of work is called summative assessment, but it can also be defined as formative assessment if it aims to improve the pupils' work in the coming work processes.

Even if the teachers give the pupils help to improve their work, they do not automatically improve their work and understanding. If they are to manage to do so it is necessary to know about the desired standards or goals for the work. Goals that only indicate that the aim is to do one's best often turn out to be less effective than no goals at all (Sadler 1989). If the pupils are aware of the aims for the work, they will be able to compare their actual performance with the performance that is desired and to act in a way that can close the gap between the two performances. This also implies that the teachers should make the criteria or standards for the work explicit to the pupils. It is vital that the pupils are given support that can help them improve. Assessment that uses marks or number grades like 5/10, gives the pupils very little help. When the pupils manage to raise their action to the desired performance level, which may also be looked upon as a new actual developmental zone, they have probably also managed to develop their metacognitive competence. During the processes they have presumably learned to regulate their work appropriately. Marks cannot be regarded as feedback. Information that is fed back to the pupils is feedback only if it aims to help the pupils to attain the desired performance (Sadler 1989). Feedback may, according to Gipps (1994), only contribute to progress in learning during processes of formative assessment.

In Norway, the authorities are attempting to formalize qualitative assessment in connection with project work, as this was made an obligatory work method in C-97 (L-97, the

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be used bearing these definitions in mind in this text. Performance is contextual, whereas competence is a concept that includes ways of doing things that also can be used in similar situations as it is learned.

National Curriculum of 1997). Project work has also been practised in Norwegian schools before this plan was implemented, and many discussions have been held on how to assess the pupils during such processes. After 1997, the results of such discussions were also made into formal statements in public documents. Below I will present theories that aim to put assessment procedures during project work into focus.

Assessment during Project Work

The aim in the Norwegian schools at the primary and secondary level is to create a basis for the pupils' holistic development (Stortingsmelding nr. 29, 1994-1995) [White paper no. 29, 1994-1995]. During project work the pupils are expected to develop in various areas that include their academic, social, aesthetic, methodological and learning competence (Skrøvset & Lund 1996, Koritzinsky 1997, Postholm et al. 1999, see Appendix 8, Figure 17, p. 411). School assessment has focused on linguistic and logical-mathematical faculties, but people also have other qualities that have to be assessed (Gardner 1992, 1999, Gardner & Hatch 1987). Such a view could be perceived as a holistic approach to people's development. Both the various subject goals and the goals presented in the general part of the Norwegian National Curriculum plan (L-97, [C-97]) are to be assessed, both during the process and at the end of the work (Stortingsmelding nr. 47, 1995-1996) [White paper no. 47, 1995-1996]. The presentation phase is an essential partial product of a project period, and this part of the project also has to be assessed (Rognaldsen 1999). When both the process and the product in projects are assessed, both formative and summative assessment forms are used. The focus on the entire personality during projects also means that this work method has a potential to meet the demands for holistic development (Stortingsmelding nr. 29, 1994-1995) [White paper no. 29, 1994-1995].

In project work it is thus of little help to use traditional tests to assess what the pupils have learned. Such tests do not manage to include the all-inclusive goals in this work method. Assessment of the whole personality widens what we can call the degree of freedom. In a great deal of assessment work there is only one degree of freedom, just one answer is correct. The more degrees of freedom, the more attention has to be paid to the assessment work (Skrøvset & Lund 1996). Logs written by the pupils and teachers, observations, dialogues and the end products can be the best tools used in the assessment of pupils during projects. None of these strategies alone can function as the basis for the assessment, but all the forms mentioned are meant to supplement each other to give a proper and justified assessment (Skrøvset & Lund 1996, Rognaldsen 1999). A test at the end of the work with open-ended or

self-defined questions can also function as a strategy to find out what the pupils have learned (Rognaldsen 1999, Helle 2000). In this way the traditional assessment practice is broadened. It is also suggested that assessment processes should include "the full range of information teachers gather in their classroom: information that helps them understand their pupils, monitor their instruction, and establish a viable classroom culture" (Airasian 1994, p. 5). Assessment is talked about as inquiry, and defined as situated, continuous and multifaceted. By situated it is meant that the assessment processes are internal, building on the processes in the classroom. In addition, this assessment is an ongoing process (continuous) taking various strategies (multifaceted) into use to gather data about the pupils (Calfee & Masuda 1997).

In the pupil's log, all the phases in the project should be included so that the teacher who reads it can follow the processes from the beginning to the end. The group's plans, appointments and the group members' assessment of the work should also be included to give an entire picture of the group work. Thus the log gives information about both the general and subject-specific criteria[63] that are focused on during the work. The teachers can also observe the pupils during the work process to find out how they work and what they have problems with. These observations can also give information to the teachers that they can focus on when they talk with the pupils. In addition to the criteria for the work, the observations the teachers make and the pupils' logs will also help the teacher to better focus the dialogues with the pupils (Skrøvset & Lund 1996).

Dialogues between the pupils and the teacher take place both during and at the end of the work. The "assessment dialogue" at the end of the work is like an oral exam in which the teachers ask the questions and the pupils answer them. These dialogues also give the pupils training for the oral exam the last year in lower-secondary school, at the same time as these projects have helped the pupils to develop their academic competence. The assessment dialogue is based on assessment criteria. At the same time, as this dialogue is meant to give information about what the pupils have learned, the conversation itself is also meant to be a learning situation for the pupils in which they listen to each others' utterances and thus become aware of each other's meanings and understandings (Skrøvset & Lund 1996). Dialogues between teachers and pupils can give teachers information about the pupils' understanding at the same time as the dialogues can enhance the pupils' understanding (Torrance & Pryor 1998). Issues from both the general and subject-specific part of the curriculum can be included during these dialogues, and pupils as well as the teachers can also

[63] The general-assessment criteria are related to the general part in the National Curriculum. The subject-specific criteria are related each subject in the Curriculum.

come to impact the situation and the assessment. Pupils may give information about themselves and their classmates that is new for the teachers, and during these dialogues the pupils may also be given the opportunity to argue for their choices in the work process (Skrøvset & Lund 1996). Thus they can also develop their exploratory talk by arguing for their choices (Mercer 1995). The assessment dialogues during the process also invite the pupils to assess their own work. In this way they also gain experience in assessing their own learning processes (Skrøvset & Lund 1996).

The pupils should also be given the opportunity to assess their own work at the end of the project period. They can assess their own product on the basis of the goals that have been set for the work from the outset. The pupils' self-assessment is meant both as information to the teacher, which can be used to direct the instruction during the process, and also as a basis for the summative assessment that also aims to include the process. On the other hand, it is important to remember that the teacher is responsible for the instruction. This means that it is the teacher's duty to ensure that the assessment work holds a proper knowledge level. Thus it is important that teachers do not forget this responsibility and let the pupils take over the assessment work. At the same time, teachers have to invite the pupils to take part in this process so that they can learn to assess their own work and thus develop their metacognitive competence (Skrøvset & Lund 1996, Rognaldsen 1999, Helle 2000, Rettleiing L-97, 1998 [Advisory Document C-97, 1998]).

If the pupils are to manage to arrive at a good result and also assess the process and the product, it is important that they know what is expected of them. Thus it is vital that the pupils know about the assessment criteria for their work (Stortingsmelding nr. 47, 1995-1996, s.16) [White paper no. 47, 1995-1996, p. 16]. Skrøvset & Lund (1996) define criteria as specifications of goals. During a project period the pupils work with various thesis questions that are examples of the overarching theme. Thus the pupils are not necessarily assessed on the basis of the same criteria. This means that the various groups may have different goals for their work. This also means that various subjects can be integrated into the work of the various groups. It is also recommended that the pupils are allowed to be involved in the formation of the goals or the criteria (Skrøvset & Lund 1996, Helle 2000, Rettleiing L-97, 1998 [Advisory Document C-97, 1998]). Thus the principles of participatory management and solidarity (Berthelsen et al. 1987) are also included in the assessment processes (Helle 2000).

In Norway, regulations give teachers directions in the assessment of projects. These regulations state that the assessment of subject topics that are integrated in the project work is

to be a part of the basis for the assessment in the various subjects. The particular project periods, on the other hand, are given a written assessment, not number grades. From the outset when project work was made a compulsory work method, it was said that the assessment of the pupils' last project in lower-secondary school should be entered on the pupils' school leaving certificate (Rundskriv F-107-1997 [Regulation F-107-1997] Rettleiing L-97, 1998 [Advisory Document C-97, 1998]). This decision has, however, been changed so just the topic the pupils have worked on is entered on the school leaving certificate. It is further stated that national rules or criteria for the assessment of the final project period shall be made on the basis of experiences in such assessment practice (Rundskriv F-44-1999) [Regulation F-44-1999].

Informal and formal assessment are the terms that have been used for the assessment of the processes and the assessment with number grades at the end of the work processes in Norway. To make these forms of assessment equal in perceived importance, the assessment forms are now called assessment with and without marks (Stortingsmelding nr. 47, 1995-1996) [White paper no. 47, 1995-1996]. This shows that the Norwegian authorities also value highly the assessment of processes without marks, and thus an assessment practice that supports learning as well as an assessment practice that is meant to summarize the pupils' learning. On the other hand, in the final project the pupils carry out during lower secondary school, the summative assessment is prominent, even though the pupils also obtain supportive assessment during the process. During this final project the pupils are given an opportunity to show what they have learned during project periods throughout their schooling with regard to holistic competence (Veiledende rettningslinjer for den avsluttende prosjektoppgaven, [Instructive guidelines for the final project] SUE-1999-003).

Projects shall usually be conducted in groups (Stortingsmelding nr. 47, 1995-1996) [White paper no. 47, 1995-1996], (Veiledende rettningslinjer for den avsluttende prosjektoppgaven, [Instructive guidelines for the final project]. SUE-1999-003). During the work process each pupil has the opportunity to learn and develop his or her understanding. Each pupil obtains help from both the teachers and classmates. The pupils work in groups in which they help each other and also receive help from teachers to perform their group work. Each group in turn contributes to the product made by the whole class. In this way assessment can be carried out both during the process and at the end of the work on the individual, group and class levels, and thus there are three levels that can be assessed during the work processes (Rognaldsen 1999, Helle 2000).

Below I will present illustrations of how assessment is practised at the three observed schools. First I will present the strategies used at the three schools separately, then I will summarize the various forms of assessment that are used during these projects. Finally, I will close this chapter with a discussion that focuses on the studied assessment practices.

Illustrations of Assessment Practices during Project Work using ICT

Illustrations from Applebee School

When I ask the teachers in the team what the goals for their teaching are Anne (teacher) responds:

Illustration 1

> *What we want is to teach the pupils to be responsible, for example, they should think for themselves, be responsible, instead of the teachers doing this for them. That's a general aim (Applebee School, intteam 101300).*

This aim is also explained to the pupils during the work process. Anne informs them that the teachers will not tell them how to do things, but they will give them some advice (description of Applebee School, The Realization Phase, p. 100). Steven (teacher) also adds that they have a number of subject goals (intteam 101300), but these goals are not given to the pupils in connection with the observed project. During this school year the pupils are in a training phase, learning to use various tools for later projects (intteam 101300). In the introduction phase of the project the pupils are encouraged to make presentations of their town and their school in a way that the persons who are watching the films will have a good impression of what they see. "That's your task," Steven tells the pupils (trec, vrec 092700). Before some of the pupils are picked out to edit the two films at the school, Steven tells them that the teachers will be observing what is going on in class. He also tells them that they will observe who are the most creative in class, and that they will use certain criteria to choose these pupils. They do not need to be the brightest, but conscientious, good collaborators, responsible pupils who are willing to take the lead in the group (description of Applebee School, The Planning Phase, p. 98). These criteria also appear to be in accordance with the general aims stated by Anne.

Steven claims that film is a medium pupils are accustomed to, and that they thus have an opinion as to what a film should look like (trec, vrec 091500). However, during the process when the pupils in the editing groups are working on the films, they ask Steven for an assessment of the work they have done. They ask him to watch the film and decide if they are finished or not. Molly asks Steven:

Illustration 2

(1) Molly: *Steven, are we finished now? Are we completely finished now?*
(2) Steven: *Yes, we have to assess that tomorrow, then we'll see (they are to finish their work process on that day).*
(3) Molly: *Is there something we haven't done? Could we record some music ourselves (she obviously wants to use other sounds than those that are already available in the programme).*
(4) Steven: *You can bring a CD with you if you want to record some music.*
(5) Molly: *Are we going to watch? (Steven and the pupils watch the film).*
(6) Mary: *What fun, what incredible fun.*
(7) Molly: *Yes.*
(8) Steven: *Do you think that you're learning anything from this?*
(9) Molly, Mary, Jack: *Yes (all the pupils answer in unison) (Applebee School, trec 101200).*

In utterance (1) Molly asks Steven if they have completely finished. She obviously wants him to assess if they have more to do to finish their job. Steven answers (2) that they will decide that tomorrow, obviously because this groups' question was asked just before they were going to complete this work session. Then Molly asks (3) Steven for concrete feedback, she asks if they can record music to accompany the film sequences. Steven suggests (4) and thus advises the pupils to bring CDs to the school to record the music they want. Molly suggests (5) that they should watch the film, and they all watch it together with Steven. While they are watching Mary comments (6) that it is "fun, incredible fun", and with that gives an assessment of the film they have made. She really seems to like the film. Molly also seems to agree (7) with her when she says "yes". Then Steven asks (8) them if they think that they have learned anything from this and all the pupils answer (9) affirmatively in unison. Steven does not ask *what* they have learned, but it is obvious that they are thinking of the programme they have managed to use so well. Steven says that the production of a short film makes the pupils collaborate. They have to decide the details of the topic, they have to plan and take decisions together and they have to be aware of the audience that is going to watch the result – the film (intinf 091500). This is not taken up explicitly with the pupils. Both the pupils and the teacher seemingly think that learning has taken place, but they do not talk about *what* this learning is about.

Before the pupils and Steven finish their work this day, the pupils also ask for more feedback. Molly asks Steven:

Illustration 3

(1) Molly: *Was it good or…?*

(2) Mary: *Did it turn out well?*
(3) Steven: *Yes, I think it's great.*
(4) Molly: *Mm (Applebee School, trec 101200).*

Both Molly and Mary ask (1, 2) Steven if it was good or turned out well, "it" in this case obviously meaning the film. Steven answers (3) them, telling them he thinks it is great, thus giving an assessment of the film the pupils have made. Molly also appears to agree with Steven by commenting (4) "mm".

The next day the pupils in the same editing group have just watched the film together with Steven when Mary starts the dialogue below.

Illustration 4

(1) Mary: *Iiippiii, we're that good (after Mary's excited comment Molly asks Steven a question).*
(2) Molly: *What are we going to do with these papers (Molly has the sheets of paper on which her production team wrote down comments on the sequences they recorded).*
(3) Steven: *Put them in your folder. So, when we're going to assess the work, then we can look at what you have done. How you've worked.*
(4) Molly: *The three of us? (rather astonished).*
(5) Steven: *Yes.*
(6) Mary: *What? What are we going to keep?*
(7) Steven: *What you've written.*
(8) Molly: *This?*
(9) Steven: *What you've written. You have to keep it until we teachers have figured out what we're going to do with it (Applebee School, trec 101300).*

In utterance (1) Mary gives a self-assessing comment indicating that she is very satisfied with the product they have managed to make. Then Molly turns the dialogue in another direction and asks (2) what they are going to do with the papers on which comments on the various film sequences have been written. The three pupils, Molly, Mary and Jack, worked on each their own production team when they did the filming. It was also in these production teams that these comments were written (trec 101000). Steven answers (3) that they can put them in their folder so that the teachers can look at them when they are going to assess their work. In utterance (4) Molly asks if the teachers are going to assess the three of them. She is probably thinking that it was the pupils in the production team who made these comments, not the three who have worked together on the editing work. Utterances (5-9) deal with what the pupils have to keep and why. The pupils seem a bit confused why the three of them are going to keep these papers, and Steven also seems (9) a bit uncertain about how the assessment work is going to be conducted.

The pupils in the editing group seem to feel responsible for their result for the other pupils in the production team who they represent. This is evident from a dialogue at the end of

the editing work when the pupils are looking at the film they have produced. The pupil Molly starts the dialogue:

Illustration 5

(1) Molly: *We've to watch the end.*
(2) Mary: *Isn't it good? We're the best.*
(3) Molly: *I think they have to be satisfied (obviously thinking of the other pupils in the production team they are working for).*
(4) Jack: *Isn't there any thing more we can do then?*
(5) Mary: *Oh, I want to do more.*
(6) Molly: *Yes (apparently also excited).*
(7) Mary: *Think that a thirteen-year-old girl could do this (Applebee School, trec 101300).*

In utterance (1) Molly suggests that they should watch the end of the film. When they watch it, Mary assesses it and says (2) that it is very good. She also says that they are the best, thus indicating that she is very satisfied with their work. Then Molly brings (3) the other pupils in the production team into the dialogue and says that they also have to be content with what they have made. Then Jack asks (4) if there is anything more they can do. Mary does not answer his question, but says (5) that she would have liked to do more. Thus she gives the impression that she has liked the work process. Molly's response (6) "yes" also indicates that she also assesses the process in the same way as Mary. Mary closes this dialogue by stating (7) that it is incredible that pupils thirteen years of age could have done this. Thus she obviously thinks that it is good work. This shows that the pupils assess their work while they collaborate, at the same time as they ask for and have their work assessed by the teacher.

The headmaster at Applebee School also has clear ideas about the assessment of pupils. He says:

Illustration 6

What is important is that the pupils should take part in their own assessment. When it comes to marks, it's the work behind them that's very important. The pupils must know what you attach importance to. You shouldn't have a situation where the teacher is sitting behind a corner waiting with a mark, and saying: here, you got this. The problem is that the examination in the final school year is not related to what we define as a good teaching situation (Applebee School, inthead 100900).

In this utterance the headmaster claims that the pupils have to be involved in the assessment process. He says that it is the work before a mark is given that is most important. He adds that the assessment of the pupils should not come out of the blue for the pupils, thus indicating that they should be a part of the assessment processes themselves. The headmaster also sees the conflicting situation between an assessment form that serves instruction and an assessment

form that often decides the instruction and also does not help the pupils in their learning activities (Campione 1996, Cizek 1997, Broadfoot & Pollard 2000, Torrance 2000). An examination in the final school year cannot help the pupils further in their learning activities, and it can thus be characterized as a summative assessment form. According to the headmaster, a good assessment procedure has a formative assessment form that can help create a good teaching situation in which the pupils are active participants in all parts of the work, also in connection with the assessment. The headmaster adds:

Illustration 7

> *That you give marks or not is not the most important thing for me. The point is that there's a better way to do the assessment. And I think that the awarding of marks is a hindrance to good assessment work because it's a soft option. And I think that's why one continues to just transmit knowledge to the pupils, also because it's so disciplinary (Applebee School, inthead 100900).*

With this utterance the headmaster says that he is not against marks per se, but rather the way they are used. He thinks that the awarding of marks is an easy way to assess the pupils. As stated above, he thinks that formative assessment is the best way to conduct the assessment process, not just to give a mark at the end of the work. The headmaster seems to relate marks with traditional teaching. In traditional teaching the teachers are transmitting knowledge to receiving pupils who they test and give a mark to at the end of the teaching period. During such a practice the teachers are not engaged in helping the pupils to learn throughout the process, and the headmaster thinks this is a soft option. He further states that if teachers are going to assess the pupils' work, they also have to talk with the pupils (inthead 100900). It is also claimed that the pupils need to be involved in the assessment processes and talked to if they are to manage to improve their understanding (Alexander et al. 1992, Gipps 1994, Tunstall & Gipps 1996, Torrance & Pryor 1998).

The eight grade class at Applebee School has an exemption from the National Curriculum plan and ordinary grading assessment as well (description of Applebee School, The Context, p. 85). The headmaster says that the class has been released from the Curriculum plan and grading with marks because the teachers are to feel free to build on each and every pupil's competence (inthead 100900). Steven also thinks that it is best to let pupils work with topics and activities they feel they can handle. He says:

Illustration 8

> *Sometimes pupils sit at their desks without doing anything because they don't know what to do. And they get a bad mark. To them it's meaningless. Therefore it's much better for pupils to know*

that they can work with tasks they master. And when we don't have these marks, we don't get this comparison between the pupils. But they have to be assessed, and we try to create an attitude that irrespective of what you do, you have to do your best (Applebee School, intinf 092900).

This utterance shows that Steven has experienced pupils sitting at their desks resigned and giving up on tasks they have found they cannot solve. Therefore he has acknowledged that it is much better for the pupils to work on tasks they know they can master. Steven also mentions that it is not that easy for the pupils to compare themselves to each other when they are assessed with qualitative descriptors (Gipps 1994). Otherwise it seems that Steven believes the aim is to make the pupils do their best irrespective of what they do, when they are able to do it.

As the concepts of dynamic assessment and "assessment while teaching" (Newman et al. 1989) suggest, the pupils' learning is enhanced more when they receive help during the task or the learning process rather than when they are awarded a mark after they have finished their work. According to Steven, the teachers in his team also assess the pupils throughout the whole process. He says:

Illustration 9

I think that we assess the pupils all the time. You saw it, when we worked with the video camera, we assessed the pupils' work then. So, I think there's a continuous assessment. We don't give the pupils marks, but when we've finished this term, we'll assess the pupils with regard to how they have worked, we can say something about their effort, and we can say something about their development with regard to the tasks they have worked on (Applebee School, intinf 102500).

Steven mentions the dialogue he had with the pupils in front of the television watching the film sequences each group had recorded (Illustration 10, Chapter 10, p. 256). During this dialogue the pupils attain shared knowledge about what they are to take into consideration and be prepared to do to make a good film. During this dialogue the pupils are given some advice on how they can conduct such an activity while Steven also assesses the way they have made the film when looking at the finished product. This illustration shows that there is a close connection between scaffolding and assessment processes.

This is also what happens when Steven scaffolds the pupils during the training with the I-movie programme. When he helps Sheila (pupil) (Illustration 3, Chapter 8, p. 176) he assesses what she is able to do before he advises her on what to do. He apparently discovers that she is able to do the task with just the help of the instruction paper because he tells her to read what is written on this paper and then leaves the situation. In this way he has assessed

what help Sheila needs to be able to finish the task, and Steven has thus given help to Sheila in her ZPD.

The dialogue between the pupils and their teachers in the auditorium is both an assessment of the process and a conversation that tries to pinpoint directions for coming project periods. In this way this dialogue at the end of the work period could be perceived both as summative and formative assessment (Scriven 1969). Harold (teacher) comments that he thinks the pupils have done very professional work, and Owen (teacher) suggests that perhaps everyone should try to make their own movie (description of Applebee School, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 103).

There is a pervasive conflict between assessment that assesses pupils in relation to standards or goals set by the authorities and an assessment form that aims to help the pupils in their learning. The purpose of assessment is traditionally to inform, certify and select pupils. In this way assessment mainly has external purposes. Assessment may also aim to help the pupils towards stated goals. Teachers help the pupils to build on their competence, to try to help them attain these goals. In this way internal and external purposes can be in interaction to help the pupils learn.

At Applebee School, the class is exempted from the Curriculum and thus also the goals listed in this plan. However, the teachers have plans and goals for their work that are expressed in periodic plans and year syllabuses. The teachers state that they do not deviate from the National Curriculum that much, but that they feel free to do so (intteam 101300). Nonetheless, the teachers appear to find it important to build on what the pupils know and can do. Steven says:

Illustration 10

> *I think it's too early to start at once to assess the pupils. You've got to see the pupils from several angles before you can assess them. When we know the pupil well we know what to look for (Applebee School, intinf 102500).*

Here Steven shows that the pupils are the starting point for the assessment, not the predetermined goals. Even though the teachers have been released from following the National Curriculum, they have clear ideas about which goals they want the pupils to attain during the learning process, but the pupils are assessed in accordance with how they develop from their actual zones and throughout their ZPDs towards these goals.

Illustrations from Bridgeford School

When the teachers and pupils at Bridgeford School start the project period, the pupils are informed about the goals for the work period by Sarah (teacher). She says:

Illustration 11

> *When we've talked about the goals for this project I hope you'll understand them. In the first place you are to learn something in the subjects. When we've finished this project you'll have learned more about the topics that are listed in our project plan. (This plan lists various subjects with different issues they are to work on). Secondly, you should have learned that it's important to collaborate, and that's a skill. It's something you can learn. We're going to be better collaborators when we've finished this project. You're going to understand that being able to collaborate is a very valuable skill. The third goal is that you should have experienced that it's useful to collaborate, and you should have acquired another attitude about learning from others, that also means that you have to make good presentations (Bridgeford School, trec 110600).*

The pupils and Sarah talk about how the pupils' work is going to be assessed with marks during the project. Sarah and the pupils also discuss the fact that they can learn something from each other's work when they present their projects. The pupils are told that there will be a test at the end of their work on the topic "Norway". Sarah ends by telling the pupils that the areas they are going to be assessed on are content knowledge, their collaboration skills and the clarity of their presentation (trec 110600). The intention was that the test questions should be from the content both in the basic course and the various group projects, but due to a lack of time before Christmas eve, the pupils were given a test that was just from the content presented in the basic course (intteam 120500). At the end of the project period Sarah instead made a competition to collect the pupils' work (description of Bridgeford School, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 123).

When Sarah starts up one of the project lessons she shows the pupils a form she will use for assessing their work during the project period. This form has a square for collaboration, one for presentations and one for content knowledge. Sarah tells them that collaboration means the collaboration they have managed to create in the group. She also tells them that the collages they have made during the basic course together with the presentation at the end of the work will form the basis for the mark they are awarded in the subject of oral Norwegian. With respect to knowledge, Sarah tells the pupils that the test and the pamphlet they make during the basic course will show what knowledge they have acquired in social studies. In addition, they will also be given a mark in the subjects the teacher found to be integrated functionally in their project. The pupils wrote a document in the beginning of the pupil-directed part of the project period to plan and structure their work. On the basis of this plan the teachers also decided what subjects naturally became integrated in the project

(description of Bridgeford School, The Planning Phase Including the Forming of Questions, p. 120).

During the work process the pupils at Bridgeford School write a log once when they are working on the pupil-directed part of the project. In this log they are asked to write about what the group is trying to find out during the project. Each of the pupils is also asked to write about the tasks they are doing the day they write the log, and what they actually ended up doing. They are also asked to write about any problems they encountered, and what the group decides to do the next day. One issue in this log is how the group has functioned, and the last question the pupils have to answer is if they have received help from an advisor and if so what this help was. This assessment log is written by all the pupils individually, but Sarah also tells the pupils that they are free to discuss what they write in the groups (trec 120400). Sarah believes that it is important to listen to the pupils' opinions in their logs when the teachers are going to assess how the collaboration between the pupils has functioned (trec 121300).

During project work the pupils should also be given the opportunity to assess their own work (Skrøvset & Lund 1996, Rognaldsen 1999, Helle 2000, Rettleiing L-97, 1998 [Advisory Document C-97, 1998]). During the work process, the pupils at Bridgeford School are encouraged by the teacher to hold meetings in which they assess their own work. There is also an item in the schedule they write at the outset of "their project" on which they are to decide what dates and times they will meet during the process to talk over their work. Sarah says that she thinks this will help the pupils to work as a group and also give them training in assessing a joint work process (trec 112700).

At the end of the project period the pupils present the result of their work to the whole class. After each presentation the pupils in the audience comment on the presentations. When the pupils present their work, the assessment of the various groups can also give them shared knowledge of how a presentation should be conducted. Sarah says that they are used to bringing the pupils into the assessment process. When the pupils assess each other's work, they offer both positive and negative comments. The pupils that present their work are also asked what they think they would have done differently the next time around (intinf 111300). The positive comments the pupils had on each other's work during the presentations were:

Illustration 12

> *Well made, well edited. Very amusing that they poked fun at each other. It's both fun and serious. You're good at using the camera. It's really fun. Good. It's humorous. It's fun. You had a lot of stuff. I think the questions were good too, you made them answer in different ways. It's quite fun. I learned a lot about clothes. I learned what sweets the pupils in the class like to eat. I think it's*

very good to use those transparencies (Bridgeford School, trec, vrec 120400, trec 120600, trec, vrec 121300).

They also comment on things that could have been done better:

Illustration 13

They could have moved the camera more steadily. There was not so much Norwegian music. It would have been an advantage if everyone had said something. There were no pictures there. Look more up from the papers when you talk. You talk a bit too softly. I think it was a bit boring because you looked down and also muttered a bit. They could have talked more clearly and crisply. Rose seemed a bit restless, moving all the time, her body going backwards and forwards (Bridgeford School, trec, vrec 120400, trec 120600, trec, vrec 121300).

Sarah also asks the pupils in one of the groups if they think that everything was good. Then one of the boys answers that their poster is a bit confusing, and says that they can take a closer look at it afterwards (trec 120600). Sarah reflects on the feedback the pupils give to each other. She says:

Illustration 14

The pupils give positive comments and also suggest better ways to do the work. But I don't know if it's good, actually, because these are just some spontaneous comments and only from a few. But, on the other hand, it's natural that the comments are given just then and there (Bridgeford School, intteam 120500).

Sarah does not appear to be entirely confident in how the assessment process is conducted, but at that moment she does not see any other ways of doing it. One way to try to make all the pupils active during this process could have been to let one pupil group be responsible for an assessment of one other group. In this way it would not be that easy to hand over the accountability to others and stay passive.

When each of the groups has presented their work, they also write a log (description of Bridgeford School, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 123). This time every pupil write their own log. Sarah argues that it is important that they write just by themselves because they are going to write down their independent assessments of the other pupils. The pupils are told to write about the collaboration processes in the groups, about the division of labour and a little bit about what they think of the work they have done (trec 121300). Sarah says that the teachers use several strategies to find out how the pupils work and collaborate. Thus they use multifaceted ways to collect data about the pupils (Airasian 1994, Calfee & Masuda 1997). They observe the pupils, and the teachers talk together to find out if they have the same impression. Sarah adds

that they observe the groups they have decided to advise at the outset of the project (trec 112700). She states that the pupils' planning document is the basis for the help they give the pupil groups, but adds that when they get the log at the end of their work, they also have another basis for their discussion (intinf 112800). Sarah says that the teachers have not written down anything from their observations during the work so they have no documentation, but the teachers talk together to get an impression of how the pupils have worked (trec 121300).

To assess what content knowledge the pupils have learned, they are given a test. Most of the questions ask for facts that the pupils can memorize from the texts they have read in their textbooks or remember from the basic course in the first part of the project period. These questions ask the pupils for facts about Norway. They are asked to write the names of the counties, to put various towns at the right place on the map, to write the name of the highest mountain, the longest fjord and the biggest island. They are also asked to explain words like revolution, democracy and monarchy. Ten of the questions on the test ask for facts, whereas two are open-ended. Tests with open-ended or self-defined questions may, according to Rognaldsen (1999) and Helle (2000), function as a strategy to find out what the pupils have learned. When answering such questions, more is up to the pupils in what they answer, and there is not one correct answer to the question. The pupils are also given the opportunity to show their own thoughts and understanding. One of the questions on the test asks the pupils to write about their community and its characteristics. The second question is very open, and asks the pupils to write about Norway from their point of view. Such a question allows the pupils to decide what they want to write about, and this question could therefore be perceived as self-defined. When writing the answer to such a question the pupils feel free to write about issues that engage and thus interest them. When teachers read such answers, they can also get a glimpse into what has impressed and interested the pupils. The topics the pupils decide to write about have apparently also become meaningful for them, and answers to these questions will probably also reveal the pupils' understanding of the topics they are writing about.

Sarah states that the aim of all teaching is learning. She adds that this learning has to be tested, and that a test with questions the pupils have to answer will measure what the pupils have learned (trec 110800). Sarah is obviously aware that questions can be asked in various ways, that questions can ask both for memorized facts and for the understanding of topics, as the test she gave the pupils contained both types of question. This also shows that Sarah attaches importance to knowledge as facts and as understanding. After the project period all the pupils receive the form that shows how the various aspects during the project have been assessed.

As mentioned above, this form covers assessment of activities during the project period and assessment at the end of the project. It also includes assessment with and without marks. As Sarah told the pupils at the beginning of the project, they are assessed on how they collaborate, and how they manage to impart what they have learned to others, which means how they present their work and what content knowledge they have appropriated. How they collaborate is assessed by qualitative descriptors (Gipps 1994), which means assessment without marks. Furthermore, they are given a mark in the subject "oral Norwegian" that is a mean grade of the marks that were given for the presentation and the group work that resulted in various collages. For content knowledge, the pupils are given marks on the test at the end of the project and the pamphlet which was based on exercises the pupils did throughout the basic course. These two marks constituted the basis for a total mark in the subject social science. The pupils also received a mark in other subjects that were integrated in the project, for example the group that had "national dishes" as their topic also received a mark in domestic science. The basis for this mark was the quality of the information search and thus a generous selection of national dishes was important. Hence, all the marks had a qualitative description (Gipps 1994, assessment schemes). In this way the assessment serves both a normative need, through the marks, while the qualitative descriptions give the pupils guidance in how to proceed in similar situations.

Even though each project work period is not to be given a mark (Rundskriv F-107-1997) [Regulation F-107-1997], the pupils at Bridgeford School receive marks both on the various tasks done during the project and also marks on the various subjects integrated in the project. Sarah believes that the pupils should get marks:

Illustration 15

> *We thought of applying for an exemption from awarding marks, but I think it‘s important that the pupils get to know where they stand, perhaps they'll think there's something wrong with them if they don’t get any marks (Bridgeford School, intinf 111300).*

Illustrations from Cooper School

The goals the teachers at Cooper School have set for the work are that the pupils shall learn something about project work, that they shall learn to find material themselves and to be independent and able to present their work. Other goals are that the pupils will have greater interest in their roots, and also contribute something to the school, to the local community and to their family during their work on the topic of emigration (intinf 091400). The teachers

explained these aims to me during an interview. It should also be expected that these goals would be explained to the pupils in the beginning of the work and also reflected on at the end of it. This is not the case, not in the beginning nor at the end of the work. I will return to this after I have examined the assessment during the project work.

In the beginning of the project the pupils acquire shared knowledge on how to proceed in the work. Marion (teacher) shows the pupils all the thesis questions the pupils have made, and tells them that they are going to make a plan for the coming work. She tells them about the logbooks and the sheet of paper they are going to write after each work session (description of Cooper School, The Planning Phase Including the Forming of Questions, p. 134). Marion also has some ideas about the logbooks:

Illustration 16

> *I don’t think there will be any problem assessing the products at the end. The pupils are going to write reports, and we have their logs. Most of the pupils have worked in groups, so we have to look at the report and the log to find out how these pupils have collaborated. But we haven't managed to assess the process the way I had hoped we would. To do that, we couldn’t have let the pupils go home to work (Cooper School, intinf 110200).*

It becomes clear that although all the pupils receive information about how these logbooks and the assessment papers are to be used, they didn't function as well as intended. Marion believes that they will be able to assess the products at the end, and remarks that they have both the pupils' logs and their written reports to help them. She further states that they have not managed to assess the pupils as much as they had planned or hoped to do. She argues that if they were to have managed to observe and thus assess the pupils' work processes, they would at least have had to keep them all at school. On the other hand, there was no plan for how the teachers should actively follow up the pupils during the process, nor were the pupils who were at school all the time followed up and thus assessed during their work. During the exhibition evening the teachers also reflected on their assessment and decided that they probably did not have enough dialogues with the pupils during the process (description of Cooper School, The Product Presentation Phase and the Teachers' Reflections, p. 139). Because of this, there was no strong formative, dynamic assessment (Scriven 1969, Dixon-Krauss 1996) in class that could help the pupils learn during the process.

Marion seems a bit confused in relation to the assessment of the pupils' work in the project. At the beginning of the project period she states that she is glad she is not going to assess the pupils' work with just a mark (intinf 091400), but at the end of the work, when the

teachers are going to give the pupils an assessment without marks, she appears to have second thoughts. She says:

Illustration 17

> *And this is pretty difficult, and I've actually thought that giving pupils a mark in project work is basically a difficult task, but in another way it would have been just as easy to give one mark for this work, but with respect to the assessment without marks, then I think the pupils and the teachers together can agree about the formulations (Cooper School, intinf 112300).*

The teachers are used to giving the pupils marks on schoolwork that is assessed. Even though this class has worked on projects for two years when the observed project started, the teachers obviously have not developed a strategy or procedure for assessing the pupils' work during projects. This shows that the assessment practice in relation to the work processes during project work appears to be a challenge for the teachers at Cooper School.

What the pupils work with and manage to learn should become a part of the assessment of the various subjects that are functionally integrated in the work (Rundskriv F-107-1997 [Regulation F-107-1997] Rettleiing L-97, 1998 [Advising Document C-97, 1998]). This was also taken up and discussed during one of the dialogues between the researcher and the teachers. This dialogue starts with a question from the researcher:

Illustration 18

> *(1) MayBritt: You've written in your plan for the project that the assessment of the whole project shall be connected to the various subjects that are functionally integrated in the work, do you have any thoughts on that?*
> *(2) Marion: Yes, I've thought a lot about that, but I don't understand how we're going to do this (Cooper School, intinf 110200).*

Marion obviously finds that relating the assessment of the project to functionally integrated subjects is a very difficult process. The teachers seem to delegate this problem to the pupils, at the same time as it is the teachers' responsibility to see to that the assessment work has a proper knowledge level (Skrøvset & Lund 1996, Rognaldsen 1999, Helle 2000, Rettleiing L-97, 1998 [Advisory Document C-97, 1998]). The pupils write their self-assessment on the assessment form and they are asked to suggest what subjects they think should be integrated in their work. Marion thinks that the pupils have been very realistic with regard to what subjects they have included in the assessment process (intinf 112300). When the teachers are asked how they are going to assess the pupils' work, Marion again mentions this form. She says:

Illustration 19

> *We use this (waves the pupils' assessment form in her hand), and we look at the pupils' products. And when we've done this, we talk to the pupils about their work. I can imagine that's the way we'll do it (Cooper School, intinf 112300).*

The pupils also give themselves a mark on the assessment form, both in connection with the process and the product. The plan is to discuss these marks with their teachers during the assessment dialogue so that the teachers and the pupils can come to an agreement.

All the pupils participate in assessment dialogues with their teachers. In some of these dialogues all the pupils in each group take part, while in other dialogues pupils talk with the teachers on an individual basis. For each group of pupils, one teacher and an assistant are present. In the dialogue rendered below the two pupils in the group talk to the teachers at the same time. These two pupils, David and Michael, have made a web page during the project period. Susie is the name of the assistant taking part in this dialogue, while John (teacher) is the one who invites the pupils into the conversation.

Illustration 20

Sequence 1:

(1) John:	*I think this is quite a thorough description. And you' ve written down what thesis question guided your work?*
(2) David:	*Mm (confirming John's utterance).*
(3) John:	*And you've written how you worked out the information. How did you actually do it?*
(4) David:	*Okay, we divided some of the work between us, and we also met during our spare time.*
(5) John:	*How did you use the information sources, you used the encyclopaedia and the Internet as sources?*
(6) David:	*Yes, we found some material there.*
(7) John:	*And then you copied it?*
(8) David:	*No, not all of it. We've written most of this in our own words. There are a few things we've used as they were, we copied something from the Internet, but not much.*
(9) Susie:	*Was it easy to find the material on the Internet?*
(10) David:	*Yes, it's quite easy to find the material there, but the work that took time was making the web page.*
(11) John:	*You could do some pro...., I call it programming the work you do when you make a web page, you use the HTML language to do some programming, but you could do that beforehand, David?*
(12) David:	*Yes a bit, not that much, a few codes.*
(13) John:	*My impression is that you got that as a by-product of this work, that you've learned a lot more about it?*
(14) David:	*Yes, I got some help from the deputy head, I understood it pretty quickly then (Cooper School, trec 120700).*

John at first comments (1) that he thinks David has written a very detailed description of the work process. David agrees (2) with him, but John also wants him to tell (3) more about how

they worked out the information. In utterances (4-8) the talk between the pupil and the teachers is about how they gathered and processed the information. It seems that David is focused on telling the teachers that they have written the text in their own words and not just copied it from the net. Susie also asks (9) if it was easy to find information on the net, and David answers (10) that it was. That David had some problems finding information on the net before Marion showed him a web page about emigration already made by pupils in Norway (trec 091400) is not mentioned in the dialogue. It could be that David has forgotten this, or that he does not want to bring this up during the assessment talk. It is likely that neither John nor Susie know about the problems David had when he was trying to find information, and therefore this issue is not brought up in the discussion. David apparently wants to talk about the web-page work, telling them how time consuming it was. From my observations of the group I totally agree with David, making the web page took up most of their time. In utterances (11-12) the talk is about David's competence in making web pages. John then says (13) that he thinks that learning more about how to make a web page is a by-product of the work. David agrees (14) with John and says that he was really helped by the deputy head. It could be a basis for a discussion whether the main focus in David's group was to develop their competence on emigration or on making a web page. From what David says, it appears that he thinks their work was mostly about making a web page because they used most of the time on this work.

Then John takes a look at Michael's assessment form and starts a dialogue with him. He says:

Sequence 2:

(15) John:	*What about you then, Michael, you couldn't do anything like this before?*
(16) Michael:	*No, I couldn't do anything like this before.*
(17) John:	*But have you learnt much about it now?*
(18) Michael:	*Yes, I can make a web page now.*
(19) Susie:	*You write that you've got a lot of help from David, and you've written that you think that's of great value.*
(20) Michael:	*Yes, I couldn't have done it without him.*
(21) Susie:	*No.*
(22) David:	*But he did find a lot of information. He's the one who found most of the material.*
(23) Susie:	*Exactly, that's interesting.*
(24) John:	*Yes, I find that interesting too.*
(25) Susie:	*David, you had the most computer skills and used them, and Michael found the material to work with.*
(26) David:	*Both of us found material.*
(27) Susie:	*But Michael found most of the material?*
(28) David:	*Yes, and he worked out a lot of the stuff.*
(29) John:	*Yes, it's interesting to see such a division of work between you. I haven't seen that before our discussion here. It's interesting, mm.*
(30) Susie:	*Michael, you've written that you should have been given more help at school, was it in connection with the computer work or…?*

(31) Michael: *Yes, in connection with writing things in our own words.*
(32) David: *We couldn't just copy the stuff, could we?*
(33) John: *Ye that's rights, and you're satisfied with the result, and you're praising each other. You are both mutually satisfied with your contribution, and that's good.*
(34) Susie: *Yes, interesting work with the project.*
(35) John: *Mm (Cooper School, trec 120700).*

Utterances (15-18) deal with Michael's increased competence in making a web page. In utterances (19-21) it also becomes evident that David has helped Michael to learn to make a web page. In this connection David also breaks into the dialogue and says (22) that Michael found most of the information they compiled. In utterances (23-29) the dialogue is about the division of labour between the two pupils, and the teachers say that it is interesting to hear that one of them had the most competence in making the web page and that the other had taken the responsibility for finding the necessary information. This dialogue also shows (29) that the teachers do not know how the pupils have worked during the process, something that also indicates that the information the teachers obtain during this dialogue is new to them. In utterances (30-32) it is clear that Michael thinks that they should have received more help from the teachers in putting things in their own words. In the self-assessment form Michael has written that the teachers just came and checked if they were doing what they were supposed to be doing and then just left again. David adds (32) in the dialogue that they could not just copy what was written on the web. Without taking this criticism from the pupils any further, the teachers bring the discussion to a close by saying (33-35) that it appears that the pupils are satisfied with the result. What David and Michael have suggested as their marks and what subjects they think can be included in the work and thus be assessed, is not discussed in the dialogue between David, Michael and their teachers. On the other hand, these issues are taken up during dialogues between other teachers and pupils. Below is a sequence from one such dialogue. Ben (teacher) opens the dialogue with Tina (pupil):

Illustration 21

(1) Ben: *In this assessment you say that both arts and crafts and social science are included. Yes, I think it's okay with arts and crafts, but do you think that you've learned so much about emigration that if you're examined orally at the end of the year you can talk about it if you're asked?*
(2) Tina: *Yes.*
(3) Ben: *Yes, then it seems that you're definite about what subjects this work is going to be a part of the assessment for, and it appears reasonable. Then you've given yourself marks: a "5" for effort, and "5 +" for the result.*[64]
(4) Tina: *Yes, at first I thought of giving myself "4 +" for effort, but then I found that we worked very well towards the end of the project, so…*

[64] Marks in lower secondary schools in Norway are number grades, from 1 to 6. Six is the best result attainable, whereas 1 is the lowest mark you can receive.

(5) Ben: *Yes, I think you're realistic, but perhaps a bit kind to yourself with regard to the process, but I think it's okay (Cooper School, trec 120700).*

During this dialogue both the subjects to be included and the marks are discussed. Ben wonders (1) if the pupil has learned enough about emigration to talk about it if she is examined on this topic. The teachers apparently have no other sources than the pupil's own word that she is prepared for such an exam. In this way it is reasonable to believe that it will be difficult for the teachers to give the pupil an assessment in the subject of social science, but it seems that the mark that they agree on in connection with the result (3-5) will count as part of the basis of the mark in this subject.

During these dialogues the goals for the work (intinf 091400) are not discussed. However, there is a short reflection on the process during the summary lesson at the end of the work (description of Cooper School, The Complementary Work Phase, p. 141). One of the pupils says that it is not easy to undertake genealogical research. Another adds that he is very satisfied with his "Power Point" presentation (trec, vrec 112300). It would probably have been useful for the pupils to hear about the other pupils' processes, to talk both about their problems and successes. The purpose of an assessment of the work processes that can become a part of the pupil's shared knowledge will be examined in the following discussion.

Discussion

During the observed project periods all assessment is either conducted by the pupils' teacher or by the pupils, either assessing themselves or each other. However, it seems that the assessment practices at the three schools have in varying ways and degrees tried to help the pupils during the work and to sum up what the pupils have learned during the processes. The teachers at the three schools have goals for their teaching, but these goals are not specified for most of the pupils, and thus the pupils are not brought into the process of making them. One of the aims of Norwegian schools is that the pupils shall try to assess their own work and thus also their work during projects (Skrøvset & Lund 1996, Rognaldsen 1999, Helle 2000, Rettleiing L-97, 1998 [Advisory Document C-97, 1998]), but when the goals or criteria are unknown to them, it is difficult for the pupils to assess how they have succeeded during the processes.

Criteria are defined as specifications of goals (Skrøvset & Lund 1996). If one of the goals during project work is to become a good collaborator, one criterion guiding the pupils to reach this goal could be to listen to what other pupils say and not interrupt them. Another criterion could be that they take responsibility for their part of the work during the work

process. If these criteria are looked upon as the "rules" that the pupils have to follow to reach the goals for the work, there is no clear distinction between the rules and the goals. This means that the pupils can develop throughout the entire process and reach partial goals, which means that they can manage to meet the criteria and thus the specifications for the goals during the work process and not just reach a goal at the end of the project. In this way it is also possible to assess if the pupils' actions are in accordance with the listed goals throughout the work, not just at the end of the work. In this way the pupils are assessed in ongoing processes when they work with real tasks and challenges (Valencia et al. 1994, Torrance 2000).

At Applebee School the pupils are informed about what the teachers are looking for when deciding what pupils to pick to edit the films (description of Applebee School, The Planning Phase, p. 98). The pupils are not informed about any other goals or criteria before the work processes, but while they work the pupils discuss with the teacher and are thus made aware of criteria that exemplify good work. This happens for instance when the teacher and a large group of pupils are gathered in front of the TV to watch and discuss the films they have made (Illustration 10, Chapter 10, p. 256). In this way the pupils both are made aware of and are assessed in accordance with the criteria that are the focus in the dialogue between the teacher and the pupils. This dialogue also makes it possible for the pupils to learn and thus understand what it means for their work to try to follow and attain these goals (Bakhtin in Volosinov 1973, Vygotsky 1978, 1986/2000, Bakhtin 1981, Holquist 1990, Skrøvset & Lund 1996, Torrance & Pryor 1998).

The teachers at Applebee School have been released from following the National Curriculum and grading with marks because they believe that such external goals and grading with marks can affect teaching and learning negatively (description of Applebee School, The Context, p. 85). According to Leontèv (1978), development and change may occur due to tensions between the various components in the Activity System. This can be illustrated in the Activity System showing the tension between the "rules" for the work stated in the Curriculum plan and the “goals” that the teachers have stated for their teaching.

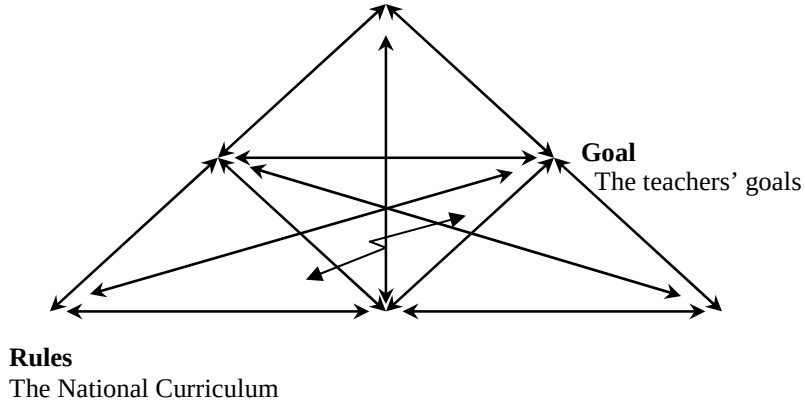

Figure 16: Tension between goals and rules for the work presented in the Activity System

According to the headmaster and Steven (teacher) at Applebee School, assessment can affect teaching and learning negatively, but the observations of the practices in Applebee School also show that assessment can influence teaching and learning positively. This occurs during the guided assessment (Brown et al. 1992) that Steven gives both in the learning of the I-movie programme (Illustration 3, Chapter 8, p. 176) and when the pupils learn to use external equipment (Illustration 10**,** Chapter 10, p. 256).

These two illustrations show that it is unreasonable to believe that scaffolding takes place without any assessment processes involved. In the setting in front of the TV when the pupils watch the film sequences together (Illustration 10, Chapter 10, p. 256), the teacher's main aim appears to be the guidance he can give to help the pupils when they film next time. This guidance is not given in a one-to-one relationship between the teacher and each pupil, but to the whole group of pupils. It also seems that the assessment is subordinated teaching, and that the process that takes place can be called "assessment while teaching", as defined by Newman et al. (1989). It also appears that Steven believes that the instruction and the help the pupils are given during the basic course may also help the pupils carry out similar tasks in the coming process, and that the pupils thus have a wide ZPD that enables a transfer between the various tasks the pupils are to solve (Brown & Ferrara 1985).

At Bridgeford School the pupils are told what issues are going to be assessed during the work, but what characterizes good collaboration and a good presentation are not specified. All they say is that the pupils should show the ability and a will to collaborate and an ability to present their work clearly and thoroughly. The pupils probably have an opinion of what these characteristics can be, but without any specification it is difficult for the pupils to know what is expected of them, and it will also be difficult for the teachers to make a progress plan

in accordance with the various issues. In connection with content matter, the pupils are informed about what topics they are to learn about (project document), and are also given a sheet of paper with questions from which the questions on the test are selected. In this way the pupils are informed about what is expected of them on the test and thus what content knowledge they need to learn.

At Cooper School the pupils are not informed about any specific criteria or goals for their work. They are given a log on which they are going to report what they have done, what has functioned well, what could have been done differently and what the plans for the next work session are. The pupils have no standards or criteria that can guide them when they assess their work. The teachers also found that they had not placed enough demands on the pupils during the work processes, and they also felt that they should have had more dialogues with the pupils (description of Cooper School, The Product Presentation Phase and the Teachers' Reflections, p. 139). According to Skrøvset and Lund (1996), assessment dialogues with the pupils must be based on assessment criteria. Sadler (1989) also highlights the importance of the pupils knowing the goals for their work. If they were to follow up the pupils it would also have been necessary for the teachers at Cooper School to have specifications of goals on which to base the dialogues with the pupils. If the pupils had been informed about the criteria, this could also have guided them during their work and thus helped them to create a good result. David and Michael (pupils) discuss during the process that they think they should get an extra plus because they made a web page. David also thinks that they will get a good mark for this work (description of Cooper School, The Realization Phase, p. 135). These pupils use the computer as a tool to present their material. Nothing is said in the beginning of the process as to whether the pupils will be assessed in how they manage to use the tools during the process, and it is obvious that both David and Michael do not know what is expected of them during the work.

If the criteria or the goals had been clearly expressed, the assessment process would have been facilitated in various ways. The pupils would have been more prepared to assess both their own and each others' work (Skrøvset & Lund 1996, Rognaldsen 1999, Helle 2000, Rettleiing L-97, 1998 [Advisory Document C-97, 1998]). Moreover, it could have been easier for the teachers to give a qualitative description (Gipps 1994) of the pupils' work during the process and also to sum up their development. If the pupils' development and thus progression is to be taken into account in the formation of the criteria or goals, these criteria must be contextualized, which means that they have to be tailored to the pupils in a specific class.

In the description of the assessing procedures at Cooper School, it was said that the assessment practice during the project appeared to be a challenge for the teachers working at this school. It also appears that the authorities have problems deciding how the work method is going to be assessed, and that there generally is an uncertainty with regard to how to assess this work method. This could be due to the tension between the various purposes of an assessment. As mentioned above, in the theoretical framework, the assessment of project work that is to be entered on the leaving certificate has changed from an assessment without marks to just a description of the topic the pupils have worked on (Rundskriv F-107-1997 [Regulation F-107-1997], Rundskriv F-44-1999 [Regulation F-44-1999]). The leaving certificate presents a summative assessment that has both selective and certificating purposes, and information about the pupil's knowledge is expressed by marks. An assessment given by means of qualitative descriptors is difficult to condense, which also means that such descriptions are difficult to compare. This is probably why descriptions of pupil performances are replaced by just the title of the final project. To rank the pupils' performances, the descriptions of them must be comparable.

If a qualitative description of the pupils on the leaving certificate is to have any significance, this assessment must also be based on each and every child's learning and development. On the other hand, one of the purposes of a leaving certificate is to rank the pupils. The qualitative descriptions of the pupil performances can be looked upon as relative, providing no meaning if they are compared. If the goals and the specific criteria for the various types of competence (see Appendix 8, Figure 17, p. 411) for the final project in each classroom were presented in connection with the descriptions of the pupil performances on the leaving certificate, a comparison or a normative assessment could also have been facilitated, while this assessment would have been a total assessment of each pupil's holistic development, which is the aim of project work.

During a project period the pupils' work can be assessed at different levels (Rognaldsen 1999, Helle 2000). In Bridgeford School the pupils are assessed individually on the goals that were stated in the beginning of the work (trec 112700). In addition to this, the group the pupils worked in was awarded a joint mark on the collages they made during the basic course (trec 120400). At Applebee and Cooper Schools there is also a short summary of the process at the end of the work, and each group at Bridgeford School makes a presentation of their work (Applebee School trec, vrec 101300, Cooper School trec, vrec 112300, Bridgeford School trec, vrec 120400, trec 120600, trec, vrec 121300). This means that the pupils are assessed at the individual, group and class levels. Sheila (pupil) is assessed and

helped at the individual level (Applebee School, Illustration 3, Chapter 8, p. 176), whereas the pupils who have done the filming are assessed and helped at the group level (Applebee School, Illustration 10, Chapter 10, p. 256). All three schools have assessment processes at the end of the work. The summaries of the processes and the short assessment of them (Applebee and Cooper Schools) and the assessment in connection with the presentations (Bridgeford School) makes it possible for all the pupils to obtain shared knowledge in connection with the presentations of the joint work processes. In this way assessment processes can help to create development towards new proximal zones, both at individual (Vygotsky 1978) and collective levels (Engestrøm 1987).

Sheila is helped in a one-to-one relationship with her teacher and thus is also scaffolded and assessed in her individual ZPD (Vygotsky 1978), whereas the group that receives help in front of the TV while watching their films are helped on a collective level. When the whole class is gathered together to talk over their work, the pupils are viewed as a learning community that constructs knowledge, and the knowledge building community is thus both guided and assessed in relation to the collective ZPD (Engestrøm 1987). The talk is both retrospective, reflecting on the processes that are accomplished, and prospective, reflecting on the processes to come, building on the experiences of the current project (Applebee School, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 103, Bridgeford School, The Product Presentation Phase, the Assessment Phase and the Complementary Work Phase, p. 123, Cooper School, The Complementary Work Phase, p. 141). In this way the assessment at the end of the project work is both summative and formative at one and the same time. All these events are illustrations that show that the pupils are both assessed and instructed at the same time (Cizek 1997, Torrance & Pryor 1998).

The teachers could have used much more time on the complementary phase of the project work to help develop the pupils' metacognitive competence. They could have let the pupils talk about the processes in which they have learned with respect to academic, social aesthetic, methodological and learning issues in the class as a whole. In this way all the competence the pupils have had the possibility to develop could have been discussed and reflected on. One of the arguments for using the project work method in schools is that the pupils are to learn to gather information, assess it, make a synthesis of it and then present the result in various ways (Berthelsen et al. 1987). When the pupils are using tools, they have the opportunity to increase their competence in using them and thus develop their methodological competence. In a whole class setting the pupils and the teachers could have discussed how

they have used the ICT equipment and shared their knowledge in how they can learn to act and think with ICT (Wertsch 1991, Säljø 1999). Such a dialogue could have helped the pupils develop their metacognitive competence with regard to ICT.

During the observed projects ICT equipment is widely used by the pupils. If they are to perceive that their competence in using ICT equipment and other tools is as important as their development of academic competence, it is vital that they are also assessed in how they develop in connection with the use of the tools. Therefore it is important that a qualitative assessment of all the types of competence is written on the leaving certificate to show that holistic development and, thus also a holistic assessment, have been emphasized. In this way the pupils will be given a leaving certificate that is something more than just marks awarded for the various subjects, as is the situation today.

If marks are to be awarded in school, the pupils probably also need to have an assessment of the various project periods they partake in if they are going to value their project work as much as the other work they do in school. According to Newmann (1997), assessment tasks communicate to students the kind of work that is valued. The pupils could for instance receive a mark in connection with academic competence and qualitative descriptors indicating their learning in accordance with the other issues that together make up a holistic development. A test could, for instance, give a picture of what the pupils have learned in connection with subject matter. An assessment dialogue could also give the teachers an overview over the pupils' knowledge and understanding of the topic they have worked on (Skrøvset & Lund 1996). This means that the theme the pupils have worked on has to be a topic of the assessment dialogue between the pupils and the teachers. This was not, however, the case during such dialogues at Cooper School. To give a proper description of the pupils, it is also necessary that the teachers develop strategies that can help them both to document and remember the pupils' thoughts and actions throughout the work process. Log entries made by both the teachers and the pupils and portfolios are examples of measures that could help the teachers in this work (Valencia et al. 1994).

This shows that when the project method is used as a work method in school, it does not necessarily mean that academic competence is overlooked or not given priority. In the beginning of a project period the teachers usually present an overarching theme that functions as an umbrella for the various sub-topics the pupils are working on. When the pupils have completed their work, it is therefore also important to collect what the pupils have learned to give a broad presentation of the common topic to the class. In this way the pupils are also given the possibility of developing their academic competence on the overarching theme, not

just in connection with the example they were working on themselves, but on the basis of the work in all the groups.

New forms of teaching appear to need new ways of assessment. It is also important to decide what is going to be assessed, by whom and why you want to assess it before settling on how the assessment procedures are to be conducted. The illustrations show that assessment takes place when the pupils collaborate, often in the form of self-assessment (when the pupils at Applebee School are editing the films, Illustration 6, Chapter 9, p. 218), when the pupils are scaffolded and when the teachers and the pupils in the whole class are talking together to create a shared knowledge base. In this way assessment is part of most of the processes in the classroom. Thus it also appears that project work needs a naturalistic and context-sensitive assessment form to give a picture of the learning processes both during and at the end of the work, which includes both productive and reflective competence. A qualitative research study aims to give a description of the emic perspective. To manage to give a thorough description it is necessary that the researcher observes the whole process and also talks to the people involved to get the information necessary to (re)present the research field in a narrative. Like a qualitative researcher, the teachers also have to observe and talk to the pupils right from the beginning and to the finished product. In this way the teachers will be able to give a holistic and thorough qualitative assessment of the pupils that can help them during the learning processes and also give a picture of the pupils' actual zones of development.

In the next and final part of the text, Part 4, Chapter 12, I report the findings of the working hypotheses presented in Chapter 1. I also present a summary of the categories that were generated from the interaction between theory and the data material. Moreover, I present other interesting issues that should be considered and suggest the direction future research in this field should take.

Part 4:

Concluding Comments

Chapter 12
Project Work Using ICT as a Mediating Artefact - Concluding Comments

In the introduction to this text I presented various ideas on information and communication technology (ICT) as a mediating artefact in learning settings. Some researchers are looking at ICT as a tool that can replace teachers (Bork 1980), whereas the culture of learning, or the classroom context, is also seen as an influence on the learning processes when pupils use ICT as a tool. Thus both the promises of the technology and the changes in the learning communities that support the realization of the new technology have to be taken into consideration in research on ICT (Mercer 1993, Crook 1994, Salomon & Perkins 1996). Salomon (1990) has also shown that actions take place in a context that forms, restricts and establishes the premises for them. He claims: “Children’s cognitions are not affected by ‘Television’ or by ‘Computer’; they are affected by specific kinds of *programs* with which they carry out specific kinds of *activities*, under specific kinds of external and internal *conditions* for specific kinds of *goals”* (p. 27, italics in original).

The main research question for my work was: *"How can information and communication technology be integrated in project work and what does this mean for the pupils' learning?"* In connection with this main question I generated several sub-question, and these sub-questions provide answers or exemplifications to the overarching problem formulation. In the coming text I present a summary of these answers supplemented with assertions made on the basis of the empirical data and theories.

(1) *The placement of equipment and the computers.* The teachers at the three schools have concurrent opinions on the placement of the ICT equipment. The teachers at Applebee and Cooper Schools mention that the ICT equipment should be placed both in the pupils' work area and in computer labs. The teachers at Applebee School argue that in this way the pupils will be able to integrate ICT in their various subjects, and the teachers will also be able to give the pupils joint training in the use of ICT in the computer labs. The teachers at Bridgeford School feel that the ICT equipment should be placed nearby the pupils' work places, not helter and skelter, thus indicating that the equipment should be placed together so that several pupils can work at the computers at the same time. At this school, groups of pupils also receive training in the use of the ICT equipment when it is necessary.

(2) *The number of computers.* The studied processes appear to show that the number of computers or other ICT equipment does not necessarily play a decisive role when pupils

are using this equipment during the learning processes. What does appear to have impact is how the teachers structure the processes. At Applebee School the pupils are divided into several groups so that they are trained in using various tools at the same time. In this way the ratio of computers to pupils does not necessarily have to be 1:1. Research supports the finding that pupils do not necessarily learn more when the pupil-to-computer ratio is 1:1 (Owston & Wideman 2001). The teachers in this school also appear to let the pupils work in groups for pedagogical reasons, not just because there might be a lack of equipment. Furthermore, many researchers claim that technical equipment should be used in accordance with the teachers' pedagogical views. This means that the instruction is theory driven not technology driven (Cuban 1986, Cohen 1987, Koschmann in press). This appears to be the case both in Applebee and Bridgeford Schools. At Applebee School the teachers had a strict plan for how the ICT equipment should be used. At Bridgeford School the "ICT corner" was furnished with six computers and a printer. The pupils could also use eight computers that were placed in the library nearby. This appeared to be enough computers for the pupils to use when they functionally integrated the computers in their work. At Cooper School the computer room was situated in a different part of the school than the pupils' classroom. This meant that it took some minutes for the pupils to go there. Nor did the teachers have a plan for how and when the pupils should work in the lab. Due to this lack of planning the computer room was a bit over-populated by pupils with regard to computers in the beginning of the project period when several of the pupils wanted to go to the computer lab to search for information. One of the teachers at this school informed that one of the rules at the school is that the teachers have to accompany the pupils when they want to search for information on the Internet or use the ICT equipment in other ways. If the computer room had been nearby the pupils' classroom, it would have been easier for the teachers to keep an eye on the activities going on there without having to accompany the pupils. The pupils could then have probably used the equipment just when they felt the time was right to do so, and not when the teachers had time to accompany them to the computer room.

(3) *Acquisition of equipment and maintenance.* The equipment that was used at the three schools was obtained in various ways. It is obvious that the equipment was not only purchased with money from the ordinary school budget. Applebee School has received a great deal of equipment from the private sector, including a server and digital video cameras. They have also been given computers by the Apple organization. Bridgeford School has received computers and other ICT equipment from Telenor and the local authorities. Cooper School bought used equipment from the private sector; apparently this was the only way that they

would have enough money to get the computers they wanted. This shows that the equipment the schools can buy within the limits of the ordinary school budget is probably restricted. It also appears that the people in the school administration and the teachers have to be open-minded when trying to obtain ICT equipment in other ways, for example the teachers and administrators in these three schools lobbied the private sector for equipment.

Once the equipment has been purchased, it obviously needs maintenance. At all three schools some teachers were given resources to look after the ICT equipment. The four teachers at Applebee School who are responsible for the technical equipment are altogether paid for ten and a half hours a week for the maintenance work. The three teachers in the ICT group at Bridgeford School have altogether nine and a half hours a week for maintaining the equipment. At Cooper School the headmaster is responsible for the technical system as part of his full job, whereas the deputy head has four hours a week for working with support teachers and pupils in the use of ICT. Even though resources have been given for maintenance work, it appears that there are some problems with the technical equipment. At Bridgeford School the equipment did not work when it perhaps mattered the most. For example, Sarah (teacher) could not show the Power Point presentation she had made for the pupils to motivate them to choose topics. Nor could a group of pupils show the Power Point presentation they had made as part of their presentation. It appears from this that it is probably necessary to have a person working full time to take care of the ICT equipment in schools with as much pupils as in the studied schools. This means that a person ideally should have a full-time job as a maintenance technician, and thus be available when the teachers and pupils need assistance.

(4) *Teachers' attitudes, cooperation and how this cooperation mediated the processes in the classroom*. In the study, ICT equipment was used in project work. The teachers at the three schools for the most part have concurrent opinions on this way of working. At all three schools the teachers believe the teacher's role is to advise the pupils throughout the work. The teachers also compare their role during projects with their traditional role. Marion (teacher) at Cooper School states that the teachers and pupils are more on the same level when they work in a project-directed way and when they use ICT as a mediating artefact. At Applebee School Steven (teacher) states that it is vital that the teachers are able to use the tools. Another teacher at this school emphasises the importance of the equipment being in order so that the teachers do not end up using more time on technical problems than on guiding the pupils. This also implies that the equipment needs to be in order so that the teachers can concentrate on their role in project work, namely to guide and support the pupils in their knowledge construction.

In my work I have focused on the context of the classroom processes and the actions taking place in the classroom settings when pupils use ICT as a mediating artefact. As part of the context I have focused on physical and social factors, and the teacher teams the observed teachers are working in are also in focus. At all three schools the teachers seem to agree that certain premises constitute the foundation of a well functioning team. The teachers at Bridgeford School mention that they have to be flexible, that they need to feel safe, that they have to co-operate and that they have to be creative. At Cooper School the teachers also mention that they have to constitute an extensive subject matter background. Furthermore, they also mention that all the team members have to participate and feel responsible. While the teachers at Applebee School think that they need to share the same educational perspective, they also believe that it is important to be able to both agree and disagree, as long as they come to consensus through their discussion. Moreover, they maintain that it is important that the pupils feel that the teachers are on "the same page", thus indicating that how the teacher team functions will also have consequences for the pupils and the processes in the classroom. The work also shows that the teachers have a clear decision of labour in the classroom, and that they make their effort to make good learning opportunities for the pupils together.

(5) *Teachers guiding the pupils and organizing group work.* During the observed processes the teachers help the pupils during the entire project period, from the introduction phase and to the final closing phase of the work. When the pupils are using the ICT equipment, the teachers help them to search for information, learn programmes, use external equipment and make presentations with the help of ICT equipment. During these activities the teachers scaffold the pupils in various ways. They ask the pupils questions, and they give them cognitive structures for their activities, structures that help them both in actions and thought processes. The pupils are given instructions before they start on exercises and they receive feedback throughout the work. In other situations the teacher does not give the pupils information that is maximally informative, such as prolepsis, where they have some grasp of the teacher's presupposition. During the activities the teachers provide models to the pupils for how they should conduct their own work. At the beginning of the project period Steven (teacher) at Applebee School shows the pupils a film that functions as a model for the films the pupils are to make during their work process. This work also shows that the teacher has to have knowledge and competence in various areas.

In addition to using scaffolding methods in dialogues, the teachers also use other ways to help the pupils. Whereas the project work method in itself structures the work processes

that require the pupils to conduct various actions, the teachers structure and organize the activities for the pupils in a way that also functions as a scaffold for them. During a project the pupils are required to choose the topic to work on, make thesis questions, plan the work, carry out the work and present their answer or result. These actions are required by the work method itself, but at Applebee and Bridgeford Schools, the teachers also introduce basic courses for the pupils before they can start on their more self-directed work. During these basic courses the pupils learn to use tools (Applebee School), and also learn some basic knowledge about the topic they are going to work on in more depth (Bridgeford School). In this way the pupils are prepared and also assisted in meeting the coming activities in their work.

The teachers thus help the pupils through advising dialogues and the structure of the activities. Moreover, the teachers also recommend or give the pupils various helping tools to assist them during the work processes. They recommend various books for the pupils to read, and they give them handouts with various URL addresses they can use when searching for information. Various search strategies are explained to the pupils, and the teacher at Bridgeford School also make a web page on which the teachers can put relevant links for the pupils. At Applebee School the pupils are given written instructive tasks during the project to help them learn and structure their work, and at Cooper School the pupils are given a handout with HTML codes to help them during the project. The pupils at Bridgeford School also learn how to use a Power Point presentation as a presentation tool.

This shows that in addition to having knowledge about how to scaffold the pupils, the teachers also need to know what tools the pupils can use. They also need to know how to handle these tools if they are to manage to help the pupils when using them. Moreover, the teachers need to know about the subject matter the pupils will functionally integrate into their work. To know what knowledge the pupils will need or to direct the pupils into knowledge fields where they will find the necessary information, also means that the teacher has to have an overview that includes holistic knowledge, not just knowledge split up according to the various subjects. This means that the project work method demands more of teachers, as more general knowledge is required than what is normal for a teacher who is specialized in just a few subjects.

The work shows that the schools emphasise various areas during the observed processes. At Cooper School the teachers do not appear to be preoccupied with teaching the pupils background knowledge about emigration to America. At this school a person born and raised in America use a school period to tell the pupils about the Statue of Liberty, Columbus

and Leif Eriksson. At Applebee School the teachers' main focus is to help the pupils to learn to use various tools. Therefore the lessons in which they work in a project-directed way are called the "toolkit" lessons. The content of the pupils' films is for the most part based on knowledge the pupils already have. At Bridgeford School, on the other hand, the teachers have intentions of helping the pupils to develop their knowledge in subjects they have integrated in the project as part of the basic course. Thus project-directed teaching does not necessarily focus on just the method, but may also involve both method and subject matter that together make up the experience (Dewey 1916).

This means that graduate and student teachers need pre-service and in-service training in both subject matter and method, in addition to training in how to use various tools that connect these two entities. ICT equipment comprises various tools that can be used to both collect and present information and in this way the equipment functions as a connecting link between the work process and the subject matter that is developed during the knowledge-construction process. This work shows that the pupils want to use the equipment in various ways, which means that teachers and student teachers have to be trained extensively in the various ways of using the tool. Teachers must be able to help the pupils when they ask for help and advise them in uses of the tool that the pupils might not have anticipated beforehand; the teachers have to be able to help the pupils look for possibilities in their work. In socio-cultural theory, learning is viewed as the "appropriation and mastery of communicative (including conceptual) and technological tools that serve as mediational means in social practice" (Säljø 1995, p. 91). This means that the pupils need to learn to master the use of technological tools at the same time as language also functions as a mediating artefact in the learning processes. The teachers use language when they scaffold the pupils in dialogues with them. The pupils also help each other during the processes using talk as an artefact during these processes.

(6) *Collaboration between pupils and ICT equipment as a mediating artefact during these processes. Differences between boys and girls with regard to computer use.* During the collaborative processes, the pupils collaborate and talk in various ways. When the pupils at Bridgeford School search for information, one group uses a cumulative, practical mode of talk, not dividing any of the work processes between them. Another group that is searching for information also works at the cumulative and exploratory level (Mercer 1995), which corresponds to Packer's (1985) practical and reflective mode of interaction. The pupils have various opinions and therefore need to argue for their beliefs. It appears that the talk during the search processes deals with the mechanical way of undertaking the search, which means

the pupils have difficulty moving from talk about mechanical problems towards talk about the task procedure and content matter. During the search processes it also appears that the pupils learn more than just mechanical issues and the topic they are working on. During this process they also need to plan and take decisions together, which means that they can develop their methodological competence, a competence they can use in similar situations in coming activities.

When one of the groups at Applebee School is being trained to master the I-movie programme, one girl helps another and therefore uses the tutorial mode of talk (Scrimshaw & Perkins 1997). The pupils can choose between various video sequences, what sounds and what text to write for commentary on the various sequences. Thus this programme gives the pupils several options to choose between when using it, and this gives the pupils extensive opportunities to discuss, plan and make decisions together. This setting creates the foundation for the pupils to use the reflective or exploratory mode of talk (Packer 1985, Mercer 1995) when they collaborate. When they use this programme to edit the films they have made, they also use these modes of talk when there are different opinions in the group. This shows that the software programmes the pupils are given the possibility to use should be open-ended so that they are encouraged to make plans, discuss and make decisions, and in this way use language in the knowledge-constructing processes (Bakhtin in Voloshinov 1973, Vygotsky 1978, 1986/2000, Bakhtin 1981, Holquist 1990), a knowledge that is also transferable to similar situations.

During the editing process the pupils work collaboratively when they try to pool their interests together. They also work co-operatively when they try to defend their own interests and the interests of the group they were filming together with (Parton 1932, Underwood & Underwood 1999). This is due to the way the teacher's organize the activities, an organization that triggers talk and thus dialogues in the pupil groups, which may then lay the foundation for reflection and thus development of the consciousness of quality, the development of arguments (exploratory talk) and the development of cooperation to make the best result possible. The short duration of the films also makes the pupils think holistically (Wegerif 1997). When they agree on how long one sequence is to be, this decision has consequences for the entire film. In this way the setting the pupils are working in lays the foundation for the decisions they make and the consequences that will follow. Thus the teacher's pedagogical view has influences on how the ICT equipment is used, not the other way around, where the technology decides how the teaching practice is organized and structured. Such a teaching

practice requires the teachers to reflect on how they will prepare for and carry out a teaching period, such as a project when pupils use ICT.

At Bridgeford School pupils in one group try to make a Power Point presentation. One of the pupils has been shown some standards from the teachers on how such a presentation should be made. This pupil then turns around to try to inform another pupil in the group about what the teacher has suggested. When she tries to convince the other pupil, she uses the teacher's argumentation, thus indicating that she has not made it her own. It appears that when the teacher presents some standards for the pupils, they function as scaffolds for the pupils in their work. These standards are not given as a directive to the pupils; they are still left free to do what they want. As the tone between the teacher and the pupils is so good, it appears that the pupil follows her thoughts and wants to make them her own. This also shows how important it is that teachers follow on the pupils and recommend how they should conduct various activities.

At Cooper School two pupils are striving to make a web page. Their talk is for the most part about mechanical challenges when one of the boys helps the other. If these boys had mastered web-page design, their talk could have had another focus. Then the talk could have been about the design of the page, if there should be a frame and if so what it should look like. They could also have made decisions about what images they wanted to insert and what texts they would have written to present them, and they could also have come to a decision on what letters and fonts they wanted to use. In this way the talk could have moved from mechanical problems towards how they should present their page. Furthermore, the pupils' mental energy could have been concentrated more on the content of the task when they were freed from expending their efforts on mechanical issues. Their talk could have been concentrated on what information to present on their page. Thus the pupils would have had to orient themselves more on the topic, and read, plan, discuss and agree on what content they wanted to put on the web. In this way they probably also would have argued for their opinions and their talk would likely move in the direction from cumulative to a reflective or exploratory mode of talk, and thus they could have developed their academic competence with regard to the topic of emigration. But they did not. According to Mercer and Wegerif (1999) exploratory talk is essential if one is to successfully take part in educated communities of discourse. Thus in their opinion it is necessary to think and reason critically to participate in such talk. If activities in school are to help pupils develop their competence in exploratory talk and meet the demands of an educated community, it is important that they have activities in the school setting that make them plan, discuss and argue, and then make joint decisions.

It seems from the observed processes in the research study that several factors influence the mode of talk the pupils are using and thus can develop. It appears that one important factor is which programmes the pupils are using. If the pupils are given the opportunity to use open-ended programmes like the I-movie programme, it appears that they have every opportunity to develop the exploratory mode of talk. It is worth mentioning again that the pupils who edited the films using this programme were instructed in its use beforehand. This means that they had practice in dealing with the mechanical obstacles they might encounter. Even though they have had this training, it appears that the pupils still encounter mechanical demands during their work, but they are also able to expend some of their efforts on reflections, thus meeting each other in an exploratory mode of talk.

Thus there appears to be little doubt that receiving instruction in the use of ICT equipment is an important factor for ensuring that the work deals with tasks procedures and also content matter, not just mechanical challenges. This is also the case with the pupil group trying to search for information on the Internet. The challenge seems to be to find anything at all, not to discuss what information they should choose and how they should process and present this information. This would appear to indicate that new kinds of software tools need to be developed to simplify the information search. The two boys at Cooper School that worked on the web page to make a presentation on emigration could obviously also have needed more training beforehand so that they could have focused more on finding information and discussing what information they should present. If they had had this background, their actions related to mechanical issues could have been transformed into automatic operations so that their efforts and main actions could have been focused on procedure, the task or thesis question, thus the content matter. If this had been the case they could also have developed even more in the direction of the aim for the activity – holistic development.

In addition to giving the pupils instruction in the use of the tools, it is also apparent that the project method itself and how the teachers structure and organize the processes have significance for how the pupils work and talk together in various phases in the project. One of the pedagogical principles for the project work method is problem orientation and that the pupils learn to formulate questions or thesis questions (Berthelsen et al. 1987). The dialogue between the pupils' and the teacher's interests will probably influence the pupils' engagement throughout the work and thus also the communicative processes. The teacher's frames for the work will also have impact for the actions that take place within these boundaries. We could say that the teacher's organization as part of the context for the activity creates both some of the restrictions and the premises for the actions throughout the project. It is probably due to

the teachers planning and organization processes that the difference I had anticipated between boys and girls with respect to computers never emerged as an significant issue in the research process. The teachers appear to be the key persons in various settings in the classroom. They initiate the activities the pupils are to work on. They scaffold the pupils or small group of pupils when they work on task, and they arrange the setting when the pupils work together in groups during the process. The teachers also arranged for joint talk on completed processes, either with groups of pupils or with the whole class. During the work the following two categories were generated through interaction between data and theory.

(i) *Shared knowledge.* In the observed processes the teachers in various ways arrange for a shared knowledge construction in the classes. At Applebee School, a pupil who asks for permission to use the Internet as an information source is told that they are going to learn to search on the net later. It appears that the teachers believe that all the pupils should learn search strategies as part of their shared repertoire (Wenger 1998). In this way they will acquire shared knowledge on search strategies on the net. This is not the case at Bridgeford School, where the pupils are given help when they need it during the project work. The teachers have repeated instruction on how to search on the net three weeks before the observed project started, but at this school the training is more tailored to the pupils' needs. Either the pupils' teachers enrol some of them in a training course, or they can decide themselves what they want to take a course in. At Cooper School there appears to be no planned practice in how the pupils are to be trained in searching on the Internet, so that the pupils learn more or less at random.

When the pupils are learning the I-movie programme at Applebee School, Steven (teacher) enters into a dialogue with the pupils to give them clear standards for how they are going to learn this programme. He tells them that they have to work towards their goal together, the goal being to learn the programme. In this way all the pupils have the opportunity to learn to master the programme, and thus this knowledge will be shared in this knowledge-constructing community. At both Bridgeford and Cooper Schools the pupils were not introduced to any software programmes during the studied project periods, so no joint knowledge about computer programmes was added to their shared repertoire during the studied project period.

The pupils at Applebee School also learn to use the video camera in a joint process. At first they are given some training in groups to learn how the camera functions. After this activity the pupils are given the opportunity to do some filming in groups. When they have finished this filming, the teacher invites the pupils into a dialogue in which he likely wants the

pupils to develop shared knowledge on filming. They articulate and reflect on the various film sequences. In this discussion they talk about the things they have done correctly, and about things they could have done in a better way. During this dialogue the pupils have every possibility to develop their awareness on filming and understand why, for example, they should prefer one technique over another.

Some of the pupils at Bridgeford School used both digital still-photo cameras and digital video cameras, but they were not given any instruction in how to use these tools. During the process the pupils discovered that neither the still-photo cameras nor the video cameras functioned as they should, so they encountered problems during the activity. Nor did the pupils at Cooper School receive any instruction in how to use the video camera. The teachers at this school realized that the pupils who were responsible for the filming did not receive an adequate amount of scaffolding during their work. In the end they decided that the films were nothing to show their parents at the exhibition evening. It appears that both digital still-photo cameras and video cameras are tools that the pupils find convenient to use during a project period. Both pictures and films can be useful when pupils are gathering data and when they are going to present the material, and both can be downloaded on the computer. The studied project periods show that it could be useful for all the pupils to be trained in mastering such external equipment so it could be a part of their shared repertoire. In this way all the pupils would be in a position to choose to use them if they had confidence in using them. But again, this all hinges on the premise that the equipment has to function, otherwise this would inhibit rather then enhance the pupils' work processes, and it is likely that they would choose other tools the next time. In this way the pupils are secluded from exploiting the possibilities these tools can offer.

When the pupils present the answers to their thesis questions at the end of the work, the teachers also help them organize the presentations in various ways. At Applebee School they make two films. At the end of the work the pupils watch these films together with the teachers. During this sequence the pupils can see that everyone has contributed to making the film, a mutual product that a computer programme has helped them to finish. All the pupils received some basic training in using this editing programme. In this way the use of the I-movie programme became shared knowledge in this class. Additionally, six of the pupils had the opportunity to develop their competence even further, and in this way move from legitimate peripheral participation towards full participation in connection with the use of the I-movie programme (Lave & Wenger 1991).

In Bridgeford School, each group presents their result to the other pupils who make up the audience. During these presentations the pupils for the most part uses collages and transparencies, but some of them also uses film as a medium to present their work, and one group has also prepared a Power Point presentation. The pupils edited their films with the help of a computer editing programme, but the whole class was not introduced to using the computer in this way. One pupil group was helped by the teacher responsible for the AV equipment when they edited these films. These pupils then helped other groups to edit their films. Sarah (teacher) at Bridgeford School finds that she needs to learn to edit films before they start up the next project period. In this way she also will be able to help the pupils when they need her assistance. This shows that teachers most probably will need to know how to use digital video cameras and also to use the computer to edit the films afterwards as a part of their role in project work.

The pupils at Cooper School end their project period with an exhibition to which parents and the local community are invited. During this exhibition one of the boys also shows a Power Point presentation. The two boys who made a web page are also connected to the net and show their page to interested visitors who visit their "stand". One of the pupils mentions during the assessment dialogues that the various groups and the pupils working individually could have said something about their work. Obviously she is thinking that this could have helped them learn more about or become more interested in the others' work so that they would ask about things when they walked around and looked at the various results. This shows that talk can be a central mediating artefact when pupils present their results at the end of a project period. The talk could have aroused interest in the work and invoke dialogues that could enhance further development of meaning and understanding (Bakhtin in Voloshinov 1973, Vygotsky 1978, 1986/2000, Bakhtin 1981, Holquist 1990).

One of the questions the pupils were asked at the end of the project period was if they had learnt anything during their work. The pupils' answers show that what they had learnt most about was their own topic. Just one pupil at Cooper School mentions that he learnt something from another group. At Applebee School six pupils mention issues that were not part of their own work. At Bridgeford School more pupils mention issues from topics other pupils have worked on. Altogether twenty pupils from both classes at this school mention topics from others' works. This indicates that when the pupils have the possibility of reflecting and commenting on each other's results, they have the greatest opportunity to create shared knowledge about an overarching theme in class. Additionally, this shows that pupils learn most from processes they are actively taking part in. This also indicates that the pupils have a

greater opportunity to learn in project-directed teaching than in classrooms where teachers are the active party.

In projects, the pedagogical principle about participatory management and solidarity (Berthelsen et al. 1987) lays the foundation for the dialogue between the pupils' and society's interests, as mediated by the teachers. This dialogue was also a central part of Dewey's (1902, 1916, 1938) theory. The result of such a dialogue can be that both teachers and pupils work towards joint goals, in other words, interest in constructing shared knowledge in the learning community. One way of starting the project period is that the teacher presents an overarching theme representing sub-topics in the Curriculum to the pupils, and further directs the pupils' work on topics that cover areas mentioned in the Curriculum. Another way to conduct this process is to let the pupils work more in accordance with their interests if the sub-topic they have chosen to work on in connection with the overarching topic is not mentioned in the National Curriculum. In this way their motivation throughout the work could be enhanced. In dialogues with the pupils in the beginning of the work the teachers can ascertain what topics in the Curriculum the pupils cover with their thesis questions. During these dialogues the pupils and the teachers can come to an agreement on which subjects are to be functionally integrated in the specific project work. In this way teachers may pinpoint what subjects and topics are covered during the project period, and based on this decide what has to be taken up in other projects or in other school lessons. The Curriculum will in this way be used actively during the entire teaching process. Thus this is not a tool teachers use just to plan their teaching, but it is functionally used during the entire teaching process.

(ii) *Assessment.* When pupils are working on thesis questions, it follows that they will be integrating various subjects during their project work. This also means that all the pupil groups may not necessarily be assessed in the same subjects. The teachers in this research study obviously use various ways to assess the pupils during the working processes. The class at Applebee School was exempted from complying with the National Curriculum and from ordinary grading, but the classes at Bridgeford and Cooper Schools followed the National Curriculum and were thus also marked according to this plan.

Steven (teacher) and the headmaster at Applebee School maintain that assessment may affect the teaching negatively, but their own practice appears to show that assessment may affect learning positively. Steven claims that they assess the pupils all the time, which indicates that assessment is a prominent aspect at all times during their work. The observed processes during project periods also show that there is no foundation for believing that scaffolding takes places in isolation from assessment processes. An example of this is when

Steven lets the pupils watch the films they have recorded together. While his main aim is to prepare the pupils for the films they are going to record later in the project, he is also guiding them so they are prepared for their next filming experience, and he obviously has some standards that he imparts to the pupils during the dialogue with them. He assesses the pupils in accordance with these standards. In this way, the pupils become familiar with the goals for their work while they are performing it, and thus the goals are part of the activities (Dewey 1916).

For most of the observed processes during the research study the pupils were not given any specific criteria so that they knew what was expected of them. When there are no criteria for the work it will be difficult for the teachers to assess the pupils, and also for the pupils to assess themselves and each other. If the pupils are to be assessed in accordance with their own zones of proximal development (ZPDs), the criteria have to be adapted to each child's development. Moreover, it is vital that the criteria are tailored to the entire class when the class's collective ZPD is the starting point for the assessment. This means that the goals presented in the Curriculum have to be tailored both to the various classes (if the Curriculum lays down mandatory goals for their work) and also to each and every individual in this class. In this way there can be a real dialogue between the Curriculum and the pupils' potentials for development.

Another aspect of assessment is deciding what is to be assessed. Traditionally content knowledge has been assessed with marks, but during project work the pupils have every opportunity to develop their entire personality or identity (Resnick et al.1997, Wenger 1998, Wells 1999, Daniels 2001). They can advance their holistic development, which includes their academic, social, methodological, learning and aesthetic competence. This means that academic competence is just a part of the developmental perspective that takes the entire person into account. Taking all aspects into consideration means that a traditional test will fall far too short. If the teacher is to find out what the pupils have learned in a holistic perspective, it appears likely that both the process and the product need to be brought into focus, which means that the assessment practice has to be integrated in all parts of the work.

It appears to be a given that the activities assessed in school will also be perceived as the most valued (Newmann 1997). In this connection it is fair to believe that project work has to be assessed to be valued as much as other teaching activities. Furthermore, all aspects that are worked on during a project also need to be assessed to be valued, on other words all types of competence that go into holistic development. This means that how the pupils handle and use the ICT equipment also has to be assessed as part of their methodological competence.

This aspect was not brought into the assessment procedures at any of the schools in this study. However, the pupils working on their web page at Cooper School used most of their project time creating this page and thought they would be assessed according to how they had managed to create their page. The two boys obviously believed that their efforts to make this page should be assessed, but the teachers had no intention of or criteria for assessing this part of their work.

The use of tools and the exploitation of the possibilities of ICT have been important aspects of the studied projects, and this undeniably represents a change from traditional teaching (Salomon & Almog 1998, Koschmann in press). The Norwegian Curriculum lays down that ICT must be integrated in all subjects in school with the exception of physical education. This means that the tool is a helping aid the pupils will be learning to master while they are using it to learn about topics related to various subjects (IT i norsk utdanning 1996-1999), [IT in Norwegian Education 1996-1999]). If the training in the use of ICT equipment is to be valued, it has to be assessed in the same way as the other activities during project work.

Earlier I maintained that both the process and the product need to be assessed, but how are these activities to be assessed, and how can we document development in accordance with the various types of competence? I have suggested that project work needs a naturalistic and context-sensitive assessment form to give a picture of the activities that are undertaken, both during the process and at the end of the work. The pupils could be given a mark in connection with academic competence, and a qualitative description of their development in connection with the other types of competence which together constitute a holistic development. This could also be recorded on the pupil's leaving certificate. The leaving certificate lists the pupils' marks for the various subjects. For project work, the topic the pupils have worked on during their final project is documented, but an assessment of the various activities included in this work is not provided. If project work and the goals of this work are to be valued, it is most likely essential to assess all aspects involved in this work method. As I have suggested, social, methodological, learning, and aesthetic competence can be qualitatively assessed, but if they are to be made comparable with descriptions of others, it is also necessary that the goals or the standards the pupils have worked towards in the specific classes are presented on this certificate. In this way the descriptions can be normative, which enables a comparison between pupils, as is one of the purposes of the leaving certificate. It is also evident that the pupils have developed in various areas during the project periods I studied. In addition to the preceding issues the following three points are food for thought.

(a) *Reported learning.* The pupils at the three schools mention several aspects they have learnt when working together in groups, but most of their answers are clustered on four issues. Twenty-four of all the pupils say that they have learnt that it helps to collaborate, whereas fourteen of them think that it is fun to collaborate. Twelve of the pupils at the three schools say that they have found that project work demands effort from everybody, and ten of them also find that they have become better collaborators. With regard to ICT equipment, the pupils also mention various issues. The most frequent answer given by the pupils at Applebee School is that they have learnt to use the video camera and the I-movie programme. At Bridgeford School the most frequent answer given by the pupils is that they have learnt to copy pictures from the Internet to their own document. Two of the pupils say that they have learnt to adapt the data material to their own needs, while two others mention that they have learnt to edit a film. The most frequent answers at Cooper School are connected to the information search process. Seven of the pupils say that they have improved the way they search for information, and three pupils tell that they have found that there is a great deal of information on the net.

(b) *ICT's actual use including consequences.* The ICT equipment was used in various ways during the project periods. The pupils used the equipment both to compile information and to process and present their data material. The computer was used as a writing utensil, and the pupils used external equipment, such as digital video cameras and digital still-photo cameras. They also learned to scan pictures. Moreover, the pupils used editing programmes to edit the films they had recorded, and they made Power Point presentations and a web page to present their work. This means that the project work method invites the pupils to use the ICT equipment in various ways. This work also shows that the pupils managed to exploit the equipment in different modes. As a consequence teachers need to master the equipment and have competence in scaffolding the pupils when they use this equipment. As mentioned above, teachers need to see the connection between matter and method, in other words, teachers are responsible for the pupils learning subject matter during the work processes.

This indicates that project work using ICT equipment offers a range of possibilities, but also places great demands on the teachers. Teachers and teacher students need pre-service and in-service training to cope with technical developments and subsequent possibilities to manage to exploit the equipment for pedagogical reasons so that the practice will be theory driven not technology driven. In this way the ICT equipment can also help the teacher see possibilities to utilize the equipment during projects, and this will give the teacher the competence and motivation to develop this work method further. In connection with the work

processes in which ICT is used, teachers probably have to admit to the pupils that they cannot do everything, and such circumstances can also lead the teachers in the school community to collaborate if they are to meet the demands of the teaching practice. The context that frames the teachers' work must also lay the foundation for well-functioning processes in the classroom. There has to be relevant equipment, and the equipment must function as intended, which means that maintenance work needs to be given priority. In this way the premises for pupils to functionally integrate ICT equipment in their learning processes can be a reality.

All the same, it appears that the teacher is the key person when it comes to the learning processes in the classroom. The teachers present the overarching theme, start up the learning processes and structure and organize the work. The teachers scaffold the individual pupils and pupil groups on tasks, they organize and structure the setting in which the pupils collaborate and they integrate assessment procedures. Moreover, the teachers are the ones who can make the pupils' work processes, including the use of ICT equipment, a topic of classroom discourse, so that the activity and its content can be interpreted and blended into a shared understanding of the participants. It is through such common dialogues that the pupils can develop metacognitive competence with regard to both the work method and the use of ICT equipment that can become shared by the whole learning community.

In project work the pupils try to answer thesis questions that are formulated on the basis of their experiences and interests. In this way the pupils' histories are brought to school in the thesis questions that direct their work. Project work can build bridges between activities in the classroom and real-life experiences (Blumenfeld et al. 1991). Technology can also provide a window onto the world outside the classroom, while it can also make activities in the classroom more visible to the surrounding community (Koschmann in press), such as a web site that is available to everyone around the globe. In this way both project work and ICT can connect life in the classroom with real life outside the classroom's borders. The aim of my work is to make a thinking tool for teachers, teacher educators and others interested in educational matters. Hopefully, this text can give a picture of the studied processes in the classrooms, a picture that initiates thoughts and discussions, and thus in this way functions as a mediating artefact in the development of the educational practice, also outside the studied classrooms.

(c) *The way forward.* I believe that one focus for future research could be to examine more thoroughly teachers' collaboration processes before and after teaching activities in the classroom. In this way the processes that take place back stage in the classroom could be brought more to the forefront, as could aspects of this setting that have implications for the

learning activities. The teachers I observed tell me it is important that they have complementary competences, but what possibilities do teachers have to develop their project directed teaching and to integrate ICT in these processes. According to this, another focus for future research could be to describe training programmes that focus on these two factors based on studies of both teachers in pre-service education and practising teachers. Research on back stage processes could then function as a mediator enhancing the learning processes in the classroom.

The focus of research could also have been directed more on each and every individual's learning and in this way address the factors in project directed teaching using ICT as a central mediating artefact that have to be present if everyone in the classroom is to be able to develop in their ZPD. Thus more attention has been paid on ICT's influence on thinking and action. In this connection, a dialogue between the teachers planning in school and the pupils' possibilities for learning to use ICT equipment at home have to be given prominence. In some settings the gender perspective presumably has to be addressed to describe a classroom practice that provides all pupils with the opportunity to develop their potential. During the research study I have briefly touched on a comparison of communication processes between pupils when working at and off the computer. This could have been studied in greater detail to discover more about the consequences ICT has for talk and thus learning.

It was important to me to collect data in classrooms in school communities that had worked in a project directed way and had integrated ICT in these processes for some time. Thus I collected data material from communities that were familiar with both these aspects. Both the project work method and the use of ICT are now obligatory in the Norwegian schools, but both these factors are relatively new in the history of teaching and learning. Needless to say, as they are so young, there is room for development. Future qualitative research on the use of ICT in projects will thus be able to create narratives from a continuously developing practice, narratives that can then also become a thinking tool for the practice they (re)present.

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Appendices

Appendix 1. The Informants' Reflections on the Research Process

A. The Key Informant at Applebee School

In the spring of 1999 May Britt Postholm asked me to be an informant in her doctoral work. I was quite surprised that a person I did not know was interested in coming into my classroom to observe how I helped my pupils use ICT tools. Right then and there I do not think I really knew what it meant to be an informant, except for being interviewed and observed in teaching situations. I decided to be an informant, and I forgot the whole thing until I received an e-mail from May Britt in June 2000 telling me that she wanted to start to collect data the coming autumn term. In the meanwhile, several things had changed a great deal which might have a bearing on what May Britt had planned to observe.

At that time I was working in another teacher team, and the teachers there had to be informed and give their consent. All of these colleagues were positive to the idea. We also had problems with the equipment that we had not solved. We were not able to edit films, and we lacked a DV camera. We had earlier agreed to take part in a project with thirteen other countries (Apple Distinguished Schools) in which we were to make two films, and the work should be done in a completely new class with new pupils coming from three primary schools. During the same period the team expected that six students from a local teacher college would have observation practice in our classroom. So there was no lack of challenges here, and I have to admit that I doubted that we would manage to get the necessary equipment to carry out the project. This problem was solved when Canon became a collaboration partner and helped us acquire a DV camera. When the technical equipment was in place, it was time to reflect on the fact that someone would be coming into the classroom to observe my teaching. Having an observer with high theoretical competence in the classroom seemed a little daunting to me. Would I manage to handle a stranger coming and asking me a lot of questions about my teaching practice, and would I manage to answer the questions?

When May Britt attached a tape recorder to my belt, put a microphone on my collar and set up a video camera to make recordings, I had to admit it took some time before I got used to the equipment and someone observing everything I did with "eagle" eyes. I felt that the pupils were in the same situation, but when the researcher's intentions were explained to them, they accepted the situation easily. I do not believe that the work process was affected by my being an informant. When I read through the narrative written by May Britt it is also easy

to recognise the setting, my own and the teacher team's intentions and the actions that were actually taking place in the classroom.

Being asked things that you had to reflect on was interesting and helpful. May Britt always had theoretical perspectives to relate everything to. This increased my awareness about my own school practice. It was important to me that the whole team was observed, since the project was interdisciplinary and because the whole team was taking part in the implementation of the project. When at the completion of the project I look back to reflect on what I have got out of this process, I find that this experience has made me more conscious of my own teaching, and I am glad I had the opportunity to take part in this research project as an informant. Thanks, May Britt.

B. The Key Informant at Bridgeford School

It is always good that people are interested in what happens in school, not least in the classroom. I think that many of the misunderstandings we struggle with in connection with school practice are due to the fact that so few people know what we are actually doing. If they did, it would have been much easier to cooperate with our surroundings, something I think is very important if one is to be a successful teacher. That is why I was positive to becoming an informant.

When you have first said that a researcher can stay in your classroom, it then has little meaning when he or she is actually there. At our school we are used to people coming and going, so an extra person in the classroom is not as special as it perhaps might have been in other situations. I have always been used to having other adults around me in my work; colleagues, students, visitors, so I do not react in any special way to having an extra person in the classroom. The pupils also have the same experience. Once the novelty had worn off, you were one of us, the way I saw it. Nor was the effect on the work process of any significance. Perhaps I reflected more on what I planned to present, but I believe that I usually do this, by that I mean what I present to the pupils at the 8th grade level, to the class and to the teacher team. But the work went on as usual, at full speed, with accomplishments and adjustments, as it always does. My impression is that you quickly found the tone and became one of us. You were explicit about what you were and were not going to be doing, and you kept it that way. Still, you were a resource for the team at the meetings because the questions you asked made us reflect more than we normally do. Perhaps we should have continued that process, because I think the team could have profited from being more focused on pedagogical perspectives.

The description you give of the project seems right to me, as far I can remember. I especially think that you give a good picture of the unpredictable school day, in spite of planning and in spite of forgotten planning. I think that the categories you have developed cover the processes during the project work. The issues you mention are all mutually dependent on each other if the project is be successful or not. The subject matter during a project is very important, and the structures for the processes have to be made clear so that the pupils do not need to spend time and effort on speculating on the form of the project. Then they can instead use their energy on the learning process. They should rather feel that it is the same whatever they do, so in this connection support and assessment are significant factors.

C. The Key Informant at Cooper School

When my team and I were asked to be informants in this doctoral work, I was immediately interested, but did not actually know what I was getting into. But after I had talked to another person on the teacher team, a person with more experience with computers than me, we agreed that we should take the chance and take part in this research project.

The class had already started the preliminary work in the spring before the researcher was involved in this project. The overarching topic of the project was decided beforehand, but the pupils were allowed to choose a sub-topic. The pupils were included in all the work processes, from the beginning through the brainstorming, and on through then the making of the thesis questions, the forming of groups, the planning of the group work and the presentation. The pupils were also allowed to decide how the result should look like, and were also involved in and thus influenced the assessment of their own work.

It was exciting that someone was interested in coming to our class to observe how we carried out our project teaching. The pupils and the teacher quickly became used to having a visitor in class, although it was a bit new for us to have both video cameras and tape recording in class. Perhaps it was the teachers that experienced it this way. It looked like that the pupils liked to be observed and got along well with the researcher. Indeed, there were pupils who liked having the focus on them.

The researcher knew about project work much more that the teachers in our team did. Often she was asked for advice, especially with regard to the work phase: How could we motivate the pupils, and how could we manage to advise and help the pupils in a better way? Another intention was that pupils in the class would become more accustomed to the use of ICT in project work. I felt that this work should be exciting. The dialogues I had with the researcher before and after each spell of work were both instructive and motivating. It was a bit exciting to have the dialogues recorded on tape, but I got used to it. The questions the researcher asked me made me see other possibilities in my work.

We are three form teachers working together in a big class, and we all were positive to having an observer in the class. All three of us were highly committed to the project right from the beginning, but I think that we experienced the situation with an observer in the classroom somewhat differently. The strength of our team is that each of us can help the pupils in most fields (we are educated in various subjects), and there is a frank openness between us. This was of great help when we were observed so closely.

Personally I look upon this situation as a positive experience. After so many years in school it is okay to be asked questions and get feedback on the processes together with the pupils. I think the teacher's role during project work is the most challenging issue related to this work method, and I think I can develop a lot in this role. I have been too afraid to intervene in the pupils' processes, but I have learnt during this project that it is preferable that the pupils are well supported all the time throughout the project work. If not, the project can deteriorate quickly.

When I read your text about our class it is easy to identify that it is our project about emigration that you are writing about. I recognize that what you have written describes the processes in the classroom exactly. Thanks, May Britt for giving me this experience, and for the inspiration I felt you have been for me, for the other teachers and the pupils during this project. Now it will be exciting to start with a new class and new projects.

Appendix 2. Descriptions of the Collected Material at Applebee, Bridgeford and Cooper Schools

Abbreviations:
obsnot = observation notes, trec = tape recordings, vrec = video-recordings, inthead = interview with the headmaster, intinf = interview with the key informant, intteam = interview with the teacher team, intdephead = interview with the deputy head. The numbers indicate the date, e.g. obsnot 091200 means observation notes, September 12, 2000.

* Because it is implied that I have observed all the processes, the data material is documented without the "obsnot" abbreviation when I in addition have tape recorded and/or video recorded the material.

A. Applebee School

I started to collect data at Applebee School from the middle of September 2000 and ended the process five weeks later, by which time I had observed and collected data from fifty-seven school periods. The data material consists of 68 pages of observation notes, transcribed collaboration dialogues between pupils when editing films, covering 54 pages, transcribed dialogues during which the key informant scaffolds film teams, covering 8 pages, transcribed introductions to the periods by the teachers, 26 pages, transcribed introduction on using e-mail, 6 pages, and transcribed introduction in the use of a camera, 13 pages. The transcriptions of both these introductions also include scaffolding processes between the teacher and the pupils and collaboration processes between the pupils. Furthermore, the data material consists of 19 transcribed pages from the introduction of the I-movie programme. 6 of these pages comprise collaboration processes between two pupils when they work on different tasks during the introductory course. Throughout the project work the pupils worked in groups. The collaboration processes in two groups have been transcribed and amount to 34 pages. The transcribed dialogues with the key informant come to 21 pages, the transcribed dialogue with the headmaster covers 10 pages and the transcribed dialogue with the teacher team covers 14 pages. In addition to all this, the summaries of the pupils' answers to Questionnaires 1 and 2 (Appendix 6A, p. 391, 6B, p. 392) cover 4 pages and 6 pages respectively and the summary of the teachers' answers to the questionnaire given them amounts to 9 pages, are part of the data material. This material altogether amounts to 292 pages. Furthermore, and in addition to the school's activity plan, the year syllabus and periodic plans, a work schedule for ICT, both for the pupils and for the teachers, and exercises given to the pupils during the training courses are included in the material. I also wrote in my logbook when I observed At Applebee School, but the key informant found that he had no time for writing a log after each spell of work.

Overview of the Material, When and What was Collected

Obsnot 091200:	Observing the pupils as they learn to use the I-movie programme.
Obsnot 091500: Trec: Vrec:	The pupils are learning to use the video camera. They also receive an e-mail account and write their first e-mail at school. Collaboration between pupils in a group when they learned to handle the camera, this is tape recorded.
Obsnot 091900:	One third of the class learn to use the I-movie programme. Pupils in another group learn about science methods, and pupils in a third group learn about using maps and an atlas as tools.
Obsnot 092600: Trec: Vrec:	Observing one third of the class learning to use the I-movie programme. Collaboration between two pupils during their work is tape recorded.
Obsnot 092700: Trec: Vrec:	Observing the brainstorming session on the theme “Our town”.
Obsnot 092800: Trec:	Observing the brainstorming session on the theme “Our school”.
Obsnot 092900: Trec: Vrec:	Observing one group of pupils learning to use the video camera, another learning to use the Apple Works programme. A third group is experimenting with science methods in the chemistry lab.
Obsnot: 100200: Trec:	The teachers motivate the pupils for the coming project period. The pupils are placed in production teams, and they make a priority list of topics they want to work on. The teachers had written the topics on the board on the basis of the pupils’ brainstorming.
Obsnot: 100300: Trec:	Each group is given a topic to work on. The pupils plan what to film and when to film. They find out which persons on the production teams are going to form the film groups.
Obsnot: 100400: Trec:	Steven talks to each of the film groups about their plans.
Obsnot: 100900: Trec:	The teachers tell the pupils how they are to organize the filming. The teachers ask each group about their work, about what they have done and what they are going to do.
Obsnot: 101000: Trec:	Observing pupils working with the background material for the films and various school subjects. At the end of the session, the teachers ask each group in front of the whole class about their work and the working processes.

Obsnot: 101100: Observing Steven talking to one of the film groups right before they are
Trec: going to film. Observing the pupils while they film. Observing pupils translating the background information for the film into English.

Obsnot: 101200: Observing two groups of pupils editing the films.
Trec: Pupil collaboration in both groups is tape recorded.

Obsnot: 101300: Observing the two groups of pupils finishing the editing work.
Trec: Pupil collaboration in both groups is tape recorded.

Obsnot: 101300: Observing the summary session with the whole class
Trec: watching the films together.
Vrec:

Pupil collaboration:
Trec:

Pupil collaboration in two groups is tape recorded during the accomplishment of the project.
Group 1: 1002, 1003, 1004, 1009, 1010, 1011.
Group 2: 1002, 1003, 1004, 1009, 1010, 1011.

Team meetings:

Obsnot: 091100: The teachers plan the project period.

Obsnot: 091800: The teachers discuss strong/weak pupils in connection with the use of ICT on the basis of their observations.

Obsnot: 092700: There is a discussion about how the pupils brainstorm. Some of the teachers think the brainstorming session was too noisy to let all the pupils talk together in the same room. They decide that they will use more rooms the next time.

Obsnot: 100200: The teachers are discussing how to set up the production teams.

Obsnot: 100400: Steven informs the other teachers in the team what each of the film groups has planned to do.

Obsnot: 100900: Steven has planned when the film groups are going to do their filming. He informs and discusses the plans with the other teachers in the team.

Obsnot: 101100: The teachers are discussing which pupils are going to edit the films. They plan a parent meeting.

Interviews : (All the interviews have been tape recorded).

Inthead: 100900: A dialogue about the school's pedagogical platform and especially about the assessment practice. The headmaster informs about technical equipment at the school and about the school community as a whole.

Intinf: 091500: Talking about the film as a medium in school. Dialogue about pedagogical comprehension and about assessment as a special topic.

Intinf: 092900: Talk about teachers working in teams. Dialogue about group work and pupil collaboration. Talk about the teacher's role during project work, about the connection between ICT and drawings. Dialogue about what is good learning, about social competence and about the use of tools.

Intinf: 102500: Dialogue about strong/weak pupils and about the community feeling in the class. Talk about the editing process, and that it is important to make the pupils' work visible. Dialogue about assessment and about the class community in which both teachers and pupils can learn.

Intinf: 102600: Dialogue about the progression of the ICT project during this first year and the coming two years.

Intteam: 101300: Talk about teacher cooperation, about objectives for teaching and about assessment. Dialogue about teaching strategies and how to teach boys and girls to work with ICT. The teachers reflect on the completed project period.

Other data:

- Written answers to open questions from both the teachers and the pupils.
- The school's activity plan.
- The class's periodic plan and the teachers' year syllabus.
- Tape recordings of all the teachers' introductions to the school lessons where the pupils worked on their project.

B. Bridgeford School

The data collection process at Bridgeford School started in the beginning of November 2000 and ended in the middle of December the same year. During this time I had observed forty-eight periods. The compiled data material consists of 67 pages of observation notes, transcribed dialogues between the pupils during the basic course, 19 pages, and transcribed dialogues between two pupil groups and part of a third during the "real project period", 36 pages. Furthermore, transcriptions of the introductions to the various periods and the scaffolding processes throughout the project period amount to 64 pages. Transcribed dialogues with the key informant cover 21 pages, the transcribed dialogue with the headmaster covers 3 pages and the transcribed dialogue with the teacher team amounts to 4 pages. The answers from the pupils on Questionnaires 1 and 2 (Appendix 6A, p. 391, 6C, p. 393) amount to 9 and 12 pages respectively, and the teachers' written answers cover 6 pages. The listed data material amounts to 241 pages. In addition to the school's activity plan with the school's social curriculum, the data materials includes the year syllabus, work schedule for the use of ICT for both teachers and pupils, material the pupils had to read and work with during the basic course, tests and the planning documents, the logs and the assessment of the three observed groups. Both the key informant and I wrote logbooks from the project period at Bridgeford School.

Overview of the Material, When and What was Collected

Obsnot 110600: Trec:	The pupils in both classes, 8A and 8B, are informed about the coming project period. The pupils are presented for the project goals.
Obsnot 110800: Trec:	The pupils are presented for the content about landscapes and how they are formed. This content forms a chapter in the pupils' textbook in the subject social science. After the midday brake the pupils are presented for the content regarding the development towards democracies. This content is also a part of the pupils' curriculum.
Obsnot 111300: Trec:	Susan presents the topic "Culture" for the pupils. She wants them to reflect on the Norwegian culture. She talks about the Norwegian culture from the Viking age and up to these days. She also plays some music composed by Edvard Grieg.
Obsnot 111500: Trec:	Observing Deborah presenting the topic "Norway today" to the pupils. She lets the pupils brainstorm around the topic. The pupils get an exercise about this theme during which they work in groups. Several of the pupils use the Internet to find information, some about the Vikings,

others about the Norwegian Independence Day. Deborah presents the topic "Religions in Norway" to the pupils. Some pupils dramatise during the presentation the events she talks about.

Obsnot 112000:
Trec:
These lessons the pupils get a group activity about the school surroundings. They are going to write about different buildings in the neighbourhood, how different people live. The pupil groups get different exercises so that they together give a holistic perspective of the surroundings.

Obsnot 112200:
Trec:
The pupils continue to work with the group work about different buildings. The pupils search for information on the Internet. Some of the pupils start to make a poster that is intended to be the result of this group work.

Obsnot 112400:
Trec.
Vrec:
The starting up of the "pupils' project". The teacher has planned to use a Power Point presentation, but the technical equipment does not work. The pupils brainstorm around the different topics that are talked about during the introductory course. The pupils write on a piece of paper what topic they want to work with.

Obsnot 112700:
Trec:
The teacher present the different topics for the pupils and what pupils that are going to work with them. Each group is assigned an advisor. The pupils start to work in the groups. At first they start to write the planning document for the work.

Obsnot 112800:
Trec:
The pupils are gathering data material. In the beginning of the working process seventeen pupils (from both classes) are searching on the Internet. Some pupils take pictures of their classmates and make an interview with them. All the pupils continue the work in the groups.

Obsnot 112900:
Trec:
Two pupil groups work at home making food. Another group is in town interviewing people about music. Some pupils are still searching for information on the Internet.

Obsnot 120400:
Trec:
Vrec:
One of the groups is presenting their result. The other pupils comment on the presentation. After the presentation the other groups continue their work. The pupils that presented write a personal log.

Obsnot 120600:
Trec:
The pupils are reminded of the pamphlet they are going to make at the end of the project. The teacher shows the pupils the assessment form. One group is working on a Power Point presentation. Some pupils are editing a film. One group presents their result.

Obsnot 121300:
Trec:
Vrec:
The pupils still work in their groups in the beginning of these lessons. This is the last day of the project period. The groups present their work, and the pupils comment on each other's presentation. The technical equipment does not work when a group is going to show their Power Point presentation.

Pupil collaboration:
Trec:

Pupil collaboration in two groups during the basic course. The pupils worked on the group task about different buildings.
Group 1: 112000, 112200.
Group 2: 112000, 112200.

Pupil collaboration in three groups during the accomplishment of the project.
Group 1: 112700, 112800, 112900, 120400, 120600, 121300.
Group 2: 112700, 112800, at home, 120400, 120600, 121300.
Group 3: 120600, 121300.

Team meetings:

Obsnot 103100: Discussion and planning of the coming project. The teachers look at evaluations of accomplished projects. They plan the goal for the project, what the pupils shall focus on.

Obsnot 110700: The teachers talk about that this project will be the longest the pupils ever have worked on. The teachers talk about the class atmosphere. They talk about how they can help the pupils to structure their work.

Obsnot 112100: The teachers discuss the project and the process so far. They talk about when the pupils have to choose which topic to work in depth with. They talk about the use of logbooks.

Obsnot 112800: The teachers talk about the atmosphere in the class. They reflect on the working process during the project. They think that the project motivates the pupils.

Interviews: (All the interviews are tape recorded).

Inthead 120400: Talk about the ICT competence at the school, and how they have got their equipment. Dialogue about the school's pedagogical platform, and about the local social curriculum. The headmaster informed about the project going on in all classes at the junior secondary level. One central aspect in this project is flexitime for the pupils.

Intinf 111300: Talk about assessment and marks. Dialogue about the ICT training and the equipment. Talk about the school's homepage and about the class.

Intinf 112800: Talk about the pupils training on ICT and about the work schedule for ICT training. Dialogue about the use of logbooks. Talk about project work and motivation. The teacher Sarah reflects on the question or the problem formulation for a project work. Talk about girls and boys and ICT and about the group formation.

Intinf 120400:	Talk about learning and about the teaching practice during "ordinary lessons". Dialogue about the assessment of the pupils' collaboration. Talk about knowledge and how pupils learn.
Intteam 120500:	Talk about learning and about project work. Discussion about the use of ICT. Talk about the team work. The teachers reflect on the accomplished project.

Other data:

- Written answers to the open questions from both the teachers and the pupils.
- The school's activity plan including also a social curriculum plan.
- The class's periodic plan and the teachers' year syllabus.
- The plan for the project period.
- The informant's logbook and the assessment form.
- The pupils' personal logbooks and the pupils' planning document.
- Tape recordings of all the teachers' introductions of school lessons in which the pupils worked on their projects.

C. Cooper School

The project period at Cooper School started late in August 2000, and ended with an exhibition in the middle of November the same year. I also visited the school on the seventh of December when the teachers had assessment conversations with the pupils. In this way the data collection period lasted almost the entire semester. The pupils had altogether nine project days at school with three lessons each day in this project. At this school I thus observed twenty-seven school periods altogether, besides the pupils' exhibition and assessing conversations. The data material consists of 57 pages of observation notes, transcribed collaboration dialogues between the pupils in two groups, 33 pages, and transcribed teacher introductions, summaries of lessons and the assessment conversations between teachers and pupils, totalling 12 pages. Furthermore, the material includes a transcribed meeting with the headmaster and the deputy head, 6 pages, transcribed conversations between the researcher and the key informant, 21 pages, and transcribed conversations between the researcher and the teacher team, 17 pages. The summary of the teachers' answers to the written questions covers 3 pages. The key informant's summary of the pupils' self-assessment, covering14 pages, is also part of the collected data material. The summary of the answers to the questions to the pupils in Cooper School amounts to 7 pages for Questionnaire 1 (Appendix 6A, p. 391) and 27 pages for Questionnaire 2 (Appendix 6D, p. 394). This data material comes to 197 pages. In addition to this, the data material includes logbooks that both the key informant and I wrote, photographs of the pupils' products at the exhibition, the school's activity plan, the year syllabus, the periodic plans, a letter to the parents and schedules to structure the pupils' process throughout the project period.

Overview of the Material, When and What was Collected

Obsnot 083100: Information is presented by an American. Talk about problems concerning how to make questions. The various groups talk about their interests in connection with the overarching project theme. The pupils group themselves. The pupils are given URL addresses to help them search on the Internet. The pupils' thesis questions are discussed.

Obsnot 090700: The teachers give the pupils a logbook and an evaluation paper that is intended to structure their process. Some pupils are still working on their thesis question and receive some help formulating it. Some pupils leave the school to work at home.

Obsnot 090700: At the computer lab. The pupils search for information on the Internet.
Trec: The teacher is walking around helping pupils find relevant web pages.

Obsnot 091400: The teachers talk together. They feel they have lost control. Several of
Vrec: the pupils have forgotten to use the logbook and the evaluation paper. The pupils are reminded to use them properly. The teachers say that they are important for the pupil assessments. If the pupils are going to work at home they are allowed to take the logbooks with them the next day. The pupils work in groups, most of them gathering data, several in the computer lab.

Obsnot 092800: The pupils have two computers in the classroom and two in a room nearby that they can use. The pupils are reminded of the logbook. The teachers say they can help them on the basis of their notes. The pupils continue their work in groups. Several pupils are working in the computer lab.

Obsnot 110200: The pupils are reminded of the "cultural evening" and how many days
Trec: are left to work on their project. The pupils work in groups. One group working on the web page receives some help from the deputy head.

Obsnot 110900: The pupils are invited to tell how much space they need for the exhibition. A teacher from the local primary school asks the pupils to come to her classroom and tell her pupils about their project. Some pupils are working in the computer lab. Some are searching for material, another pupils is using the computer to write a text. One boy is scanning a picture.

Obsnot 111600: The pupils are finishing their work. The teacher Marion thinks I will be positively surprised this evening when the pupils are going to exhibit their work. During these three lessons they also go to the exhibition hall to prepare the "cultural evening".

Obsnot 111600: In the exhibition hall. The pupils are putting their work on tables and on the walls. Marion and Ben (teachers) sit in the middle of the room contemplating the pupils' work.

Obsnot 111600: The "cultural evening". The visitors walk around and look at the pupils' work. The pupils are at their exhibition "stand" to answer any answers from the visitors. The visitors can also buy something to eat and drink.

Obsnot 112300: The project period is summarized. During this summary all the teachers,
Trec: the headmaster and a representative from the local historical
Vrec: association are present. Each group tells about their experiences from the project.

Obsnot 120700: The pupils have a dialogue with the teachers regarding the assessment of
Trec: the project period. The pupils' products and their self-assessment forms form the basis for these dialogues.

Pupil collaboration: Trec:	Pupil collaboration in two groups is tape recorded during the accomplishment of the project. Group 1: 090700, 091400, 092800, 110200, 110900. Group 2: 090700, 091400, 092800, worked at home.
Team meetings:	
Obsnot 083000:	Planning of the project period.
Obsnot 092700:	The teachers read the pupils' logbooks and assessment papers. Talk about each group, what they have done and what they are going to do.
Interviews:	(All the interviews have been tape recorded).
Inthead 110200:	Dialogue mostly about the ICT equipment at the school. The headmaster informs about how many computers the school has and how they are maintained. The headmaster also gives his opinion as to where the equipment should be placed.
Intdephead 111600:	The deputy head informs about his work as a support person in the use of ICT. He is paid to use four hours a week on this work.
Intinf 090700:	Conversation about the teacher's role in project work. Marion talks about what she thinks about ICT as an information source, and the library as another. Talk about the class atmosphere. Marion talks about the importance of the pupils feeling that they are succeeding.
Intinf 091400:	Ben also takes part in this interview. Dialogue about the goals for the project. Talk about the different subjects that are scheduled during the project lessons. Conversation about the ICT equipment and its placement.
Intinf 092800:	Talk about the pupils who decide to work at home instead of at school. Talk about how they have conducted project work earlier.
Intinf 110200:	Dialogue about the teacher's advising practice. Talk about the pupils working together with parents and grandparents. Dialogue about the use of the log. Marion's thoughts on what is most important for the pupils to learn.
Intinf 112300:	Ben also participates in this interview. Talk about the assessment of the pupils. The groups and the group formation process are discussed. Marion and Ben talk about what they have learned during the project period.
Intteam 090600:	Talk about groups, the teacher's planning and how to structure the process. Talk about the motivational part of the project. Reflection on log use. Discussion about the co-operation with the local historical association. Talk about the parent meeting.

Intteam 110900: Talk about the pupils working at home. Talk about the ICT training and how to use ICT. Marion talks about her attitude on the use of ICT. Reflection on the advising practice and the teacher's role during project work.

Other data:

- Written answers to open questions from both the teachers and the pupils.
- The school's activity plan and the class's periodic plan.
- The pupils' self-assessment form.
- The teachers' plan for the project period.
- Letter to the pupils' parents.
- The informant's logbook.

Appendix 3. The Content and Coding of the Categories

A. The Content of the Categories

Scaffolding:
During project work the pupils decide which topics they are going to work on, which questions are to guide their work, how they are going to find or collect the needed information and how they are to present their work. During all these processes the teachers help the pupils on their way to their goals. This category especially focuses on actions taking place when pupils use ICT as a mediating artefact, and on how the pupils are helped in dialogues with their teachers during these processes. The category deals with scaffolding processes when the pupils are working on task, searching for information, when they are learning new programmes, when they use external equipment and when they present their work. During these activities the pupils use the Internet. They learn to use editing programmes and video cameras to make films. They also use Power Point presentations and a web page to present their work at the end of the process.

Pupil collaboration:
During project work the pupils mainly work in groups. In the observed projects the pupils' activities for the most part are also arranged as group activities. This means that the pupils have to collaborate and show consideration throughout virtually the entire process. The category illustrates in dialogues how the pupils help each other in their talk with each other during the various activities in the project period. Special focus is given to the processes when pupils help each other while using ICT as a tool. The pupils support each other when they search for information on the net, when they learn new programmes, when they use cameras to do some filming and when they use ICT as a mediating artefact when presenting their work. In this category some of the learning aspects of the computer and the software programmes the pupils use are also taken into consideration.

Shared knowledge:
From the outset the computer was looked upon as a tool that just one pupil should use at a time. In classrooms, the normal situation is that a group of pupils is seated in front of a computer collaborating on the same task. This means that the knowledge each pupil constructs is created together with others in a joint process. Thus the constructed knowledge is shared between the group members. This category deals with finished work sequences, both at the group and class level. Thus this category is about knowledge construction at both these levels with the teacher as a central person organizing the learning processes. This category focuses on whether or not processes like information-searching, learning to use programmes, using external equipment and making presentations are shared by all the pupils. In addition to this organization level attention is given to how dialogues, including the teachers and the pupils in large groups or the whole class, can make up a shared repertoire or shared knowledge. The dialogues at the group level are accomplished with all groups, and thus the content in this activity is also shared by all the pupils in class.

Assessment:
This category looks at the assessment practice at the three schools. Assessment dialogues between the teachers and the pupils and the teachers' utterances and thus reflections on the work processes are part of the data material in this category. The category includes the

teachers' assessment of the pupils work, the pupils' assessment of each other and their assessment of themselves. The focus is on assessment practice when ICT plays a central role in the activities. The rendered data material shows that assessment processes are present in most activities during the work; during information-searching processes, during the learning of new programmes, when using external equipment and when presenting the work.

B. Coding of the Categories. Example from Applebee School

(T=teacher, P=pupil)
(P.P.= Project Phase. Material used in the description of the schools)

Shared knowledge P.P	T: Yes, there's just one tripod like that at school. So, then you have to continue. All of you have to be active. And make sure you discuss together how you can solve this problem.	How to work

(Four pupils in a group try to open and close the case housing the camera).

Pupil collaboration	P1: Where should we put it (they are trying to put the camera on the tripod)? P2: Here. P3. Does it fit well? P4. Yes it does (George holds the camera and checks if it is firmly placed on the tripod. Now they have managed to put the camera on the tripod).	Try to put the camera on the tripod
Pupil collaboration	P1: There's no battery! We have to have a battery (eagerly to the others). P3: How clever we are (rather ironically). (They all hurry to the camera case to find the battery. Then Jeff tries to put the battery on the camera). P4: It should be placed here (pointing).	Finds the battery
Scaffolding	T: Are you helping each other? (Steven comes up to the group after he has observed it for a couple of minutes). P3. Yes. T: That's good (then he leaves the group again). P1: Where are we going to put it?	The teacher ask if they work together

(The pupils try to zoom the camera)

(The teacher comes back to group 1)

Scaffolding	T: Now we're going to look at how you have placed the camera. Do you have any idea how you could have done it somewhat differently? (looks at the boys) E1: (Turns the camera). T: Okay, like that. Yes, now you can move it forwards and sideways. I want you to make sure that everyone tries to do it. Have you found out how you focus the camera? (Shows the pupils how they should do it). Try it. Look at the items in your instructions, then you'll find out how to do it. P2: We should do it like this (shows). T: Good. How far have you got with the things you're supposed to do? P2: To A. T: Have you just finished the first page? P1: What are we going to do now then? T: In about five minutes we'll finish this sequence. (The pupils read and collaborate around the camera, they try to film) P1: We've finished. T: Finished ? Good.	How to put the camera on the tripod

C. Coding of the Categories. Example from Bridgeford School

(T=teacher, P=pupil)
(P.P.= Project Phase. Material used in the description of the schools)

Project phases	T1: What is this then? P1: A newspaper. T1: What other media do we have? P1: Radio, TV, computers. T: By computer you mean the Internet, yes. What role do TV and newspapers play in what happens in Norway today, P2? P2: In Norway people read lots of newspapers. T1: Yes, they do. And what are they interested in? Well, it has to be things about Norway. Here I can read about unrealistic cuts, I can read her (stands with a newspaper in her hand). What is that? What is being cut? P2: The budget. T1: The budget, what consequences does that have for our own municipality? Yes, that perhaps one of the schools in this district will be closed down. That's what it leads to. But by reading the newspapers we get to know about it. When you start to work, there will be four or five of you in each group. Here I have noted some issues I think are important in Norway today (has a paper in her hand). I'm going to read it to you, then we'll find out if the things I have thought of agree with your ideas (reads). Here's the exercise. What I'm going to do now is look at this together with you so that you can ask questions before we start to work with it.	Accomplishing the basic course
Shared knowledge P.P.	We're going to have a group activity in the regular groups. We're going to imagine that we're taking part in a Nordic contest, and the aim is to present our country in the best way possible, and it's therefore important that the presentations come across well. And the work must be informative, and clear. There must be some information that shows that you have knowledge about Norway, and the information must be correct. You have to have more than just goat's cheese, national costumes, mountains and fjords, that's not enough. You'll get as many sheets of paper as you need. It should be short and as clear as possible. You can use the list I have made as support, but you choose yourself. You're going to draw and to cut and paste. You'll get papers like this, and you're going to divide the work between you in the group so that all of you work independently with your sheet of paper after you have split the work between you.	Competition, motivation Should be informative and clear
P.P.	T2: It's very important then that you don't just make slogans and write about things you already know, you know easy, ready-made information. It should be information that shows that you have knowledge about Norway.	Expect that they develop their knowledge

D. Coding of the Categories. Example from Cooper School

(T=teacher, P=pupil)
(P.P.= Project Phase. Material used in the description of the schools)

P.P.	T: I can't manage to teach people on twelve computers all at once. I'll teach two now to be experts, and then they can help others afterwards.	Accomplishment Expert pupil
	Pupil group:	
Pupil collaboration	P1: (to P2). Perhaps we should try to search on emigration, and try to find a link from there to try to find something. P2: I have an uncle we can find on the web, but I don't know his address. There we can find his name in America. P1: Are you trying to find your uncle's web page? (P2 is searching on the net). Are you sure you're writing the right address. P2: I just want to look at the Norwegian Telecom start page, I don't want to waste my time trying to write the address. P3: What's he doing? P1: He's trying to find his uncle's web page.	Accomplishment Searching on the Internet
Pupil collaboration P.P.	P3: I'm going home to do something. I can't do anything here, okay? P2: Are you going home? P1: I'm going home too. P2: Are you going home? Are you allowed to do that?	Talk about going home
	(Both P1 and P3 rise and walk out of the computer room)	
P.P.	P3: I'm going home to work, I can't mange to do anything here. (He says this to himself, but continues to search on the web). I can't find anything (still talking to himself).	Talk about going home
Scaffolding	P4: What are you searching for? P2: I'm trying to find a relative of mine. P4: I think Jill knows it (the person who is born and raised in the US). P2: (To the teacher): Do you know about any pages where you can find relatives from America? T. Yes, I know about some. I suggest that you write "relatives.no", that's a gateway. P2. Nor? T: No, for Norway you know. P2: I thought you said nor (the page shows up). Should I just write the name here? Should I just write the last name? T: (Nodding, as he goes to help another pupil). P2: Here, I guess you could say I found a lot (he finds nothing he is looking for).	Searching on the Internet

Appendix 4. Gaining Access

A. Letter to the Headmaster

May Britt Postholm
Department of Education
NTNU
7491 Trondheim Date:

School
Headmaster
Address

Application for permission to carry out a research study in connection with my doctoral-paper entitled "Project work with the use of ICT as a mediating artefact"

Thank you for a pleasant chat and for the interest you have shown in my work that I will begin this autumn. Although I have received oral permission to conduct this study at your school, I would also like to formalize this arrangement with the school.

My background:
I have worked as a teacher for sixteen years, for the most part in the lower secondary school. In Autumn 1998 I completed my masters degree with project work as the topic. This work has been edited in a book in the series "Classroom Research". Project work will also be the topic of this study, but with the focus on ICT as a mediating artefact. In the spring of 2000 I have been a student at Stanford University, California, where I took doctoral courses in method, science theory and substantive theory. One of the courses was entitled "Information Technology in the Classroom".

Mentors:
Sigrun Gudmundsdottir and Annlaug Flem at the Department of Education, NTNU, are the mentors for my project. The topic, my plans for the thesis question, the method and the data collection process have been discussed with and supported by them.

The focus for the research study:
During the data collection process I will observe how the teachers help pupils when ICT is used in the classroom. I also want to focus on how the pupils collaborate and what function ICT has in this collaboration process when it comes to learning and development. In addition I will observe the social environment both at the class and school level, and look at how the actions in the classroom can be affected by the context.

Classroom research and the data collection process:
During the research study I will use a qualitative approach by carrying out a case study in an ethnographic framework. This means that I will stay at the school for an extensive period of time. Before I start up the research study I will try to become acquainted with the pupils and the teachers so that they will be accustomed to having me there. Observation will be my main strategy during the data collection process. In addition to this, processes in the classroom will be recorded on video, and pupil communication in their groups will be tape recorded. I will also have interviews with the teachers in the teacher team and the headmaster. I will have interviews both before and after teaching periods with one of the teachers.

The purpose of the research:

The purpose of the research is to develop a thinking tool for how ICT can be integrated in project work. Other teachers who read the research report shall be able to adapt what they have read to their own classroom. The work can thus become a tool that can affect the practice in school. Teachers at teacher colleges and universities can also use the final written text as a tool to develop their practice. The results will be given to the school when they are available. All the data material that is collected will also be given to the key informant. All the collected data will be kept strictly anonymous.

Before I start the research study, I will also take part in a parents' meeting to tell them about the research work. I also have to have the parents'/guardians' permission before the work in the classroom can begin.

I look forward to a pleasant and fruitful cooperation.
Sigrun Gudmundsdottir, mentor, has read and approved this application.

Yours sincerely

May Britt Postholm Sigrun Gudmundsdottir

B. Letter to Municipalities

May Britt Postholm
Department of Education
NTNU
7491 Trondheim Date

Municipality
Address

Application for permission to carry out a research study in connection with my doctoral-paper entitled "Project work with the use of ICT as a mediating artefact"

In telephone calls and meetings with the headmaster (..) and the teacher (...), the key informant, and his/her team at (...) school my project was met with interest and goodwill. I have also made arrangements with both the headmaster (...) and the teacher (...) and his/her teacher team. In addition to their approval of my project, I will also formalize my arrangement with them. Before the research study can begin, I will also obtain permission from the parents/guardians. I will inform the parents about the research work at the first parent meeting in the autumn.

My background:
I have worked as a teacher for sixteen years, for the most part in the lower secondary school. In Autumn 1998 I completed my masters degree with project work as the topic. This work has been edited in a book in the series "Classroom Research". Project work will also be the topic of this study, but with the focus on ICT as a mediating artefact. In the spring 2000 I have been a student at Stanford University, California, where I took doctoral courses in method, science theory and substantive theory. One of the courses had the title "Information Technology in the Classroom".

Mentors:
Sigrun Gudmundsdottir and Annlaug Flem at the Department of Education, NTNU, are the mentors for my project. The topic, my plans for the thesis question, the method and the data collection process have been discussed with and supported by them.

The focus for the research study:
During the data collection process I will observe how the teachers help pupils when ICT is used in the classroom. I also want to focus on how the pupils collaborate and what function ICT has in this collaboration process when it comes to learning and development. In addition I will observe the social environment both at the class and school level, and look at how the actions in the classroom can be affected by the context.

Classroom research and the data collection process:
During the research study I will use a qualitative approach by carrying out a case study in an ethnographic framework. This means that I will stay at the school for an extensive period of time. Before I start up the research study I will try to become acquainted with the pupils and the teachers so that they will be accustomed to having me there. Observation will be my main strategy during the data collection process. In addition to this, processes in the classroom will be recorded on video, and pupil communication in their groups will be tape recorded. I I will also have interviews with the teachers in the teacher team and with the headmaster. I will have interviews both before and after teaching periods with one of the teachers.

The purpose of the research:
The purpose of the research is to develop a thinking tool for how ICT can be integrated in project work. Other teachers who read the research report shall be able to adapt what they have read to their own classroom. The work can thus become a tool that can affect the practice in school. Teachers at teacher colleges and universities

can also use the final written text as a tool to develop their practice. The results will be given to the school when they are available. All the data material that is collected will also be given to the key informant. All the collected data will be kept strictly anonymous.

I hope you will consider this application quickly and positively as I would like to commence the research study when the teaching starts up this autumn.

Yours sincerely

May Britt Postholm

Sigrun Gudmundsdottir

C. Letter to Parents/Guardians

To parents/guardians Date

My name is May Britt Postholm and I am a teacher with many years of experience from the lower secondary school. In the spring of 1999 I took my masters degree, where the topic of my studies was project work. Now I am working as a doctoral student in education science. In this study I will also be examining project work, but I will especially focus on ICT as a mediating artefact.

To collect the necessary data material, I would like to make tape and video recordings of the class. Classroom observation will also be an important strategy. I will be trying to find out how the teachers help the pupils and how ICT can function as a helping tool in the learning process during project work. Both project work and ICT are new factors for most teachers and pupils in the Norwegian compulsory school. The result of this work is meant to become a thinking tool for other teachers and teacher educators to help them with project work in the future.

Teacher (...) has shown interest for this work and said that he/she is willing to take part in this research study. The headmaster (...) has also reacted positively to my intended study, and the counsellor (...) in the municipality of (...) has also consented to my research in the classroom.

In the final report I may cite some dialogues between the teacher and pupils and between pupils, while also describing the setting. All the information that is collected will be treated as strictly confidential and will thus be anonymous in the report. All data (tape recordings, video recordings and observations notes), will be erased/deleted after the research work has been finished.

Bearing all this in mind, I would like to ask for your permission to:

- get to know the pupils in the classroom some time before the project starts
- study the class after this initial introductory phase and during the project work
- analyse the data material and interpret and use it in my doctoral thesis

As a teacher and a doctoral student I appreciate collaborating well with the school, with the teachers and with the parents/guardians.

If any parents/guardians have any objections, please inform the school before (date).

Kind regards from

May Britt Postholm
-doctoral student-

Please return to the school before (date)

I/we consent to the collection of data in our child's class, and which will then be used in the doctoral study.

_____

Parents'/guardians' signature

Appendix 5. Interview Guides

A. Questions for Key Informants

Some questions asked in Applebee School in the dialogue conducted 091500:

1) What is "net days", and what is going to happen then?
2) You encourage the pupils to work in groups all the time, why do you do that?
3) The teacher's role. What do you think about it in relation to the modern school?
4) Do you think it is important that the teachers in a team have the same pedagogical perspectives?
5) Could you say something about what you feel is important that pupils learn?
6) You talked about the films that will be made as a product of this project, and that all the pupils should feel that they have taken part in the production. How have you planned to accomplish this?
7) You say that the pupils are not going to be awarded any marks. Could you tell me how you are thinking of assessing the pupils?

Some questions asked in Bridgeford School in the dialogue conducted 112800:

1) Does the school have a progression plan with respect to the use of ICT?
2) Have the pupils learnt to make a web page, does such training have any priority?
3) The pupils' planning document says "date and time for collaboration". Are the pupils supposed to plan when they are going to meet and discuss their work together?
4) In what way do the pupils use the log?
5) What do you think motivates the pupils most during a project period?
6) I observed that you paid great attention to the thesis question. What would you say makes a good thesis question?
7) It is often said that ICT produces gaps between pupils. How do you meet this challenge at your school?

Some questions asked in Cooper School in the dialogue conducted 090700:

1) What do you think about the activity in the classroom today?
2) Do you have an overview of how many pupils went home today?
3) Did everyone write in their logbook today?
4) What do you think about the Internet as an information source?
5) I heard you tell the pupils in one of the groups that they had to work more on their thesis question. What do you think is a good thesis question?
6) One of the boys said during the last work session that they should have worked on another theme. What do you think he was getting at?
7) The forms the pupils made; how have you teachers planned to use them in your work?

B. Questions for Teacher Teams

Some questions I asked the teacher team at Applebee School 101300

1) What do you feel is the underpinning of a well functioning team?
2) What is it that forms the structure or framework for the work when the curriculum no longer directs what you do?
3) How do you make up the content of the year syllabus?
4) What about traditional tests and marks?
5) What did you want the pupils to learn during this project?
6) Why did team no.1 get the theme no one else wanted to work on?
7) If you think of the project, is there anything you would do differently the next time?

Some questions I asked the teacher team at Bridgeford School 120500

1) What do you feel is the underpinning of a well functioning team?
2) What do you think of project work compared to traditional teaching?
3) What challenges does the project-work method give teachers?
4) Now that this project is finished, do you think you would change anything the next time?

Some questions I asked the teacher team at Cooper School 110900

1) What do you feel is the underpinning of a well functioning team?
2) Do you think the pupils went home to work because their parents, grandparents or other relatives could help them, or do you think they went home for other reasons?
3) How do you think the advisory work was divided between the teachers?
4) How will the summary session be carried out?
5) In what way have the pupils received training in the use of ICT earlier?
6) What thoughts do you have at the end of the project period? Is there anything you would do differently the next time?

C. Questions Asked Headmasters

1) How many pupils does your school have altogether?

2) How many teachers work here?

3) How many computers do you have in your school and where are they placed?

4) How many teachers have education in project work and/or computer science?

5) Does the school have any continuing education plan for project work and for computer science?

6) When you purchase ICT equipment, where do you get the money?

7) Does your school have any plans in connection with the use of ICT in the school?

8) How are the project lessons scheduled?

9) What subjects are formally integrated in the projects?

10) Are the same teachers teaching the whole project period, or do subject teachers also teach a few of the lessons?

11) Do you insist that teachers who have computer-science teaching credentials teach during project work?

12) What thoughts do you have on the formation of teams?

13) Is anyone employed and given the resources at your school to maintain the ICT equipment?

14) Is anyone employed and given the resources at your school to buy hardware and software?

15) What access do the teachers have to computers at their workplaces at school?

16) One issue often discussed at schools is where the ICT equipment should be placed. What do you think is the best pedagogical solution for the placement of the equipment? What persons in the school community should in your opinion take part in this decision?

Additional questions asked of the headmaster at Applebee School

17) What reasons does the school give for its exemption from the National Curriculum plan in the class I studied?

18) With respect to the teachers in the team that I studied, what pedagogical ideas do the teachers take into consideration for the project work?

19) What about marks?

Appendix 6. Questionnaires

A. Questionnaire 1

Questions asked of the pupils at the beginning of various project periods

Boy ☐ Girl ☐

	Yes	No
1) Do you have a computer at home?	☐	☐

If yes:

	Yes	No
Are you connected to the Internet?	☐	☐

	Yes	No
Do you have an e-mail account at home?	☐	☐

2) Do you think that you can learn more when you use the computer as a helping tool?
If yes, why?
If no, why not?

3) Do you think that ICT equipment is used enough in school, or would you have liked to use this equipment more?
Give reasons for your answer.

4) What importance do you think ICT equipment will have in your adult life?

5) What advantages or disadvantages do you find with group work?

Advantages:	Disadvantages:

B. Questionnaire 2, Applebee School

Film team ☐

1) What have you learnt:

a) about the use of helping tools?

b) from working in groups with other pupils?

c) about your school and town?

C. Questionnaire 2, Bridgeford School

Boy ☐ Girl ☐

Theme:
Thesis question:

1) How do you like working in a project-directed way compared with ordinary teaching?

2) What information sources did you use during the project?

3) What have you leant from working in groups during the project?

4) In what way have you used ICT during the project?

5) What have you learnt about the use of ICT during the project?

6) What have you leant about Norway after your own group had finished the work and after you have listened to the other presentations?

D. Questionnaire 2, Cooper School

Boy ☐ Girl ☐

Theme:
Thesis question:

1) What have you learnt about emigration to America?

2) What have you learnt about working in groups?

3) Why did you choose to work individually?

4) Did you work at home during school hours when you had project-directed teaching on Thursdays?
If yes, why?
If no, why not?

5) What information sources did you use?

6) In what way did you use ICT during the project?

7) What have you learnt about the use of ICT?

8) How do you like working in a project-directed way compared with ordinary teaching?

E. Questionnaire for the Teachers in the Three Teacher Teams at Applebee, Bridgeford and Cooper Schools

Name:

1) What and how many years of working experience do you have?

2) What education do you have?

3) How would you define project work as a work method?

4) How would you describe the teacher's role during project work compared to the traditional role?

5) How are you organized in teams, and how do you divide the work between you during projects?

6) What significance do you think it has for the pupils' learning that they work in groups?

7) What meaning do you think ICT can have as a helping tool in pupils' collaborative processes?

8) Do you think that the teacher's role changes when ICT is used during project work, and if so in what way?

9) How do you draw up overarching themes for project work?

10) Where do you think the ICT equipment should be placed in schools so it can be integrated in the teaching the best way possible?

11) How have you assessed the work the pupils have carried out during the project work?

12) How would you describe the social environment in the class?

13) What meaning do you think ICT will have in the future?

14) Are you a user of ICT at home?

Appendix 7. Descriptive Material Presented in Tables

I asked all the pupils the same open questions at the beginning of the observed project period (Questionnaire 1, Appendix 6A, p. 391), and more open questions adapted to the different work processes at the end of each project period (Questionnaire 2, Appendix 6B, p. 392, 6C, p. 393, 6D, p. 394).[65] The answers summarized in the tables below form part of the context description in which the actions in the classroom take place. These tables also present and summarize the pupils' utterances, and thus they express their opinions. The tables show both the pupils' situation when the project work started and the pupils' utterances when the project period had ended. The tables thus provide information on the situation before the work was started, on the pupils' experiences throughout the process and on their opinions about learning.

My first question was if the pupils had a computer at home and if they were connected to the Internet and also had an e-mail account. This was to ascertain what opportunities the pupils had to use computers at home, something I could take into account during my observations. One pupil from Applebee School[66] said that he was lucky he could use the computer at school because he did not have one at home. Table 2 below indicates the pupils' situation at home.[67]

Table 2: Questionnaire1: Pupils equipment at home, answers from boys (B), girls (G) and all (B+G)

Answers	School A			School B					School C			School A+B+C		
	G	B	G+B	8 A		8 B		8A+ 8B	G	B	G+B	G	B	G+B
				G	B	G	B							
Computers	14	14	28	15	5	14	8	42	19	20	39	62	47	109
Connected	9	10	19	10	5	12	5	32	14	19	33	45	39	84
E-mail	9	10	19	10	5	11	5	31	13	18	31	43	38	81
Number of answers-pupils	19-19	18-20	37-39	16-16	5-5	15-15	9-9	45-45	20-23	21-21	41-44	70-73	53-55	123-128

[65] I did not find it useful to present the answers to four questions (Question 1c in Appendix 6B, question 6 in Appendix 6C, and the questions 1 and 4 in Appendix 6D) in tables. Still, these answers are included in the main text.

[66] In all tables I use the terms "School A", "School B" and "School C" for **A**pplebee, **B**ridgeford and **C**ooper Schools respectively.

[67] In the tables I have split classes 8A and 8B because they sometimes worked at different times and also now and then in different rooms when their project lessons were at the same time. Therefore I could only closely observe the activities in one class (8B) throughout the whole project period. In the tables presenting information on the use of ICT, the answers are also divided according to boys and girls.

The table shows that thirty-nine of forty-one pupils at Cooper School have a computer at home and that forty-two of forty-five pupils at Bridgeford School have a computer they can use in their leisure time. At Applebee School twenty-eight of thirty-seven pupils have a computer. Thus two pupils at Cooper School, three pupils at Bridgeford School and nine pupils at Applebee School do not have a computer to use at home. Eighty-four of all the pupils that have a computer are connected to the Internet, and eighty-one have an e-mail account.

Another question I asked the pupils was their opinion on using ICT at school, if it was used enough or too little. Table 3 below provides an overview of the pupils' answers.

Table 3: Questionnaire 1: Answers to: "Is ICT used enough or too little at school?", from boys (B), girls (G) and all (B+G)

Answers	School A			School B					School C			School A+B+C		
	G	B	G+B	8A		8B		8A+ 8B	G	B	G+B	G	B	G+B
				G	B	G	B							
Enough	5	7	12	5	1	6	1	13	6	6	12	22	15	37
Too little	14	11	25	10	4	9	8	31	13	14	27	46	37	83
Don't know				1				1	1	1	2	2	1	3
Number of answers-pupils	19-19	18-20	37-39	16-16	5-5	15-15	9-9	45-45	20-23	21-21	41-44	70-73	53-55	123-128

The answers from all three schools show that far more pupils think ICT is used too little than enough. Thirty-seven of the pupils from all the three schools think that ICT is used enough, but eighty-three are of the opinion that it is used too little. Bearing in mind that these schools focus on the use of ICT and the teachers are aware of the need to integrate the tool in the pupils' work, these answers indicate that the pupils like to use ICT in their learning processes. The number of pupils at Applebee School who think they use ICT enough is not lower than the other two schools, even though there were more pupils at Applebee School who did not have a computer at home. Thus it was not expectable that so many pupils answered that they used the computer enough at this school. The reason why the pupils at Applebee School answer the way they do could be due to the fact that at the moment they answered the question they also had started on their basic course in tool use and thus were using ICT equipment a great deal. Although this question does not clearly divide the pupils in one direction or the other, the question on whether they think they learn more when they use ICT does. The pupils' answers to this question are summarized in Table 4 below.

Table 4: Questionnaire 1: Answers to: “Do you think you learn more when you use ICT?”, from boys (B), girls (G) and all (B+G)

Answers	School A			School B					School C			School A+B+C		
	G	B	G+B	8A		8B		8A+ 8B	G	B	G+B	G	B	G+B
				G	B	G	B							
Yes	16	16	32	15	4	13	9	41	17	15	32	61	44	105
No	1	1	2		1	1		2	2	4	6	4	6	10
Don’t know	2	1	3	1		1		2	1	2	3	5	3	8
Number of answers-pupils	19-19	18-20	37-39	16-16	5-5	15-15	9-9	45-45	20-23	21-21	41-44	70-73	53-55	123-128

These answers show that the pupils think that ICT helps them in the learning processes. Altogether one hundred and five pupils answer this question in the affirmative. Just ten of all the pupils think they do not learn more when they use ICT. Eight of the pupils do not know. In both Applebee and Bridgeford Schools, two pupils answer in the negative. In Cooper School, six of the pupils think they do not learn more when they use ICT.

Another question on ICT's importance in the future also indicates that the pupils have a positive attitude to the use and importance of ICT. The pupils' answers to this question are summarized in Table 5 below.

Table 5: Questionnaire 1: Answers to: “Will ICT have great importance in the future”, from boys (B), girls (G) and all (B+G)

Answers	School A			School B					School C			School A+B+C		
	G	B	G+B	8A		8B		8A+B	G	B	G+B	G	B	G+B
				G	B	G	B							
Yes	14	15	29	12	5	14	8	39	17	21	38	57	49	106
No				1				1				1		1
Don’t know	5	3	8	3		1	1	5	3		3	12	4	16
Number of answers-pupils	19-19	18-20	37-39	16-16	5-5	15-15	9-9	45-45	20-23	21-21	41-44	70-73	53-55	123-128

One-hundred and six of all pupils think that ICT will have great importance in the future. Just one pupil answers this question negatively. Sixteen of the pupils think that it is difficult to answer this question and remain unsure.

One of the questions aimed at the teachers also asked if they believed that ICT would have great importance for the pupils in the future. All the teachers answered that they believed that ICT would have immense significance in the pupils' future lives (Questionnaire, Appendix 6E, p. 395).

Generally the pupils sit in groups when they are working on a project. One of my questions to the pupils in the beginning of the project period was if they could think of any

advantages and also any disadvantages of working in groups. The pupils' answers on the advantages of group work are summarized in Table 6 below.

Table 6: Questionnaire1: Advantages of group work

Answers	School A	School B			School C	School A+B+C
		8A	8B	8A+B		
Acquaintance. Get to know each other better. Learn about the others in the group. Get to know what persons I work best with	4	2	5	7	4	15
Get to know that you are not always right		1	1	2	1	3
Make friends		1		1		1
Improves friendship			1	1		1
Change			1	1		1
Interesting			1	1	1	2
Fun	2	4	5	9	7	18
Social. Cosy. Pleasant	1	1	7	8	5	14
Learn to collaborate	2	3	6	9	1	12
Division of work. Get more done Find the answer faster	7	3	11	14	16	37
Discuss and plan	1	1		1		2
Get ideas from others Get to know others' opinions	3				12	15
Help each other	12	2	1	3	8	23
Share knowledge	3	6		6	3	12
Learn more	1	1		1	2	4
Better result	2		1	1	2	5
Total numbers of answers-pupils	37-39	21-21	24-24	45-45	41-44	123-128

These answers show that for Bridgeford and Cooper Schools most pupils answer that the advantage of group work is that the work is "divided between pupils", that "more gets done" and that they "find the answers faster". This is also the most frequently answered category when the answers from all the schools are summarized. For Applebee School this category is the second largest. Most pupils in this school state that the advantage of group work is that they "help each other" when they work in groups. For all schools together this is the second largest category. The frequency of answers to the categories "acquaintance", "fun" and "social, cosy, pleasant" is also high. Pupils in class 8B at Bridgeford School have especially given numerous answers that are categorized within these headings. Twelve pupils from Cooper School think that an advantage of group work is that they can "get ideas from others" and "get to know others' opinions". The categories "learn to collaborate" and to "share knowledge" also have a high frequency of answers. Six pupils in 8B think that group work helps them to learn to collaborate, and six pupils in 8A think that group work helps them to share knowledge. The pupils also think group work may have some disadvantages. The pupils' opinions on the disadvantages of group work are summarized in Table 7.

Table 7: Questionnaire 1: Disadvantages of group work

Answers	School A	School B			School C	School A+B+C
		8A	8B	8A+B		
More irrelevant talk	2				5	7
Quarrelling. Disagreement.	9	10	15	25	7	41
Noise	9	1	2	3	11	23
Some are irresponsible	2	2		2	7	11
Have to show consideration		1		1	4	5
Not responsible for group composition		1		1	1	2
Dislike someone					1	1
Work at a different pace					1	1
Feel more responsible to do a good job on behalf of the other pupils					1	1
Work better alone					1	1
Want to sit in pairs	1					1
Boring	1	2		2		3
Get answers from others	1					1
Total numbers of answers-pupils	37-39	21-21	24-24	45-45	41-44	123-128

The answers show that the pupils at all three schools think that "quarrelling, disagreement" and "noise" may be the most conspicuous disadvantage with group work. At Cooper School the categories "more irrelevant talk", "some are irresponsible" and "have to show consideration" are otherwise the most frequent answers given. The categories except for "quarrelling, disagreement" and "noise", have few answers at Applebee and Bridgeford Schools.

I also asked the pupils at the end of the project period how they liked project work compared with traditional schoolwork. This question was just asked of the pupils in Bridgeford and Cooper Schools because the teachers in Applebee School had not introduced the concept "project work" in connection with their "toolkit lessons". My key informant at Applebee School, Steven, says that the pupils are learning about project work and to work in a project-directed way without knowing it. He adds that the work processes the pupils have been through during the observed period can function as illustrations when the pupils are informed more about project work as a work method (intteam 101300). The answers from the pupils in Bridgeford and Cooper Schools are summarized up in Table 8 below.

Table 8: Questionnaire 2: How the pupils like project work compared with traditional school work

Answers	School B			School C	School B+C
	8A	8B	8A+B		
Like project work:					
Can work with friends	5	2	7	2	9
A change from traditional school work	2		2	7	9
More fun	6	3	9	11	20
Learn to collaborate		2	2		2
Can help each other	2		2		2
Better result				2	2
Learn more	1	2	3	1	4
Learn in a new way				1	1
Can show our knowledge				1	1
Can work together and get to know others' opinions				1	1
Can work with self-selected, interesting topics	5	2	7	11	18
Can work more in depth with topics		1	1	1	2
Not just one correct answer				1	1
Gives more freedom	1	8	9	6	15
The pupils work more independently				6	6
Can visit places and make interviews		2	2		2
Are allowed to use ICT equipment		3	3	1	4
Do not need to sit still and listen to the teacher		1	1	5	6
Dislike project work:					
Learn more from traditional school work				2	2
Like traditional school work better		1	1		1
Project work is difficult				1	1
Not answered	1	3	4		4
Numbers of answers-pupils	20-21	21-24	41-45	40-44	81-89

Altogether twenty pupils at the two schools think that project work is "more fun". This is also the most frequent answer for all pupils, both in 8A at Bridgeford School and in Cooper School. Altogether eighteen pupils answer that they like that they "can work on self-selected, interesting topics" during project work. This is the second most frequent answer in class 8A at Bridgeford School. In Cooper School this category has received the most answers, more than the category "more fun". Fifteen of all the pupils at both schools think that project work "gives more freedom". This category is the most frequent for class 8B at Bridgeford School where eight pupils in this class give this answer. Seven pupils at Cooper School think that project work is a good "change from traditional school work". Six pupils at the same school think that project work "gives more freedom" and another six of the pupils at Cooper School have the opinion that they can "work more independently" when they work in a project-directed way. Five pupils in class 8A at Bridgeford School say they like that they "can work with friends" during project work. The same number of pupils at Cooper School say that they are positive to the fact that they "do not need to sit still and listen to the teacher" when they have project work. In Bridgeford School one pupil says that he likes traditional schoolwork better than project work. In Cooper School two pupils think that they learn more when they

have traditional schoolwork, and one pupil at Cooper School thinks that project work is difficult. This means that just four out of eighty-one pupils at these two schools do not prefer to work in a project directed way. Four of the surveyed pupils did not answer this question.

The pupils use different information sources to find material to answer their questions. Tables 9 and 10 show the frequency of use of various information sources. Applebee School is not mentioned because, as the description of the project period make clear, the pupils at this school did not use the Internet or other information sources during the project period (trec 100300). Table 9 below shows the use of information sources in Bridgeford School.

Table 9: Questionnaire 2: Information sources used during the project, School B, Groups (Gr) 1-8 in 8A and 1-7 in 8B

	8 A									8B								8A+B
	Gr1	2	3	4	5	6	7	8	All	Gr1	2	3	4	5	6	7	All	15
Internet	x	x	x	x	x	x	x	x	8	x	x	x	x	x		x	6	14
Encyclo-paedias	x		x						2		x						1	3
Books		x	x		x	x	x		5				x			x	2	7
Teachers												x					1	1
Papers			x			x			2			x					1	3
Maga-zines						x			1			x				x	2	3
Inter-views			x			x	x	x	4			x	x	x	x	x	5	9
TV			x	x					2									2
Numbers of answers-pupils									20-21								21-24	41-45

All but one group in Bridgeford School use the Internet as an information source. Pupils in one group only hold interviews to gather their data material. For one group in class 8B, the Internet is the only information source used, but several groups also combine the Internet with other information sources. Ten of the fifteen groups at Bridgeford School use the Internet together with books, newspapers, magazines and/or encyclopaedias. Three groups also combine to use the Internet together with either TV or interviews. Table 10 below presents the use of information sources in Cooper School.

Table 10: Questionnaire 2: Information sources used during the project, School C, Groups (Gr) 1-12 + 8 pupils working alone

	Gr1	2	3	4	5	6	7	8	9	10	11	12	8 alone	All	
														Gr	Alone
Internet	x	x	x		x	x	x	x	x		x	x	5	10	5
Encyclopaedias		x	x		x		x						1	4	1
Books	x	x			x	x			x		x	x	1	7	1
Teachers		x			x					x				3	
Letters from the USA									x					1	
Parents, grand-parents and other relatives	x	x		x	x	x							7	5	7
Pictures								x						1	
Numbers of answers-pupils														40-44	

In Cooper School all but two groups use the Internet to gather their information. Pupils in one of these groups only collect their information from parents, grandparents or other relatives. The other group, which is making a film, uses their teachers as an information source for their work. Five of the eight pupils working alone also use the Internet as an information source. No groups use only the Internet to compile information. All the groups using the Internet combine this source with the use of either encyclopaedias, books, letters from the USA and pictures, or several of these sources.

During the project period the pupils also use the ICT equipment in different ways. The pupils in Applebee School are introduced to the different ways of using it in their "toolkit" lessons. The introduction is found in the description of the basic course taught at this school (p. 93). The description includes how all the pupils are to become acquainted with the use of the I-movie programme, how they are to be introduced to word processing and Apple works, how they each receive an e-mail account and learn to send e-mails and how they learn to use the video camera and make films. During these "toolkit" lessons they also learn to use tools such as maps, an atlas and scientific methodology. In Bridgeford and Cooper Schools the pupils decide how to use the ICT equipment when they compile and present their information. Table 11 below illustrate how the ICT equipment was used during the project periods in Bridgeford School.

Table 11: Questionnaire 2: How ICT was used as a tool during the project period, School B, Groups (Gr) 1-8 in 8A and 1-7 in 8B

	8 A									8B								8A+B
	Gr1	2	3	4	5	6	7	8	All	Gr1	2	3	4	5	6	7	All	15
Information source	x	x	x	x	x	x	x	x	8	x	x	x	x	x		x	6	14
Word processing		x	x		x	x	x		5				x				1	6
Filming/video camera										x		x			x		3	3
Power Point														x			1	1
Digital camera						x		x	2				x			x	2	4
Numbers of answers-pupils									20-21								21-24	41-45

Table 11 shows that ICT is most frequently used as an information source. All but one group use the Internet to gather information. Altogether six groups also use ICT as a word-processing tool. In 8B, three groups make films with a digital video camera, whereas two groups both in 8A and 8B take pictures with a digital camera. One group in 8B also makes a Power Point presentation on the basis of their data material. Table 12 below shows how the ICT equipment was used during the project in Cooper School.

Table 12: Questionnaire 2: How ICT was used as a tool during the project period, School C, Groups (Gr) 1-12 + 8 pupils working alone

	Gr 1	2	3	4	5	6	7	8	9	10	11	12	8 alone	All	
														Gr	Alone
Information source	x	x	x		x	x	x	x	x		x	x	5	10	5
Word processing	x	x		x	x	x	x		x		x		7	8	7
Filming/video camera										x				1	
Scanning pictures	x		x											2	
Web page			x											1	
Power Point													1		1
Numbers of answers-pupils														40-44	

Table 12 shows that ICT is also used mostly as an information source in Cooper School. As listed above, ten groups of twelve and five of eight pupils working alone compile information by using the Internet. Eight of the twelve groups and seven out of eight pupils working alone use ICT as a writing utensil. Two groups are scanning pictures, and the pupils in one of these groups are also making a web page. One pupil working alone presents his answer as a Power Point presentation. As presented in the Table 12 above, one of the groups in Cooper School is using a video camera to make a film of the work process during the project period, but this camera is not digital, so the film cannot be downloaded to a computer (intinf 091400).

At all three schools the teachers have focused on how the boys and girls use the ICT equipment. The teachers at Applebee School think that when they use ICT in a creative way the girls will be encouraged to use ICT more (intteam 1013009). Sarah, my key informant at

Bridgeford School, tells me about an arrangement they had at the school in 1996 when they started to use ICT. The pupils had the opportunity to use the ICT equipment three hours three evenings a week. One of the pupils guiding the others during these evening sessions was a girl, and Sarah thinks that more girls came because of her. Sarah also tells that when they got the projector and the Power Point programme, a girl was hired to train other pupils. Moreover, Sarah finds it advantageous that two of the three persons in the ICT group at the school are women. She says that previously girls were more hesitant to embrace ICT than boys, but now she thinks girls are as eager as boys when it comes to using ICT (intinf 112800). John, teacher at Cooper School, thinks that several of the pupils have become more adept at using ICT during this project period, but he also believes that some girls are still anxious about using ICT and thus need more training (intteam 110900).

The pupils in the three schools were also asked what they had learnt in connection with tool use. In Applebee School the pupils were asked to write down the types of tools they felt they had learned to use. Table 13 shows what the pupils answered.

Table 13: Questionnaire 2: What tools the pupils have learned to use. School A

Answers	Girls	Boys	All
E-mail	1	4	5
Filming/video camera	14	7	21
I-movie/editing	4	16	20
Word processing/Apple works	2	2	4
Maps/atlas	1	2	3
Science method/chemical-lab. activity		2	2
About computers	5	1	6
Number of answers-pupils	19-19	18-20	37-39

Most of the pupils answer that they have learnt to use the film camera and make films and to use the I-movie programme and edit films. What is worth noticing is that altogether sixteen boys of eighteen mention the I-movie programme and the editing work. Just four girls mention this even though all the pupils had the same introduction. Indeed, four girls, two in each of the two groups that were composed of two girls and a boy, edited the class's two films. Five girls claim that they have learnt about computers. When it comes to the I-movie programme, the number of girls mentioning this programme is still seven fewer than the boys. With respect to filming/the video camera, the outcome is reversed. Fourteen of nineteen girls say that they have learnt to use the video camera and make films. Seven of eighteen boys mention this tool. Though the pupils have had the same introduction to the different tools, the boys and girls focus on two different tools.

The pupils at Bridgeford and Cooper Schools were also asked if they have learnt anything at all about the use of ICT. The answers of this question from the pupils at Bridgeford School are showed in Table 14 below.

Table 14: Questionnaire 2: Learnt how to use the ICT equipment, answers from School B, boys (B), girls (G)

Answers	School B				
	8A		8B		8A+B
	G	B	G	B	
Copied pictures from the Internet	3				3
Adapted the data material to our own needs	2				2
Difficult to find something you are searching for	1				1
Learnt to find information on the net		1			1
Copied pictures from the net and pasted them into own documents		1			1
Easier to write with a computer		1			1
Learnt to make and edit a film			1	1	2
Learnt to use the photo-wise programme				1	1
Learnt that ICT is a helpful tool				1	1
Learnt to use a digital photo camera			1		1
Learnt that material can be lost			1		1
Can't always manage to do what you want to do			1		1
Number of answers-pupils	16-16	4-5	13-15	8-9	41-45

In class 8A at Bridgeford School three girls say they have learnt to copy pictures from the Internet. Two other girls write that they have learnt not just to print out material from the net, but also to adapt the data material to their own needs and write it in their own words. Another girl says she has learnt that it is sometimes difficult to find something you are searching for. One boy remarks that he has learnt to find information on the Internet, another says that he has also learnt to copy pictures from the Internet and paste them in his own document. One boy has also found out that it is easier to write on a computer than by hand. In 8A three of four boys and six of sixteen girls think they have learnt something about the use of ICT during the project period.

In class 8B one boy and one girl say that they have learnt to make and edit a film. Another boy says he has learnt to use the photo wise programme. One boy has also acknowledged that ICT has been a helpful tool throughout the process, while one of the girls remarks that she has learnt to use a digital camera, and another that she has learned that while material can be lost, because you can not find the saved file. One girl also says that: "Often you can't manage to do what you want to do, for instance when you're working with Power Point." Three out of eight boys and four out of thirteen girls in 8B and three out of four boys and six out of sixteen girls in 8A think they have leant something about the use of ICT during

the project work. The answers of this question from the pupils at Cooper School are showed in Table 15 below.

Table 15: Questionnaire 2: Learnt how to use the ICT equipment, answers from School C, boys (B), girls (G)

Answers	School C		
	G	B	G+B
Better at searching for information	6	1	7
Not easy to find information on the net	1		1
Learnt to make a homepage		1	1
Found that there is a lot of information on the net		3	3
Learnt everything about Power Point		1	1
Learnt to make a family tree in Microsoft Word		1	1
Number of answers-pupils	20-23	20-21	40-44

Six of twenty girls in Cooper School think they have become better at searching for information on the Internet during the project period. Another girl thinks that she has learnt that it is not easy to find information on the Internet. One of the boys says that he has learnt to make a homepage, and another boy remarks that he has learnt to search for information. Three boys say that they have found out that there is a great deal of information on the net. Another boy adds that he has learnt everything about Power Point, while another boy says that he has learnt to make a family tree using Microsoft Word. Altogether fourteen pupils answer that they have learnt something. Thus twenty-six indirectly say that they have not learnt anything about the use of ICT during the project work

During the observed project periods all pupils at both Applebee School and Bridgeford School work in groups. At Cooper School eight pupils work individually. At the beginning of the project period the pupils were asked if they thought there were any advantages or even some disadvantages to working in groups. Just after the project period had ended they were also asked if they had learnt anything about working in groups during the project work. Table 16 shows the pupils' answers.

Table 16: Questionnaire 2: What the pupils have learnt about working in groups during project work

Answers	School A	School B			School C	School A+B+C
		8A	8B	8A+B		
To be better collaborators	5	2	3	5		10
Accept others' opinions			1	1	1	2
That we can disagree			1	1		1
Not everyone is a good collaborator	2		1	1	1	4
Some talk to much	1					1
To show consideration for others	1	1		1		2
Listen to each other	4	1	1	2		6
Not to quarrel			2	2		2
Get to know each other better	2					2
It is fun	2	1	7	8	4	14
Cosy			3	3		3
It helps to collaborate	8	7	2	9	7	24
Different opinions shape learning	1				3	4
Finds answers faster	1					1
Useful that the work is divided		3		3	5	8
Have to plan the work well					1	1
Demands effort from everybody	2	4		4	6	12
Find more information					1	1
Get help			1	1	2	3
Have to help others	1				2	3
People are different		1		1	1	2
Have to solve problems in groups		1		1		1
Nothing	2		2	2	3	7
Do not know	1					1
Not answered	7	1	1	2	8*	17
Number of answers-pupils	37-39	20-21	21-24	41-45	40-44	118-128

* 8 pupils worked individually.

Most of the pupils' answers are clustered on four issues. Ten of all the pupils at the three schools think they have "become better collaborators". Twelve of all the pupils have found that group work "demands effort from everybody". Fourteen of the pupils have learnt that group work "is fun", and altogether twenty-four say that they have learnt that it "helps to collaborate". At Applebee School, in class 8A at Bridgeford School and in Cooper School this is the most frequent answer. In class 8B at Bridgeford School most pupils have answered that they have learnt that group work "is fun".

Appendix 8. Holistic Development Related to the National Curriculum in Norway

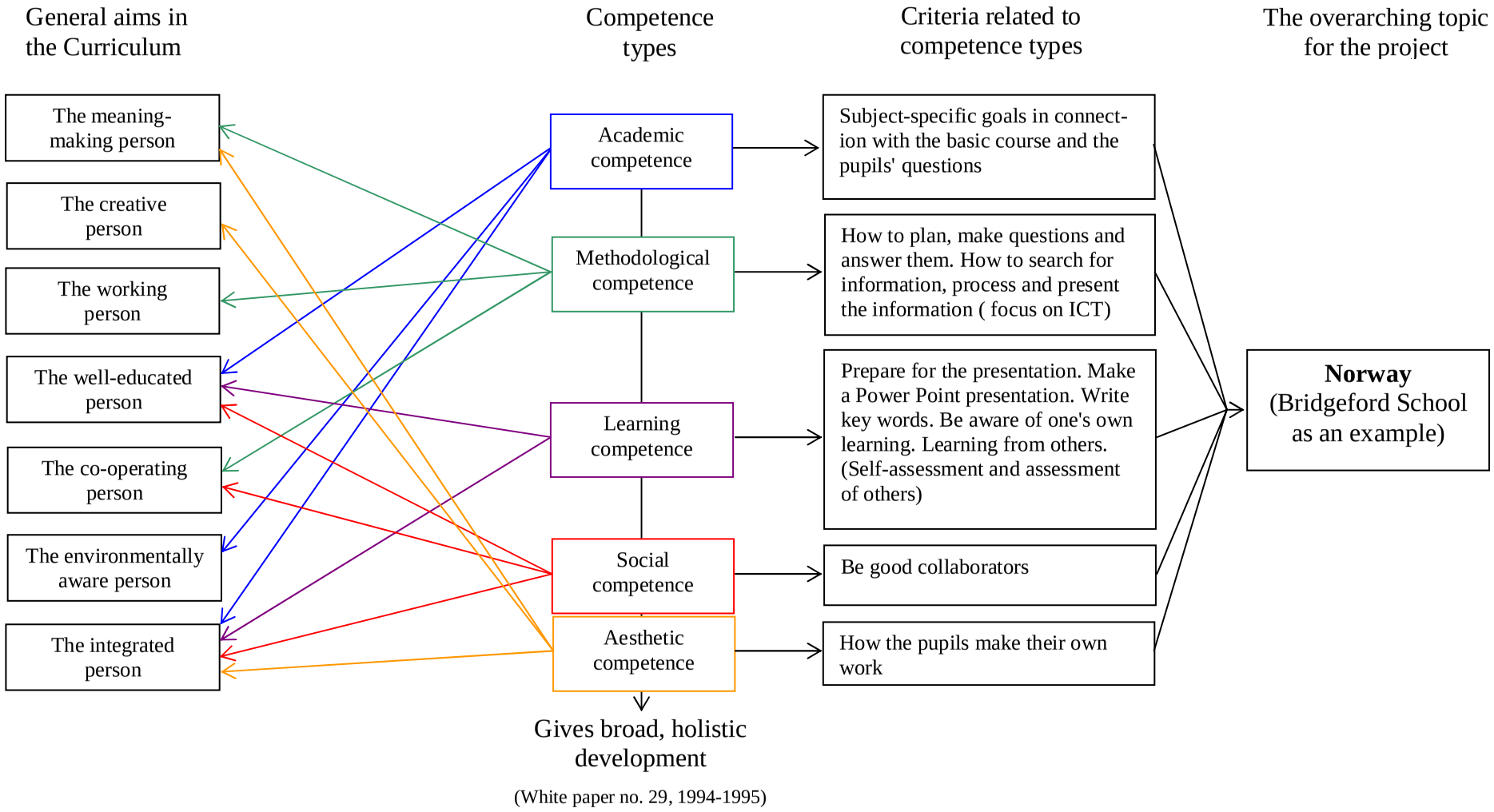

Figure 17: Holistic development