Master's thesis

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Department of Computer Science

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The super:bit project: a model for introducing programming to teachers and pupils - from the teachers' perspective

Master's thesis in Natural science with Teacher education
Supervisor: Monica Divitini & Ola Kleiven
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Abstract

Programming is needed for most professional occupations nowadays. Many countries have already included programming in their curricula for the compulsory education, and from 2020 Norway is doing the same. This is challenging for many in-service teachers, who lack adequate competence.

A project in Norway called super:bit organised by the regional science centres, Lær Kidsa Koding (LKK) and the Norwegian Broadcasting Corporation (NRK) is aiming to increase the programming competence among in-service teachers and pupils in 6^{th} grade. This research examines how participation to super:bit impacts the in-service teachers´ professional development in the field of programming. Super:bit has two main parts, a three hours teacher training part and a two hours pupil training part. Together, the two parts are intended to form a basis for further work with programming at the schools. Super:bit is designed to be a time-efficient and free offer for the in-service teachers at all primary schools in Norway.

To explore how participation to super:bit has impacted the teachers' professional development, a mixed methods research approach is used. Three different data sets are used to explore how participation to super:bit has impacted the four factors: teacher knowledge, attitudes, motivation and self-efficacy in the field of programming. A teacher survey collected by the science centres, containing both qualitative and quantitative data were analysed. Next observational data from the teacher training part and pupil training part were collected and analysed. Lastly, the researcher collected and analysed a questionnaire to further explore the findings already done and to better be able to answer the research questions.

The results indicate that the in-service teachers who have participated to super:bit experienced an increase in at least one of the four factors. This indicates that well designed short-term professional development programs can improve the in-service teachers' ability to teach programming seen in the light of teacher knowledge, attitudes, motivation and self-efficacy. It can also motivate the teachers to continue their professional development in the field of programming.

Sammendrag

Programmering er en ferdighet som nå er nødvendig i de fleste profesjoner. Mange land har allerede inkludert programmering som en del av læreplanene i grunnskolen, og fra 2020 gjør Norge det samme. Dette er en utfordrende situasjon for mange lærere, som mangler tilstrekkelig kompetanse.

Super:bit er et norsk prosjekt organisert av Vitensentrene, Lær Kidsa Koding og NRK som har som mål å øke programmeirngskompetansen blant lærere og elever i 6. klasse. Denne forskningen undersøker hvordan deltagelse i super:bit påvirker lærernes evne til å undervise i programmering. Super:bit består av to hoveddeler, et lærerekurs og et elevekurs. Sammen har de som mål å danne et grunnlag for videre arbeid med programmering i skolen. Super:bit er utformet for å være et tidsbesparende og gratis tilbud for alle barneskolelærerne i Norge.

For å forstå hvordan deltagelse i super:bit har påvirket lærernes profesjonelle utvikling har en kombinasjon av kvalitative og kvantitative metoder vært brukt (mixed methods research approach). Tre forskjellige datasett er brukt for å undersøke hvordan lærernes deltagelse i super:bit har påvirket de fire faktorene: kunnskap, holdninger, motivasjon og mestringstro til å undervise i programmering. En spørreundersøkelse utført av Vitensentrene som innheholdt både kvaliative og kvantitative data ble først analysert. Neste steg var å samle in observasjonsdata fra lærer- of elevkurs og analysere disse. Til slutt samlet forskeren inn og analyserte en spørreundersøkelse for å kunne undersøke interessante funn og for å kunne svare på forskningsspørsmålene på best mulig måte.

Resultatene indikerer at lærerne som har deltatt i super:bit har opplevd en økning i minst én av de nevnte fire faktorene ovenfor. Dette indikerer at godt utformede, kortsiktige utviklingskurs kan forbedre lærernes evne til å undervise programmering sett i lys av deres kunnskap, holdninger, motivasjon og mestringstro. Det kan også motivere lærerne til å fortsette den faglige utviklingen sin innen programmering.

Acknowledgements

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Trondheim, January 2021
Atle Vågen Svendsgaard

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Acronyms

ICT Information and Communication Technology. 10

NTNU Norwegian University of Science and Technology. 2

PD Professional Development. ix, xiii, 2, 3, 9–12, 15, 18, 19, 58, 85–89, 91, 93, 95

UDIR The Norwegian Directorate for Education and Training (Utdanningsdirektoratet). 21, 22

Chapter 1

Introduction

1.1 Motivation

In Norway about 8% of the jobs were lost due to automation from 2009-2014. If this trend continues 35% or more of the employment in Norway could be automated in a twenty year period. At the same time digitalisation is believed to be a big driver for new jobs [1]. The digitalisation of our society affects all kinds of job sectors. This will increase the already growing demand for people with digital competence. A basic understanding of programming is one of the skills required to posses this digital competence [2]. According to the EU more than 90% of professional occupations require digital competence [3].

Countries all around the world has already introduced programming in their curricula for compulsory education. This trend has been particularly strong in Europe [4]. In the recent years it seems like the Norwegian government has taken this into account. In 2016-2017 a pilot project with programming as an optional subject at some selected secondary schools was started [5]. From August 2020 the Norwegian school system will gradually implement a new curricula. The new curricula includes digital competence as one of the five basic skills in all subjects [6]. In the subjects arts & crafts, natural science, mathematics and music programming is explicitly mentioned. As an example one of the competence goals in mathematics in 5^{th} grade is to “program algorithms with the use of variables, conditional expressions and loops” (transelated by researcher) [7].

The introduction of programming in the new curricula can be challenging for many teachers, who suddenly have to teach programming. This has been seen in other countries [4], and can be illustrated by a report written three years after the introduction of programming in the United Kingdom, which showed that 48% of the teachers did not feel confident in teaching the new subject "computing". The report found that a common explanation from the teachers were "that they were lacking sufficient theoretical and technical knowledge of computing that included

aspects of programming and coding" [8].

A survey conducted on primary school teachers in Norway, showed that they are positive to the introduction of programming in primary school. Although the survey showed that many of the teachers miss relevant competence and are unsure how the introduction of programming will affect their teaching due to their limited competence [9]. Since programming is integrated as a part of existing subjects, the in-service teachers will have to see the coherence between their teaching subject(s) and programming. Kaufmann and Stenseth concluded in their study that to be able to integrate programming with mathematics "a teacher with satisfactory programming skills is required"[10].

As Norway is relatively late in introducing programming in compulsory education compared to other European countries[4], Norway has had the opportunity to learn from the experiences of other countries. However, it seems like Norway is facing the same problem as many other countries, with teachers who do not feel ready to include programming in their teaching[9], as the new curricula demands them to. A big ongoing project for supporting in-service teachers and pupils with the introduction of programming in Norway is called super:bit and this will be the case of study in this research.

1.2 Context

This research is done in the context of master thesis at the Norwegian University of Science and Technology (NTNU), Department of Computer Science. The thesis is written by a student at Natural Science with Teacher Education [11], under the supervision of Professor Monica Divitini. The research looks into how participation to the national project super:bit is impacting in-service teachers professional development (PD).

1.3 Problem and Research Questions

As explained, programming is now a part of the new curricula for the compulsory education in Norway, and programming is explicitly mentioned in the subjects arts & crafts, mathematics, music and natural science. Most of the in-service teachers in these subjects have no foundation for including programming in their teaching [9], and are now facing a great challenge.

There are many approaches for supporting in-service teachers, where continuing education in programming may be the most traditional one. However, when programming is introduced in four subjects there are a large amount of in-service

teachers who will need support. Continuing education in programming for all these in-service teachers will not be feasible due to several obvious reasons, like the capacity of the continuing education programs, time constraints among the in-service teachers, teacher motivation and school economy. As an alternative approach aiming to reach all the in-service teachers at 6^{th} grade, the national project super:bit has been created [12]. This is designed to be a time-efficient and free introduction to programming for teachers and pupils. In super:bit the popular pocket-sized programmable physical computing device "micro:bit" [13] is used. Micro:bit is designed to be engaging and interactive. It has gained a good reputation among pupils and teachers [14]. This research aims at exploring how participation to the super:bit project impacts the in-service teachers PD.

To explore this, the following research question was chosen:

> **Main research question:** *How has participation to super:bit impacted the teachers' professional development (PD)?*

There are several factors that could be considered when looking into how participation to super:bit has affected the in-service teachers PD. To explore the main research question the researcher chose four factors based on the second step in Desimone´s conceptual model for teacher PD [15] and used these factors to form four sub-questions. The conceptual model are further explained in Section 2.2.1 and can be seen in Figure 2.1.

In Desimone´s conceptual model teacher knowledge is a part of the second step [15]. Teacher knowledge is an essential factor for a teacher to be able to provide adequate teaching in a specific field [16]. What is interesting, but also challenging is that many in-service teachers have no experience in the field of programming, but are now required to teach it. Teacher knowledge consists of different kinds of knowledge and in this research teacher knowledge is divided into content and pedagogical knowledge. For further details see Section 2.2.2. The first sub-research questions is then:

> **RQ1.1:** How has participation to super:bit influenced the teachers' perceived knowledge?

In Desimone´s conceptual model teacher attitudes are a part of the second step [15]. With a positive change in attitudes teachers are able to provide better teaching [17]. For the teachers' willingness to change their teaching to include programming, their attitudes towards computing and programming is important [18]. For further details see Section 2.2.4. The second sub-research question is then:

> **RQ1.2:**How has participation to super:bit influenced the teachers' attitudes towards programming?

In Desimone´s conceptual model teacher motivation is a part of the second step [15]. Teacher motivation is crucial for the actual implementation of new reforms [19], such as the new curricula in Norway. In this research the focus is on the teachers' motivation to learn more about programming and their motivation to teach it. For further details see Section 2.2.4. The third sub-research questions is then:

> **RQ1.3:** How has the participation to super:bit influenced the teachers' motivation to learn more about and teach programming?

In Desimone´s conceptual model teacher beliefs are a part of the second step [15]. The term teacher beliefs is not used consistently in research [20]. Teacher self-efficacy is a part of teacher beliefs, and associated with aspects such as classroom quality, pupil outcomes and teacher outcomes. In recent years, there has been shown a growing interest in teacher self-efficacy [21]. Therefore, the researcher has chosen to focus on this specific aspect of teacher beliefs. Teacher self-efficacy can be defined as "individual teachers beliefs in their own ability to plan, organise, and carry out activities that are required to attain given educational goals" [22]. For further details see Section 2.2.3. The fourth sub-research questions is then:

> **RQ1.4:**How has participation to super:bit influenced the teachers' perceived self-efficacy towards teaching programming?

1.4 Research Method

To answer the research questions from the previous section, the researcher has used a mixed methods research approach, which uses a combination of a qualitative and a quantitative approach [23]. The researcher received a data set consisting of both qualitative and quantitative data collected by the science centres. This approach was chosen to try to draw from the strengths and minimise the weaknesses of qualitative and quantitative approaches [23]. At the same time it gave the researcher the opportunity to explore the full data set received, which was seen as useful since it contained relevant data from about all the teachers who had participated in super:bit until September 2020.

This research can be seen as a case study, as it "involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" [24]. In a case study, the case can for example be the situation, group or organisation of interest [24]. The case in this research will be primary school teachers who have participated in super:bit.

To enrich the data received from the science centres and to be better able to answer the research questions, the researcher has done a total of three interactive observations [25] and collected a questionnaire.

The observations were done early in the research process, and helped the researcher with the understanding of the case. To collect observational data was seen as a good supply to the two other data sets, which rely on self-reporting from the teachers. Carrying out the observations early in the research process gave the researcher the opportunity to take a closer look at interesting findings.

In the data received from the science centres the researcher presents the quantitative data, to describe the sample of teachers and show how they evaluate super:bit. In addition the data received contained textual comments from the teachers, which were structured and analysed using open and axial coding.

After the analysis of the teacher comments, some of the sub research questions still missed relevant data and the researcher created and distributed a questionnaire, which also gave the researcher the opportunity to look into some of the interesting findings done during the observations.

There was also planned to do interviews with some of the teachers, but due to trouble with recruitment and time constraint, this was not done.

1.5 Ethical concerns in research

It is important to give serious thoughts to the ethical aspects of a proposed research project at a very early stage. The researcher should think through the ethical aspects of a research project before he/she enters the research field [26]. Ethics in research is a process and should be reviewed throughout the whole research process and ethical concerns should be discussed with others [24].

The National Research Ethics Committee for social sciences, humanities, law and theology (NESH) has developed research guidelines for its discipline fields. Research most fundamental obligation is the ideal about pursuing the truth. At the same time research can never fully achieve this ideal. Most conclusions are temporarily and limited. In the context of humanities and social sciences interpretation are often a part of the research process and different academic and theoretical

approaches can open for various interpretations of the same material. Hence, it is important to reflect through and be aware that one's own values and attitudes can influence the choice of topics, data sources and interpretations. [27]. During this research the researcher has analysed and interpreted data. During the research process the researcher has tried to keep track of own values and attitudes. This approach can help the researcher to become more aware of its own assumptions, attitudes, prejudices, values and views towards the phenomena of interest [26].

Participants should be provided as much information as possible about the purpose of the research and the research activities [26]. Therefore, the researcher's co-supervisor did inform the participants about the observation and its purpose before the observation. In the researcher's questionnaire information about the research were given in the consent form at the top of the questionnaire. More about this will follow in the relevant chapters.

1.6 Results

The results indicate that the teachers who have participated to super:bit have had a positive experience. In terms of their professional development the results indicate that the in-service teachers experienced an increase in one or more of the four factors looked into, namely teacher knowledge, motivation, attitudes and self-efficacy after participation. This does not necessarily mean that the teachers felt ready for teaching programming after participation, as there were ambiguous results in this area. Of the four factors, teacher motivation seemed to be the factor where most teachers experienced an increase. 97% of the teachers who have participated to super:bit reported that they were motivated to start teaching programming with the use of the micro:bit, and over 90% of the teachers in the researchers' questionnaire reported that they were motivated to learn more about programming.

In total it seems like well designed short-term teacher professional development program such as super:bit can be an effective way to introduce a large number of in-service teachers to programming.

1.7 Outline

The thesis consists of eight chapters. In Chapter 2 an overview of definitions and relevant literature are presented. In Chapter 3 the case, which is primary school in-service teachers who have participated in super:bit is described more in detail. At the end of the chapter quantitative data received from the science centres are presented.

In Chapter 4 an analysis of the teacher comments gathered by the science centres are provided. The data, method and results are described. Chapter 5 presents the data, method and result of the three observations carried out by the researcher. Chapter 6 presents the data, method and results for the questionnaire created by the researcher.

In Chapter 7 results of the three previous chapters are discussed and seen in the light of teacher professional development, with the focus on teacher attitude, motivation, knowledge and self-efficacy. Chapter 8 provides answers to the research questions. Limitations of the research and recommendations for further work are also presented.

Chapter 2

Theory and Related work

2.1 Chapter overview

In this chapter the key concepts and literature used for the development, understanding and exploration of the research questions will be presented. This is followed by the early experiences in the United States with Logo programming and later experiences with programming in Sweden and Denmark.

2.2 Key concepts and definitions

The key concepts and literature used for the development, understanding and exploration of the research questions will be presented in this section.

Firstly, seven characteristics of effective teacher PD [28] are presented. These characteristics together with Desimones' conceptual model [15] were used for both the creation of the research questions and later on the exploration of them. Definitions and some literature on the importance of teacher knowledge, attitude, motivation and self-efficacy follows to support the sub-research questions. To be able to explore the usefulness of participation to super:bit, well known challenges faced by teachers who teach programming will be presented. To investigate if participation to super:bit impacts these challenges, and further on the teachers' knowledge, attitudes, motivation and self-efficacy the evaluation framework proposed by Decker, McGill and Settle [29] is described. This framework has inspired the preliminary steps of the research, the data collection and the way results are reported.

2.2.1 Teacher PD in the context of programming

In many countries, included Norway pupils are now starting to learn programming in primary school. Sophisticated forms of teaching are needed to develop programming and other ICT related pupil competencies. For the teachers to able to carry out such teaching they need the opportunity to increase their content knowledge and refine their pedagogical knowledge [30]. Teacher professional development (PD) is about "teachers learning, learning how to learn and transforming their knowledge into practice for the benefit of their students' growth" [31]. Teacher PD can take various forms, from formal structured courses or workshops to informal discussions with colleagues or self-study [31]. Research on teacher PD has showed that not all PD programs actually improve teachers' practices or pupil learning. At the same time it is clear that well-designed teacher PD programs can lead to positive changes in teacher practices and pupil outcomes [28]. The focus for this section will be on how to design effective teacher PD programs.

In the report "Effective Teacher Professional Development" the authors identifies seven prevalent elements in successful teacher PD programs [28]. The findings confirms the five elements from Desimone [15], and expands this framework.

Content focused learning is the first characteristic of effective teacher PD. This means that the teacher PD program is focused on the content that teachers teach, such as mathematics, programming or natural science. It is often job embedded, meaning that the teacher PD takes place in the teachers' classrooms together with their pupils. This opens for many new opportunities compared to classic external teacher PD programs. In content focused PD the teachers can try new curriculum together with their students, study the pupils work, a particular element of pedagogy or student learning in the content area. This type of PD is also good for addressing the diverse needs of pupils [28].

Active learning is the second characteristic of effective teacher PD. This often involves the use of artefacts, interactive activities and other types of activities that involves the teachers. This in contrast to traditional lectures. A form of active learning that is commonly used, is that teachers are taking part in the same learning activities as they are designing for their pupils. [28]

Collaboration learning is the third characteristic of effective teacher PD. Collaboration learning can be on many levels, from group work, school wide collaboration to external collaboration. The importance of collaboration should not come as a surprise, as this type of learning is widely used at schools all over the world [28].

Use of models and modelling of effective practice is the fourth characteristic of effective teacher PD. The use of models and modelling can be done i various ways such as demonstration lessons, observation of peers and video analysis. With the use of these kinds of models and modelling, teachers can develop a vision of practice

in which they can anchor their own learning and growth [28].

Coaching or expert support is the fifth characteristic of effective teacher PD. These coaches or experts are often educators themselves, but could also be content experts such as professors. Typically the expert will employ some of the PD strategies above, such as having a demonstration lesson about programming where active and collaborative learning is deployed. Experts can also be effectively used in the implementation of new curricula and tools [28].

Feedback and reflection is the sixth characteristic of effective teacher PD. Often these tools are employed during coaching or expert support. Feedback and reflection are two distinct practices, but together they can help teachers to move towards the expert vision of practice, that they may have learned or seen modeled during the teacher PD program. To get feedback and reflect on own practices the teachers need time to think about, receive input on and make changes to their practice [28].

Sustained duration is the seventh and last characteristic of effective teacher PD. Research has not identified a strict limit for the duration of effective PD models, but implicates that short single time workshops does not lead to PD that translates into change in practice [28].

Based on these characteristics and Desimones conceptual framework [15], Figure 2.1 evolved. This is a simplified model that shows the relationship between the most critical features of teacher effective PD.

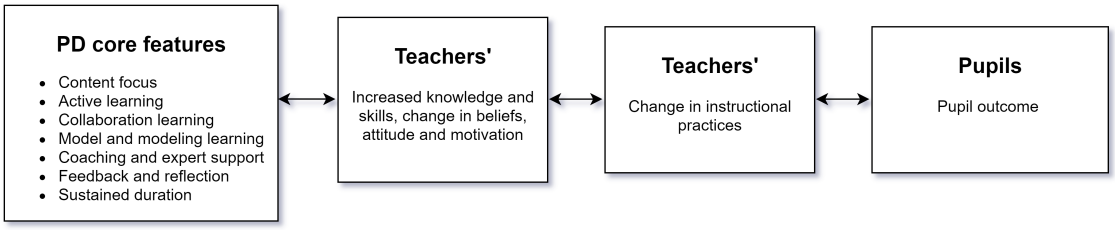

Figure 2.1: Conceptual framework for studying the effects of teacher PD based on Desimones' work [15], but adopted to the characteristic of effective teacher PD proposed by Darling-Hammond, Hyler and Gardner [28].

2.2.1.1 Primary school teachers PD in the context of programming

The literature review done by Mason and Rich [32] used Desimones conceptual model [15], similar to Figure 2.1 to evaluate in-service primary school teach-

ers participation to teacher PD programs in computer science. Nine studies were looked into and six of these involved programming. All the nine studies were following the recommendation about active learning. For the other characteristics of effective teacher PD, it varied which of them were included and not in the teacher PD programs. For the duration of the PD programs, two of them had a total duration of less than 20 hours. Despite the variations all nine studies showed teacher improvements in one or more of the the categories content knowledge, pedagogical knowledge or attitudes/beliefs/motivation. For the the evaluation of the next step in Desimones' model, only one of the studies looked into how the teachers' instructional practices changed. This one study showed positive results. None of the studies looked into the last step of the conceptual model, namely how the participation to the teacher PD programs affected the pupil outcome [32].

2.2.2 Teacher knowledge

Teaching is a complex activity and a talented teacher needs different kinds of knowledge. An expert programmer is not automatically good at teaching programming. In the same way a pedagogy expert who struggles with programming is likely to be a bad at teaching programming. Shulman is one of the pioneers in the field of teacher knowledge, and in the mid 1980s he introduced the idea about pedagogical content knowledge. This is a type of knowledge that occurs in the intersection of content knowledge and pedagogical knowledge. Pedagogical content knowledge "represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised, represented and adapted to the diverse interests and abilities of learners and presented for instruction" [33]. Content knowledge is knowledge in the specific subject that is to be taught and pedagogical knowledge is a generic form of knowledge that involves pupil learning, classroom management, planning and implementation of lessons and pupil evaluation. Based on Shulmans work Koehler and Mishra have developed a more complex framework for teacher knowledge that can be seen in Figure 2.2, which is widely used today. [34].

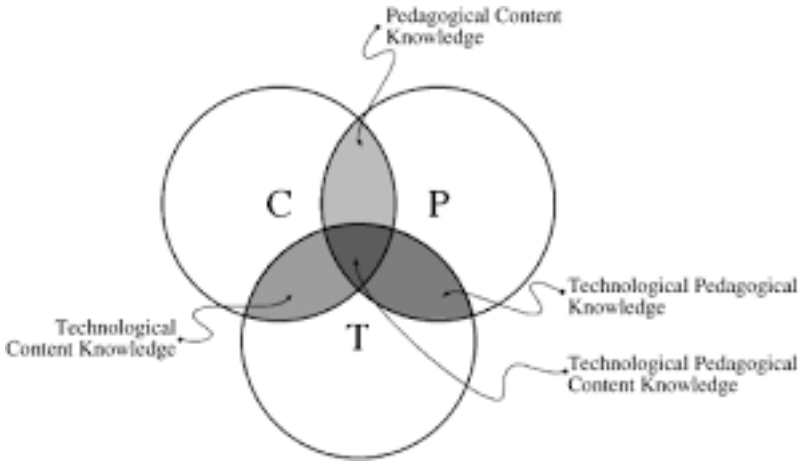

Figure 2.2: Framework for teacher knowledge proposed by Koehler and Mishra [34]

In the parts of this research that investigates teacher knowledge the model in Figure 2.2 is simplified. The researcher will divide teacher knowledge into two categories. Content knowledge will be the first category and this will be as defined in Figure 2.2 (the white part of "circle C"). This will refer to knowledge in the field of programming. Pedagogical knowledge is the second category and will throughout the research be the remaining parts of Figure 2.2 ("circle P" and "circle T"). This will include as the figures shows include many types of knowledge, but the focus throughout the research pedagogical knowledge will mainly be seen as what the teachers know about how to teach programming.

This simplification is done because looking into the seven types of knowledge in Figure 2.2 would require both time and resources way beyond the scope of this master thesis. It is also a difficult task to determine the boundaries for the different knowledges in such a complex model. The teachers in this research are mostly novices in teaching programming. This implies that many of them has limited content knowledge in the field of programming and hence it relevant to look into this aspect. For the pedagogical knowledge as defined by the researcher, the parts that intersect with the content knowledge circle would be the most relevant for this research, as super:bit is concentrated around the field of programming.

2.2.3 Teacher self-efficacy

In Albert Bandura's social cognitive theory, perceived self-efficacy refer to "people's beliefs about their capabilities to produce effects" [35]. Teacher self-efficacy can be seen as "individual teachers beliefs in their own ability to plan, organise, and carry out activities that are required to attain given educational goals" [22]. Since

the late 1970s research has shown a growing interest in teacher self-efficacy. It has been shown that teacher self-efficacy impacts several aspects such as classroom quality, student and teacher outcomes. A positive teacher self-efficacy is important in a high-quality classroom environment, where the teacher plan lessons to develop the pupils abilities, involve them in a meaningful way and effectively handle pupil misbehaviour. For the pupil outcomes a positive teacher self-efficacy has been linked to the pupils academic achievement, motivation and self-efficacy. For the teacher outcome a positive teacher self-efficacy is associated with lower levels of burnout and stress and higher levels of commitment and job satisfaction [21]. Self-efficacy is at least as important as possessing the skills themselves. It is shown that a person who lacks a certain skill, still can complete a task requiring that skill, if their self-efficacy towards that skill is high enough [36]. In theory this means that a teacher who lacks programming skills, still can be able to provide sufficient programming teaching, if the teacher has a high sense of self-efficacy towards teaching programming. In some cases there are a correlation between self-efficacy and teacher knowledge [37, 38]. Then an increase in teacher knowledge might be the way to increase the teacher self-efficacy. In other cases no correlation is found [39, 40].

2.2.4 Attitudes and motivation

Studies of primary school teachers attitudes towards science have indicated that teachers with less positive attitude share a number of characteristics. They have lower self-efficacy and confidence in teaching science and are less able to increase the attitude of their pupils. They also spend less time teaching and discussing science. With more positive attitudes, it is showed that the teachers provide higher quality teaching and are able to improve the pupils attitudes [17]. To be more specific to the field of programming, computer attitude can be defined as "a person's general evaluation or feeling of favourableness or unfavourableness toward computer technologies and specific computer-related activities" [41]. For teachers to successfully include programming in their teaching, there are multiple factors that should be considered. Along with teacher knowledge and beliefs, the teachers computer attitudes are one of the most important factors for technology adoption and hence programming [18].

Motivation are in the fields of psychology and education viewed as "energy or drive that moves people to do something by nature". However it seems to be no consensus in the understanding of teacher motivation [42]. Dörnyei and Ushioda [43] highlights the two dimensions of teacher motivation, namely the motivation to teach and the motivation to remain in the profession.

Teacher motivation is another important factor to consider during implementation of a new curricula that includes programming. Motivated teachers are more likely

to work for educational reforms and more importantly motivated teachers are the ones who guarantees for the actual implementation of the reforms. Teacher motivation is also important for the teachers themselves and the pupils. It is linked to both teacher satisfaction and pupil motivation. Despite the importance of teacher motivation, it is a common research finding that teachers show lower levels of motivation than other professional groups [19]. For teachers new to the field of programming, they need to be motivated to advance their PD. This research will focus on the teachers motivation to teach, but also their motivation to develop their knowledge in the field of programming.

2.2.5 Challenges faced when teaching programming

In order to support the teachers who will teach programming, we need to know what challenges these teachers are facing when teaching programming.

One of the main challenges that teachers faces are that their limited pedagogical and content knowledge makes it difficult to provide adequate teaching. Teachers also tend to find it hard to assess the pupils. Another big challenge is isolation and the solitude of working without peers in one's content area. Traditional content area teachers, such as Mathematics or Norwegian has support groups of teachers where teachers can discuss and help each other. Hence many teachers want to be a part of a community of practice, where they have the opportunity to share ideas about how to teach programming, practical examples and to develop collaborative relationships. Such a community of practice would also be an area for the teachers to develop their content and pedagogical knowledge. IT challenges, often old technology and the lack of resources for upgrades is also a challenge some teachers faces. Many teachers are finding it hard to asses the quality of online material and wishes for a more structured repository organised by level and topic. [30].

2.2.6 Evaluation of outreach computing activities

To evaluate computing outreach activities Decker, McGill and Settle [29] proposes some guidelines for preliminary steps, data to be collected and reporting to make studies more comparable and increase the quality of such research.

Before the data collection starts, the researcher(s) should define research questions to be studied and ensure approval from the local institutional review board for data collection and reporting. Variables outside the research that may effect the outcomes should be considered and reported in the research. Lastly it is important that the data to be collected provides answers to the research questions.

The data that is being collected should contain basic demographic information about the participants. Other unique characteristics of the participants that could influence the research, such as participation to previous similar activities or previous experience should be collected. If self-efficacy, attitudes or skills/knowledge is to be studied, reliable, validated survey instruments should be used when possible. The number of participants should be considered, and it should be 26 or more participants when statistical analysis is applied.

In the report the research questions and/or the purpose of the computing activity should be provided. For the collected data, the basic demographic information should be provided. Data counts and percentages should both be reported. The type of activity and the place it was held, including country should be described. The time frame for the activity and information on who ran it should be provided [29].

2.2.7 Micro:bit and bit:bot

Micro:bit is a popular pocket-sized programmable physical computing device developed by BBC [13, 14]. Figure 2.3 shows the front and the back of the micro:bit. It can be programmed using several programming environments, an example could be the web environment Microsoft MakeCode. The micro:bit is developed to be an educational tool for complete novices in the field of programming [14].

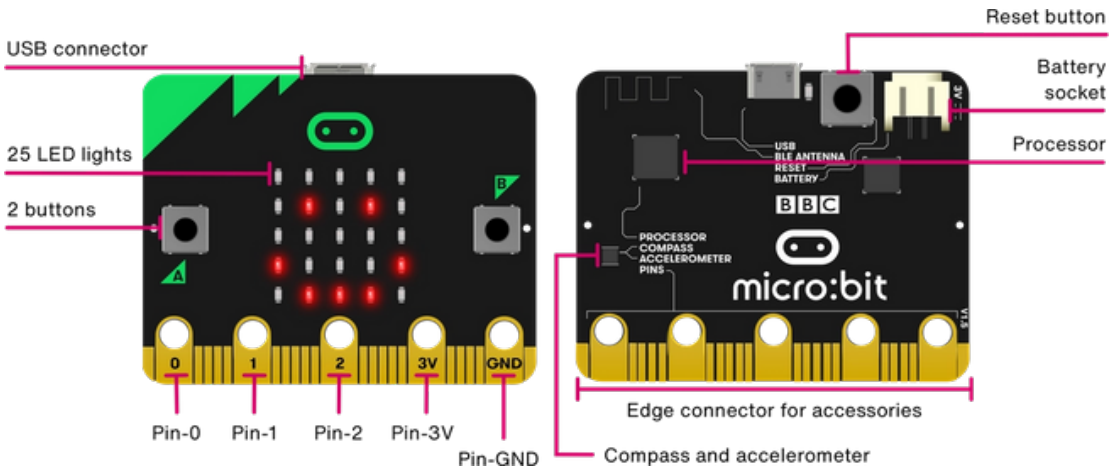

Figure 2.3: The original micro:bit [44].

The bit:bot is a robot car, which can be controlled with a micro:bit [45]. Figure 2.4 shows a bit:bot.

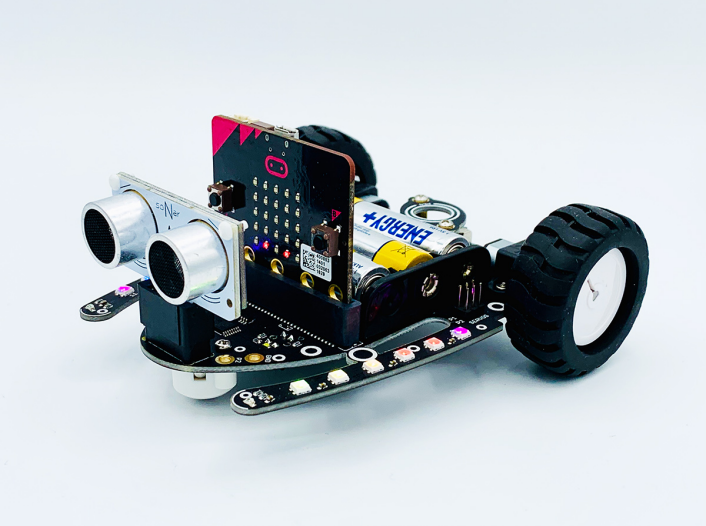

Figure 2.4: The bit:bot [45].

2.3 Lessons learnt from other countries

In the past, and especially in the last ten years many countries have included programming in their curricula for compulsory education [4]. This means that these countries could already have faced teacher challenges similar to the ones Norway are up against now. What can be learnt from these experiences? To look into this a brief summary of the early experiences with Logo programming in the United States and later ones in Sweden and Denmark will follow. The two latter countries are both geographical and cultural close to Norway and were chosen based on their similarities to Norway. While Logo is chosen as it was the first attempt to include programming in compulsory education, and thereby add some historical aspects.

2.3.1 Logo programming

The idea of learning about computational thinking through programming in early education is not new at all, and Seymour Papert started working with this in the 1960s [46]. In the 1966 Papert and his colleagues at Massachusetts Institute of Technology developed Logo, a programming language for children [47], designed to help the children learn mathematics. It was the first programming language that was specially designed to facilitate learning among children. Logo was developed for children, and it was possible to build robots using LEGO blocks and then use Logo to control the robots. It was developed special LEGO blocks like

gears, sensors and motors [47].

Papert claimed in 1988 that Logo was in use in more than one third of all the primary schools in the United States. Papert and his colleagues travelled around the country and tested the Logo programming language together with the LEGO integration on a dozen primary schools classes, mostly 3rd to 5th grade. Each class worked with Logo for about ten weeks, three hours a week [47].

Some of the education researchers were critical to the claims that working with Logo could enhance the children's problem solving skills. [46]. While Papert meant that some of the educational research on Logo was too suspended with measuring specific cognitive effects. For Papert working with Logo was more than learning pupils to program, he saw Logo as "a cultural building material". [48].

2.3.1.1 Teachers and Logo

To prepare the teachers to use Logo, there was different teacher PD initiatives, such as extensive two-week teacher trainings during the summer and workshops during the school year [49]. Most of the teachers who used Logo, had several after-school workshops or a single computer literacy course as their computer background [50].

Researchers did not agree on how Logo affected children's learning. In 1982 Cynthia Solomon observed a class with children aged from 11 to 12 years old working with Logo. At the same time the researchers Roy Pea and Midian Kurland were conducting their studies about the use of Logo in the same class. The two teachers that were responsible for teaching the children how to program in Logo, had just attended a three week long Logo workshop. One problem during the teaching was that the teachers and the pupils used different versions of Logo on different types of computers. The instruction handout from the teachers also contained several bugs. Roy Pea and Midian Kurland reported disappointing results, not surprising to Solomon who observed the failed session. Other studies done when Logo researchers were responsible for the teaching have showed positive results. These examples shows that the teacher have an important role and could be the difference between success and fail when introducing programming in schools. As Solomon writes, "if there are to be consistent positive outcomes in educational settings, significant investment in teacher preparation is sure to be crucial. The central importance of teacher preparation remains a crucial lesson today, as schools attempt to bring computer science into the classroom." [46].

2.3.2 Sweden

In 2012 a Swedish report highlighted the need for more focus towards digital competence. Programming as a part of primary and secondary education was especially mentioned. During the spring 2017 a new curricula for primary schools were developed and it had to be implemented from autumn 2018 at latest. Programming is mainly introduced as a part of the subject mathematics. At the time of the introduction of the new curricula the need for in-service teacher PD were huge [51]. One year after the the introduction of the new curriculum few teachers had received adequate training. As of this there is a risk that programming is being taught by teacher who lack relevant content knowledge [52].

2.3.2.1 Teacher PD in Sweden

The main approaches for teacher PD in Sweden were a local workshop, internet resources, the Hour of Code initiative, previous teaching experience, new school books and the local mathematics teacher networks. On of the biggest initiatives for teacher PD in Sweden were the National Agency for Education creation of a MOOC (Massive Open Online Course) in basic programming. This intention was that this should communicate the National Agency for Education vision of programming as a part of the mathematics curriculum. However none of the four teachers interviewed by Stigberg and Stigberg mentioned the MOOC [52].

2.3.3 Denmark - Ultra:bit

The Danish Broadcasting Corporation (DR) launched a project called ultra:bit during the summer of 2018. The project was planned for three years and developed together with The Teachers Resource Centre (CFU). The project aimed at inspiring children to develop digital competencies, strengthen the teachers' views of the relevance of technology in teaching and to increase the teachers programming competence. Ultra:bit consist of several children TV-programs on DR, online teaching material, a micro:bit to each children in 4^{th} grade and different teacher training's [53]. Since the launch ultra:bit has experienced an overwhelming commitment, and it was decided to expand to project for three more years until 2023 [54].

2.3.3.1 Teacher PD in Ultra:bit

More than 4000 teachers have participated in teacher training's (ultra:bit introduction course) carried out by the The Teachers Resource Centre (CFU) [54]. The

teacher training is free and have been held out at the primary schools. The teacher training has a duration of three hours and is organised as a hands-on work shop with a lot of practical work. The training introduces micro:bit and how to use it in teaching. The training also focuses on technology understanding and creativity. The training has a preparatory work to be done before participation, which has a duration for about one hour. If a school signs up for ultra:bit, it is obliged to have around 30 participants to the teacher training, which could be arranged together with other schools nearby. Exceptions can be made for small schools in outlying areas. The schools are given a date where they are required to participate. The head of the school should expect and encourage teachers to work with ultra:bit and technology understanding during the current school year. In the next years the head of the school should expect and encourage teachers to work with ultra:bit and technology understanding in ether mathematics, nature technology, arts craft, danish or supportive teaching [55].

In November 2018 there was done an effect survey among the teachers who have participated in ultra:bit. 90% of them thought it was easier to program after the work with ultra:bit. 85% of the teachers felt that they were ready for teaching how to use technology and programming for creative solutions. 61% of the teachers were inspired to develop their own teaching plans and activities with the micro:bit. 96% of the teachers reported that the pupils wanted to learn more about programming and technology. 83% of the teachers had started using the micro:bits, while most of the remaining teachers planned to do so [53].

Chapter 3

Case: Super:bit

3.1 Chapter overview

This chapter purpose is to describe the super:bit initiative with focus on the part carried out by the science centres. First the organisation and purpose of the super:bit initiative is described. A more detailed description of the different parts in super:bit and its resources will be presented. Towards the end of this chapter, quantitative data received from the science centres describing the teacher sample and their evaluation of the pupil and teacher training part are presented.

3.2 The purpose and organisation of super:bit

Ten of the science centres[1] have teamed up with NRK (Norsk Rikskringkasting AS) and LKK (Lær Kids Koding) and created an project called super:bit [57]. Super:bit is a part of "den teknologiske skolesekken" (meaning "the technological schoolbag") which is a part of the Norwegian government digitalisation strategy for primary and lower secondary education. The science centre organisation [2] has been commissioned from UDIR to coordinate the efforts of the ten science centres. Through "den teknologiske skolesekken" the science centre organisation will receive 50 millions NOK in a five year period to work with the teaching part of super:bit [58, 59]. The teaching part of super:bit is the part of super:bit that is developed by the regional science centres for the schools [59].

The teaching part of super:bit is the focus for this research and it consists of five

[1] There are 12 regional science centres in Norway [56]

[2] The science centre organisation is working as an organ for collaboration between the science centres [56].

parts. These parts are in this research referred to as the teacher training part, the preparatory work, the pupil training part, the complementary work and the bonus work, as seen in Appendix A. The science centres is responsible for the teacher and pupil training part, while the teachers are in charge of the preparatory work, complementary work and bonus work. In addition to these parts, the initiative includes a free programming toolkit for schools who attend[60], online resources and follow-up from the regional science centre or the science centre organisation [61]. Since super:bit is a national initiative, the intention is that the initiative and the different parts of super:bit should be similar all over the country. Super:bit is a free offer for all the around 2400 primary schools in Norway [12].

3.2.1 Purpose of the super:bit initiative

With the focus on the teachers, there are slightly different descriptions for the aims of super:bit. According to the science centre organisation, the aim for the super:bit initiative is "to give the teachers insight, ability and desire to teach programming". While the purpose of the ready-made teaching plan consisting of the preparatory work, the super:bit mission, the complementary work and the bonus work (described in the next sections) is to "support teachers such that they are able carry out the activities to their pupils" [59].

UDIRs objective for their subsidies are to increase the teachers' programming competence [58].

On super:bits webpage, UDIRs aim of increased competence is described. In addition to that, the aim of the ready-made teaching plan is "that the teachers should be able to use it on their own the next year, after the regional science centres are in charge of the first implementation" [57].

3.2.2 Organisation of the super:bit initiative

Super:bit is organised as seen in Figure 3.1. A more detailed explanation of the different parts in the Figure will follow in the next sections.

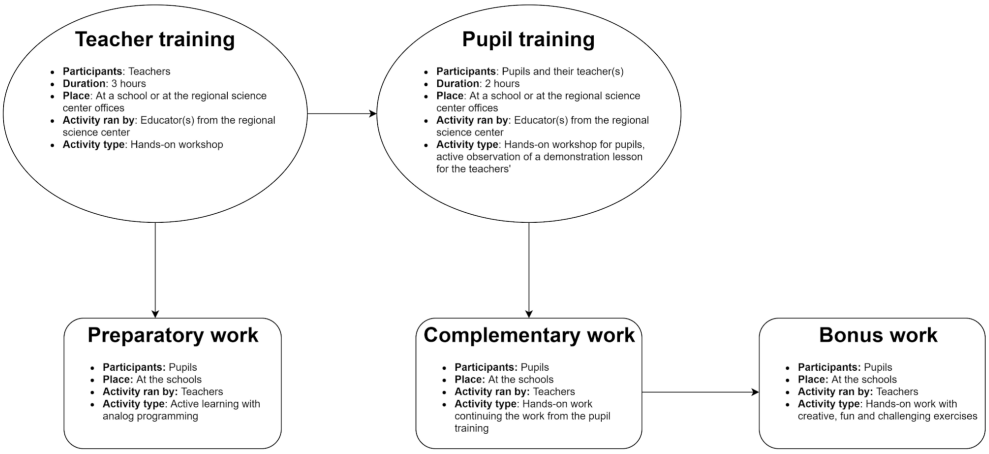

Figure 3.1: The super:bit model, Figure created by the researcher

In super:bit there are a total of 15 exercises [62–65], which is associated with the different parts of super:bit. Presenting all 15 exercises would have needed 15 pages, but the researcher found it useful to short present two of the exercises before describing the different parts. This are exercises that both the teachers and the pupils are working on during the teacher training part and the pupil training part. The two exercises are:

3. Make the bit:bot drive one meter forward, turn and drive back to the starting point [63].
4. Make the bit:bot follow one of the trails marked at the smart-city mat seen in Appendix B [63].

The descriptions of the different parts are based on the PowerPoint in Appendix A, info received from co-supervisor Ole Kleiven, along with the references.

3.2.2.1 Teacher training part

The teacher training part is held either at the science centre offices or out at a school. An educationalist from the science centre is responsible the training, and teachers from schools in the same area are attending. The duration of the teacher training part is three hours, and attending schools should try to have at least two teachers at the training [66].

The teacher training starts with a short introduction on why pupils should learn about programming at school, how it is implemented in the new curricula, information about the toolkit and some about basic programming concepts. In the main part the teachers work in pairs to solve exercises with micro:bit and bit:bot,

where the latter is a robot car that can be programmed using the micro:bit. The exercises [1] are exactly the same as the ones the pupils will work with later on, during the pupil training part. Exercises 3 and 4 described in Section 3.2.2 are the "main" exercises and are referred to as the super:bit mission. This is where the teachers use most of their time. If some of the pairs finishes both exercise 3 and 4, they can go on and choose exercises from the complementary work [2].

3.2.2.2 Preparatory work

The preparatory work consists of three exercises [3] and explanation of important terms. The teachers are encouraged to go through this material with their pupils before the pupil training part. All the exercises are different forms of unplugged computing activities and hence no computers are needed to do the preparatory work. After each exercises the teachers are given a suggestions how to relate the exercise to algorithms, programming and computers. The aim of the preparatory work is to introduce the pupils to the concept of algorithms before the pupil training part [67].

3.2.2.3 Pupil training part

After the teacher training part and the preparatory work, an educationalist will have a pupil training with the 6^{th} grade at all the schools represented at the teacher training part [61]. It is the intention that teachers who have been through the teacher training part should be at the pupil training and take a active part in the work together with the pupils. The pupil training is held at either the science centre offices or out at the different schools. It has a duration of 2 hours. The responsible science centre provides computers or iPads.

The first part is a short intro to programming, micro:bit and bit:bot. In the main part the pupils work with the exact same exercises [4] as the teacher did during their teacher training. If some of the pairs finishes the exercises they will can on with the one of the exercises from the complementary work.

[1] The exercises for the teacher and pupil training part can be found at `https://www.vitensenter.no/media/1728/laerer_superbitoppdrag_bm.pdf`

[2] The exercises for the complementary work can be found at `https://www.vitensenter.no/superbit/laerer/etterarbeid/`

[3] The exercises for the preparatory work can be found at `https://www.vitensenter.no/media/1294/forarbeidet-superbit-alle-oppgaver.pdf`

[4] The exercises for the teacher and pupil training part can be found at `https://www.vitensenter.no/media/1728/laerer_superbitoppdrag_bm.pdf`

3.2.2.4 Complementary work

The complementary work consists of multiple exercises that the teachers are recommended to do together with their class shortly after the pupil training part. The exercises are of different degree of difficulty and the pupils should choose which exercises to work on themselves. It is recommended that everyone does at least two of the exercises [64].

3.2.2.5 Bonus work

The bonus work consists of a video with exercises and explanations on how to program a drawing robot using the micro:bit and the bit:bot. It also provides a link to a Facebook group [68], where the teachers can ask questions or share their experiences [65]. More exercises that explores the programming toolkit and are relevant in different subjects [65] will be posted gradually, according to the science centres webpage [69].

3.2.3 Super:bit resources

The super:bit initiative includes some free resources for the participating schools. The different resources will be describe in the next sections.

3.2.3.1 Programming toolkit

Each school who participates to super:bit will receive a programming toolkit for free. This includes (by September 2020), as seen in Appendix A:

- 20 micro:bits with battery packs and USB cables
- 10 bit:bots
- 10 ultrasound sensor to the bit:bot (missing in Appendix A)
- 10 servos
- 5 buzzers
- 30 white LED lights (5mm)
- 200 LED lights (10mm) in 5 different colours (40 in each colour)
- 3 smart city mats (missing in Appendix A)
- 1 LED strip
- 5 rolls with black tape
- 80 alligator clips

This will give all the schools an equal starting point, independent of their economical situation.

3.2.3.2 Online resources

The online resources for super:bit can be found at `https://www.vitensenter.no/superbit/`. It has one part for pupils and one for teacher guidance. The webpage contains information about the initiative, the different parts of the initiative, information about the toolkit and some tips & tricks.

3.2.3.3 Follow-up

After a school has been through both training's, they can contact the responsible science centre or the science centre organisation with any kind of requests [61]. On super:bits webpage [69] there is a link who states "forum for super:bit teachers". This link takes the user to the open Facebook group "super:bit lærerforum", which means "super:bit teacher forum". By the 16^{th} of December the group has 688 members. The group description states "A group for everything that has to do with super: bit in school. Here, there will be a high tolerance for various content and the opportunity to ask all kinds of questions, share projects and get inspiration to use the super:bit toolkit in the classroom" [68].

3.3 Quantitative data from the science centres

The science centres have together designed three questionnaires, two for the teachers and one for the pupils. At the end of both the teacher and pupil training part the participants are asked to answer a questionnaire. The questionnaires contained mandatory closed-ended questions and optional open-ended questions.

The researcher have received the data gathered from all the science centres in the period from the start of the pupil and teacher training part in 2019 and until September 2020. The data is depersonalised. In this section the researcher will present the quantitative data from the closed-ended questions. This is done to describe the sample of the case and show how the teachers evaluate their participation to super:bit. The figures presented in this chapter are translated from Norwegian to English by the researcher. All the figures have the question number and question at the top, and reports the count before a semicolon and then the percentage of teachers that choose the given alternative, as recommended by Decker, McGill and Settle [29]

In Chapter 6 the open-ended questions will be analysed by the researcher.

3.3.1 Teacher training part

In this section the teachers' answers to the questionnaire for the teacher training part will be presented. 1027 teachers have participated in the questionnaire. The results considered as most relevant for the research questions will be presented with translated versions of the figures in Appendix C. The rest of the results are described with text. In Appendix C the complete results can be seen.

Based on Appendix C the sample of teachers for the teacher training part will be described. 62.51% of the participants are female teachers, 36.90% are male teachers and the rest did not wish to answer. Given the gender gap in the field of programming [70], it is interesting to note that most of the teachers in super:bit are females. Most teachers are between 25 and 55 years old. The most taught subject is mathematics, which is taught by 73.15% of the teachers, followed by Norwegian and Natural Science. The least taught subject is music. This can be due to the fact that music is the subject with the lowest number of teaching hours of all subjects in primary school [71]. At the same time music is one of the subjects where programming are introduced in the new curricula, and one of the learning objectives after 7^{th} grade are to "use technology and digital tools til create, practice and process music" [72].

The teachers were also asked if they felt ready for having the preparatory work with their pupils. 76.53% of the teachers felt ready to a great or very great extent. 15.77% felt somewhat ready and 7.7% of the teachers felt ready to a little or very little extent.

Figure 3.2 shows the teachers' previous experience with teaching programming. 50.83% have no previous experience with teaching programming, while 46.25% have some experience. 2.92% of the teachers are experienced in teaching programming. Even the new curricula got introduced after the first year of super:bit, almost half of the teachers state that they have some experience with programming.

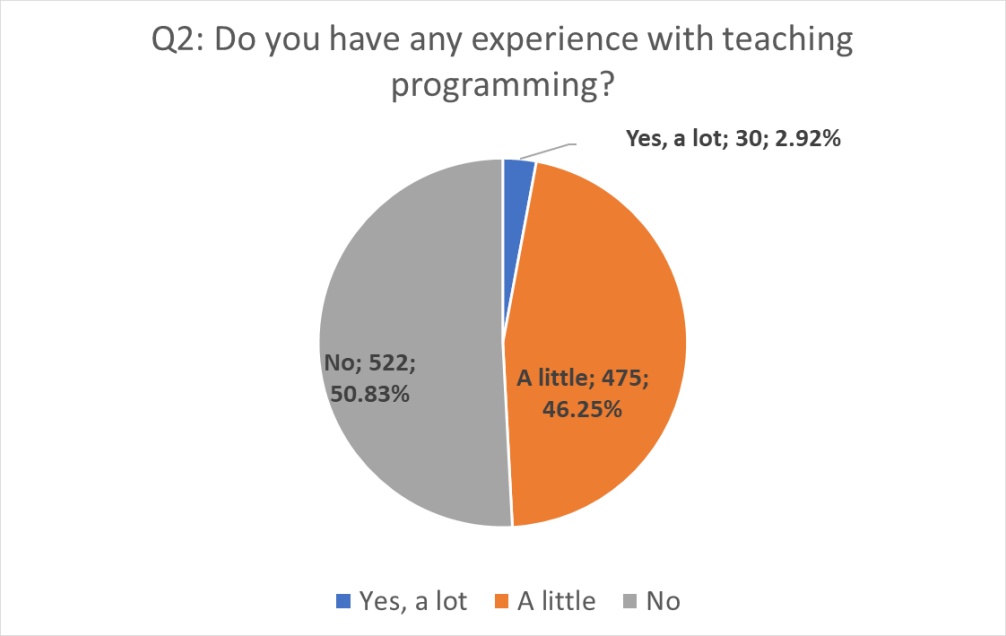

Figure 3.2: The teachers previous experience with teaching programming, translated from "SP2" in Appendix C.

Figure 3.3 shows the teachers' previous experience micro:bit. 75.46% of the teacher has no experience with micro:bit, while 22.89% have some experience and 1.56% of the teachers are experienced with micro:bit. This means that the teacher training part will be a first introduction to micro:bit for most of the teachers.

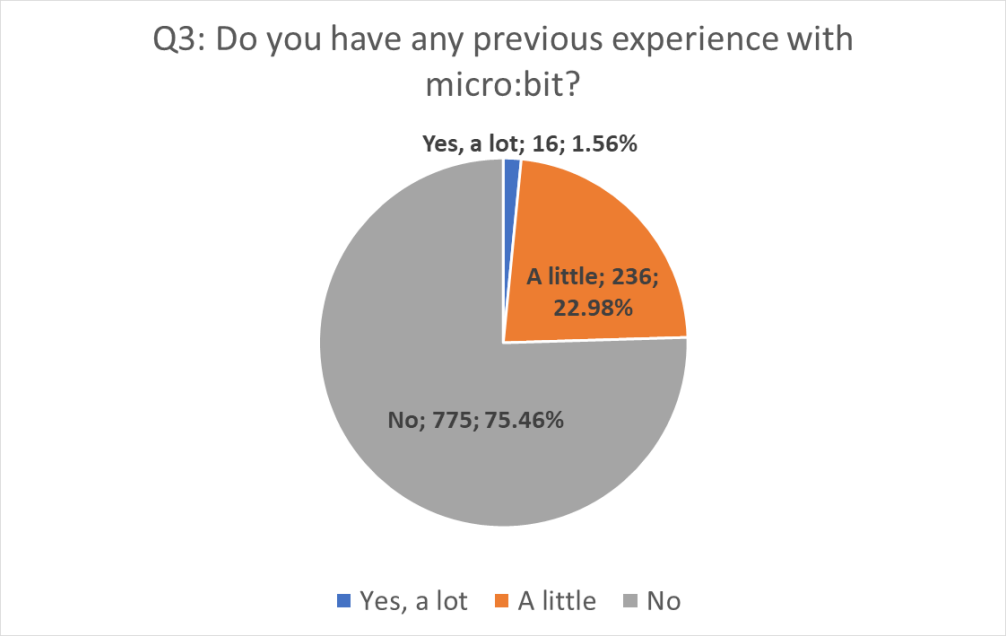

Figure 3.3: The teachers previous experience with micro:bit, translated from "SP3" in Appendix C.

In Figure 3.4 the teachers are asked to evaluate their overall experience of participation to the teacher training, the professional content of the training, the lecturer and the information received before participation. The overall evaluation, professional content and the lecturer were all rated by over 97% of the teachers to be excellent or good. The information received before participation is more evenly rated, and just above 34% rated the information received to be fair, poor or very poor. In total it seems like most teachers are very happy with the teacher training, even the information received before the training could have been better.

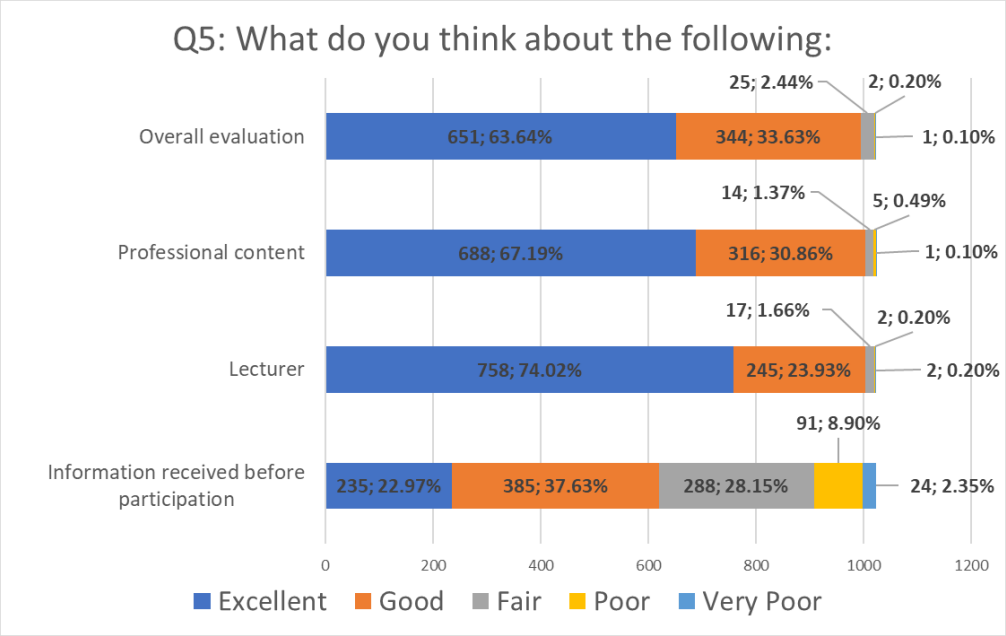

Figure 3.4: The teachers valuation of overall experience, professional content, lecturer and information received before participation, translated from "SP5" in Appendix C.

3.3.2 Pupil training part

In this section the teachers answers to the questionnaire for the pupil training part will be presented. 833 teachers participated in the questionnaire. The results seen as most relevant for the research questions will be presented with translated versions of the figures in Appendix D. The rest of the results are described with text. In appendix D the complete results can be seen.

Based on Appendix D the sample of teachers for the teacher training part will be described. 63.51% of the teachers are females, 36.37% are males and the rest did not wish to answer. 68.39% of the teachers teach mathematics which is the most taught subject, followed by Norwegian and Natural Science. Music is the least taught subject. These results are similar to the ones for the teacher training part. Most teachers are between 25 and and 55 years old. 6.60% of the teachers are between 22 and 25 years old, which is almost a doubling from the teacher training part.

72.39% of the teachers had attended the teacher training part before they attended the pupil training part, meaning 27.61% did not attend the teacher training part. The intention from the science centres were that the teachers should have done the preparatory work with their pupils before attending the pupil training

[67]. For the ones who had done it, just above 93% reported that the preparatory work was good or excellent, while few reported fair, poor and very poor. 11.40% reported that they had not done the preparatory work with their pupils. All of the 833 teachers except one thought that the pupil training part would contribute to increased programming interest among the pupils.

In figure 3.5 the teachers were asked to what extent they thought the pupils had a positive learning experience during the pupil training. Over 99% of the teachers thought that the pupils had a very good or good learning experience.

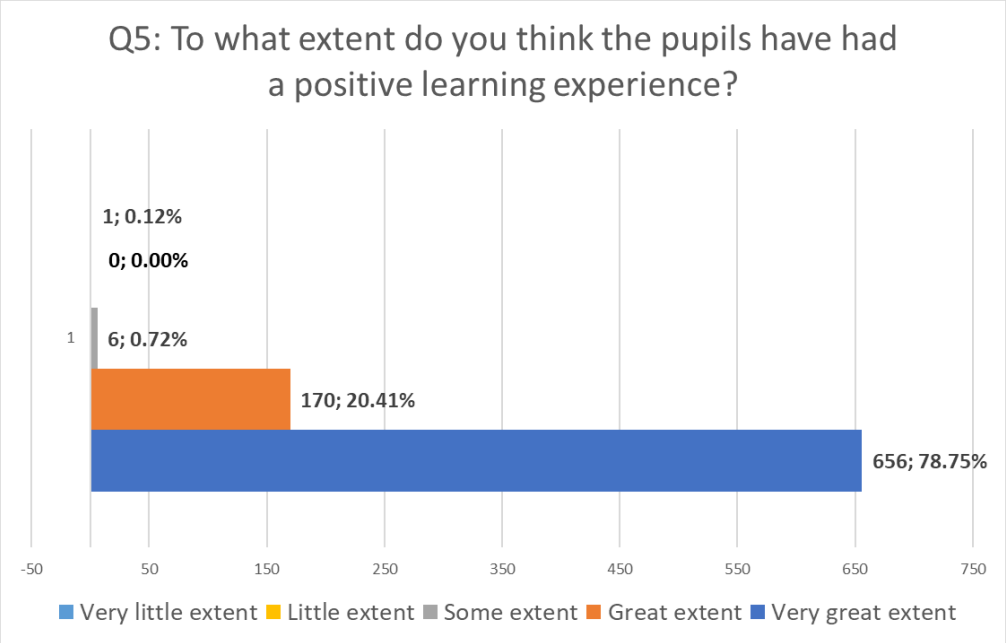

Figure 3.5: The teachers perception of the pupils learning experience, translated from "SP5" in Appendix D.

Figure 3.6 shows the teachers' overall evaluation of the pupil training part, the professional content and the lecturer. Around 98% of the teachers reported all the parts as excellent or good, where all three parts have been rated to excellent by over 80%. This shows that almost all the teachers were happy with the pupil training part.

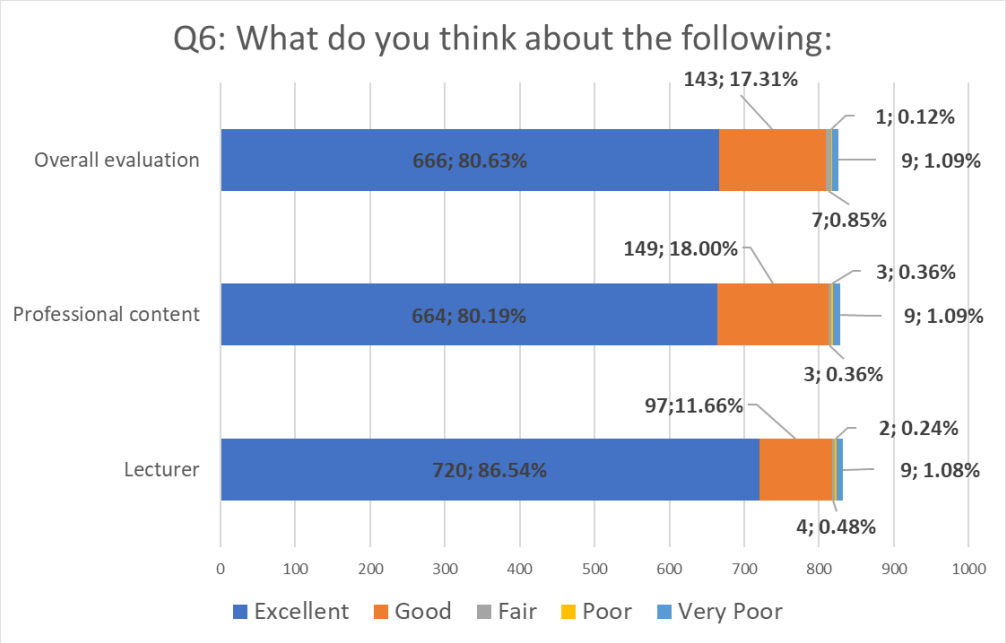

Figure 3.6: The teachers valuation of overall experience and the lecturer, translated from "SP6" in Appendix D.

Figure 3.7 shows the teachers' motivation to start using the programming toolkit. Over 97% of the teachers report that they are motivated or very motivated to start using the toolkit.

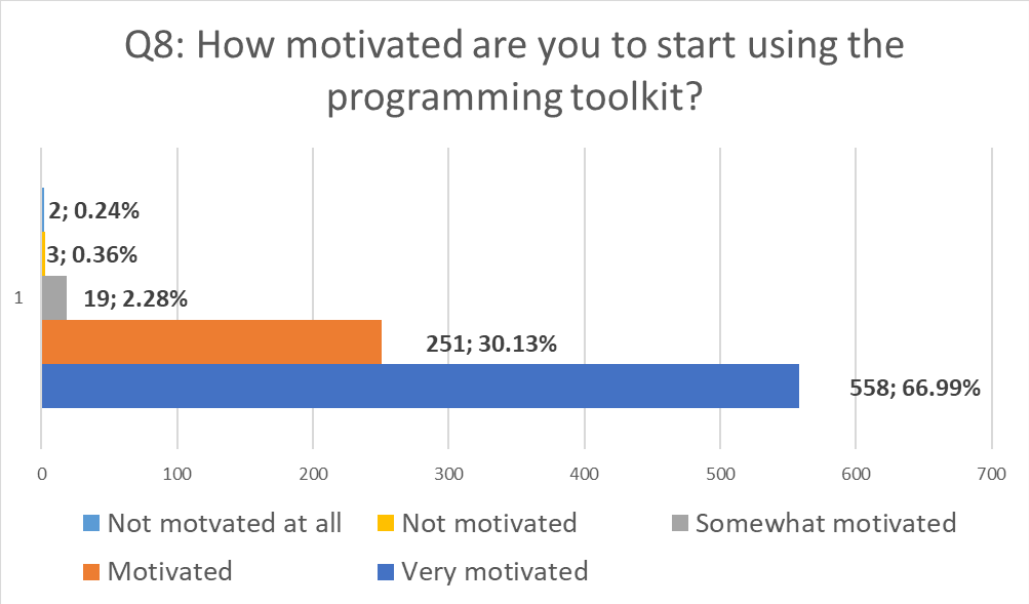

Figure 3.7: The teachers motivation to start using the programming toolkit they have/will receive, translated from "SP8" in Appendix D.

3.3.3 Summary of the questionnaires

The results shows that above 60% of the teachers are women. The most taught subject among the teachers are mathematics. Very few teachers are very experienced in teaching programming, while about 50% have no teaching experience. Most of the teachers are new to micro:bit. The teachers are positive to the learning outcome the pupils had during the pupil training and thinks the initiative will lead to increased programming interest among the pupils. The vast majority of the participants are positive in their descriptions of the initiative and report that they are looking forward to start using the programming toolkit.

Chapter 4

Study of the Questionnaires conducted by the Science Centres

4.1 Chapter overview

This chapter presents the study of the open-ended questions in the two questionnaires collected by the the science centres. The data will first be presented, followed by a description of the research process. Lastly. the results of the analysis will be presented followed by a summary of the results.

4.2 Data: Teacher questionnaires

The data used in this chapter consists of two questionnaires that the science centres have collected. The first questionnaire is answered by teachers after participation to the teacher training part. The second is answered by teachers after the pupil training part. The questionnaires were not mandatory, but at the end of each session the teachers were encouraged to answer and given some time to do so. The data is gathered from the start of the super:bit project in 2019 and until September 2020, this means that the data was gathered before the observational study in chapter 5 was conducted. The data was depersonalised when the researcher received it. Hence it was not possible to see all connections in the data, e.g. connect comments from the teacher training part to the pupil training part or connect teacher comments to answers of the multiple choice questions. This fact limits the analysis.

Relevant excerpt presented in this chapter were translated to English by the researcher, as the questionnaires were conducted in Norwegian.

The questionnaires consists of mandatory multiple choice questions and optional open-ended questions. In this chapter the focus has been the open-ended questions. Both questionnaires has the same open-ended questions:

1. Feel free to elaborate on what was good and/or what could have been done better
2. Do you have any additional comments?

A total of 1027 teachers have answered the questionnaire from the teacher training part and the open-minded questions received a total of 507 answers. The length of the answers varied from one word to 84 words.

A total of 833 have answered the questionnaire from the pupil training part and the open-minded questions received a total of 506 answers. The length varied from one word to 83 words.

Since the data is depersonalised it is not clear exactly how many different teachers that have answered the open-minded questions. The same teacher can have answered zero, one or two of the open-ended questions. Most of the teachers have participated to both trainings, but some participated to only one of them. The questions allows for a variety of answers which made the data unstructured and sometimes hard to understand and analyse. The questionnaires contained general answers like "Good!", answers who did not provide any information like "No" and longer more detailed answers.

4.3 Method

4.3.1 Data collection

The researcher received the data from Ola Kleiven, who works as a project leader for the super:bit initiative at the science centre in Trondheim. Since the data was depersonalised it could all be sent to the researcher.

4.3.2 Analysis

As described the data is various in length and specificity. The analysis focuses on the teachers' views of participation to super:bit. The analysis is done using a qualitative approach. To make the data more manageable it is structured through coding. The coding process was inspired by the principles of data analysis in grounded theory [26]. This research did not aim to develop a theory like a grounded the-

ory approach normally do, yet some of the coding principles were seen as useful. NVivo 12 [73] is used as the analysis tool. The coding was firstly done for the teacher training part, and then for the pupil training part. All the coding was first done in the native language of the researcher (Norwegian), to have it as correct as possible. In the presentation of the data relevant excerpt is translated to English by the researcher.

During the coding process the researcher always tried to have the "questions to consider while coding" recommended in Saldanas coding manual in mind. This means to try to track the assumptions, personality, attitude and belief system of the researcher at all times [74]. Such an approach do not remove the researcher's subjective individual theories, but is meant as a method to help the researcher to become aware of his prejudices, views and assumptions around the phenomena that is being studied. This could help the researcher to see the phenomena with an open mind [26].

4.3.2.1 Open coding

The researcher read carefully through all the material to get an overview of and reflect on the data, before the open coding process. Open coding is the process of dividing the data intro discrete parts, and closely compare them for similarities and differences [74]. The goal for the open coding is to "remain open to all possible theoretical directions indicated by the readings of the data" [75]. There are different ways to do the open coding. In this study of the questionnaires, a mix of line-by-line and in vivo coding was chosen. In line-by-line coding each line is given a code. In vivo coding means that the codes are kept close to the data, usually represented with a "word or a short phrase from the actual language found in the qualitative data record" [74]. This was seen as helpful to get the analysis as reliable as possible. The in vivo coding was found appropriate to keep the teachers views without too much interpretation from the researcher, as this was the focus of this study. The form of the data was seen as appropriate for line-by-line coding, as most of the answers were one line comments and about a specific theme. As not all answers were on the same form there was done some adaptions where the researcher found it appropriate.

The process of assembling groups of concepts that appear to cover the same phenomena is called categorisation [26]. Already at the first perusal of the data the researcher started to get an impression of the different categories the data could be divided into. After the open coding, each code was given a category until there were no codes left. Next categories were merged together and given new names. At the end there were four categories left. Some few codes that did not fit any of the categories and were seen as non-relevant or unintelligible by the researcher were placed in an "other" category which later on in the process got deleted along

with its codes. The process of creating categories were done in an iterative manner and both the categories and the codes changed during the different coding steps. The final categories did not emerge at this stage, but they will be presented later on in Section 4.4.

4.3.2.2 Axial coding

Axial coding is the process of relating categories to subcategories, such that the explanations of the phenomenon gets more precise and complete [26]. In this way the data gets structured and reassembled after the splitting of the data in the open coding [75]. During the axial coding the researcher started with one of the categories and created subcategories for all the codes belonging to that category, until all codes had a subcategory. Next subcategories were merged if possible and given new names. This process was performed repeatedly until there were no subcategories that it was reasonable to merge left. The creation of subcategories were done first on the data from the teacher training part and then on the data from the pupil training part. It appeared many similarities between the categories and subcategories for the two trainings, but also some differences.

4.4 Results

4.4.1 Teacher training part

After the open and axial coding the categories shown in Table 4.1 below emerged.

Table 4.1: Categories and their descriptions for the teacher training part.

Category	**Description**
Experience of participation to the teacher training part	Teacher comments related to their experience of participation to the teacher training part. This includes comments on the educators, time use, content, structure, communication before participation and general feedback.
Learning and self-efficacy	Teacher comments related to how participation to super:bit have impacted their knowledge or self-efficacy.
Attitudes and motivation towards programming	Teacher comments related to their attitudes and motivation towards programming in general or programming as a part of the new curricula.
The super:bit model	Teacher comments related to the super:bit model structure, seen in Figure 3.1. The exercises are also considered as a part of the model.

The subcategories that emerged during the axial coding is seen below in Table 4.2. The teachers' comments on some topics were only positive, hence subcategories like "Positive attitude/motivation towards programming". In categories like "Organisation of super:bit" the teacher comments were both positive and negative. None of the subcategories had only negative feedback.

Table 4.2: Categories and their subcategories for the teacher training part.

Category	**Subcategories**
Experience of participation to the teacher training part	Communication before participation
	Content
	Educationalist
	Overall positive feedback
	Structure
Learning and self-efficacy	Learning outcome
	Self-efficacy
Attitudes and motivation towards programming	Attitudes towards programming
	Increased motivation
	Motivated for the continuation
	Motivated to learn
The super:bit model	Community creation
	Exercises
	The different parts and resources of super:bit

In Table 4.3 the results are presented as a codebook. The codebook contains the frequency for the different subcategories including data examples from each subcategory. The results for each category and subcategory will be explained more in detail with references to Table 4.3 in the sections below.

Table 4.3: Codebook for the teacher training part.

Subcategory	**Freq.**	**Data examples**
Experience of participation to the teacher training part		
Communication before participation	54	Not happy with the information received before participation. (1) Insufficient and late information before the training, time frame, place etc. (2) Preparatory work to the teacher training part, don't know what this means. (3)
Content	19	Could have had some more info about what micro:bit actually is. (4) It had been interesting to get some practical tips on how to use programming as a part of the teaching in subjects like Norwegian, social science and English. (5) The content of the training was very good. (6)

Table 4.3: Codebook for the teacher training part.

Subcategory	**Freq.**	**Data examples**
Educationalist	33	Talented lecturers that explained clearly how to do the different activities. (7) Engaging lecturers. (8) Get programmers to have the trainings. (9)
Overall positive feedback	68	Great! (10) The training was very good. (11) Everything good. (12)
Structure	193	Excellent that we got the chance to try ourselves. (13) Would have liked to have better time to try out the different possibilities with micro:bit. (14) Progressed to fast some times. (15)
Learning and self-efficacy		
Learning outcome	30	Learned a lot in a short time. (16) Informative! (17) I really liked the way this teaching plan can solve problems within several areas of competence and that we became aware of this. (18)
Self-efficacy towards teaching programming	11	I have so limited knowledge about this, so I feel I need to read/practice more before I am able to teach this in a proper way. (19). Good sense of achievement. (20) Need many hours to master this. (21)
Attitudes and motivation towards programming		
Attitudes towards programming	59	Thought I had no interest in this... But it was very fun. (22) We need such training and practice! (23) I am sure the pupils also will like this. (24)
Increased motivation	4	The training was really motivating and fun. Was a little bleak about being sent here. Considerable more positive when going home. (25) Motivating. (26) Motivating training. (27)
Motivation for the continuation	29	Looking forward to the next training! (28) We are looking forward to do this with the class! It is nice to go through it again together with the pupils . (29) Got inspired to try this with my class. (30)

Table 4.3: Codebook for the teacher training part.

Subcategory	Freq.	Data examples
Motivated to learn	18	I would like more trainings like this, so that we get more time to learn. (31) Now I want to learn more. (32) I wish for more trainings for advanced beginners with tips on how to use more of the programming toolkit. (33)
The super:bit model		
Community creation	1	Create a web-page where we can communicate and get notified when new material are ready. (34)
Exercises	18	Nice to work with exercises that we can take straight out to the classroom. (35) Fits pupils at all levels. (36) More clear exercises. (37)
The different parts and resources	24	Great that we all get a programming toolkit. (38) Nice with a structure where the teachers first attend a training and later on gets an introduction together with the pupils. (39) Too short time from teacher training part and until pupil training part. (40)

4.4.1.1 Experience of participation to the teacher training part

This is the category with highest total frequency, which is 367. The frequency for the different subcategories can be seen in Table 4.3. Based on how the open-minded questions in the questionnaire were asked, it is natural that most of the answers relate to this category. "Experience of participation to the teacher training part" covers everything related to the teachers experience of participation to the teacher training part. This includes comments on the training itself such as time use, working methods and content. Other comments in this category are related to the teachers overall experience and the information and communication before participation to the training.

4.4.1.1.1 Communication before participation

54 of the comments in the category "Experience of participation to the teacher training part" were related to the communication before participation. 47 of these

comments were negative to the communication and information received before participation. Of these 47 comments most of the teachers were not happy with the information received, had not received any information or had received the information too late. The first two comments in Table 4.3 is examples of this. Six of the comments were teachers who stated they did not know about the preparatory work, who according to them should have be done before participation to the teacher training part. This seems like a misunderstanding, as the preparatory work is meant to be done between the teacher training part and pupil training part, and not before the teacher training part, as these teachers seem to believe. The third comment in Table 4.3 is an example of this. There were also one teachers who were positive to the communication and information received before participation.

4.4.1.1.2 Content

19 of the comments in the category "Experience of participation to the teacher training part" were related to the content of the teacher training part. 11 of these comments were different topics that the teachers wanted more about or to be included in the training. Examples of this are comments 4 and 5 in Table 4.3. Seven of the comments were positive to the content or specific parts of the content, like comment 6 in table 4.3. While the last comment thought that there was too much information in this one training.

4.4.1.1.3 Educationalist

33 of the comments in the category "Experience of participation to the teacher training part" contained considerations in regard the job done by the educationalists from the different science centres. 26 of the comments were positive towards the job done by the educationalist, like comment 7 and 8 in table 4.3. The last seven comments were more critical towards the educationalists or wanted professional programmers to be responsible for the training, like comment 9 in Table 4.3. The criticism was mostly about that it was difficult to hear what they said or that they spoke over each other.

4.4.1.1.4 Overall positive feedback

68 of the comments in the category "Experience of participation to the teacher training part" contained positive overall considerations. This were general positive answers without further explanation, like comments 10, 11 and 12 seen in Table 4.3. Many of these considerations could indicate increased motivation or attitudes towards programming. Common for all the answers in this subcategory is that they

are short and not specifying what was "good" or "great".

4.4.1.1.5 Structure

193 of the comments in the category "Experience of participation to the teacher training part" contained considerations about the structure of the training. 66 of the comments were positive to the large amount of practical work during the training, like comment 13 seen in Table 4.3. 48 of the teachers wanted more time and 15 teachers thought the training was progressing to fast, examples of this can be seen in comment 14 and 15 in Table 4.3. Another 15 teachers thought the training was clear and informative. 14 teachers wanted even more practical work and 12 teachers reported technical issues during the training. The last 18 comments were evenly spread out on different topics regarding the structure of the training, five of these were positive, and 13 were somewhat negative or contained suggestions on how to improve the training.

4.4.1.2 Learning and self-efficacy

This category has a total frequency of 41. Comments in this category are related to the teachers perceived learning during the teacher training part or to their self-efficacy.

4.4.1.2.1 Learning outcome

30 of the comments in the category "Learning and self-efficacy" is describing the teachers learning outcome during the teacher training part. 24 teachers described that they learned a lot in short time or described the training as informative, as seen in comments 16 and 17 in Table 4.3. Three teachers see the relevance of using programming in their teaching. Two others noticed the multidisciplinary opportunities programming has and were positive to this, as seen in comment 18. The last teacher meant that he/she should be better prepared to maximise his/hers learning outcome from the training.

4.4.1.2.2 Self-efficacy towards programming

11 of the comments in the category "Learning and self-efficacy" contained reflections from the teachers about their self-efficacy. Four teachers described a low self-efficacy as seen in comment 19 in Table 4.3. Four other teachers described

the training as difficult, which implies that their self-efficacy are low. Two teachers described a sense of achievement during the training, which implies increased self-efficacy, as seen in comment 20 in Table 4.3. The last teacher described that he/she needed many hours to master this, which again implies a low self-efficacy as seen in comment 21 in Table 4.3.

4.4.1.3 Attitudes and motivation towards programming

This category has a total frequency of 110. Comments in this category express directly or indirectly something about the teachers motivation or attitude towards programming. Some of the comments from the subcategory "Overall positive feedback" described earlier in this section, could be similar to some of the comments in this category. The difference are that the comments in this category have a more specific wording which can be associated with teacher attitude or motivation.

4.4.1.3.1 Attitudes towards programming

59 of the comments in the category "Attitudes and motivation towards programming" contained reflections that described the teachers attitudes towards programming. All the 59 comments were showing positive attitudes towards programming. 48 of the comments were teachers describing programming as fun, exciting or similar, like comment 22 in Table 4.3. 7 teachers were positive towards the introduction of programming and sees the teacher training part as useful, as seen in comment 23 in Table 4.3. Four teachers were convinced that programming would be catchy for the pupils, as comment 24 in Table 4.3 is an example of.

4.4.1.3.2 Increased motivation

Four of the comments in the category "Attitudes and motivation towards programming" contained reflections that described increased teacher motivation, without further specificity. Examples are comment 25, 26 and 27 in Table 4.3.

4.4.1.3.3 Motivation for the continuation

29 of the comments in the category "Attitudes and motivation towards programming" contained reflections that showed that the teachers were motivated to use what they have learnt when returning to school, through either teaching, the upcoming pupil training part or in discussion with colleagues. 21 of the teachers were looking forward to the pupil training part, as seen in comment 28 and 29

in Table 4.3. Seven teachers were motivated to start teaching programming, as seen in comment 30. The last teacher wanted to convince his colleagues to start teaching programming.

4.4.1.3.4 Motivation to learn

18 of the comments in the category "Attitudes and motivation towards programming" were teachers that wanted to learn more about programming. 15 of the teachers wanted to learn more and many of them through trainings similar to the teacher training part, comment 31 and 32 in Table 4.3 are example of this. Three of the teachers wanted trainings for advanced beginners, as comment 33 in Table 4.3 shows.

4.4.1.4 The super:bit model

This category has a total frequency of 43. The comments in this category are related to the different parts of the super:bit model, the resources, the exercises and the community of practice creation. At this stage most of the comments were related to the main exercises/teaching plan, the structure of having a teacher training part followed by a pupil training part and the resources.

4.4.1.4.1 Community creation

This subcategory only had 1 comment, which was a teacher who wanted a webpage for communication, as seen in comment 34 in Table 4.3. The questionnaire presented in Chapter 6 will look closer into this aspect.

4.4.1.4.2 Exercises

18 of the comments in the category "The super:bit model" contained reflections about the exercises that are a part of the super:bit model. Five were positive to the ready-made exercises/teaching plans which the teachers could use in the classes without any further preparation, as seen in comment 35 in Table 4.3, while two teachers wanted more ready-made exercises/teaching plans. Three teachers were positive towards the exercises, while three others wanted more complementary exercises. Three teachers thought the exercises were well made and adapted so that pupils on different levels could all work with them, as seen in comment 36. The two last teachers wanted more clear descriptions of the exercises as seen in comment 37.

4.4.1.4.3 The different parts and resources

24 of the comments in the category "The super:bit model" contained reflections about the different parts and resources super:bit, at this stage this included the teacher training part, for some teachers the preparatory work and the division of the trainings into a teacher and a pupil training part. This subcategory also includes comments on the online resources and the programming toolkit. Six teachers were positive to that all schools get a programming toolkit for free, as seen in comment 38 in Table 4.3. Five teachers thought there was too much time between the teacher training and the receipt of the programming toolkit. Five of the comments were related to the division into a teacher and pupil training part, where two were positive towards this structure as seen in comment 39 in Table 4.3, two thought it was too short time between the trainings as seen in comment 40 in Table 4.3 and the last teacher thought it was hard to understand the enrolment system for the different parts. Another six teachers had comments to the resources. Two of these teachers were positive towards the preparatory work, two were positive towards the online resources available. One teacher wanted more than 20 micro:bits and and one teacher was unsure if the programming toolkit was just for 6^{th} grade or if it could be used in other grades. The last two comments were teachers who meant the duration of the teacher training part was just right.

4.4.2 Pupil training part

After the open and axial coding the categories shown in Table 4.4 below emerged. The categories are the same as for the teacher training part, except the category "Observing the pupils" which is new for the pupil training part. Even if most of the categories and subcategories remain the same, there is differences between the data sets. Therefore the categories and subcategories will be explained again in this section, in the same way as for the teacher training part. The distribution of the comments to the different categories and subcategories also differs between the data sets.

Table 4.4: Categories and their descriptions pupil training part.

Category	**Description**
Experience of participation to the the pupil training part	Teacher comments related to their experience of participation to the pupil training part. This includes comments on the educators, time use, content, structure, communication before participation and general feedback.
Learning and self-efficacy	Teacher comments related to how participation to super:bit have impacted their knowledge or self-efficacy.
Attitudes and motivation towards programming	Teacher comments related to their attitudes and motivation towards programming in general or programming as a part of the new curricula.
The super:bit model	Teacher comments related to the super:bit model structure, seen in Figure 3.1. The exercises are seen as a part of the model.
Observing the pupils	Teacher comments related to reactions observed among the pupils during the pupil training part.

The subcategories that emerged during the axial coding for the pupil training part is seen below in Table 4.5. The first four categories and associated subcategories are exactly the same as the the teacher training part. The last category and associated subcategories are new.

Table 4.5: Categories and their subcategories pupil training part.

Category	**Subcategories**
Experience of participation to the teacher training part	Communication before participation
	Content
	Educationalist
	Overall positive feedback
	Structure
Learning and self-efficacy	Learning outcome
	Self-efficacy
Attitudes and motivation towards programming	Attitudes towards programming
	Increased motivation
	Motivated for the continuation
	Motivated to learn
The super:bit model	Community creation
	Exercises
	The different parts and resources of super:bit
Observing the pupils	Observing the pupils enjoying the session
	Observing learning among the pupils
	Observing adapted education

In Table 4.6 the results are presented as a codebook. The codebook contains the frequency for the different subcategories including data examples from each subcategory. The results for each category and subcategory will be explained more in detail with references to Table 4.6 in the sections below.

Table 4.6: Codebook for the pupil training part.

Subcategory	**Freq.**	**Data examples**
Experience of participation to the pupil training part		
Communication before participation	8	Let us know in advance that we were going to use Chrome. (1) Insufficient information about the school visit (2) Would like a reminder about time and date, such that we know when to to the preparatory work (3)
Content	17	The intro of the pupil training part was very good(4) Unsure how to relate this to the different subjects. (5). Why are we doing this? Don't think the educationalist said anything about that. (6)

Table 4.6: Codebook for the pupil training part.

Subcategory	**Freq.**	**Data examples**
Educationalist	89	Engaged educationalist (7) Good and clear instructions (8) Give instructions when it is quiet. Let us know about the pair working in advance, so that we can divide the pupils. (9)
Overall positive feedback	132	Excellent training (10) We are very happy. (11) All was good. (12)
Structure	81	Great with some theory and A LOT of practical work. (13) Could have had some more time. (14) Working in pairs did such that all the pupils took part in the work. (15)
Learning and self-efficacy		
Learning outcome	11	Both teachers and pupils learned a lot. (16) Informative! (17) Two funny and informative hours. (18)
Self-efficacy towards teaching programming	3	Went to fast on the teacher training part. We did not know how to work with the program, and than it got hard. (19) I do not feel competent to continue teaching - wish for follow-up afterwards for either teahcers' or both teachers and pupils. (20) I think I would have used this if I had attended to the teacher training part in advance. As a digital immigrant, I feel too insecure to run this on my own. Nice to be a part of this and be able watch the pupils work and what they have managed to achieve.. (21)
Attitudes and motivation towards programming		
Attitudes towards programming	50	Exciting. (22) Inspirational! (23) This is the future! (24)
Increased motivation	14	Motivating topic. (25) Motivating. (26) Motivating teaching. (27)
Motivation for the continuation	9	We are excited to start using this! (28) I am looking forward to use the programming toolkit. It will not be left in a closet! (29) Looking forward to receive the programming toolkit. (30)

Table 4.6: Codebook for the pupil training part.

Subcategory	**Freq.**	**Data examples**
Motivated to learn	26	More of this!. (31) Feel free to come back. We can act as pupils. (32) Great that the school has the toolkit, such that we can continue with this at home :). (33)
The super:bit model		
Community creation	1	Very professionally. I will have a seminar with the other teachers in next week. (34)
Exercises	34	Good pedagogical exercises that give the pupils sense of achievement. (35) Engaging exercises. (36) Great that the teaching plan are available online with all the necessary details. (37)
The different parts and resources	44	Great that you visit the schools. (38) Good preparatory work. (39) MakeCode was easy to understand and had a good user interface . (40)
Observations done during the pupil training part		
Observing the pupils enjoying the session	94	The pupils had an enjoyable time (41) The pupils were very engaged (42) The pupils started quickly with the work. They had been looking forward to this! (43)
Observing learning among the pupils	14	They pupils learned a lot during this two hours. (44) The pupils are learning by doing. (45) It was a lot of learning in multiple areas. (46)
Observing adapted education	52	The pupil training part included many types of pupils, both strong and those with special needs. (47) Maybe even more challenging exercises for the ones who have experience with micro:bit. (48) Gave a sense of achievement for pupils with different skills and needs. (49)

4.4.2.1 Experience of participation to the pupil training part

As for the teacher training part, this is the category with the highest total frequency of 327. The frequency for the different subcategories can be seen in Table 4.6. Based on how the open-minded questions in the questionnaire were asked, it is natural that most of the answers relate to this category. "Experience of particip-

ation to the pupil training part" covers everything related to the teachers' experience of participation to the pupil training part. This includes comments on the training itself such as time use, working methods and content. Other comments in this category are related to the teachers overall experience and the information and communication before participation to the pupil training part.

4.4.2.1.1 Communication before participation

Eight of the comments in the category "Experience of participation to the teacher training part" were related to the communication before participation. All eight teachers wanted more information before the training, as seen in comment 1-3 in Table 4.6. Compared to the teacher training part the number of teachers who were negative towards the communication are low.

4.4.2.1.2 Content

17 of the comments in the category "Experience of participation to the teacher training part" were related to the content of the training. Six of the teachers were positive to the intro, which included unplugged computing and some theory, as seen in comment 4 in Table 4.6. Five teachers wanted the teaching to include more examples of how to include programming into different subjects, as seen in comment 5 Table 4.6. Two teachers thought it could be helpful if the pupils got a clear explanation of why it is useful to work with programming as seen in comment 6 Table 4.6. Two other teachers thought the training included too much new information at once, one were negative towards an intro game and the last wanted more about the fundamentals of programming.

4.4.2.1.3 Educationalist

89 of the comments in the category "Experience of participation to the teacher training part" contained considerations in regard to the job done by the educationalists from the different science centres. 70 of the comments were positive towards the job done by the educationalist, like comment 7 in table 4.6. 15 teachers thought the educationalist(s) were clear and easy to understand as seen in comment 8 Table 4.6. Four of the comments contained tips on how the educationalist(s) could improve, as seen in comment 9 Table 4.6. Compared to the teacher training part the number of positive comments towards the educationalists are significantly higher for the pupil training part.

4.4.2.1.4 Overall positive feedback

132 of the comments in the category "Experience of participation to the teacher training part" contained positive overall considerations. This were general positive answers without further explanation, like comments 10, 11 and 12 seen in Table 4.6. Many of these considerations could indicate increased motivation or attitudes towards programming. Common for all the answers in this subcategory are that they are short and not specifying what was "good" or "great".

4.4.2.1.5 Structure

81 of the comments in the category "Experience of participation to the teacher training part" contained considerations about the structure of the training. 32 of the comments were positive to the amount of practical and exploratory work during the training, like comment 13 seen in Table 4.6. 21 of the teachers had time related considerations, where 15 wanted more time as seen in comment 14 Table 4.6, four thought the time was adequate and two had suggestions on how to more efficient use the time. Six teachers were positive towards collaborative learning as seen in comment 15 Table 4.6. Four thought the progress at times were too fast and four wanted to use more time on the programming. Three others thought the structure of the training were good, while one wanted the training to be more structured. Four teachers thought the training's balance between practical work and theory were good, three others thought the training had too much theory, while one teacher wanted more theory and discussion in plenary. One teacher thought it could be better if each pupil had his/her own PC and one teacher wished that teachers also had and micro:bit and bit:bot to practice with.

4.4.2.2 Learning and self-efficacy

This category has a total frequency of 41. Comments in this category are related to the teachers learning during the pupil training part or to their self-efficacy.

4.4.2.2.1 Learning outcome

14 of the comments in the category "Learning and self-efficacy" is describing the teachers learning outcome during the pupil training part. Ten teachers are describing the pupil training part as informative. Some comments, as comment 16 in Table 4.6 describes explicit who learned during the training. Other comments such as comment 17 in Table 4.6 does not describe this explicitly. This makes it unsure if comment 17 and similar comments means that the pupil training part

has been informative for the teachers or for the pupils. These comments are written by the teachers and do not mention the pupils, so they were interpreted by the researcher to describe the teachers learning outcome. This is however a bit unsure, and some of the comments in this subcategory can possibly be the teachers observing learning among the pupils and not the teachers. One teachers described the training as easy to understand for someone new to programming.

4.4.2.2.2 Self-efficacy towards programming

3 of the comments in the category "Learning and self-efficacy" contained reflections from the teachers about their self-efficacy. Comment 19, 20 and 21 in Table 4.6 shows three teachers that express a low self-efficacy towards teaching programming.

4.4.2.3 Attitudes and motivation towards programming

This category has a total frequency of 99. Comments in this category express directly or indirectly something about the teachers motivation or attitude towards programming. Some of the comments from the subcategory "Overall positive feedback" described earlier in this section, could be similar to some of the comments in this category. The difference are that the comments in this category have a more specific wording which can be associated with teacher attitude or motivation.

4.4.2.3.1 Attitudes towards programming

50 of the comments in the category "Attitudes and motivation towards programming" contained reflections that described the teachers attitudes towards programming. All the 50 teachers were showing positive attitudes towards programming. 32 teachers are describing the pupil training part as fun, exciting, inspirational or similar as seen in comments 22 and 23 in Table 4.6. Eight teachers describes programming as relevant topic as seen in comment 24 in Table 4.6. Seven teachers expresses a positive attitudes towards programming in slightly different ways, but all recommends the pupil training part in some way. Two teachers are positive towards mixing programming with other subjects and the last teacher are positive towards the pupils understanding and interest for programming after the pupil training part.

4.4.2.3.2 Increased motivation

14 of the comments in the category "Attitudes and motivation towards programming" contained reflections that described increased teacher motivation, without further specificity. Examples are comment 25, 26 and 27 in Table 4.6.

4.4.2.3.3 Motivation for the continuation

9 of the comments in the category "Attitudes and motivation towards programming" contained reflections that said something about the teachers motivation for the continuation. Five of the teachers were looking forward to start teaching programming as seen in comment 28 in Table 4.6 and four were looking forward to receive the programming toolkit as seen in comment 29 and 30 in Table 4.6.

4.4.2.3.4 Motivation to learn

26 of the comments in the category "Attitudes and motivation towards programming" were teachers that wanted to learn more. 23 teachers wanted to attend more similar trainings, as seen in comment 31 and 32 in Table 4.6. Two teachers wanted to learn more without specifying how and the last teacher was motivated to start learning by exploring the programming toolkit at home, as seen in comment 33 in Table 4.6.

4.4.2.4 The super:bit model

This category has a total frequency of 79. The comments in this category are related to the different parts of the super:bit model, the resources, the exercises and the community creation. At this stage most of the comments were related to the main exercises/teaching plan, the structure of having a teacher training part followed by a pupil training part and the resources.

4.4.2.4.1 Community creation

This subcategory had only one teacher comment, where the teacher was planning to have a teacher seminar with the other teachers at his/her school one week after the pupil training part as seen in comment 34 in Table 4.6. This to pass on what was learnt during the participation to super:bit. Together with the teacher training part this subcategory has a frequency of only two, and in Chapter 6 it will

be investigated closer if super:bit can be the start of the creation of a community of practice.

4.4.2.4.2 Exercises

34 of the comments in the category "The super:bit model" contained reflections about the exercises/ready-made teaching plans that are a part of the super:bit. 25 of the teachers had comments to the exercises, where 22 of them were positive to the exercises as seen in comment 35 and 36 in Table 4.6, while three teachers thought the exercises were too hard or unclear. Four teachers were positive to ready-made teaching plans which are available online, as seen in comment 37 in Table 4.6, while one wanted more ready-made teaching plans with solution manuals. Four teachers wanted more exercises.

4.4.2.4.3 The different parts and resources

44 of the comments in the category "The super:bit model" contained reflections about the different parts of the super:bit model. Eight teachers were positive to the school visits (the pupil training part), as seen in comment 38 in Table 4.6 and three were positive towards the structure of a teacher training part before the pupil training part. Nine teachers had comments to the preparatory work, where six were negative or had suggestions on how to improve the preparatory work, while three others were positive as seen in comment 39 in Table 4.6. Eight teachers thought that the programming toolkits arrived to late, while six other were happy with receiving the toolkit. Four teachers had comments to the Microsoft MakeCode, where three were positive as seen in comment 40 in Table 4.6, while one teacher were negative. Three teachers had comments to the bit:bot, one were positive, one experienced some problems with the wheels and one thought that the pupils should have seen more examples of what it is possible to do with the bit:bot. One teacher wished that the online material were available in the language "New Norwegian", one wanted the pupil training part to have other exercises than the teacher training part and the last teacher suggested that a video with an unboxing of the programming toolkit could increase the motivation and expectations among the pupils.

4.4.2.5 Observing the pupils

This category has a total frequency of 160. This category is only for the pupil training part, as it contains teacher reflections from the teachers on how the pupils behaved during the pupil training part.

4.4.2.5.1 Observing the pupils enjoying the session

94 of the teacher comments in the category "Observing the pupils" described pupils that in someway enjoyed the pupil training part. 90 of the comments were about pupils being engaged, motivated, active, having fun or similar as seen in comment 41 and 42 in Table 4.6. Four teachers observed that the pupils started working with the exercises right after the introduction, which implies that they are engaged. All the comments inn this subcategory were positive towards the pupils behaviour during the pupil training part.

4.4.2.5.2 Observing learning among the pupils

14 of the teacher comments in the category "Observing the pupils" were teachers who observed learning among the pupils during the pupil training part, as seen in comment 44, 45 and 46 in Table 4.6.

4.4.2.5.3 Observing adapted education

52 of the teacher comments in the category "Observing the pupils" were observations due to adapted education. 27 of the teachers observed how the pupils experienced the degree of difficulty for the exercises. 20 of teachers thought that the exercises were providing good adapted education as seen in comment 47 in Table 4.6, while seven teachers thought there were a potential for better adapted education as seen in comment 48 in Table 4.6. 13 teachers were observing a sense of achievement among the pupils, which is an indication of good adapted education. Another 12 teachers were observing the progression during the pupil training part, where 11 teacher observed good progression and one teacher observed the progression as too fast for the pupils.

4.4.2.6 Summary of the results

In total, all the categories for both trainings have a frequency of 1247, and 78.2% of the comments were understood as positive by the researcher. For the teacher training part the total frequency were 561 and 64.0% of the comments were positive, while the pupil training part had a total frequency of 686 and 89.8% of the comments were positive. 23.3% of the negative comments for the teacher training part were related to the information and communication before participation. This shows that the majority of the teachers who have answered the open-minded questions were happy with their participation to super:bit, which is supported by the quantitative data presented in Section 3.3. The main complaints were the

communication and information received before the teacher training part, which is also supported by the quantitative data presented in Section 3.3.

In the context of teacher PD and the conceptual model presented in Figure 2.1, 41 teachers reported increased knowledge, 109 reported a change in or a positive attitude towards programming and 100 teachers reported an increased or high motivation towards learning more about and teaching programming. 11 teacher comments implied a low self-efficacy, while two teacher comments implied an increase in self-efficacy. In addition to this many other teacher comments could also be seen in the context of increased knowledge, skills, beliefs, attitudes or motivation, as for example the comments from the subcategory "Overall positive feedback". It is important to remember that the open-minded questions did not explicitly ask about these factors, and hence the number of comments that reports about an increase in one or more of these factors is hard to interpret. The limited duration of the trainings should also be considered when looking into these factors.

Chapter 5

Study of Observations

5.1 Chapter overview

This chapter presents the observation study carried out by the researcher. The first sections explains how the observational data were collected. The results for the teacher training and pupil training part are presented next followed by a summary of the results.

5.2 Observation

Based on the data received from the science centres and conversations with co-supervisor Ola Kleiven at the science centre in Trondheim the researcher decided that the next step in the research process would be an observation of the teacher training part and pupil training part. The reasoning behind this was two folded. Firstly, it would help the researcher to gain better insight into the case and build an understanding of how the science centres carries super:bit out to the teachers and pupils. Secondly, the observation data was seen as a good supply to the two other data sets, which rely on self-reporting from the teachers.

Observational data are collected in real time and hence it can provide information that participants are unable to recall afterwards, in for example an interview. In an interview participants can have some topics that they are unwilling to talk about or that they are unaware, but that gets reviled through observation. Observation is usually performed in the participants natural environment which allows for examination of contextual factors, while interviews or surveys does not capture this context [76].

At the same time observations can be influenced by the Hawthorne effect, meaning that participants may change their behaviour since they know they are being observed. The researcher has to choose what to note or record and this influences the content and focus for the observation data [76].

5.3 Method

The researcher has in total done three observations, one of the teacher training part and two of the pupil training part. The science centre in Trondheim were responsible for the trainings and co-supervisor Ola Kleiven approved the observations. The observations were done together with another master student, who also conducted research on super:bit, but with focus on the use of micro:bit.

At the time of the observations, the next planned step in the research was to interview some of the teachers. Based on that it was seen as most appropriate to use "interactive Observation" as proposed by Aksel Tjora [25] for all three observations. In "interactive Observation" the researcher is initially a pure observer, but can be involved in various forms for interaction such as conversations, assistance or similar ad hoc together with the ones being observed. This to limit the unnaturalness with the passive observer role. This is a sort of a combination of Golds "observer as participant" and "participant observer" [77] as there will always be some kind of interaction between the observer and observed [25]. This means that the researcher did not search for interaction during the observations. However, some interactions found place were it was seen as natural.

The reasoning behind choosing "interactive observation" was that the observational data could potentially reveal differences between what people do (observations) and what they later say (interviews, questionnaires). At the same time using "interactive observation" was considered the best way to get an overview of the structure for the different parts .

For all the observations the researcher used time stamps, to make the notes from the observations more structured. The notes are not objective descriptions of actions that took place in front of the researcher. The notes are a result of the choices made by the researcher during the observations on what to write down. The theoretical background and the experiences of the researcher influences the researcher's view and hence the observational notes could be described as subjective notes [26].

5.3.1 Observation of teacher training

The aim for the observation of the teacher training part was two folded. Firstly it was needed to get an overview on how the teacher training was structured and what the main focus of the training was. Secondly the researcher wanted to look at how the teachers behaved during the training. In appendix E the template used for the observation of the teacher training part can be seen. The template is based on the data received from the science centres and a draft of the research questions that the researcher had at the time of the observation. At the structural level the researcher was interested in identifying the main topics for the training, how this topics got addressed and how they were related to the new curricula. For the behavioural part, the researcher had to choose what to focus on and not during the training.

This particular teacher training was held in an auditorium at a primary school. The researchers took place in the back of the auditorium, with all the teachers in front. With this the researchers wanted to minimise the teachers feeling of being observed. The researchers co-supervisor Ola Kleiven was responsible for the training and informed the teachers about the observation at the start of the training.

5.3.2 Observation of pupil training

The aim of the observation of the pupil training was also two folded. Since the researcher's focus is on the teachers, it was firstly needed to get an understanding of the teachers role during the pupil training part, even the teachers are not the main participants of the activity. Secondly, the researcher wanted to look at how the teachers behaved during the activity along with the pupils reactions to the training. In appendix F the observation template used for the observation can be seen. The template is based on the the data received from the science centres and a draft of the research questions that the researcher had at the time of the observation. At the structural level the researcher was interested in identifying the content of the training. At the behavioural level, the researcher was interested in the role of the teachers and how they behaved when helping pupils. The researcher also looked at the pupils reaction to the training. In addition the researcher was free to focus on interesting aspects that emerged during the training.

The two pupil training's were held in the same classroom at the same school. The researchers took place in the back of the classroom, to again minimise the pupils and the teachers feeling of being observed. Co-supervisor Ola Kleiven were in charge of both the pupil trainings and informed about the observation at the start of both trainings.

5.4 Results

5.4.1 Teacher training

The teacher training can be seen as a hands-on workshop, where most of the time is used by the teachers to explore the micro:bit, bit:bot and Microsoft MakeCode, where the latter is used for writing code. 20 teachers participated to this specific teacher training. The auditorium had a capacity well beyond 20 persons, and the teachers from the same schools sat down together.

The intro exercises about unplugged computing seemed to engage and amuse the teachers. Smiles and laughter among most of the teachers were observed frequently. Some teachers came in contact with other unknown teachers during the intro exercises. While the teachers were working on the last intro exercise, the educationalist handed out the micro:bits and bit:bots. The educationalist showed a PowerPoint slide with some information about the micro:bit. One of the teachers took a photo of the slide, while the others seemed to pay close attention. The educationalists demonstrated how to create a simple program that displayed "Hello" on the micro:bit. After this the teachers got some time to explore the micro:bit and Microsoft MakeCode on their own. In the break before starting with the main exercises some of the teachers were taking a cup of coffee with the educationalist. A few other teachers continued to explore the micro:bit during the break. "This was fun", one of the teacher said during the break.

In the work with the main exercises the intention was that the teachers should work in pairs to solve them. All the main exercises involved programming the bit:bot to drive a certain way. The first exercise was to program the bit:bot to drive one meter forward, turn 180 degrees and drive one meter back to the starting point. The second exercise was to program the bit:bot to follow a line on the city mat in the front of the auditorium. The city mat can be seen in Appendix B. If some pairs finished both these exercises, they could chose among the complementary exercises to continue with.

Some of the pairs used one PC each while programming, while others were working together using one PC. It seemed like the pairs sharing one PC used more time for discussion after they had tested the bit:bot. The pairs were progressing differently and were on different exercises after some time. All pairs used the method of trial and error, and it was busy in the front of the auditorium. When testing their programs, most teachers seemed to be really engaged. Shouts like "YEEES!" were heard when a pair had completed an exercise. One teacher were frequently taking pictures and also filmed while other teachers were testing their bit:bots. When multiple teachers were gathered in the front of the auditorium to test their bit:bots the pairs asked each other for help and discussed their solutions. Teachers

from different schools came in touch in this way.

About halfway into the training the researcher observed a sort of grouping. The first group were the teachers who had been very engaged throughout the training and worked hard. Teachers from this group were frequently in the front of the auditorium to test their bit:bots. Most of the teachers in this group were also working in a pair where the programming were done on one PC, and the teachers were doing it together. The second group were the teachers who seemed to struggle more with the exercises and their working spirit decreased with time. Most of these teachers were working on their own, even if they originally were split into pairs. These teachers were not observed so frequently in the front of the auditorium testing their bit:bots. One of the teachers in this group started walking around in the auditorium and seemed rather bored the last part of the training. The last 30 minutes several of the teachers from group two seemed to have given up and did not put much effort in their work with the exercises. At the same time some of the teachers from the first group finished the two main exercises and started to work with the complementary exercises. The teachers in group one worked hard and seemed engaged throughout the whole training. Approximately 70% of the teachers at the training belonged to group one, and the rest to group two.

5.4.2 Pupil training

The pupil training part has a similar structure to the teacher training part. Most of the time is used for the pupils to work with the two main exercises, which is exactly the same exercises as the teachers have worked with earlier.

The pupil training started with some theory about what micro:bit is and how it works. Unplugged computing were used to demonstrate how loops works. The pupils were "programmed" by the educationalist, as he presented a code snippet from Microsoft MakeCode. It contained a simple for-loop telling them to first jump, then sit down on their chair for five seconds. The educationalist showed different versions of the code snippet, where the range of the loop varied. The pupils seemed engaged during this part, and the whole class were participating. In the last part of the intro the educationalist showed how to make a simple program displaying some text on the micro:bit and how to transfer this program from the PC to the micro:bit. The introduction lasted for about 20 minutes.

After the introduction the first class started with the two exercises. At this stage the educationalist changed his role from being a classic classroom teacher to more of a facilitator role. Already at the first testing of the bit:bot with a preloaded code given by the educationalist, a pupil said "this was fun!". The pupils were also working in pairs and most of them were observed running between the city mats in the back of the classroom, and their desks. The pupils showed joy when they got

closer to a solution or had finished an exercise. Many discussions within the pairs were observed, and the pairs who finished an exercise first, got many questions from the other pairs. The pupils were more enthusiastic than the teachers were during the teacher training part. They also seemed less afraid to do something wrong and tested their programs more frequently. The result of this was that many pairs managed to solve the two main exercises faster than the teachers did during the teacher training part. When there was time for an optional break, two of the 12 pupils decided to go out. The rest were continuing working with the exercises. Towards the end most of the pairs had finished the two exercises and were working with the complementary exercises. The working spirit got a little reduced towards the end, but was still considered good. When they had to tidy up, about half of the pupils wanted to test their bit:bot one last time, which they got the chance to do. One pupil said "I am definitely going to buy this!", referring to the micro:bit and the bit:bot at the end of the session. During the session all the pairs solved at least one of the exercises.

The teachers present were mostly sitting in the back of the classroom observing. "This seems really catchy for the pupils", one of the teachers said to the other one while observing. "It is so good that the pupils gets suc an offer like this" says another teacher. The teachers took a role similar to the researchers, mostly observing from the back of the classroom. Towards the end the teachers started to walk around in the classroom to see how the pupils were doing. Another finding in this first class were that the teachers were not present during the whole session. It was observed a total of four teachers and two teacher students in the class during the session. The teacher students were present the whole training and worked with the same exercises as the pupils. None of the teachers were present during the whole session. The different teacher movements can be seen in Table 5.1. Teacher 1 was the only teacher who got recognised from the teacher training part. The pupil training started at 08:43 and ended at 11:04.

Time	In	Out	Present
08:43			Teacher 1, Teacher 2
09:16	Teacher 3	Teacher 1	Teacher 2, Teacher 3
09:56		Teacher 2	Teacher 3
10:14	Teacher 4		Teacher 3, Teacher 4

Table 5.1: Teacher movements during the pupil training part of class one

The second class were going through the exact same session as the first class. The introduction seemed again to engage the pupils and especially the part were they were being "programmed".

When starting with the two main exercises the pupils were also in this class observed running between the city mats and their desks. All the pairs seemed really happy when they finished an exercise or got closer to an solution. This class did

not have a break and the pupils were working good throughout the whole session. As in the first class the pairs were helping each other and frequently discussed different solutions while testing the bit:bots in the back of the classroom. When the pupils were told to tidy up and give back the micro:bits and bit:bots, several of the pairs begged the educationalist to "just get a last try" to test the bit:bot, which they got. At the end of the training several pupils asked about the name of the web page that were used for the programming, as they wanted to continue programming at home. Also in this class all the pairs solved at least one of the exercises.

In the second class there were only two teachers and two teacher students present. In this class both teachers were in the classroom almost all the time and both got recognised from the teacher training. One of the teachers leaved the classroom for about 10 minutes, while the other was present all the time. The teachers in this class were more active during session compared to the teachers in the first class. They were walking around, observing and helping the pupils. They took a role similar to the educationalist facilitator role. One of teachers also asked the researchers some questions during the session. The teacher explained that the pupils were taking the programming really fast, probably faster then he/she did during the teacher training. The teacher seemed a little concerned about this.

5.5 Summary of the results

The teacher training part seemed to engage about 70% of the teachers throughout the session. These teachers worked hard and their programming skills seemed to progress throughout the teacher training part. The remaining 30% of the teachers started of well, but their engagement and working spirit decreased with time. These teachers programming skills did not seem to have the same progress. Teachers from different schools got in touch with each other during the teacher training part, and this could potentially be the start of the creation of a community of practice.

The pupil training part seemed to really engage the pupils. This is exemplified by the fact that most of the pupils continued to work during the breaks and that they did not want to stop programming when the session was done. All pupils seemed to solve at least one exercise, which is an indication that the pupils experienced a sense of achievement and hence good adapted education.

The majority of the teachers were not present during the whole pupil training part. Given the positive experiences the pupils had during the sessions, the pupil training part could serve as "modelling of effective practice" for the teachers. However, this will not be as useful as it could be, if the teachers do not attend the whole session. It was also found that teachers recognised from the teacher training part were more active during the pupil training part, while the teachers

who only had attended the pupil training part took more of an observational role.

Chapter 6

Study of the Researcher's Questionnaire

6.1 Chapter overview

This chapter presents the study of the researchers questionnaire. Firstly, the data is described. Next a description of the research process and the design choices made for the questionnaire follows. Towards the end of the chapter the results will be presented before a summary of the results.

6.2 Data: Questionnaire

The data used in this chapter is conducted using a questionnaire created by the researcher, which can be seen in Appendix G. Most of the questions will also be presented in English in section 6.4. 21 teachers have answered the questionnaire. The questionnaire consist of 21-24 mandatory multiple choice questions, depending on the answers. It also has up to four optional open-ended questions depending on the answers.

6.3 Method

6.3.1 Process before data collection

After the researcher had received the data collected by the science centres presented in Chapter 3 and Chapter 4 and done the observations presented in Chapter 5 the plan was to interview teachers who had participated to super:bit. The plan was to use a qualitative approach and conduct interviews based on the interview guide seen in Appendix H. This to further investigate the most interesting findings already done and to better be able to answer the research questions. The master project was reported to NSD [1] and approved as seen in Appendix I.

At this stage of the research the case was concentrated around the science centre in Trondheim and the e-mail in Appendix J, together with the consent form in Appendix K was sent to all the teachers who had participated to the super:bit trainings under the auspices the science centre in Trondheim. Due to the GDPR [2] the researcher could not receive the e-mail addresses of the participants and all communication were done through co-supervisor Ola Kleiven. None of the teachers responded. The e-mail seen in Appendix L together with the same consent form was sent to the teachers at the school where the observations were done, as the researcher already had been in contact with some of these. Also this time there were no positive responses. As a last try co-supervisor Ola Kleiven posted a post in the open Facebook group "super:bit lærerforum", providing some information about the master project and trying to recruit some of the teachers to interviews [68]. The post got no responses, and since the time frame for a master thesis is limited, the researcher decided to create a questionnaire instead. The questionnaire was based on the interview guide seen in Appendix H. At this time the researcher expanded the case to yield the whole super:bit project, and had to redo the analysis presented in Chapter 4, as this firstly only was done for the data gathered by the science centre in Trondheim.

6.3.2 Questionnaire design

The questionnaire were designed using "Nettskjema" [3]. This was chosen after a discussion with the researchers contact person at NSD. The questionnaire does not have any questions about personal information and to ensure anonymity the questionnaire was set to no handle personal information. When using this setting, neither IP-address, username, point in time or other information from the

[1] The Norwegian centre for research data, `https://www.nsd.no/`

[2] General Data Protection Regulation, `https://gdpr.eu/`

[3] Nettskjema is a simple questionnaire tool developed by the University of Oslo, `https://www.uio.no/english/services/it/adm-services/nettskjema/`

respondent will be stored [78]. Although there is a possibility that respondents can be identified through a combination of answers and hence the respondents had to read and consent to the consent form at the start of the questionnaire seen in Appendix G.

Due to the problem of recruiting teachers to interviews, the researcher found it important to not make the questionnaire too long. The first questions of the questionnaire are included to gather useful background information. Since this research focus is on the teachers and not the students, some adjustments are done to the "data to be collected" recommendations by Decker, McGill and Settle [29]. Next previous experience with programming was seen as the most important "unique characteristics" that could influence the answers and hence the teachers were asked about this.

The four sub research questions presented in Section 1.3 are considering teacher knowledge, attitudes, motivation and self-efficacy. The quantitative data received from the science centres, the results of the coding in Chapter 4 and the results of the observations in Chapter 5 provided a reasonable amount of information about how participation to super:bit affected teacher knowledge, attitude and motivation, but not much on how it affected teacher self-efficacy. Due to this the questionnaire contains some control questions about teacher knowledge, attitude and motivation, to see if the results will concur with the earlier findings. The questionnaire contains several questions about teacher self-efficacy, to investigate if/how participation to super:bit have affected the teachers self-efficacy.

The potential community of practice creation is investigated further, as the observations in Chapter 5 indicated super:bit could be the start of a such creation. The last part of the questionnaire moves the focus to what the teachers actual have done after participation, as the two other data sets contain no information on this.

After the questionnaire was done, the researcher updated the application to NSD and got the approval seen in Appendix M.

6.3.3 Data collection

Since recruiting via e-mails had failed earlier, the questionnaire were shared in the Facebook group "super:bit lærerforum" [68]. At the time when the group had 688 members. The researcher posted two times in the Facebook group to inform and recruit participants to the questionnaire. The first post was on the 16th of November 2020 and the second on the 14th of December 2020. The questionnaire was open from the first post until and the 20th of December. It was informed that the questionnaire was anonymous, that it would be a part of the researchers master thesis and should take around five minutes.

6.4 Results

6.4.1 Teacher background information

Figure 6.1 shows the teaching subjects for the 21 teachers. The distribution have many similarities to the teaching subjects reported by the teachers in the data received from the science centres, reported in Chapter 3 and seen in Appendix C and Appendix D. Among the 21 teachers, mathematics and natural science are the most taught subjects.

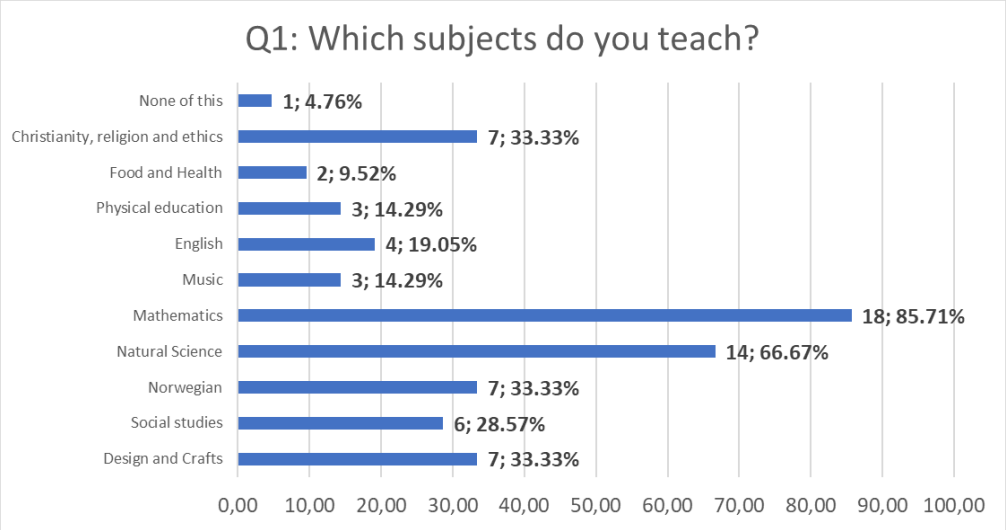

Figure 6.1: Question 1 about teaching subjects.

Figure 6.2 shows the attendance to the two trainings. 61.90% of the teachers have attended both, 33.33% have only attended the teacher training and 4.76% have only attended the pupil training. This supports the finding during the observations where it was observed that a relatively big share of the teachers did not attend the whole pupil training. The quantitative data in Chapter 3 also showed that almost 30% of the teachers who attended the pupil training part had not attended the teacher training part.

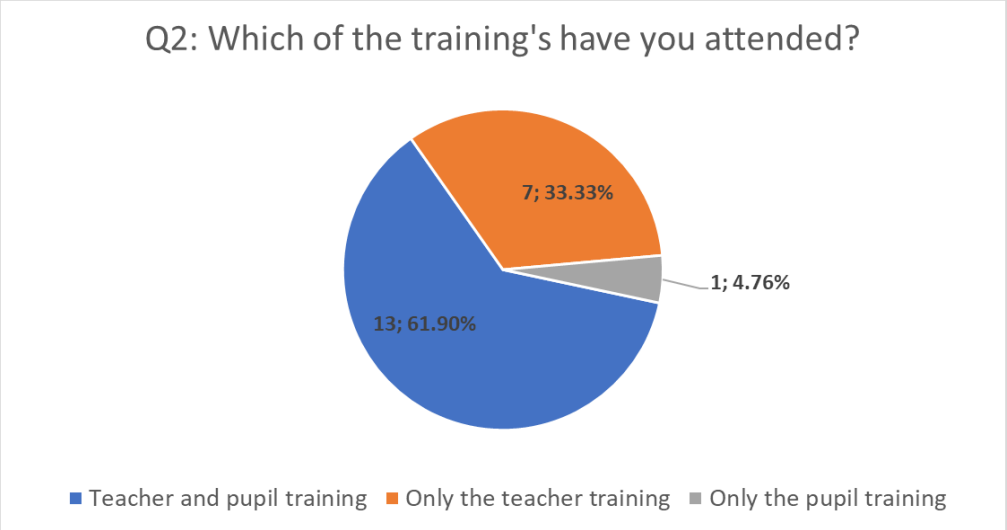

Figure 6.2: Question 2 about participation to the two trainings.

Figure 6.3 shows where the teachers have attended their trainings, the share between the science centres are quite similar. Oslo science centre is missing as no teachers who answered the questionnaire had attended their trainings there.

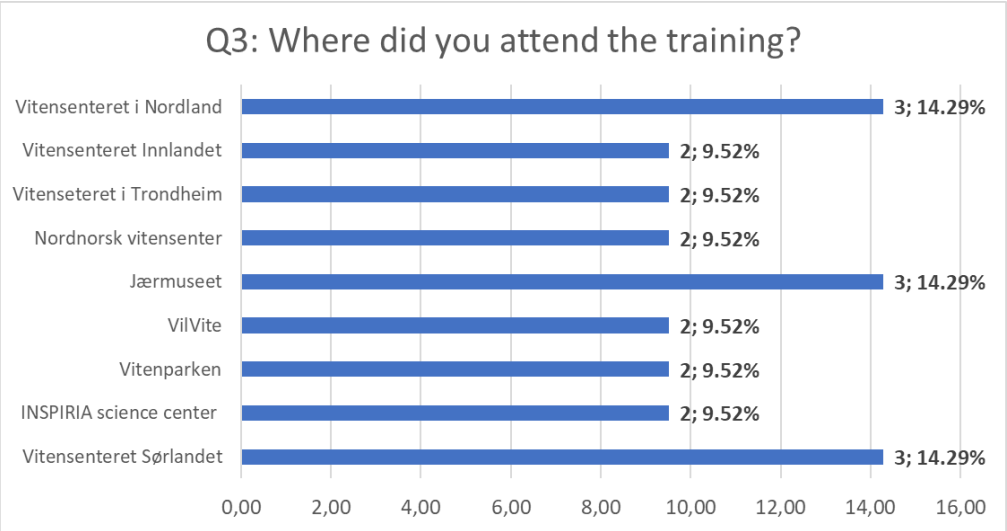

Figure 6.3: Question 3 about location for the trainings.

Figure 6.4 shows when the teachers attended the trainings. 52.38% of the teachers participated the during the autumn 2020, 33.33% during the autumn 20q9 and 14.29% during the spring 2020.

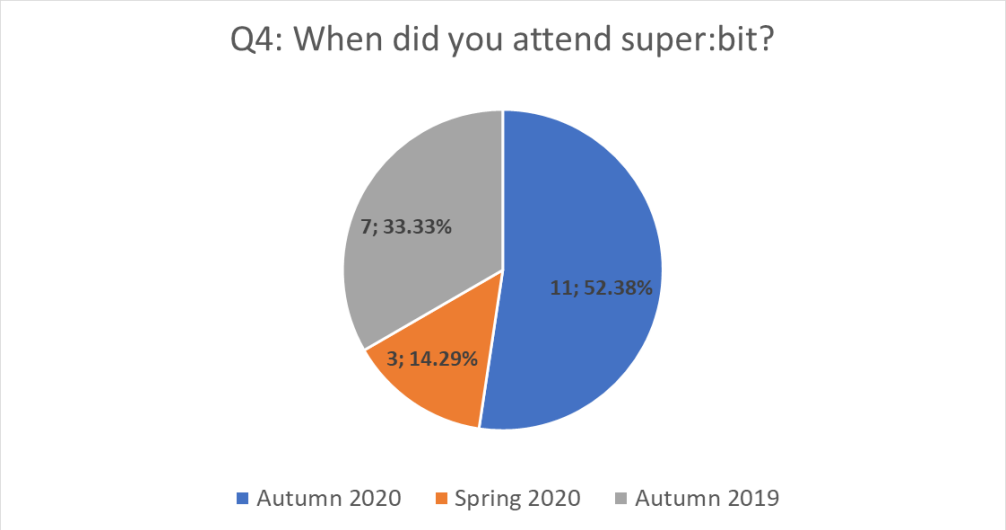

Figure 6.4: Question 4 about time of participation

Figure 6.5 shows the teacher's previous experience with programming. In this question it was possible to select multiple options. Just 19.05% of the teachers who reported no previous experience. The most common experience were self-study, which 57.14% of the teachers reported to have done. 38.10% of the teachers had taught programming, while 19.05% of the teachers had formal education in the area of programming and 19.05% reported other experience.

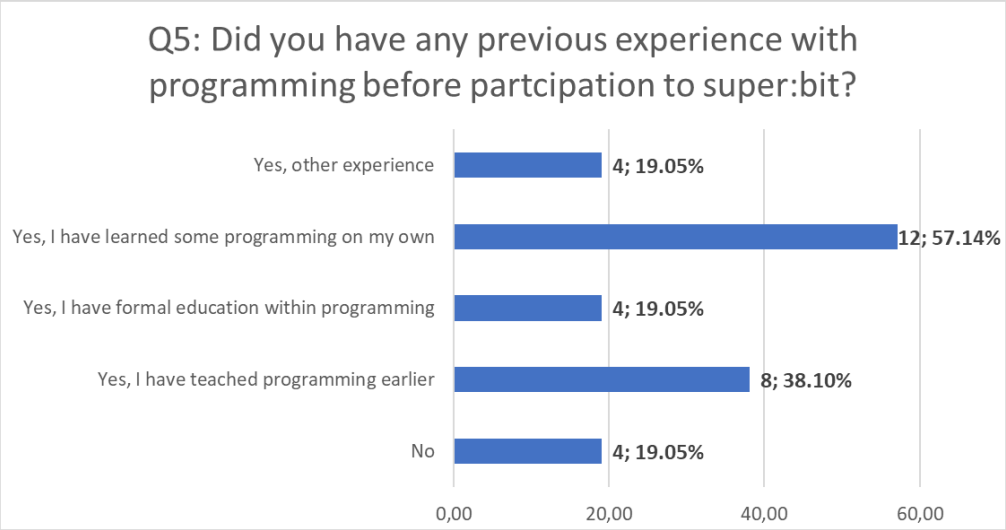

Figure 6.5: Question 5 about previous experience with programming.

Questions 6 showed that for the teachers who had taught programming earlier,

25% of them felt the teaching went okay, 37% felt it went pretty well and 37.5% felt in went well.

6.4.2 Teacher attitude

Figure 6.6 shows how participation to super:bit affected the teacher's attitudes towards the inclusion of programming in the new curricula. 52.38% of the teachers report that they are much more positive after participation. 19.05% are more positive after participation and 28.57% reports no changes in attitude. None of the teachers report a decrease in attitude.

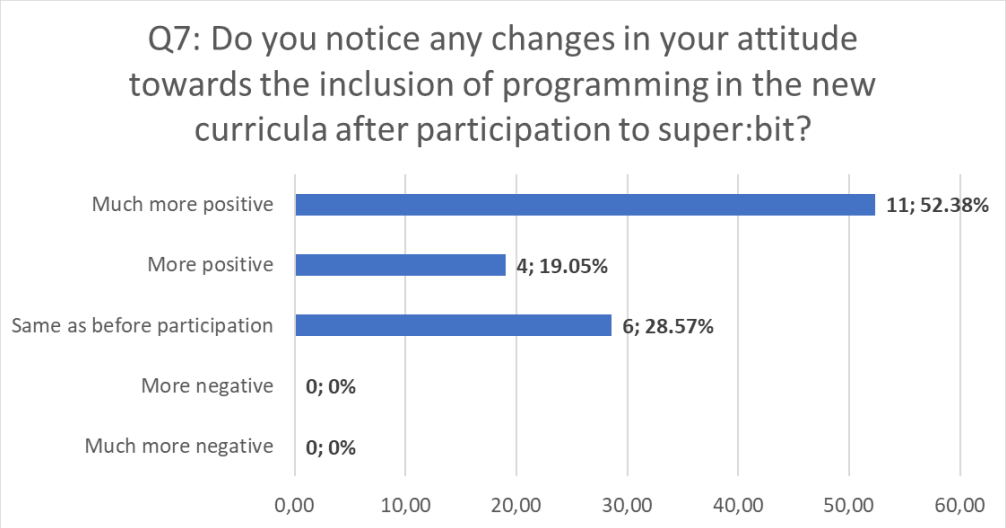

Figure 6.6: Question 7 about teacher attitude.

For the teachers who reported a change in attitude, four of them answered the open-ended question 8 about why their attitude had changed. Two of them reported that programming were easier than they had imagined. One reported increased knowledge as the reason for the attitude change. The last reported that programming with a physical object (micro:bit and bit:bot) caused the change in attitude.

6.4.3 Teacher motivation

Figure 6.7 shows the teacher's motivation to learn more about programming after participation to super:bit. 47.62% of the teachers are much more motivated to learn, 42.86% are more motivated to learn and 9.52% reported no changed in

motivation to learn. No teachers reported a decrease in motivation to learn more about programming.

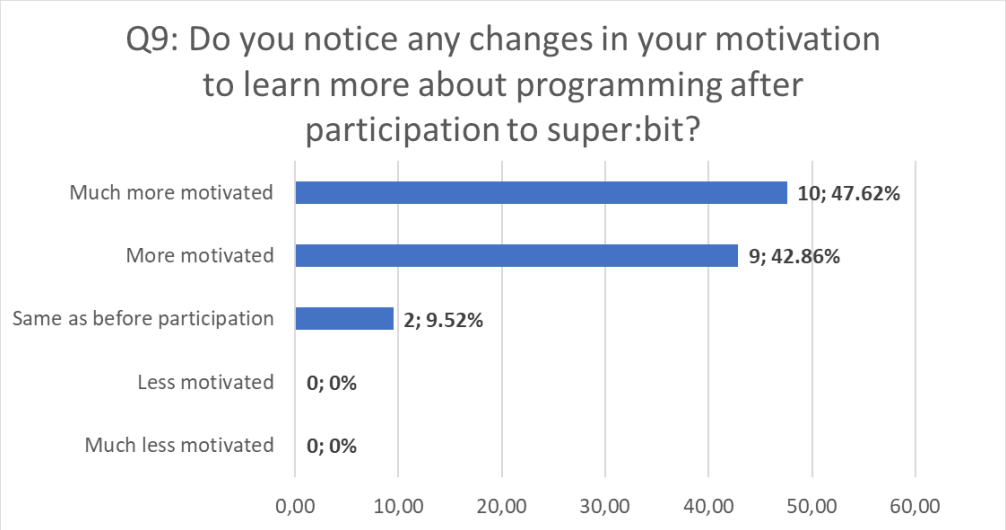

Figure 6.7: Question 9 about teacher motivation.

For the teachers who reported a change in motivation, six of them answered the open-ended question 10 about why their motivation had changed. Sense of achievement, increased knowledge, new possibilities with the introduction of micro:bit, engaging exercises, the discover of new opportunities and that everything worked/enough time were reported by the teachers.

6.4.4 Teacher knowledge

Figure 6.8 shows how participation have affected the teacher's content knowledge. For this question a simple definition of content knowledge were given under the question. 9.52% of the teachers reported a very great increase and 38.10% reported a great increase in content knowledge. Most of the teachers with 42.86% reported a somewhat increase in content knowledge. 4.76% of the teachers reported a little increase and 4.76% reported a very little increase in content knowledge.

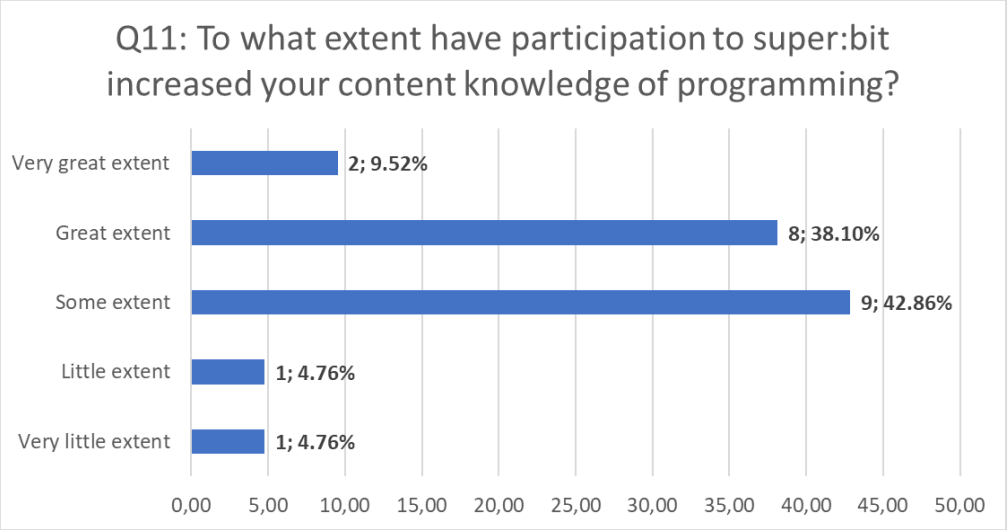

Figure 6.8: Question 11 about content knowledge.

Figure 6.8 shows how participation have affected the teacher's pedagogical knowledge. For this question a simple definition of pedagogical knowledge were given under the question. The result is similar to the result for content knowledge. The difference is that the one teacher who reported little increase in content knowledge, reported a great increase in pedagogical knowledge.

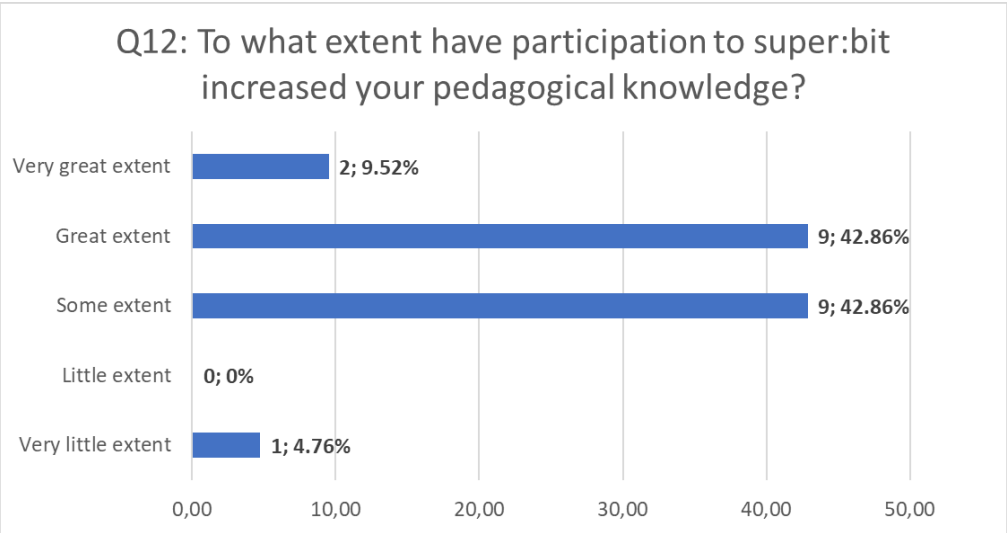

Figure 6.9: Question 12 about pedagogical knowledge

6.4.5 Teacher self-efficacy

Figure 6.10 shows how the teachers feel prepared for including programming in their teaching after participation to super:bit and this question were used to say something about their self-efficacy. Most of the teachers, with 61.90% feel better prepared , and 28.57% feel much better prepared after participation. 9.52% feel no changes in how they are prepared.

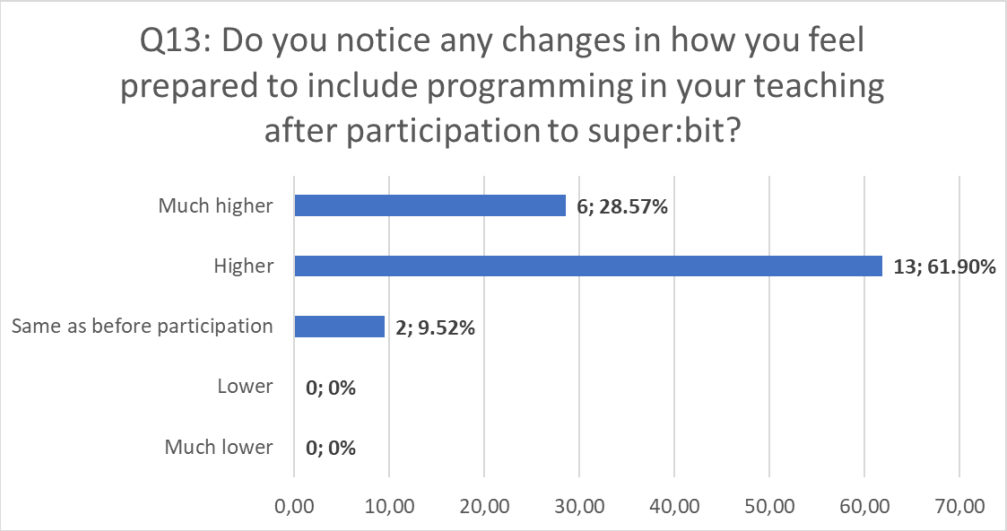

Figure 6.10: Question 13 about self-efficacy.

Figure 6.11 shows the teacher's self-efficacy towards using the ready-made teaching plan created by the science centres. Most of the teachers, with 66.67% feel well prepared, while 28.57% feel very well prepared for using the ready-made teaching plan. 4.76% feel somewhat prepared. This result is promising, as one of super:bit's purposes is that the teachers should be able to use the ready-made teaching plan on their own after participation [57].

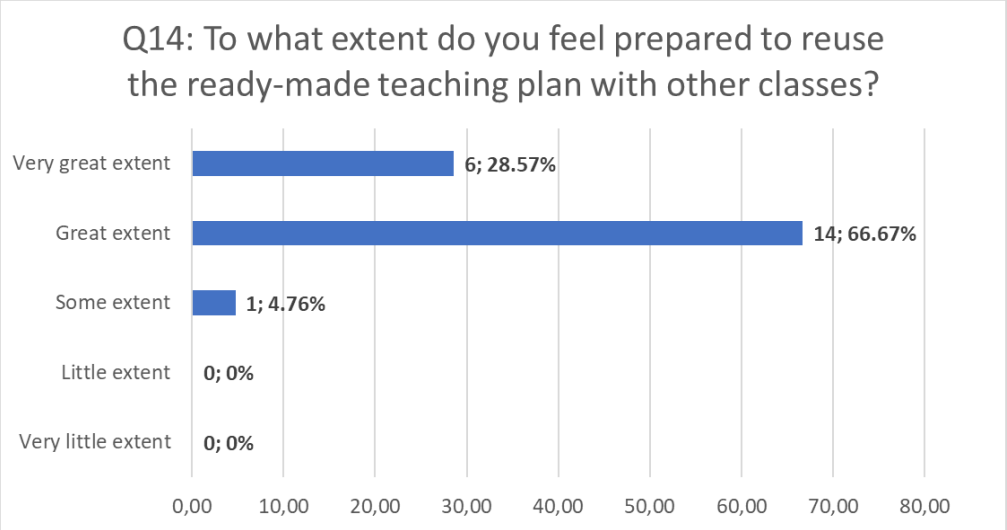

Figure 6.11: Question 14 about self-efficacy towards using the teaching plan made by the science centres.

Figure 6.12 shows that the teacher's self-efficacy are slightly lower for finding other ready-made teaching plans and use them. 57.14% of the teachers feel ready and 23.81% feel very ready for finding other ready-made teaching plan and use these. 19.05% of the teachers feel somewhat ready.

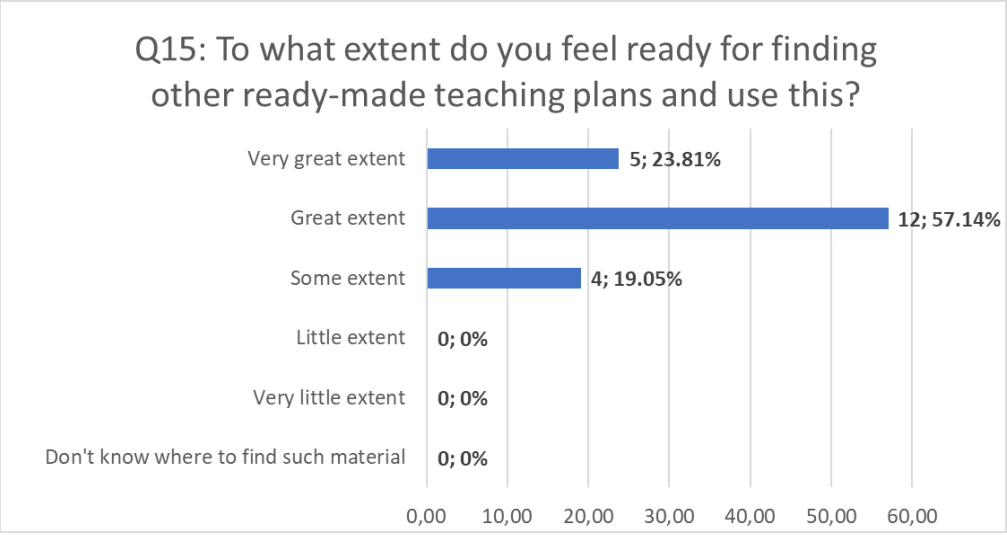

Figure 6.12: Question 15 about self-efficacy for finding and using other teaching plans.

Figure 6.13 shows that the teacher's self-efficacy are again slightly lower for cre-

ating their own teaching plans which includes programming. 52.38% feel ready and 14.29% feel very ready for making their own teaching plans that includes programming. 28.57% feel somewhat ready and 4.76% feel less ready for this.

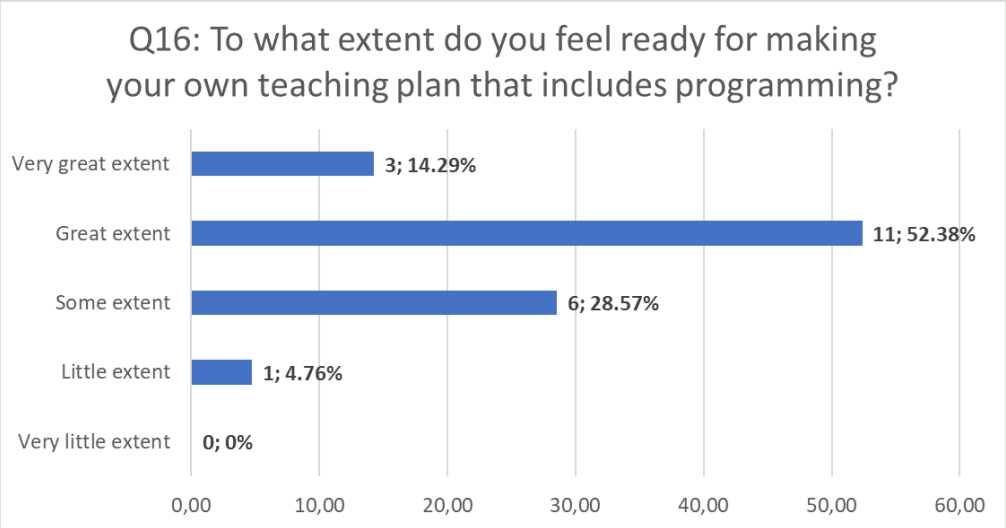

Figure 6.13: Question 16 about self-efficacy for creating own teaching plans.

6.4.6 After participation

Figure 6.14 shows to what extent the teachers think that super:bit has created a community of practice.. All teachers agree at least to some extent that they have an area for asking and discussing programming related stuff after participation to super:bit. 52.38% agree to a great extent and 9.52% agree to a very great extent that such a community has been created after participation. 38.10% agree somewhat that such a community has been created after participation.

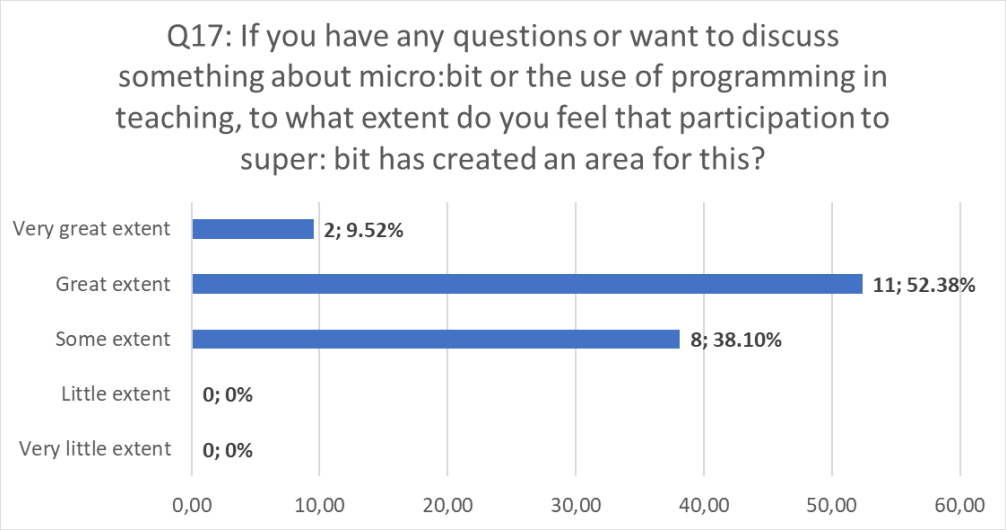

Figure 6.14: Question 17 about community creation.

Figure 6.15 shows to what extent the teacher have continued some of their new knowledge to other teachers at their school after participation. Most of the teachers with 57.14% reports to have done this to some extent. 23.81% reports that they have been good at continuing their knowledge and 9.52% reports that they have been very good at continuing their knowledge to other teachers. 9.52% reports that they have been bad at continuing their knowledge to other teachers.

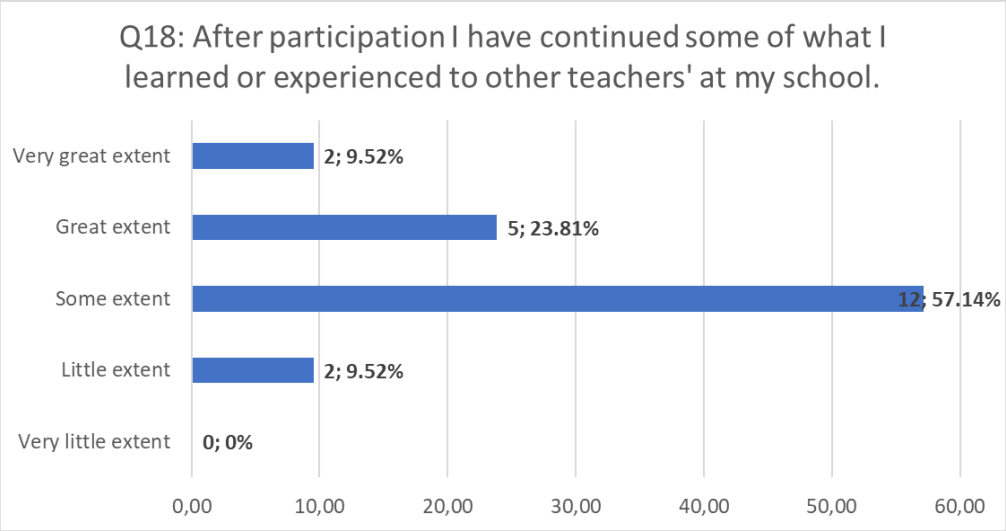

Figure 6.15: Question 18 about the teacher's continuation of knowledge after participation to super:bit.

Figure 6.16 shows how frequently the programming toolkit has been used at the schools after super:bit. 47.62% of the schools reports occasionally use, 38.10% report frequently use, and 9.52% report very frequently use. 4.76% reported that the toolkit had not been in use. This teacher wrote in a follow-up question on why it had not been used that he/she just attended the pupil training and had not found time to use it yet. The teacher was sure that the toolkit would be used in the future.

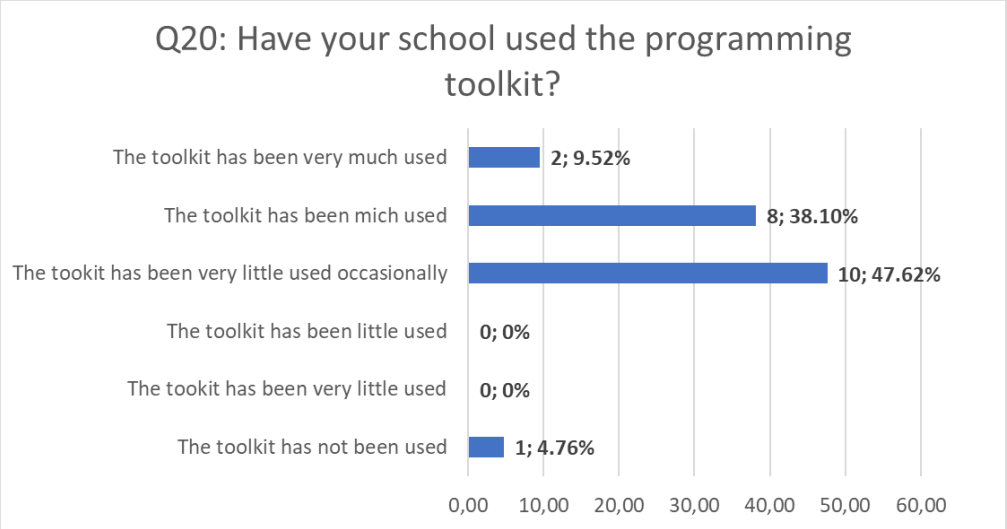

Figure 6.16: Question 20 about the use of the programming toolkit.

Figure 6.17 shows how the teachers have used the super:bit teaching plan after participation. Most of the teachers with 42.86% have used it in another class, while 19.05% have used it in the same class. 14.29% have used in multiple other classes and 9.52% have done both. 14.29% have not used it at all.

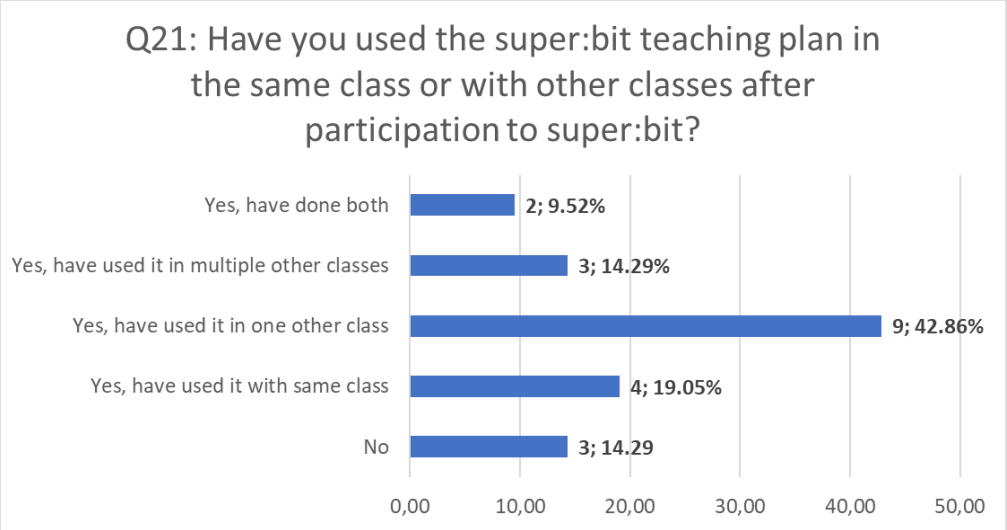

Figure 6.17: Question 21 about the use of the super:bit teaching plan after participation.

Question 22 were an optional open-ended questions for the three teachers who had not used the super:bit teaching plan after participation. Two of the three teachers answered that this was due to time related issues and that they just had attended the pupil training. The last teacher did not answer.

Question 23 and 24 asked how the teachers felt it went to do as they answered in question 21. Among the teachers who used the teaching plan in another class, 64.29% (9) reported that it went pretty well and 35.71% (5) reported that in went well. For the teachers who continued with the same class 66.67%(4) reported that it went pretty well and 33.33%(2) reported that it went well. No teachers reported "neutral", "pretty bad" or "bad". This seems to concur with question 11 seen in Figure 6.11.

Figure 6.18 shows how frequently the teachers have included programming in their teaching, here meaning other activities than the super:bit activities. 61.90% of the teachers report that they include programming in their teaching occasionally, while 33.33% have done it often. 4.76% (one teacher) have not included programming in his/her teaching after participation. Although this teacher answered that he/she had worked on with super:bit in the class who had the pupil training. The three teachers who answered that they had not continued working with super:bit in question 21, had all included programming occasionally or many times in their teaching. This means that all the teachers have taught programming after participation to super:bit. Of the teachers who had done other programming activities than super:bit, 70.0% of them reported that the teaching went well and 30.0% reported that the teaching went very well.

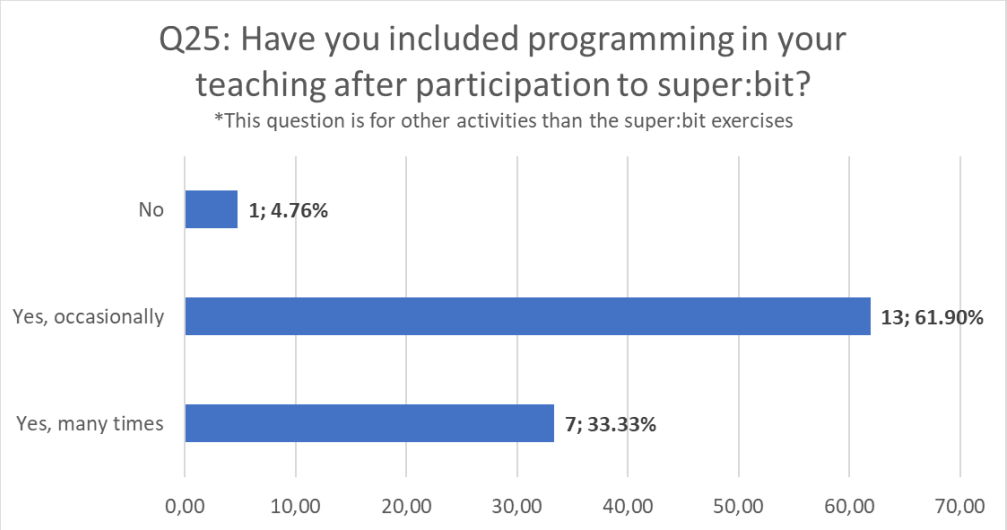

Figure 6.18: Question 25 about teaching programming after participation.

Figure 6.19 shows the share of teachers that has been in contact with their regional science centre after participation to super:bit. 71.43% of the teachers have not been in contact with their science centre. 23.81% had been in contact once and 4.76% had been in contact more than once with their regional science centre. This can indicate that even super:bit has follow-up as a part of the project, most teacher do not take direct advantage of this opportunity.

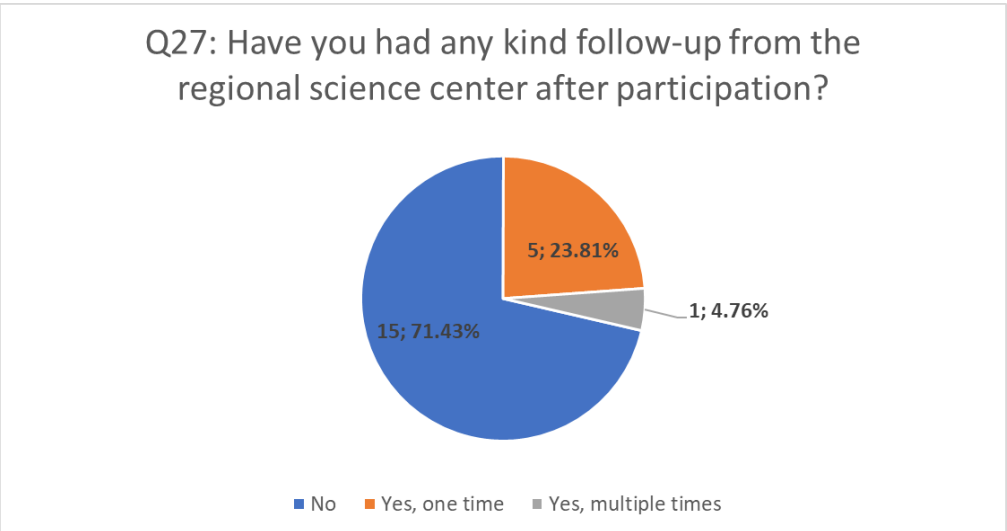

Figure 6.19: Question 27 about follow-up from the regional science centres.

6.5 Summary of the results

Some of the findings in this questionnaire seems to be consistent with the quantitative data presented in Chapter 3 and some of the findings in Chapter 4 and 5. All teachers report an increase in at least one of the following: attitude towards programming, motivation to learn, content knowledge, pedagogical knowledge or self-efficacy.

In addition the results provide some new information about the teacher's self-efficacy, what the teachers have done after participation and to what extent they are feeling that super:bit has created a community of practice.

In the context of teacher self-efficacy, over 90% of the teachers reported an increased self-efficacy after participation. Almost all teachers are feeling ready to reuse the super:bit teaching plan, while some less are feeling ready for creating their own teaching plans that include programming. After participation, the programming toolkit has been used on all schools, except one who have planned to use it in the near future. All teachers have taught programming after participation to super:bit and the majority of the teachers felt this went good. Most of the teachers has not received/asked for any follow-up from the regional science centre. The teachers mostly agree that participation to super:bit has created a community of practice where they can discuss and ask questions related to programming.

Chapter 7

Discussion

7.1 Chapter overview

The previous chapters has explored how participation to super:bit have impacted the teacher's knowledge, attitudes, motivation and self-efficacy in the field of programming. In this chapter the researcher discusses why the super:bit model is interesting with the use of the results from the previous chapters and relevant theory. Next, the research questions from Section 1.3 are explored through a discussion of the results from the previous chapters in the light of relevant theory. Lastly, some suggestions to further improve super:bit or similar teacher PD programs are given.

7.2 What makes the super:bit model interesting?

When Papert and his colleagues introduced Logo programming at primary schools in the 1970s and 1980s, it did not turn out the be the success they had hoped for. One of the main reasons for this were that the teachers lacked the necessary experience and competence to teach programming [46]. One year after Sweden introduced programming as a part of their curricula in mathematics there were still few teachers that had received adequate training [52].

After the introduction of programming in the national curricula for compulsory education, Norway has a great demand for teachers with programming competence. When the government choose to include programming in four out of ten subjects in primary school and did not have a strategy for the neither in-training or in-service teachers one can raise the question if we have learned from the experiences of other countries. With this in mind, the importance of teacher PD

programs such as super:bit is crucial.

Super:bit combines traditional teacher training (the teacher training part) with an outreach activity (the pupil training part). The outreach activity is not just designed for the pupils, but is itself a part of the teachers PD. The combination of the teacher and pupil training follow most of the seven recommendations for effective teacher PD proposed by Darling-Hammond, Hyler and Gardner [28]. Together the teacher and pupil training are content focused, as both training is focused on the super:bit exercises, where on of the goals are that the teachers should be able to teach on their own using the same exercises after participation [57]. The pupil training also typically takes place in the teachers classrooms which is another characteristic for *content based learning*. The teacher training part is mainly based on *active learning*, where the teachers are exploring the micro:bit and bit:bot and are taking part in the same learning activity as their pupils will work with during the pupil training part. *Collaborative learning* is used in the teacher training part, where the teachers work together in pairs. *Modelling of effective practice* and *coaching/expert support* are exactly what the pupil training part is for the teachers, where they observe and learn from the educationalist when he/she is having a kind of a demonstration lesson. *Feedback and reflection* can not be argued to be included in super:bit, but it could have been used without changing too much of the super:bit structure. For example as a collective discussion with the educationalist from the science centre and all the teachers present at the pupil training right after the pupil training part. *Sustained duration* can not be argued to be a part of super:bit. As super:bit is a national project, with the goal of reaching all primary schools in Norway [12], it would not have been possible to have a *sustained duration* and expect that all schools and their teachers signs up for the project. With the structure of super:bit, attending teachers only need to be away from their school and classes for the teacher training part. This should make it possible for teachers who do not have the possibility to attend more time demanding teacher PD programs to attend. It could also make it easier for less motivated teachers to sign up.

With participation in super:bit the schools receives a programming toolkit for free. This can help the teachers to overcome challenges due to unavailability of technology and resources, which is one of the main concerns for some teachers [30]. Super:bit also includes free available online resources. Teachers often find it challenging to assess the quality of online resources [30], super:bit's resources are already used and tested by the regional science centres and this could help the teachers to overcome this challenge.

The teachers who have attended super:bit until September 2020 seems to be overall very happy with their participation, rating the pupil training part slightly above the teacher training part when looking into the quantitative data received from the science centres and the analysis of the teacher comments in Chapter 4.

7.2.1 The super:bit model - with an additional last step

As the researcher see the the super:bit initiative, there is an additional sixth step in the super:bit model, the creation of a community of practice. This is supported by the open Facebook group "super:bit lærerforum" [68], which is described as "a group for everything that has to do with super: bit in school. Here, there will be a high tolerance for various content and the opportunity to ask all kinds of questions, share projects and get inspiration to use the super:bit toolkit in the classroom". The group has 771 members by the 26th of January 2021 [68]. In the Facebook group there are also members from the regional science centres. The results of the researcher's questionnaire in Section 6.4 showed that all the teachers in the questionnaire felt that they were a part of a community of practice after super:bit to at least some extent. Over 60% of them felt this to a great or very great extent. The observational findings presented in Section 5.4 also gave some minor support to the community of practice creation. During the teacher training part teachers that were facing some of the same challenges were meeting and got the opportunity to establish new connections. Based on this the researcher developed the refined super:bit model seen Figure 7.1.

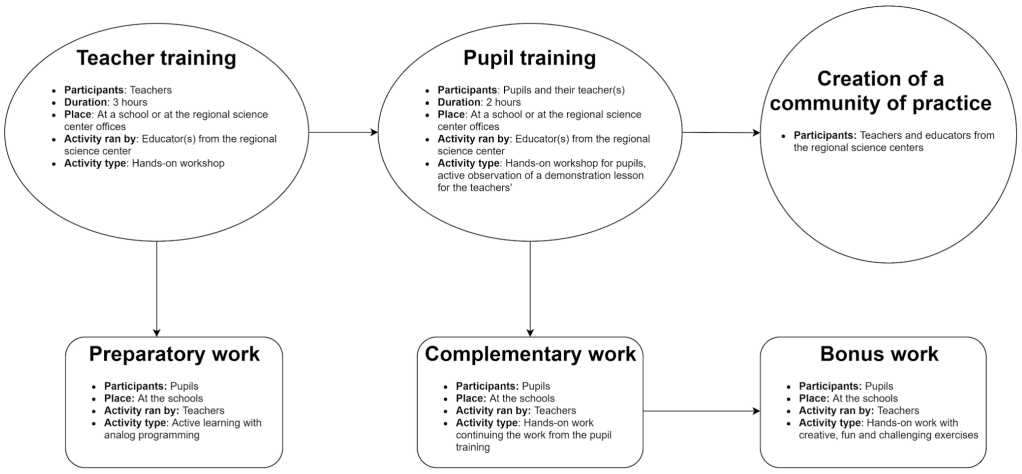

Figure 7.1: The super:bit model

A such community of practice creation is important, considering one of the main challenges among teachers who teach programming are isolation [30]. With a community of practice, the teachers have an area to continue their teacher PD.

7.3 How does participation to super:bit impact the teachers?

To look into how participation to super:bit impacted the teachers professional development this research has focused on the first two steps of Desimones [15] conceptual framework, adapted to the recommendations for effective teacher PD by Darling-Hammond, Hyler and Gardner [28], as shown in Figure 2.1. The focus has been on how participation to super:bit have impacted the teacher's knowledge, attitudes, motivation and self-efficacy.

To look into these four aspects the three data sets presented in Chapter 3, 4, 5, 6 are used. In the science centre questionnaire almost all super:bit teachers have participated, but the questions are focused towards an evaluation of super:bit. The researchers questionnaire are focused towards the research questions, but has few participants. The observations of the teacher training part and pupil training part add some value to the other data sets in the sense that it does not contain self-reporting from the teachers, but the researchers observations.

The teachers in the researcher's questionnaire were more experienced with programming than the average super:bit teacher when comparing it to the science centres questionnaire. This could be due the fact that the researchers questionnaire were posted in the super:bit Facebook group [68] which does not include all super:bit teachers, but a sample of the teachers which on their own initiative have joined the group.

Super:bit is implementing most of teaching methods recommended for effective teacher PD by Darling-Hammond, Hyler and Gardner [28], which increases the opportunity for positive changes in teacher attitude, motivation and self-efficacy and knowledge.

7.3.1 Teacher attitude

The analysis of the teacher comments from the science centres questionnaire showed that many teachers found both the teacher training part and the pupil training part engaging, fun, useful or similar, which can indicate both a positive attitude and a positive change in attitude towards programming. The researchers questionnaire found that about 72% of the teachers reported a more or much more positive attitude towards programming after participation. This is interesting considering that the teachers of that questionnaire is considered to be more interested and hence also more positive towards programming than the average super:bit teacher. The observation during the teacher training part also supports this, where about 70% of the teachers were very engaged and worked hard during

the training. That most of the teachers are positive towards programming are in line with Jom and Berggren's [9] findings.

7.3.2 Teacher motivation

The questionnaire from the science centres hows that over 97% of the teachers are motivated or very motivated to take the programming toolkit into use after participation. The teacher comments from the science centres questionnaire about teacher motivation are only positive, showing that the teachers have increased motivation after participation, are motivated to learn more and are motivated for the continuation. The questionnaire made by the researcher indicates that the teachers motivation to learn more about programming is the factor that have increased most among the four factors this research has looked into. Over 90% of the teachers reported to be more or much more motivated to learn more about programming after participation. The observation of around 70% of the teachers being engaged during the teacher training part does also support that participation to super:bit motivated most of the teachers to learn more and for the continuation. The observations of the pupil trainings showed pupils enjoying and learning, which the teachers also observed and as many described in the teacher comments. Many teachers reported in the comments that they observed possibilities with adapted education when teaching programming. Observing this is also likely to be a motivating factor for the teachers and their opportunities when they are teaching programming. Motivated teachers are a key factor for a successful implementation of new curricula [19], and given the results it seems like super:bit could help with the actual implementation of the new curricula in Norway.

7.3.3 Teacher knowledge

The teachers participating to super:bit has various programming experience, and this could influence if and how much their perceived knowledge increase. A teacher with little or no previous experience with programming has low content knowledge and he/she will most likely not need much training before the perceived content knowledge increases. While a teacher with formal education in programming would most likely need much more training before the perceived content knowledge increases. The same goes for pedagogical knowledge, where teachers who never have taught programming needs less training than teachers who are experienced in teaching programming to increase their perceived pedagogical knowledge. Most of teachers who have attended super:bit have little or no experience with teaching the subject of matter (programming), which is different from a typical teacher PD program in other subjects.

The main area for the teachers to develop their content knowledge in super:bit

seems to be the teacher training part. This is supported by the teacher comments from the science centres questionnaire where most of the teachers who report a positive learning outcome, does this after participation to the teacher training part. This assumes that most of the teacher comments in the subcategory "Learning outcome" from the teacher training part describes an increase in content knowledge. This assumption is made because most of the teacher training part is used to practice programming using the micro:bit and bit:bot. In the researcher's questionnaire about 47% of teachers report a great to very great increase in content knowledge. Compared to the changes in teacher attitude and motivation the changes in content knowledge are a little smaller. Taken the limited duration and the different teacher background into consideration this seems logical.

The pupil training part is a type of modelling learning. This is a opportunity for the teachers to increase their pedagogical knowledge through observation. Even few teachers reported a positive learning outcome in the teacher comments from the science centres questionnaire after the pupil training part, many of them reported to observe good adapted education and that the pupils enjoyed the session. This observations could also result in an increase in pedagogical knowledge, if the teachers also observed and learned about how to use adapted education and how and engage pupils when teaching programming. For the teacher's pedagogical knowledge the researchers questionnaire showed a similar increase as for the content knowledge, but a little higher with about 52% reporting a great to very great increase.

7.3.4 Teacher self-efficacy

Teacher self-efficacy is linked to pupils academic achievement, motivation and self-efficacy [21], in other words it is linked to the pupils outcome, which is the last step in the conceptual framework for in Figure 2.1. In the teacher comments there were some few comments who were interpreted by the researcher to be about teacher self-efficacy. Most of these comments described a low sense of self-efficacy towards teaching programming. This does not match the results of the researchers questionnaire which tried to measure the teachers self-efficacy at three different levels, in addition to how participation to super:bit have affected their overall self-efficacy towards teaching programming. The results showed that over 90% reported an increase in self-efficacy, while none of the teachers reported a decrease in self-efficacy towards teaching programming after participation to super:bit. For the first level, over 95% of the teachers showed a high to very high self-efficacy towards re-using the teaching plan used in super:bit. This is promising for one of super:bit own goals, namely that the teachers should be able to re-use the teaching plan the year after participation [57]. For the next level, about 80% of the teachers showed a high to very high self-efficacy towards finding other ready-made material that includes programming and use this in their teaching.

While just above 65% of the teachers showed a high to very high self-efficacy towards creating their own teaching plan that included programming and use this, which was the last level for measuring the teachers self-efficacy. The total number of teacher comments for both the teacher and pupil training part that belonged to the subcategory "Self-efficacy towards teaching programming" were only 14, and even most of these expressed a low self-efficacy, this does not necessary mean that they did not increase their self-efficacy towards teaching programming during their participation to super:bit. At the same time the teachers in the researchers questionnaire is not believed to be a representative sample, meaning their self-efficacy at the different levels could be misleading and higher than the actual average. The teachers not responding to the questionnaire are either not a member of the Facebook group or not an active member and this could reflect less eager to learn about programming and how to teach it. If so, the average self-efficacy at the different levels could be lower than the researchers questionnaire shows, which would be more in line with the analysis of the teacher comments. The results showing increased self-efficacy towards teaching programming, can be understood as a broader finding. This interpretation is based on the fact that the teachers who showed a low to medium self-efficacy on the two highest levels, still reported an increase in overall self-efficacy towards teaching programming.

7.4 Suggestions for improvements of super:bit

Based on the result and the discussion above the researcher has come up with some suggestions to improve super:bit or to be implemented in similar teacher PD programs.

Based on the results from both questionnaires, and also confirmed by the observations under 70% of the teachers attend both the teacher and pupil training part. Most of the teachers who only participated to one part, participated to the teacher training part. The two parts seems to impact the teachers differently as described earlier, with content knowledge more in focus for the teacher training part and pedagogical knowledge in focus for the pupil training part. In Denmark the schools and school leaders have some clear obligations and expectations that comes with participating to the ultra:bit project. Super:bit could also have been more clear in their expectations to schools, school leaders and teachers who participate. Teachers who signs up could be expected to participate to the both trainings and especially the importance of participation to the pupil training should be more clear.

Super:bit contains most of the characteristics for effective teacher PD [28]. *Feedback and reflection* together with *Sustained duration* are the two characteristics that the super:bit initiative is missing. The duration part is a choice made to make it easier for more teachers to participate. As the researcher sees the super:bit ini-

tiative, the pupil training are a form for model learning and could be combined with *feedback and reflection*. This could be done as a short discussion right after the pupil training part, where the educationalist from the science centre and the teachers are present. This could help the teachers to move towards their vision of practice [28].

Chapter 8

Conclusion

8.1 Answers to research questions

This research has explored how a short term teacher PD program in programming can impact the participants. The case used is the national initiative super:bit, which is designed for introducing programming and the use of it in education to primary school teachers. The research is based on the research question:

How has participation to super:bit impacted the teachers' professional development (PD)?

To investigate this research question, four sub research questions were chosen:

RQ1.1: *How has participation to super:bit influenced the teachers' perceived knowledge?*
RQ1.2: *How has participation to super:bit influenced the teachers' attitudes towards programming?*
RQ1.3:*How has the participation to super:bit influenced the teachers' motivation to learn more about and teach programming?*
RQ1.4:*How has participation to super:bit influenced the teachers' perceived self-efficacy towards teaching programming?*

The conclusions for each sub-research questions will follow.

RQ1.1: *How has participation to super:bit influenced the teachers' perceived knowledge?*

This research has used a simplified model for teacher knowledge, where teacher knowledge is divided into content knowledge and pedagogical knowledge. The research indicate that the majority of the teachers who have participated in su-

per:bit has experienced an increase in perceived content knowledge or perceived pedagogical knowledge or both.

RQ1.2: *How has participation to super:bit influenced the teachers' attitudes towards programming?*

The research indicate that the majority of the teachers have a more positive attitude towards programming after participation to super:bit. The results also indicate that the majority of the teachers have a positive attitude towards programming.

RQ1.3:*How has the participation to super:bit influenced the teachers' motivation to learn more about and teach programming?*

The research indicate that the teachers' motivation for both learning more about programming and teaching it are increased for the majority of the teachers who have participated to super:bit. It seems like teacher motivation is the factor where most teachers experience an increase after participation to super:bit.

RQ1.4:*How has participation to super:bit influenced the teachers' perceived self-efficacy towards teaching programming?*

The research indicate that the majority of the teachers experienced an increase in self-efficacy after participation to super:bit. This does not necessarily mean that the teachers had a high self-efficacy towards teaching programming after participation. The results indicate that the majority of the teachers had a high sense of self-efficacy towards reusing the teaching plan created by the science centres. The teachers self-efficacy at higher levels, such as finding and using other teaching plans or create and use their own teaching plans were lower. The results in this area were ambiguous and hence the teachers' self-efficacy towards teaching programming seems to be various.

8.2 Limitations

There are several limitations in this research.

The research explores how participation to super:bit impacted the teachers' knowledge, attitudes, motivation and self-efficacy towards teaching programming. It does this by looking into the first two steps of the conceptual model in Figure 2.1. It does not look into how these findings actually influences step three and four in the conceptual model, namely the teachers practices and the pupil outcomes. It hence be that the findings are short term effects and not present a year after participation.

The sample in the researchers questionnaire is based on active participants of a Facebook group and could not be considered as a representative sample of teachers who have participated to super:bit. The number of participants in the questionnaire were also low (21).

The research touches the surface of teacher knowledge, attitude, motivation and self-efficacy towards teaching programming, but do not provide a deep investigation of each of the four factors. A deeper investigation should have included the use of validated measurement instruments for each factor. To see how teacher knowledge, attitudes, motivation and self-efficacy changed with participation to super:bit a more ideal approach would have been to measure the the four factors at different points in time. For example before participation, between the teacher and pupil training part and after participation.

Another limitation could be the researcher himself. It is important to say that the researcher is studying mathematics and informatics with teacher education, and hence has certain attitudes and views towards many of the topics in this research. The researcher has been aware of this throughout the process and has tried to have an open mind, but it can not be neglected that this has influenced the research. It should also be considered that this is the first time the researcher is doing a research project of this size and also the first experience with a mixed method research approach.

8.3 Recommendations for further work

Many countries are in a similar situation to Norway, where programming is being introduced in compulsory education and teachers lack adequate training. Further research should examine different approaches for solving this problem.

This research looks into an approach using a short term teacher PD program to reach as many teachers as possible. This research implies that participation to a short term teacher PD program combining a teacher training workshop with an outreach activity can increase teacher knowledge, attitudes, motivation and self-efficacy. Although deeper and more sophisticated research are needed and the long term effects of participation to such programs should be examined. Do the teachers instructional practices change? Do the pupil outcome change? Do the teachers continue their professional development after participation? It should also be used validated measurement instruments for looking into teacher knowledge, attitudes, motivation and self-efficacy. There are also other factors than these four who should be further explored.

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Appendix A

PowerPoint from teacher training in September 2020

Registrer deg på: https://bit.ly/Registrering_ViT

VITENSENTRENE
skaper realfagsglede

Lærerkurs i super:bit

- 12:00 Velkommen
  - Oppvarming
  - Programmering og lærers rolle
  - Introduksjon til super:bit
  - Ressurser

    Bli kjent med micro:bit
    Løs oppdrag med micro:bit
- 13:30 Kaffepause
- 13:45 Fortsette oppdrag med micro:bit
- 14:50 Oppsummering og avslutning

VITENSENTRENE
skaper realfagsglede

1 👏 2 🦶 3 👌

- To og to går sammen. De skal telle til tre annenhver gang. (Nr 1 sier 1, nr 2 sier 2, nr 1 sier 3, nr 2 sier 1 osv…)
- Vent på klart og tydelig START for å begynne og STOP for å stoppe.

VITENSENTRENE
skaper realfagsglede

Hvorfor programmering?

- En ferdighet i seg selv og nødvendig for det 21. århundre
- Kunne forstå den digitale verdenen vi lever i
- Fremmer kreativitet
- Lærer å samarbeide og kommunisere over landegrenser gjennom et felles språk
- Trener algoritmisk tekning – en problemløsningsmetode

VITENSENTRENE
skaper realfagsglede

Hvorfor programmering?

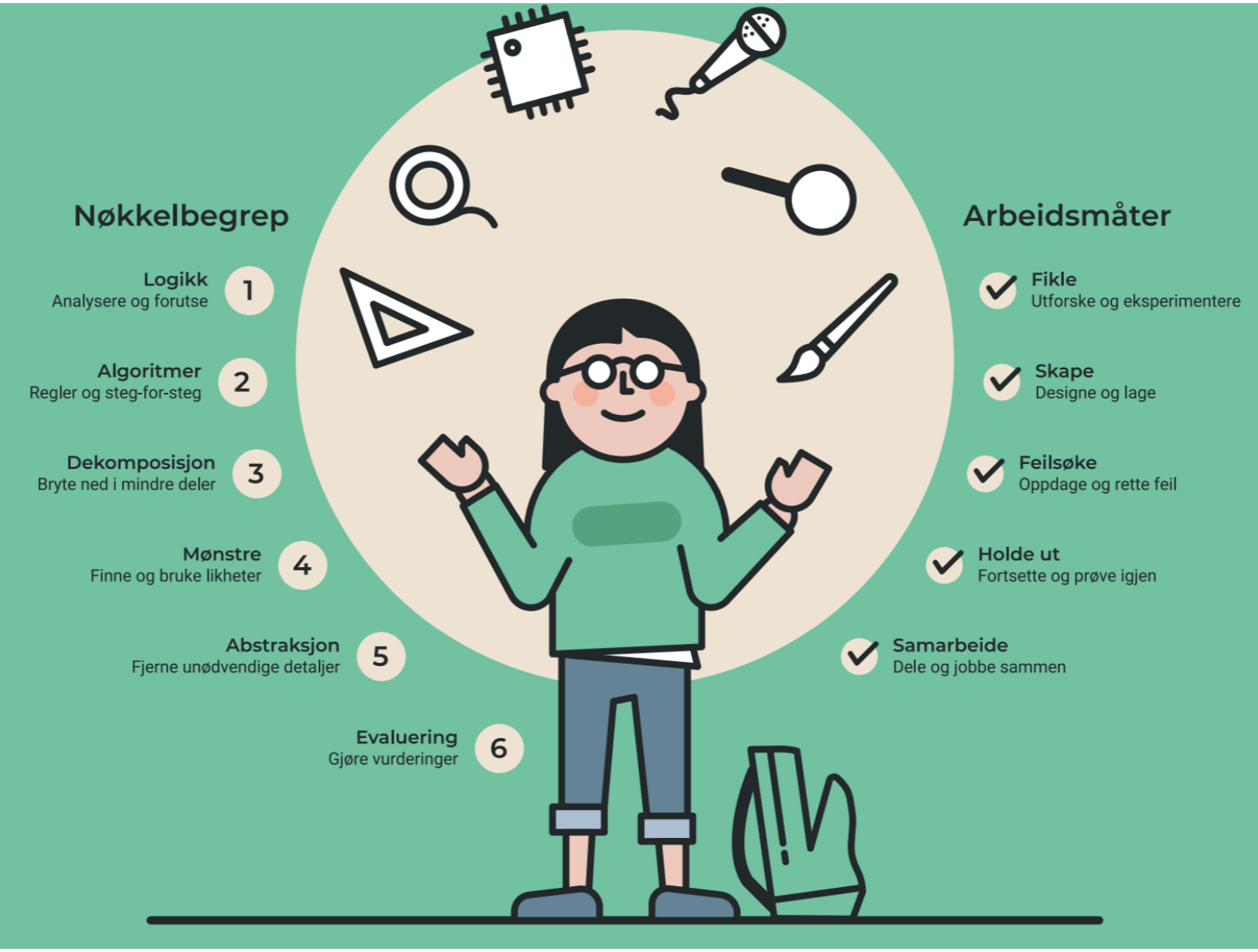
- ligheter for det 21. århundre
- som fremmer
- Trener algoritm

Den algoritmiske tenkeren

Algoritmisk tenkning er en problemløsningsmetode. Algoritmisk tenkning innebærer å tilnærme seg problemer på en systematisk måte, både når vi formulerer hva det er vi ønsker å løse og når vi foreslår mulige løsninger.

Å tenke algoritmisk er å vurdere hvilke steg som skal til for å løse et problem, og å kunne bruke sin teknologiske kompetanse for å få en datamaskin til å løse (deler av) problemet. I dette ligger også en forståelse av hva slags problemer/oppgaver som kan løses med teknologi og hva som bør overlates til mennesker.

VITENSENTRENE
skaper realfagsglede


Nøkkelbegrep
Logikk
Analysere og forutse
1
Algoritmer
Regler og steg-for-steg
2
Dekomposisjon
Bryte ned i mindre deler
3
Mønstre
Finne og bruke likheter
4
Abstraksjon
Fjerne unødvendige detaljer
5
Evaluering
Gjøre vurderinger
6
Arbeidsmåter
Fikle
Utforske og eksperimentere
Skape
Designe og lage
Feilsøke
Oppdage og rette feil
Holde ut
Fortsette og prøve igjen
Samarbeide
Dele og jobbe sammen

Fagfornyelsen

- Naturfag – kompetansemål etter 7.trinn:
  - utforske, lage og programmere teknologiske systemer som består av deler som virker sammen
- Matematikk
  - 2.trinn: lage og følgje reglar og trinnvise instruksjonar i leik og spel
  - 4.trinn: lage algoritmar og uttrykkje dei ved bruk av variablar, vilkår og lykkjer
  - 5.trinn: lage og programmere algoritmar med bruk av variablar, vilkår og lykkjer
  - 6.trinn: bruke variablar, lykkjer, vilkår og funksjonar i programmering til å utforske geometriske figurar og mønster
  - 7.trinn: bruke programmering til å utforske data i tabellar og datasett
- Kunst og håndverk – kompetansemål etter 7.trinn:
  - bruke programmering til å skape interaktivitet og visuelle uttrykk

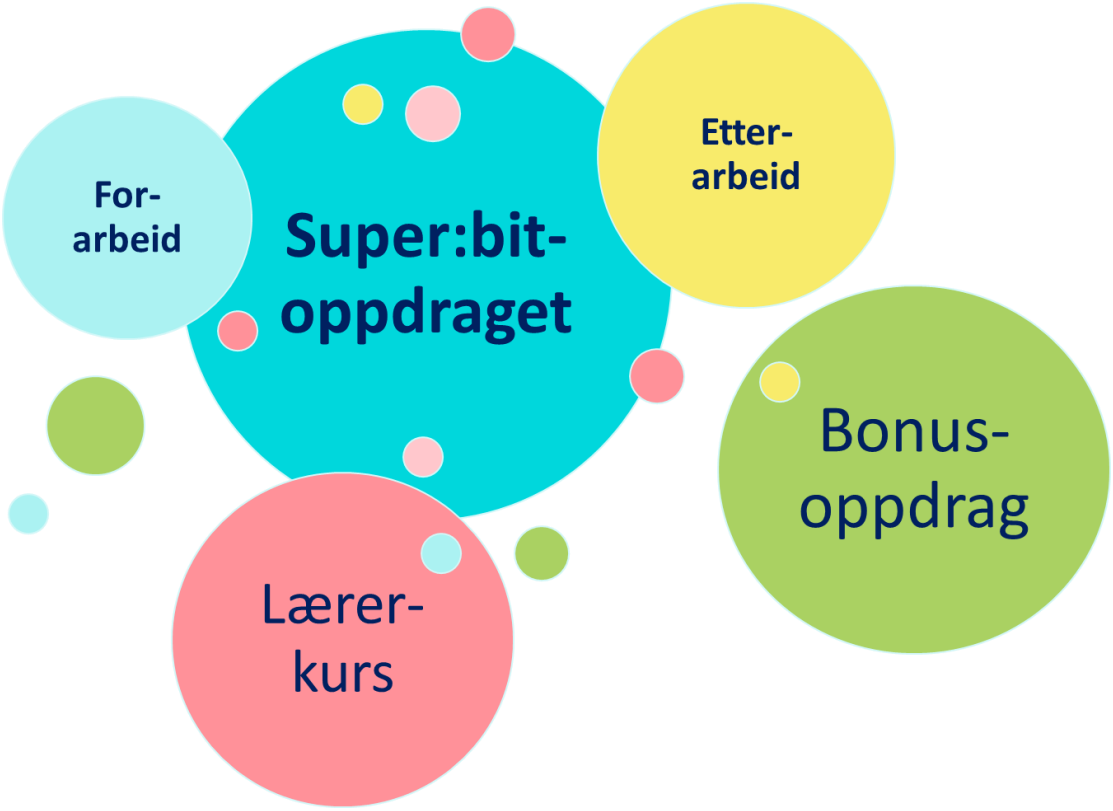
VITENSENTRENE
skaper realfagsglede

super:bit

- Vitensenterforeningen koordinerer en del av Utdanningsdirektoratets satsing «Den teknologiske skolesekken» i forbindelse med fagfornyelsen.
- Målet er å styrke programmeringskompetansen i skolen.
- Vitensenterforeningen gir hele landets 6.trinn tilbudet i løpet av skoleåret 2019/2020 og 2020/2021.
- Sparebankstiftelsen har gitt 20 millioner til prosjektet slik at alle skoler som deltar får ett klassesett med micro:bits og tilbehør.
- Et samarbeid mellom Lær Kidsa Koding og NRK Super har gitt prosjektet navnet super:bit.

VITENSENTRENE
skaper realfagsglede

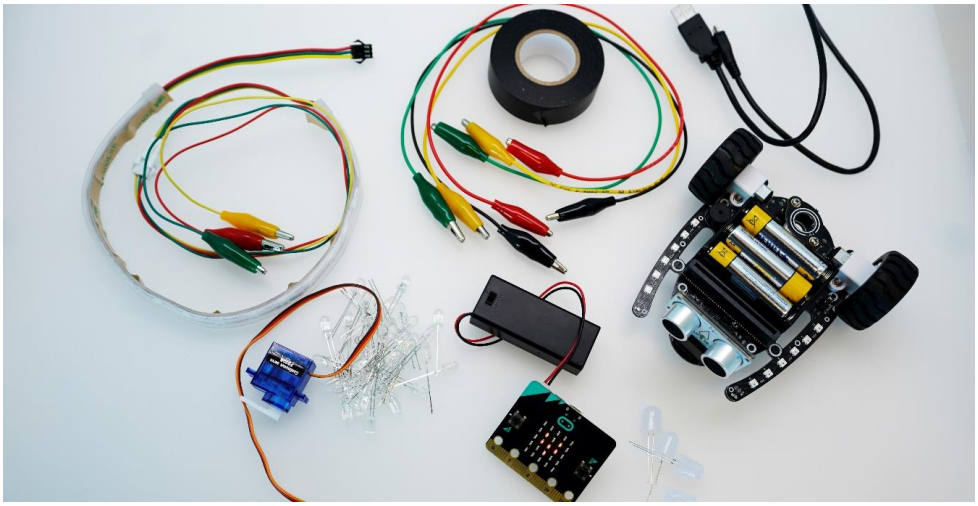
Vitensentrenes tilbud



VITENSENTRENE
skaper realfagsglede

Utstyr til skolene

- 20 microbit m/batteripakke og USB
- 10 bit:bot - ny og forbedret utgave
- 5 360-grader servo
- 5 180-grader servo
- 5 bittesmå Buzzere
- 30 stk 5mm Hvite led (til å lage gatelys)
- 40 stk 10mm LED pærer i 5 farger (totalt 200 stk)
- 1 stk LEDstrip med tilkobling
- 5 ruller sort tape
- 20 stk Alligatorklemmer pr farge (totalt 80 stk)



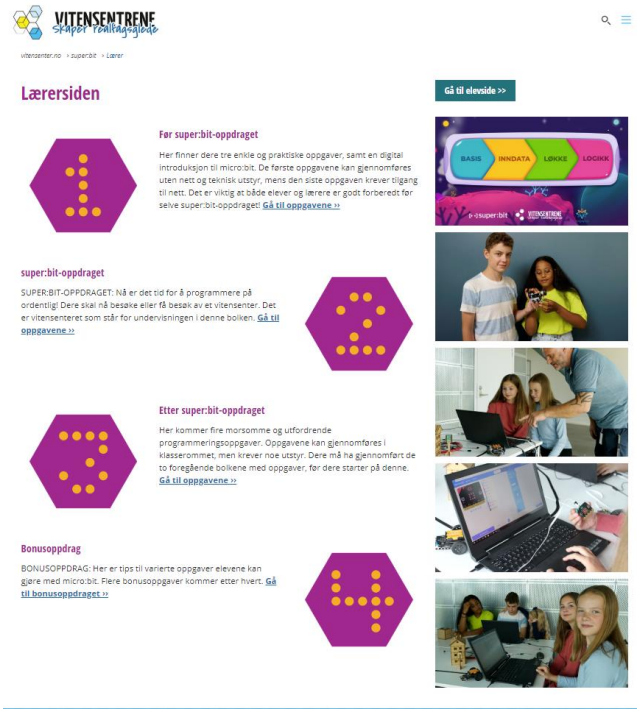
VITENSENTRENE
skaper realfagsglede

Ressurser

www.superbit.no

Nettsted med egen del for elever og lærere.

Lærerveiledning til forarbeid, etterarbeid og ekstraoppdrag



VITENSENTRENE
skaper realfagsglede

Forarbeidet

- Programmering uten datamaskin
  - 1 – 2 – 3
  - Tegn etter instruksjoner
  - Kompis programmering

- Lærerveiledning med grundig forklaring (Hensikt, Tid, Utstyr, Gjennomføring) og videoforklaringer.

VITENSENTRENE skaper realfagsglede

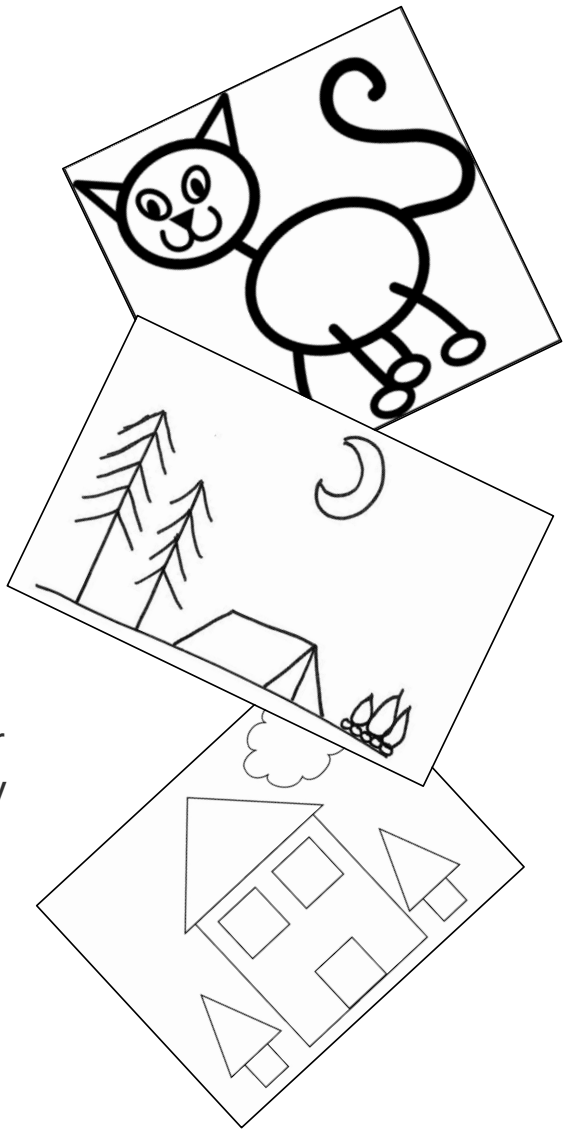
Forarbeidet

Tegn etter instruksjoner

- Utstyr:
  - Papir og blyant, men kan også utvides med linjal, gradskive og passer.
  - Tegneinstruksjoner

- Tid: 20 min.

- Hele klassen skal være «datamaskiner» og tegne etter lærerens instruksjoner.
  - Kan utvides til at 2 og 2 eller grupper gjør samme øvelsen, men at det da er en elev som leser instruksjonene.



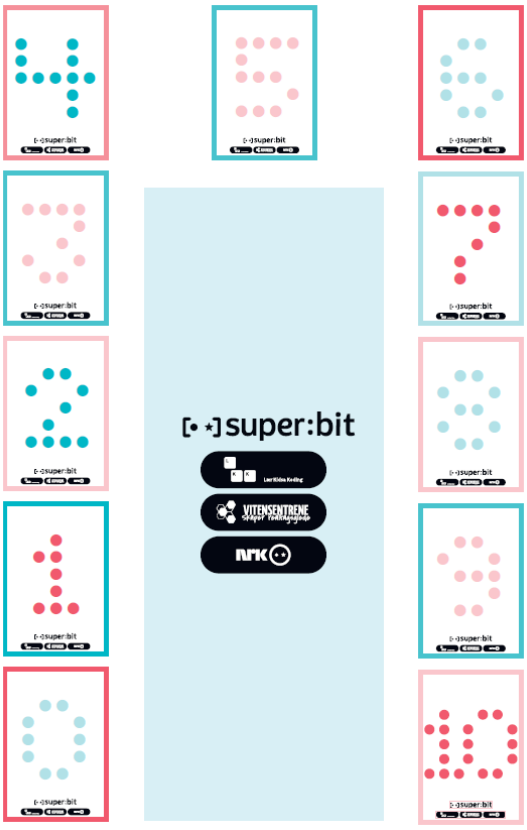
VITENSENTRENE skaper realfagsglede

Forarbeidet

Kompis programmering

- Utstyr:
  - 8 Programmeringskort
  - 11 A4-ark (fra 0 til 10)

- Elevene blir delt opp i grupper med 3-4 stk pr gruppe.
  - Kortene fra 0-10 ligger i en hestesko på gulvet
  - Elevene skal lage en programmeringskode med programmeringskortene og programmere en av elevene i gruppen til gå fra 0 til 10.



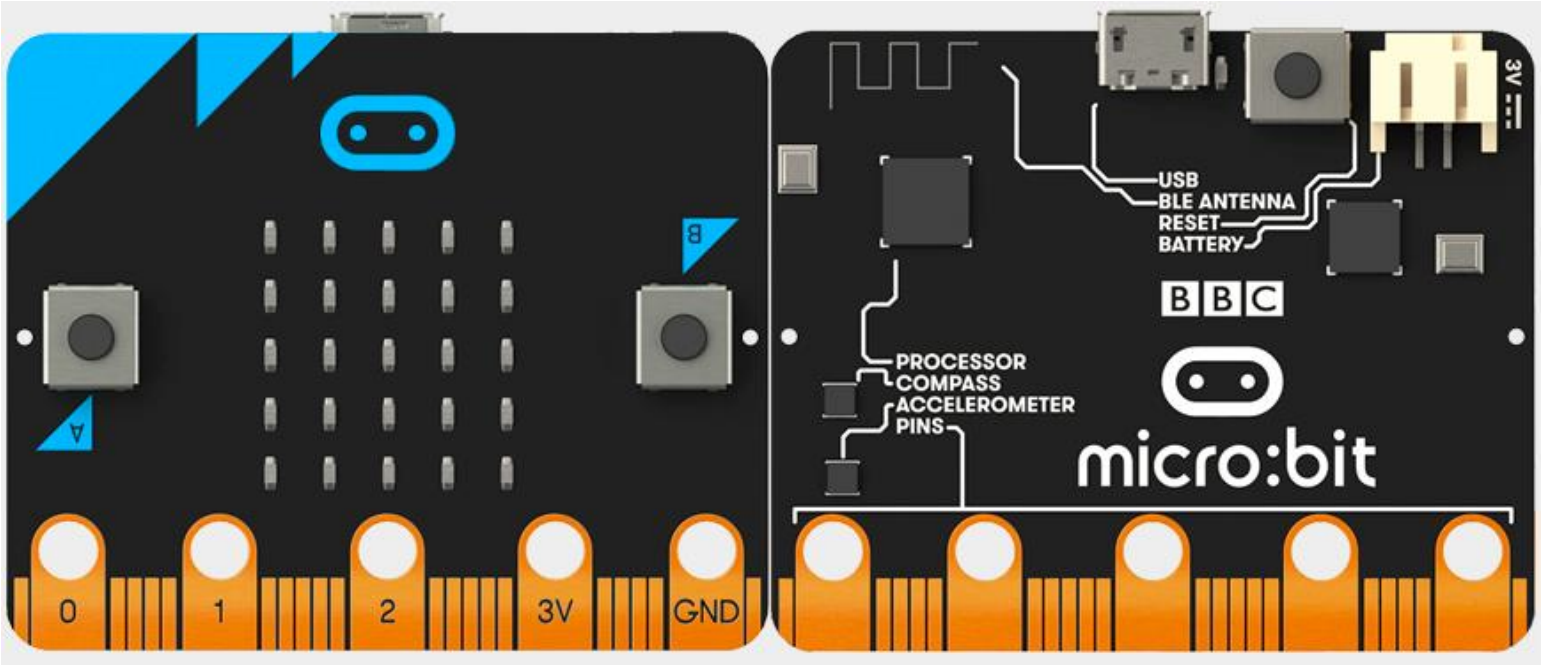
VITENSENTRENE skaper realfagsglede

Elevøvingene

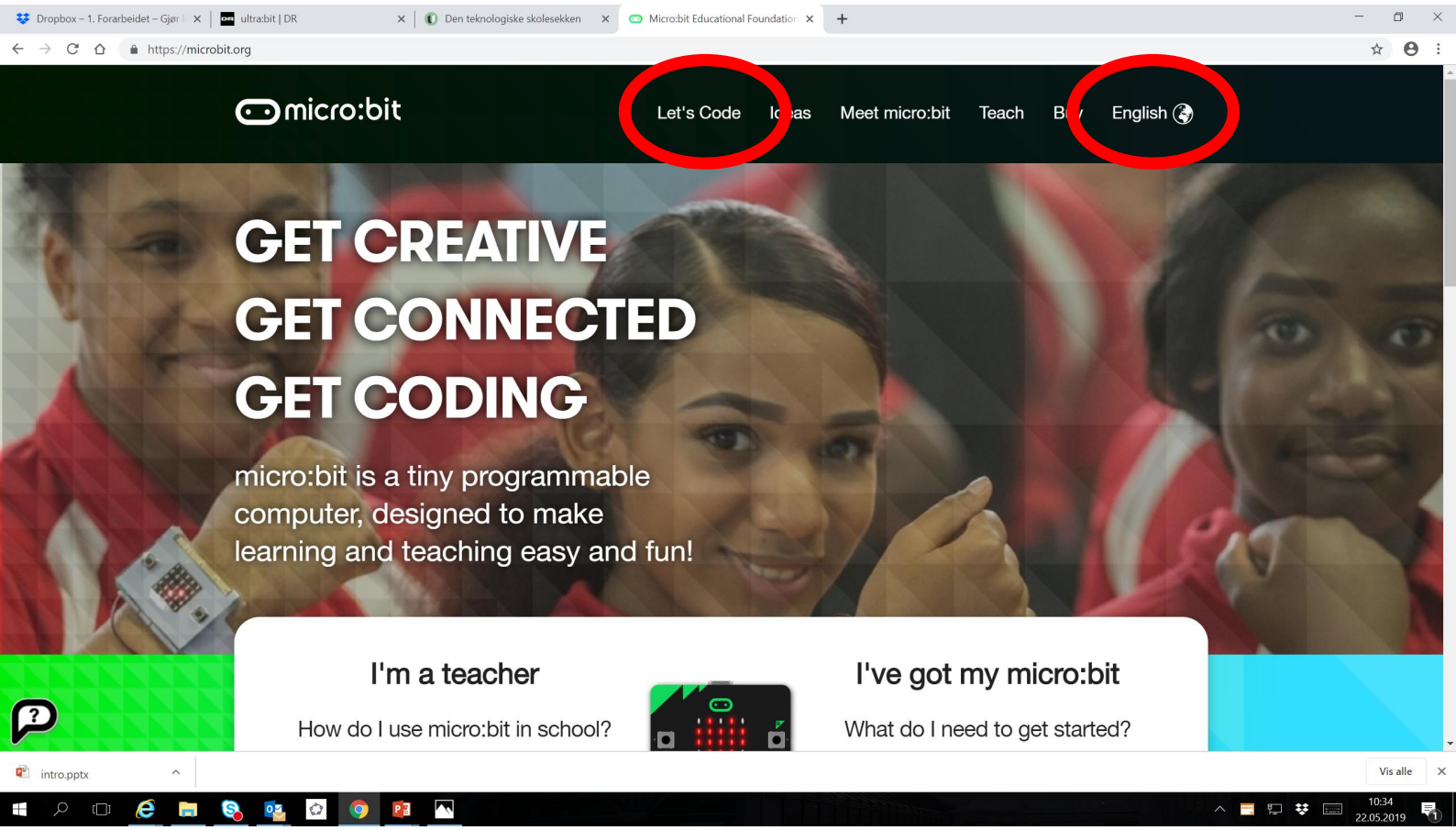
- Oppdrag i smartby Hvordan differansiere på nivå og erfaring
  - Nybegynnere blir kjent i makecode og får basistekning med ferdig kode som tilpasses for å løse oppdrag
  - Med litt erfaring kan det fokuseres i høyere grad på logisk tenking og elevene får forslag til blokker som er nyttig, men må sette de sammen selv.
  - Eksperter bør få rike oppdrag der de kommer med egne idéer til hvordan micro:bit kan brukes for å løse deler av eller hele oppdraget.

VITENSENTRENE
skaper realfagsglede

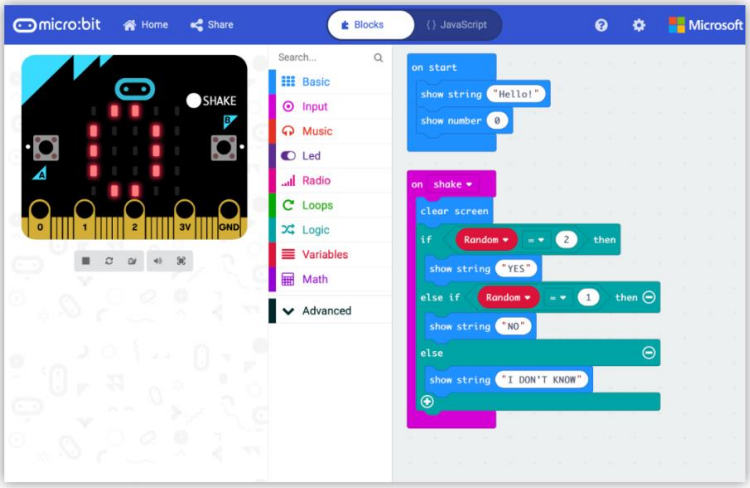
micro:bit


A
B
0
1
2
3V
GND
USB
BLE ANTENNA
RESET
BATTERY
BBC
PROCESSOR
COMPASS
ACCELEROMETER
PINS
micro:bit
3V

microbit.org



La oss kode!



MakeCode Editor

The MakeCode editor provided by Microsoft makes it easy to program your micro:bit with blocks and JavaScript. Find out more about the latest features in MakeCode.

If you have any issues accessing the editor, check that it isn't blocked in your school.

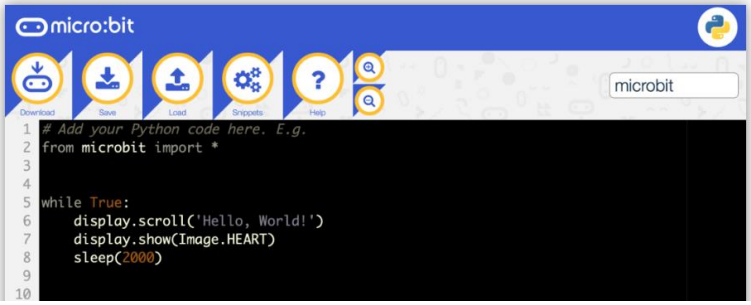
Start koding!

Referanse

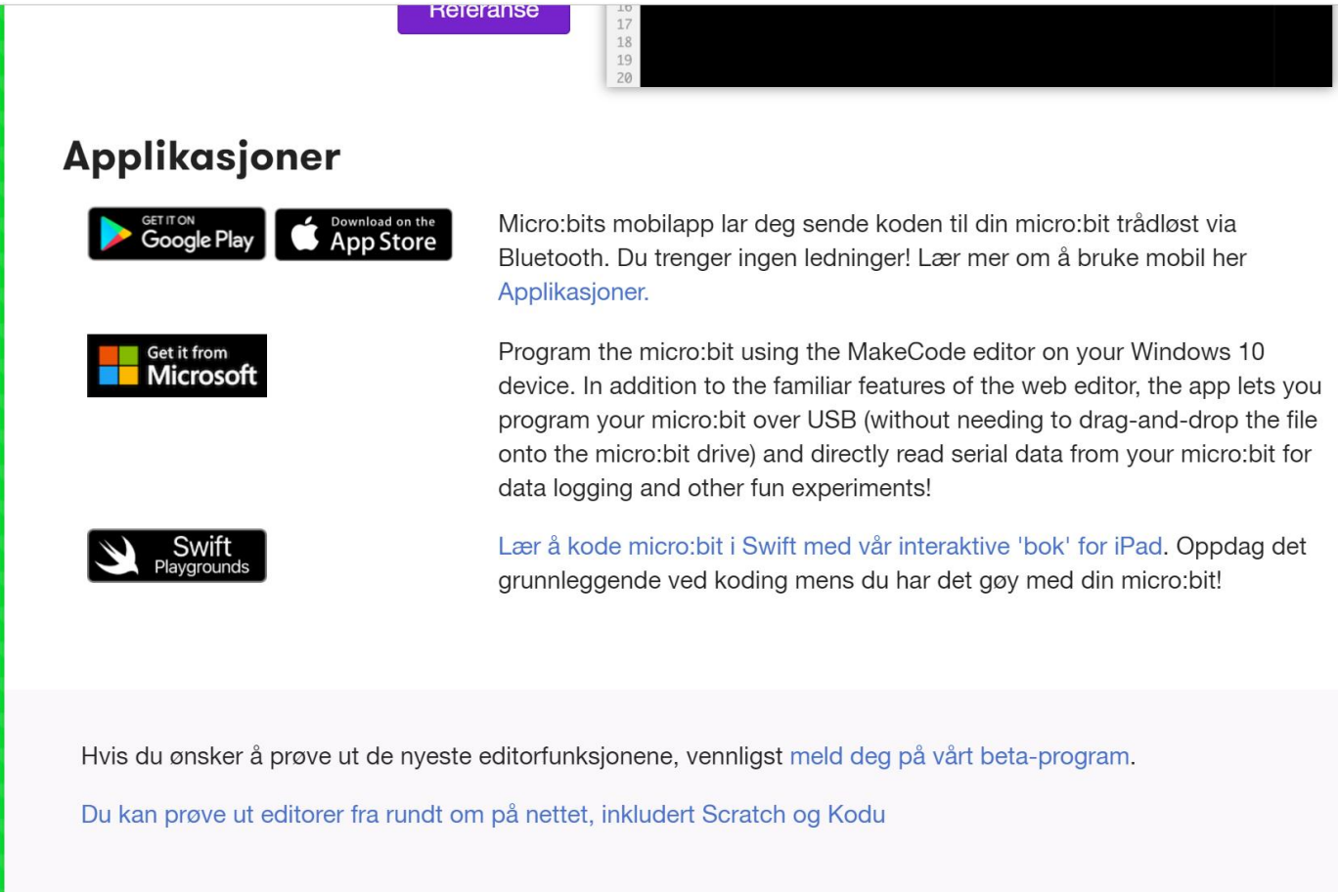
Lessons

Pythoneditor

Pythoneditor er perfekt for alle som ønsker å presse kodingsferdighetene sine videre. Et utvalg av kodebiter og en rekke forhåndsdefinerte bilder og musikk, gir deg en hjelpende hånd med koden din. Drevet av det globale Python-felleskapet.



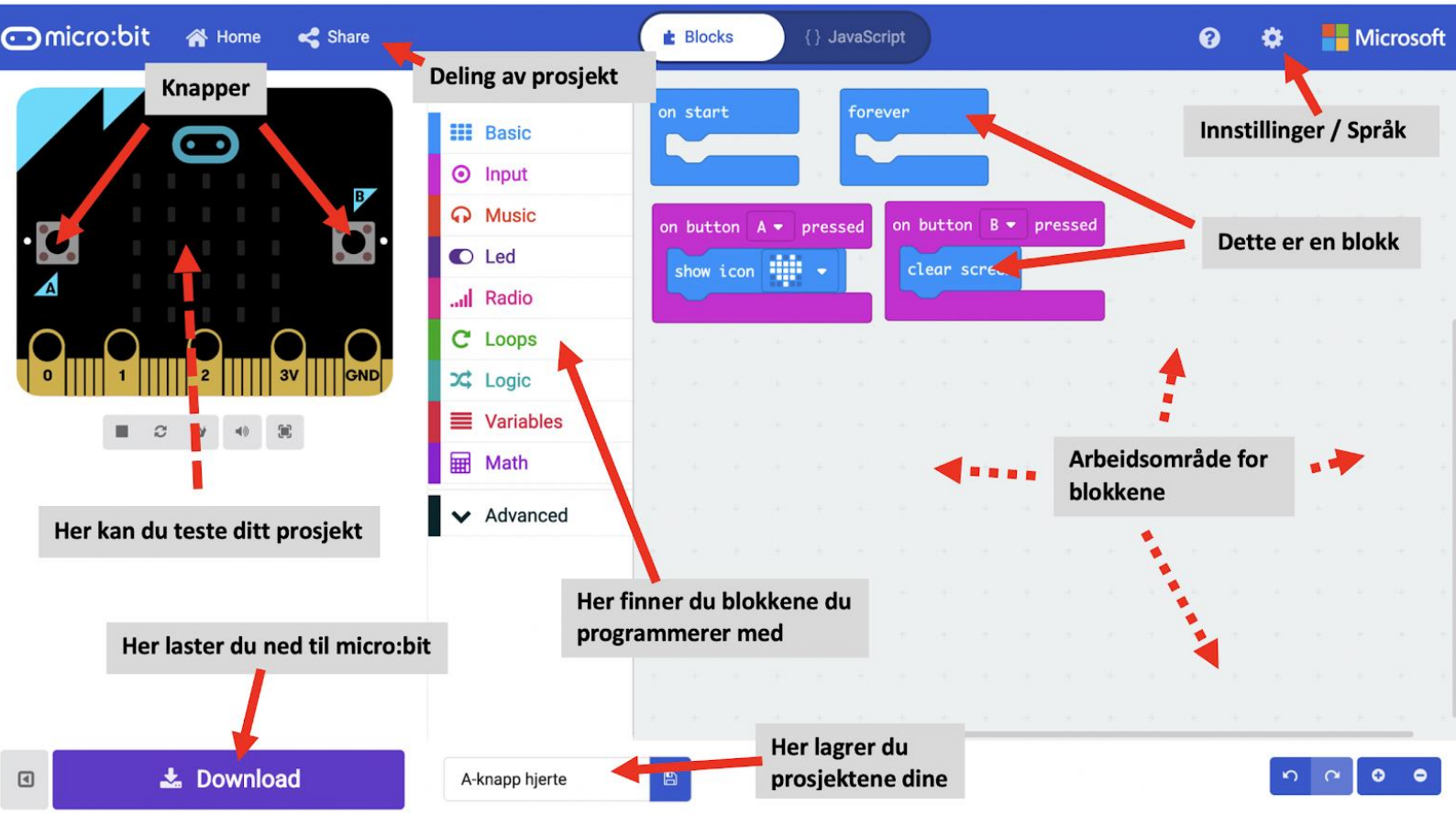
APPer


Referanse
16
17
18
19
20
Applikasjoner
GET IT ON Google Play
Download on the App Store
Micro:bits mobilapp lar deg sende koden til din micro:bit trådløst via Bluetooth. Du trenger ingen ledninger! Lær mer om å bruke mobil her Applikasjoner.
Get it from Microsoft
Program the micro:bit using the MakeCode editor on your Windows 10 device. In addition to the familiar features of the web editor, the app lets you program your micro:bit over USB (without needing to drag-and-drop the file onto the micro:bit drive) and directly read serial data from your micro:bit for data logging and other fun experiments!
Swift Playgrounds
Lær å kode micro:bit i Swift med vår interaktive 'bok' for iPad. Oppdag det grunnleggende ved koding mens du har det gøy med din micro:bit!
Hvis du ønsker å prøve ut de nyeste editorfunksjonene, vennligst meld deg på vårt beta-program.
Du kan prøve ut editorer fra rundt om på nettet, inkludert Scratch og Kodu

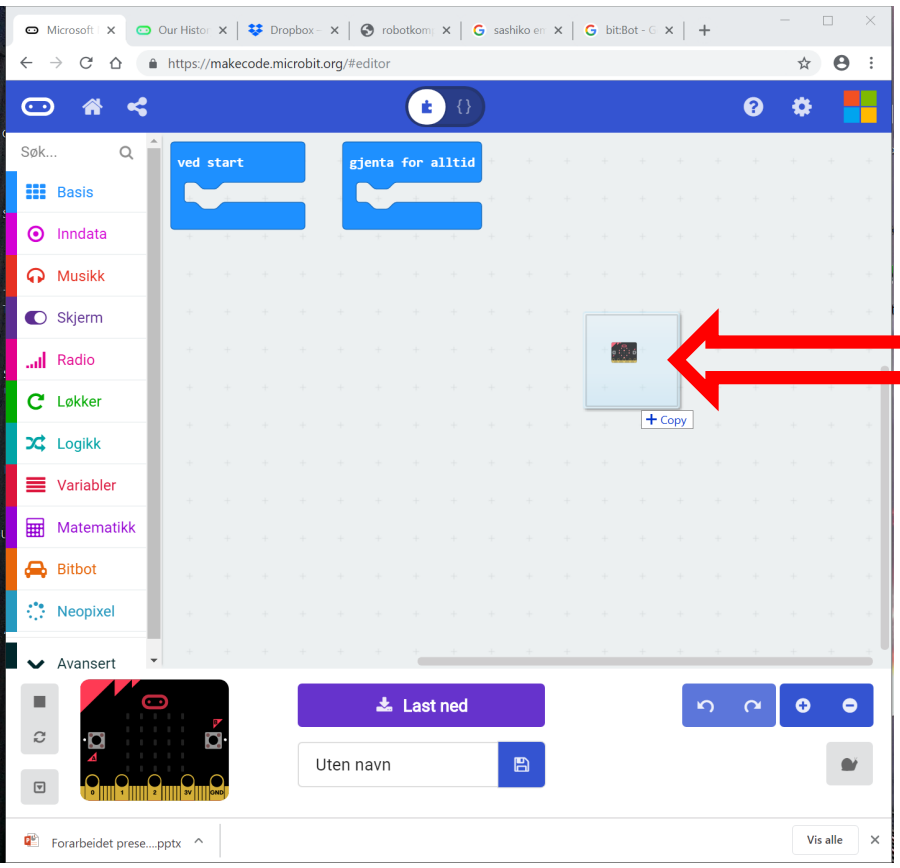
Prosjektsida (hjem)

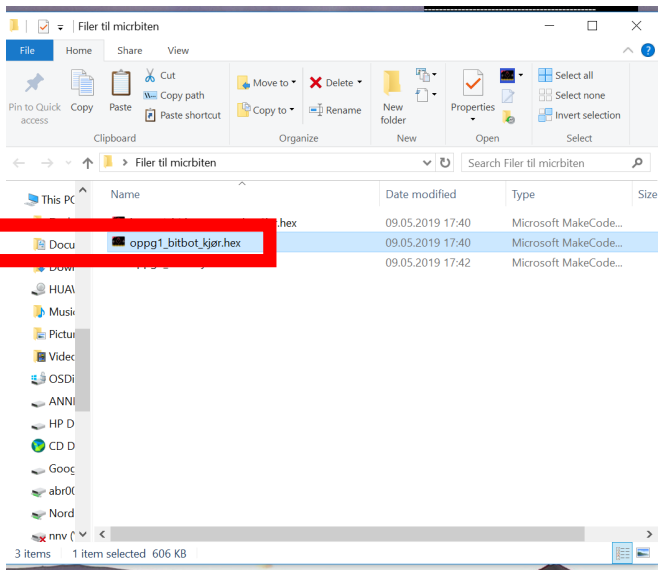
VITENSENTRENE skaper realfagsglede

Programmeringssida



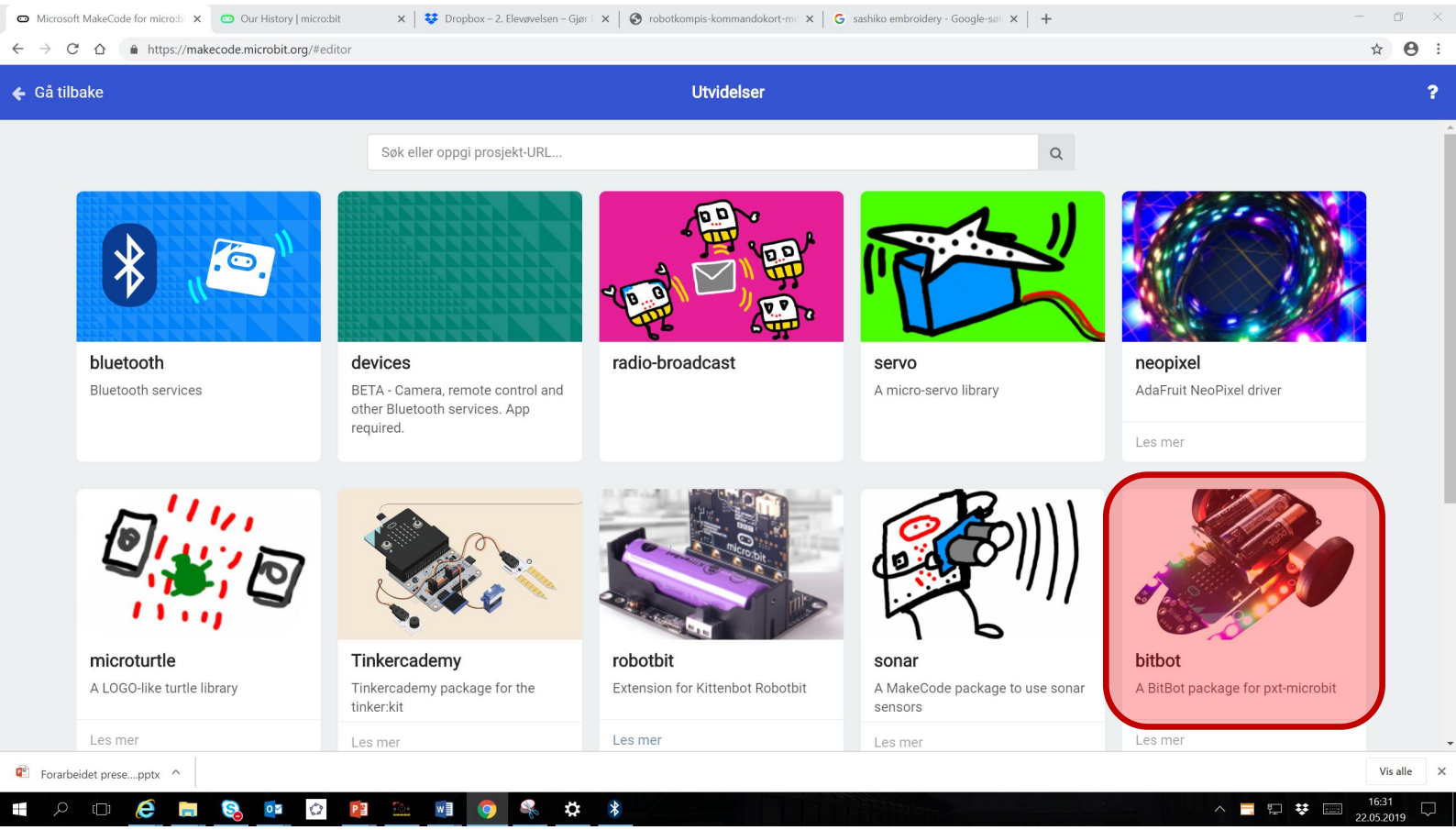
Laste opp filer - online





VITENSENTRENE
skaper realfagsglede

Finne blokker for bit:bot



http://bit.ly/vit_kurs

Oppgave 1a)

Programmer Bit:bot til å kjøre en meter, snu 180 grader og kjøre en meter tilbake.

Oppgave 1b)

Programmer Bit:bot til å kjøre «hinderløypa» i smartbyen. Fortsett med programmet du lagde i oppgave 1a

Velg blant bonusoppgavene (2A – 2E)

Oppsummering og refleksjon

- https://no.surveymonkey.com/r/superbit-kurs
- Er det matematikk i dette?
- Hva med
  - naturfag
  - musikk
  - kunst og håndverk
- Flere eksempelkoder for microbit: bit.ly/startmicrobit

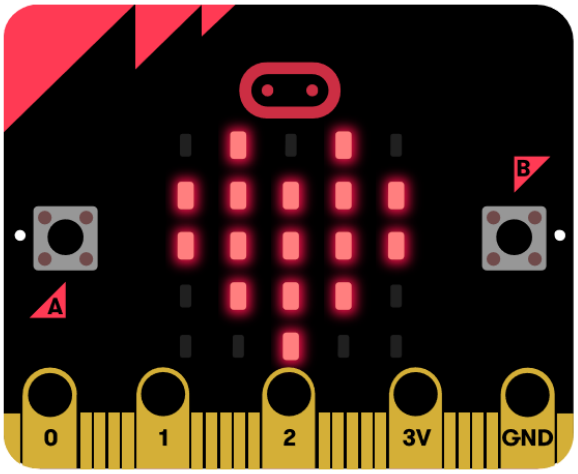
VITENSENTRENE skaper realfagsglede

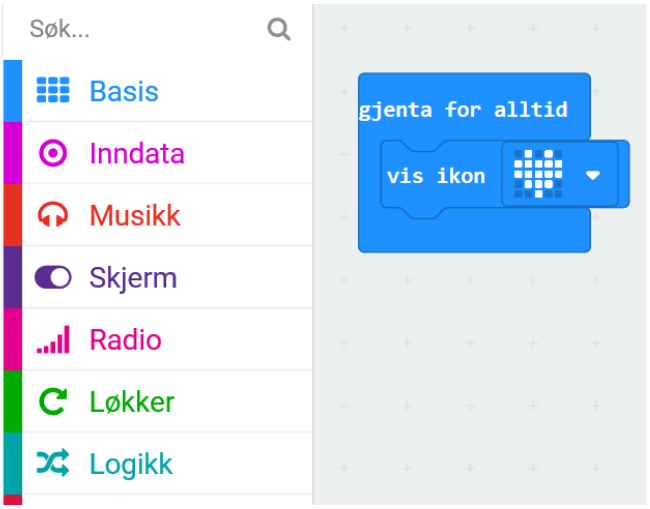
Skolebesøk

Dato	Oppstart	Skole	Klasse	Ant elever
28.09.2020	09:00	Frol barneskole	6A	82
28.09.2020	09:00	Frol barneskole	6B	
28.09.2020	11:30	Frol barneskole	6C	
28.09.2020	11:30	Frol barneskole	6D	
29.09.2020	09:00	Skogn Barne og ungdomsskole	6A	43
29.09.2020	11:30	Skogn Barne og ungdomsskole	6B	
29.09.2020	09:00	Åsen Barne og undomsskole	6A	24
29.09.2020	12:00	Ekne	Mellomtrinn	
30.09.2020	09:00	Nesheim	6A	49
30.09.2020	09:00	Nesheim	6B	
30.09.2020	11:30	Nesheim	6C	
30.09.2020	12:00	Vårtun	6	12
01.10.2020	09:00	Halsan barneskole	6A	30
01.10.2020	11:30	Halsan barneskole	6B	
14.10.2020	10:15	Ytterøy Barne og Ungdommskole	6	6

VITENSENTRENE
skaper realfagsglede

Lykke til med programmeringa!

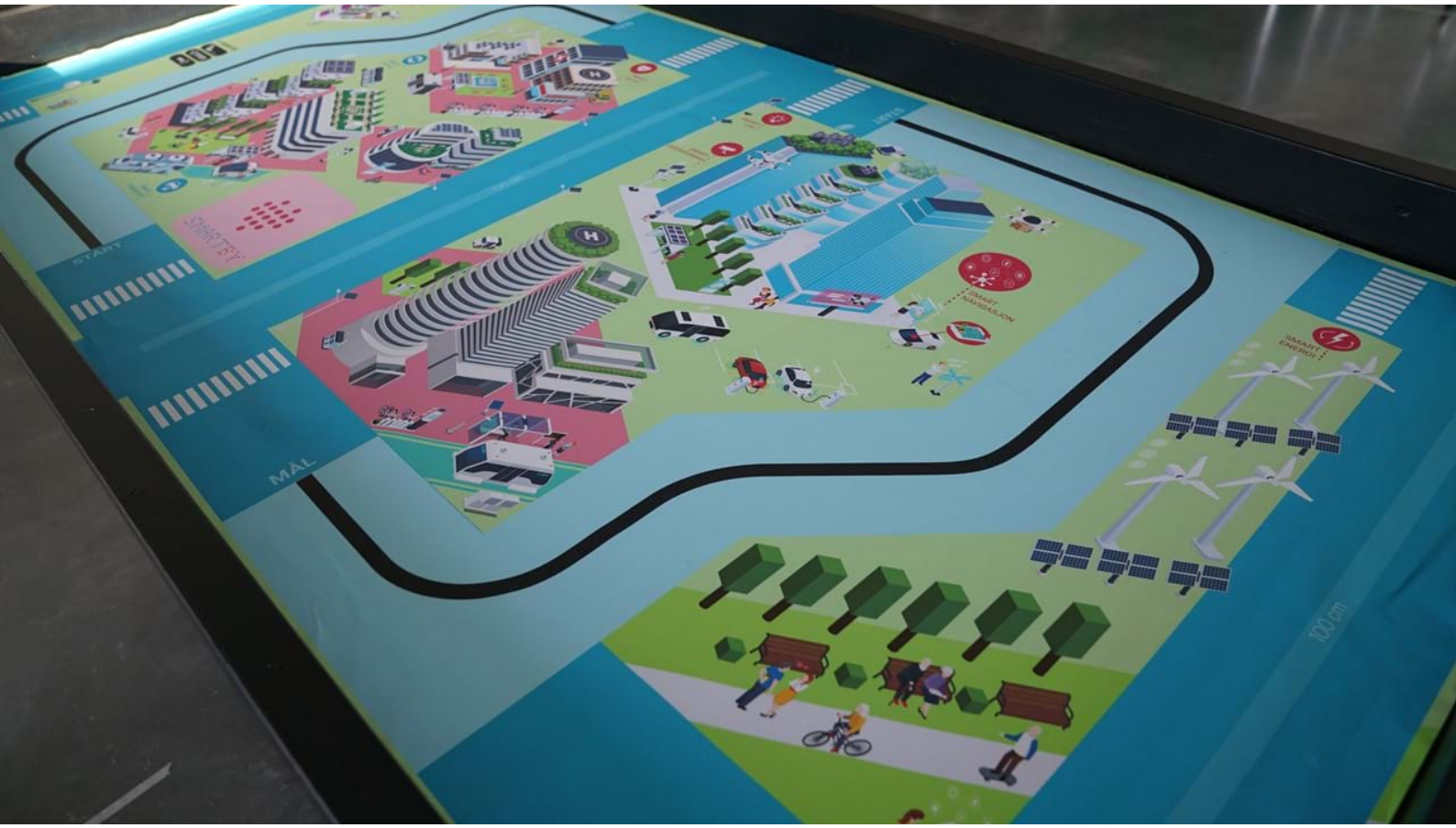




VITENSENTRENE
skaper realfagsglede

Appendix B

Smart city mat

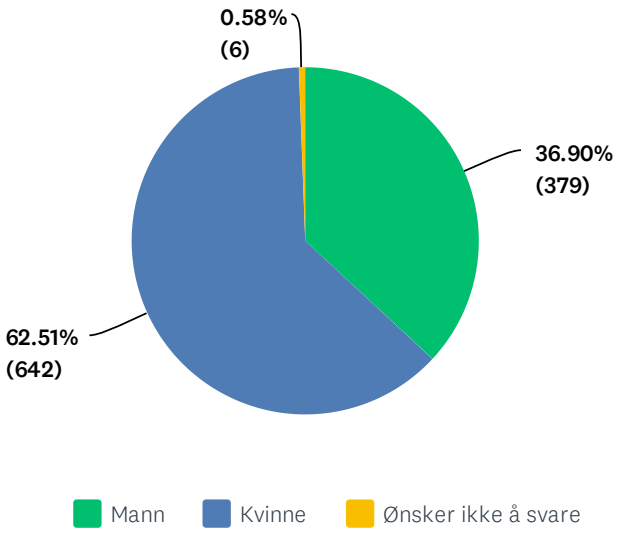

START
MÅL
SMART NAVIGATION
SMART ENERGY
100 cm

Appendix C

Science centres questionnaire teacher training part

SP1 Jeg er:

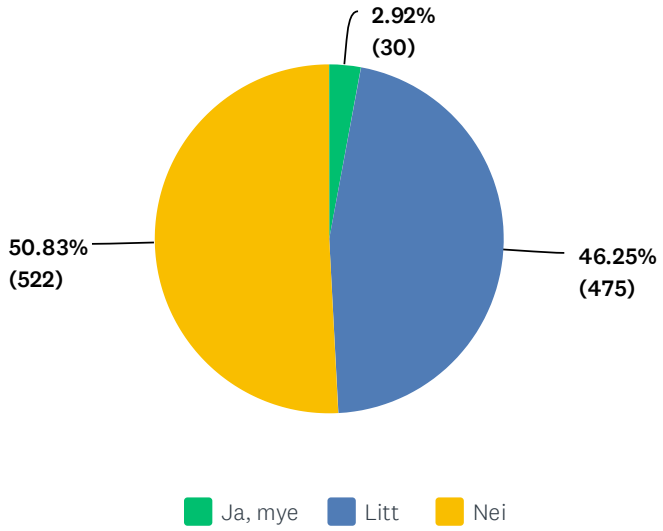
Besvart: 1,027 Hoppet over: 0



	MANN	KVINNE	ØNSKER IKKE Å SVARE	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	36.90% 379	62.51% 642	0.58% 6	1,027	2.64

SP2 Har du erfaring med programmering i undervisning fra tidligere?

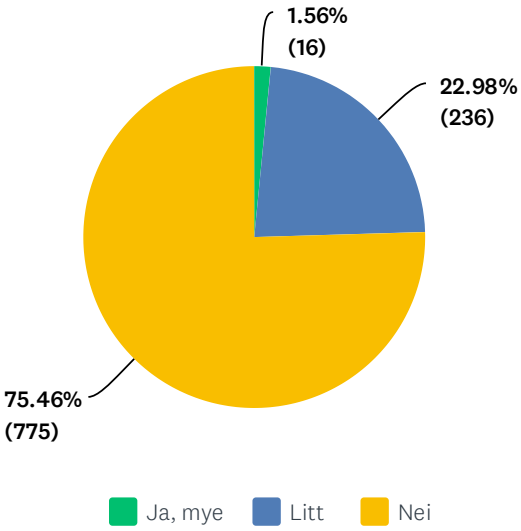
Besvart: 1,027 Hoppet over: 0



	JA, MYE	LITT	NEI	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	2.92% 30	46.25% 475	50.83% 522	1,027	3.45

SP3 Har du erfaring med micro:bit fra tidligere?

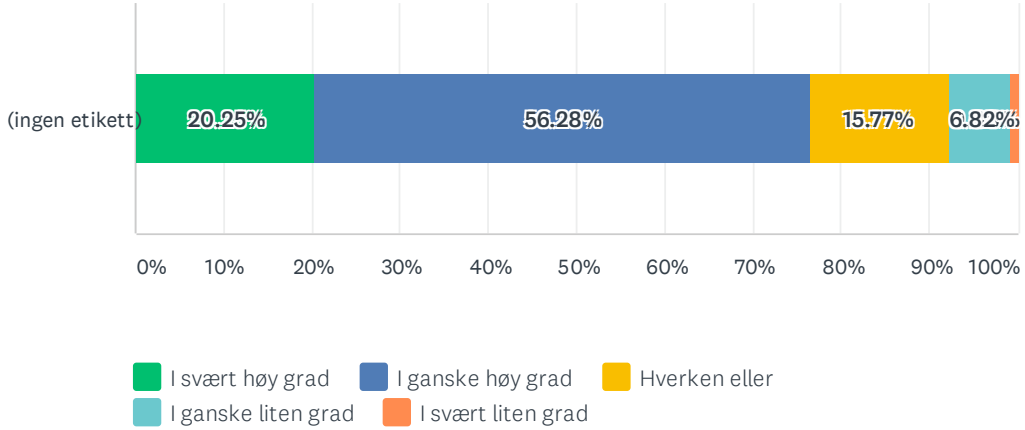
Besvart: 1,027 Hoppet over: 0



	JA, MYE	LITT	NEI	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	1.56% 16	22.98% 236	75.46% 775	1,027	4.49

SP4 I hvilken grad opplever du å være i stand til å holde forarbeidet til super:bit for dine elever?

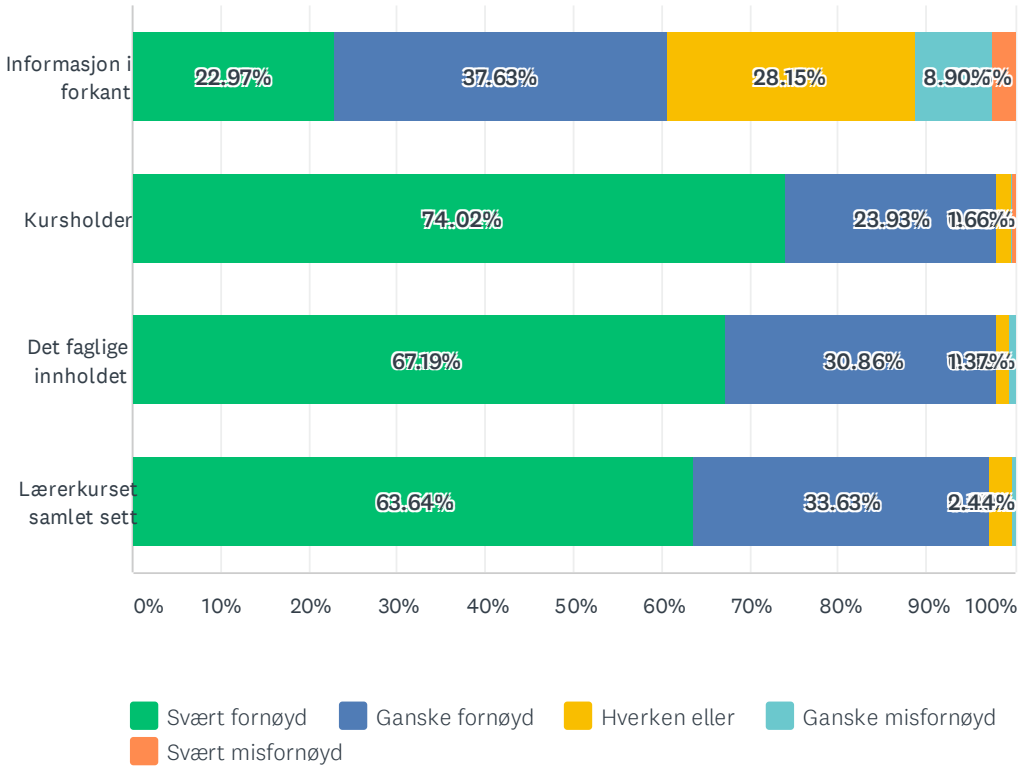
Besvart: 1,027 Hoppet over: 0



	I SVÆRT HØY GRAD	I GANSKE HØY GRAD	HVERKEN ELLER	I GANSKE LITEN GRAD	I SVÆRT LITEN GRAD	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	20.25% 208	56.28% 578	15.77% 162	6.82% 70	0.88% 9	1,027	2.12

SP5 Hvor fornøyd er du med følgende:

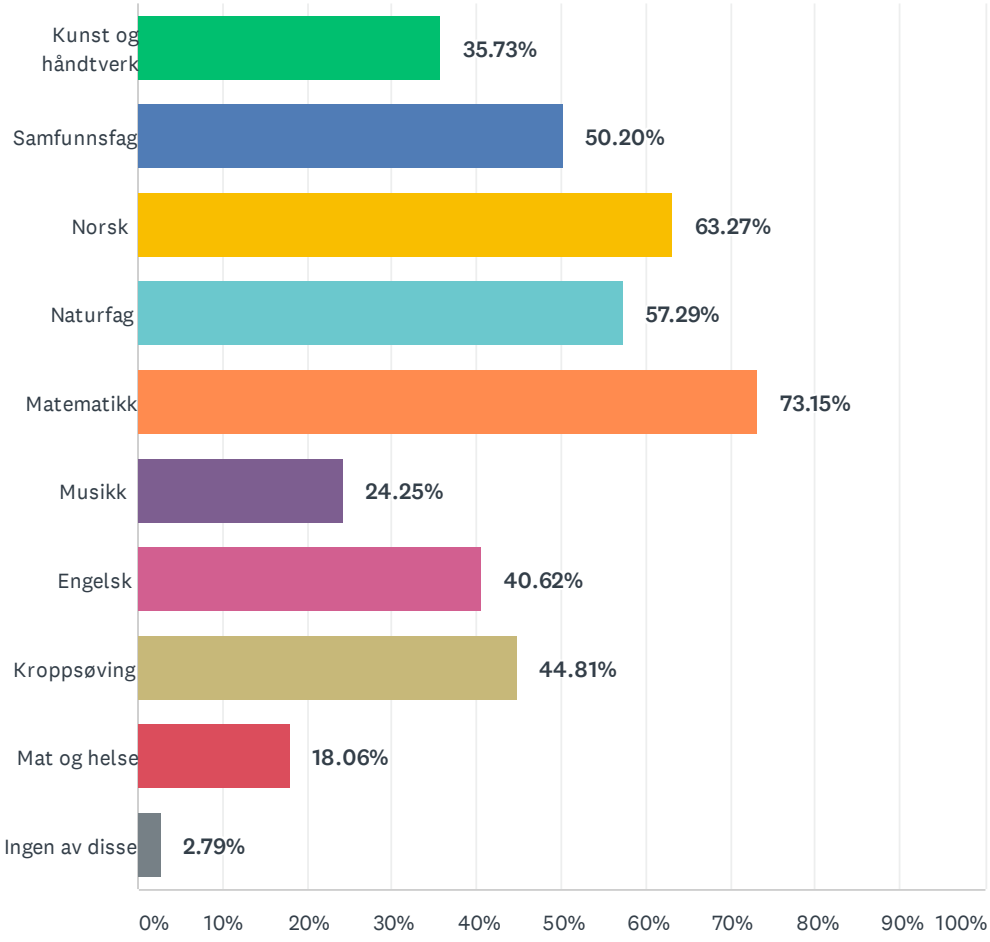
Besvart: 1,027 Hoppet over: 0



	SVÆRT FORNØYD	GANSKE FORNØYD	HVERKEN ELLER	GANSKE MISFORNØYD	SVÆRT MISFORNØYD	TOTALT	VEKTET GJENNOMSNITT
Informasjon i forkant	22.97% 235	37.63% 385	28.15% 288	8.90% 91	2.35% 24	1,023	2.24
Kursholder	74.02% 758	23.93% 245	1.66% 17	0.20% 2	0.20% 2	1,024	1.28
Det faglige innholdet	67.19% 688	30.86% 316	1.37% 14	0.49% 5	0.10% 1	1,024	1.35
Lærerkurset samlet sett	63.64% 651	33.63% 344	2.44% 25	0.20% 2	0.10% 1	1,023	1.39

SP7 Hvilke fag underviser du i?

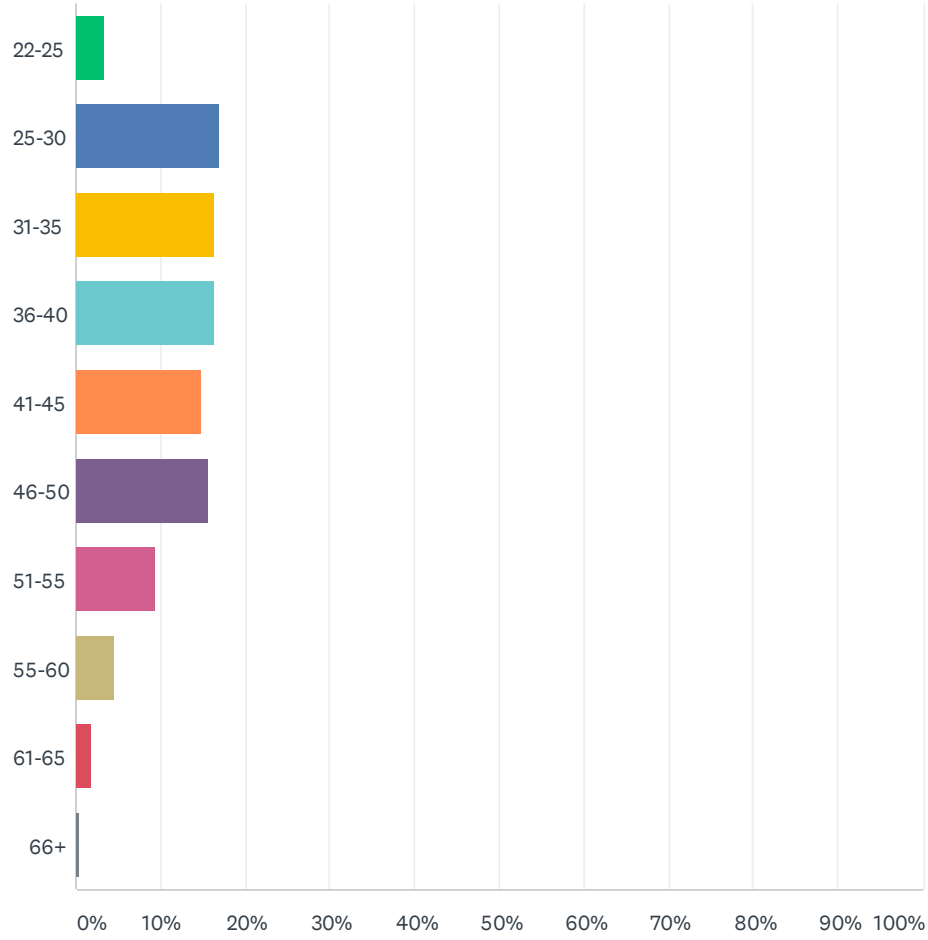
Besvart: 1,002 Hoppet over: 25



SVARVALG	SVAR	
Kunst og håndtverk	35.73%	358
Samfunnsfag	50.20%	503
Norsk	63.27%	634
Naturfag	57.29%	574
Matematikk	73.15%	733
Musikk	24.25%	243
Engelsk	40.62%	407
Kroppsøving	44.81%	449
Mat og helse	18.06%	181
Ingen av disse	2.79%	28
Totalt antall respondenter: 1,002		

SP8 Hvor gammel er du?

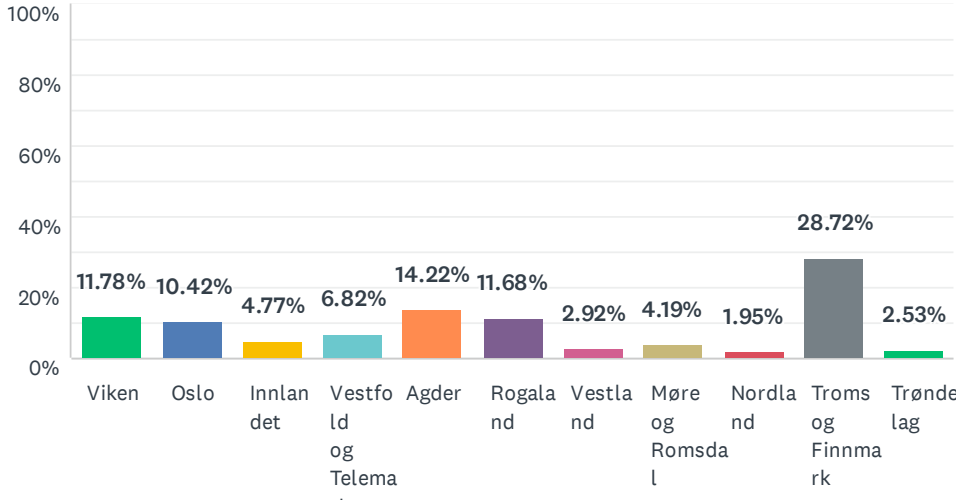
Besvart: 1,027 Hoppet over: 0



SVARVALG	SVAR	
22-25	3.41%	35
25-30	16.94%	174
31-35	16.26%	167
36-40	16.36%	168
41-45	14.90%	153
46-50	15.77%	162
51-55	9.35%	96
55-60	4.67%	48
61-65	1.95%	20
66+	0.39%	4
TOTALT		1,027

SP9 Hvilket fylke kommer du fra?

Besvart: 1,027 Hoppet over: 0



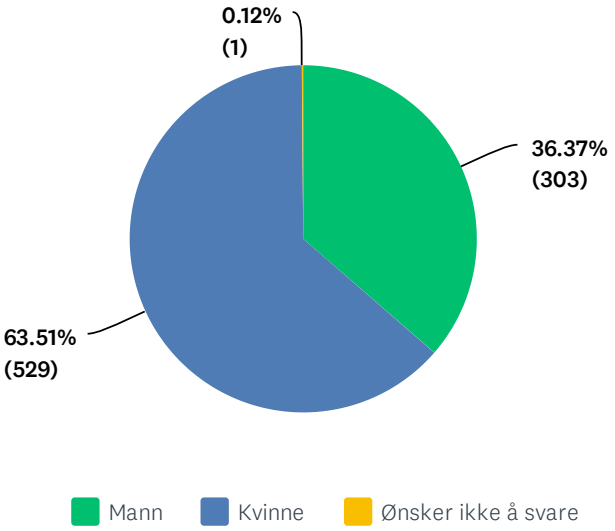
SVARVALG	SVAR	
Viken	11.78%	121
Oslo	10.42%	107
Innlandet	4.77%	49
Vestfold og Telemark	6.82%	70
Agder	14.22%	146
Rogaland	11.68%	120
Vestland	2.92%	30
Møre og Romsdal	4.19%	43
Nordland	1.95%	20
Troms og Finnmark	28.72%	295
Trøndelag	2.53%	26
TOTALT		1,027

Appendix D

Science centres questionnaire pupil training part

SP1 Jeg er:

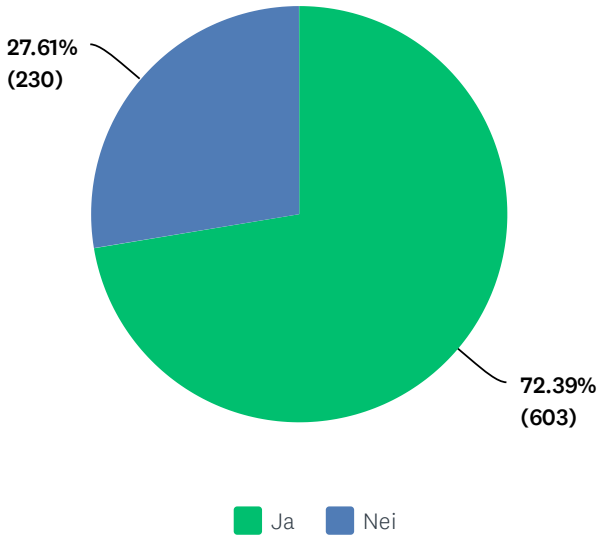
Besvart: 833 Hoppet over: 0



	MANN	KVINNE	ØNSKER IKKE Å SVARE	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	36.37% 303	63.51% 529	0.12% 1	833	2.64

SP2 Har du deltatt på lærerkurset i super:bit?

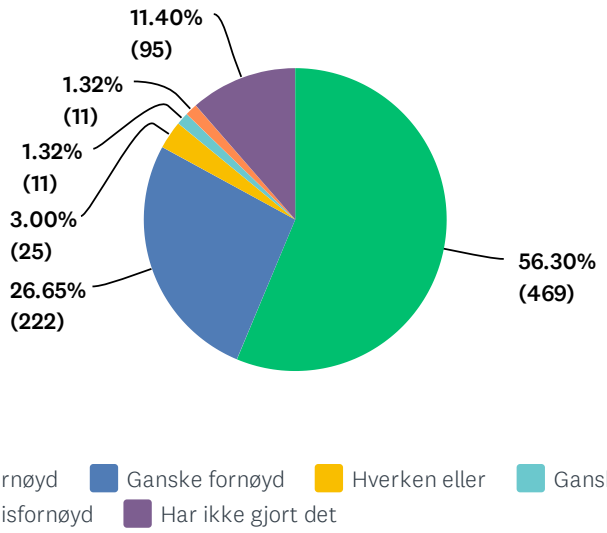
Besvart: 833 Hoppet over: 0



	JA	NEI	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	72.39% 603	27.61% 230	833	2.55

SP3 Hvor fornøyd er du med forarbeidet til super:bit-oppdraget?

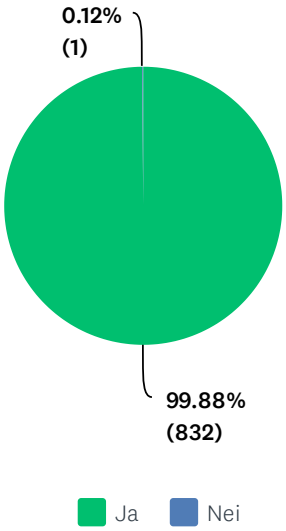
Besvart: 833 Hoppet over: 0



	SVÆRT FORNØYD	GANSKE FORNØYD	HVERKEN ELLER	GANSKE MISFORNØYD	SVÆRT MISFORNØYD	HAR IKKE GJORT DET	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	56.30% 469	26.65% 222	3.00% 25	1.32% 11	1.32% 11	11.40% 95	833	2.82

SP4 Tror du at elevprogrammet super:bit vil bidra til økt interesse for programmering blant elevene?

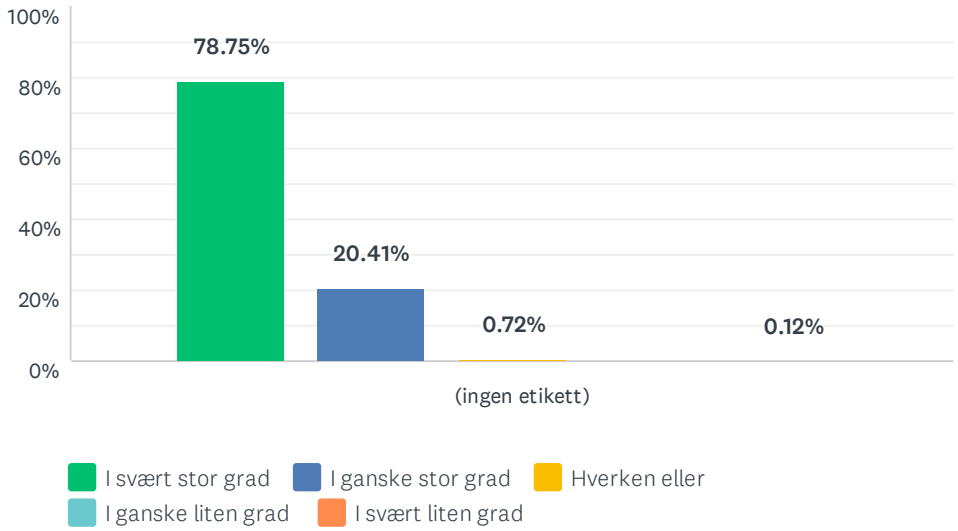
Besvart: 833 Hoppet over: 0



	JA	NEI	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	99.88% 832	0.12% 1	833	1.00

SP5 I hvilken grad opplever du at elevene har hatt en positiv læringsopplevelse?

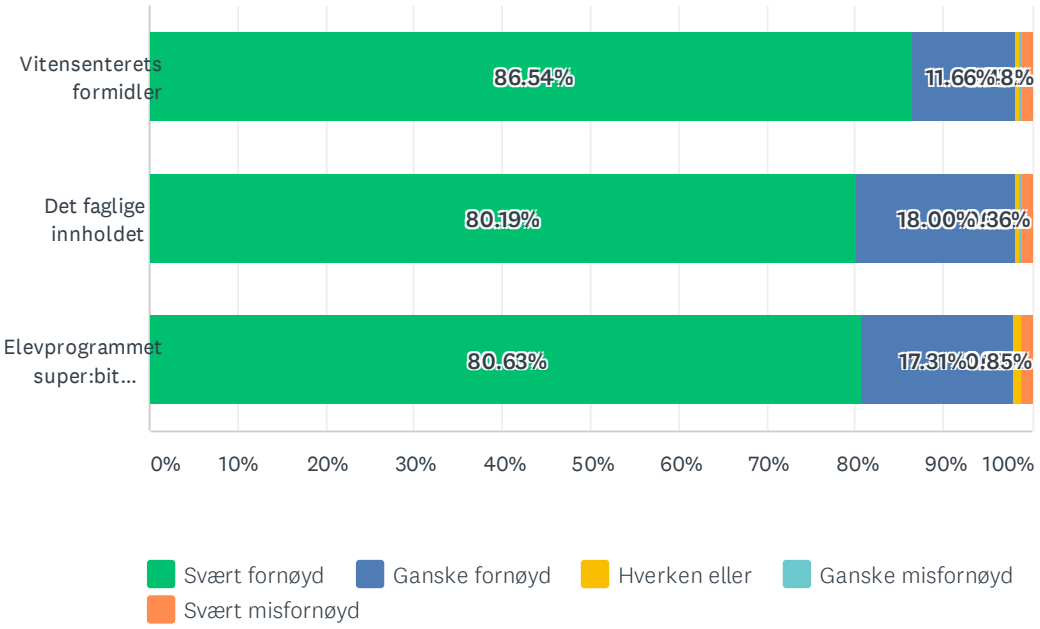
Besvart: 833 Hoppet over: 0



	I SVÆRT STOR GRAD	I GANSKE STOR GRAD	HVERKEN ELLER	I GANSKE LITEN GRAD	I SVÆRT LITEN GRAD	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	78.75% 656	20.41% 170	0.72% 6	0.00% 0	0.12% 1	833	1.22

SP6 Hvor fornøyd er du med følgende:

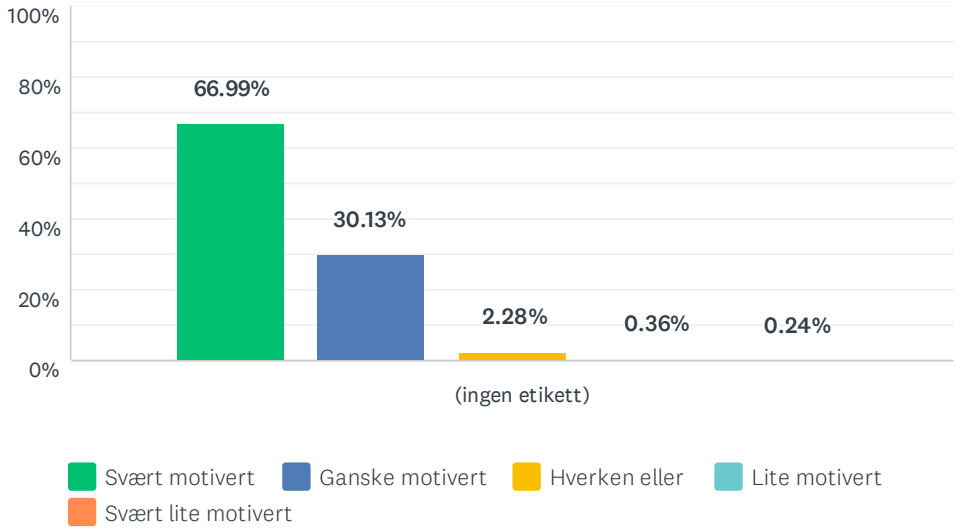
Besvart: 833 Hoppet over: 0



	SVÆRT FORNØYD	GANSKE FORNØYD	HVERKEN ELLER	GANSKE MISFORNØYD	SVÆRT MISFORNØYD	TOTALT	VEKTET GJENNOMSNITT
Vitensenterets formidler	86.54% 720	11.66% 97	0.48% 4	0.24% 2	1.08% 9	832	1.13
Det faglige innholdet	80.19% 664	18.00% 149	0.36% 3	0.36% 3	1.09% 9	828	1.20
Elevprogrammet super:bit samlet sett	80.63% 666	17.31% 143	0.85% 7	0.12% 1	1.09% 9	826	1.20

SP8 Hvor motivert er du for å ta i bruk utstyret til super:bit?

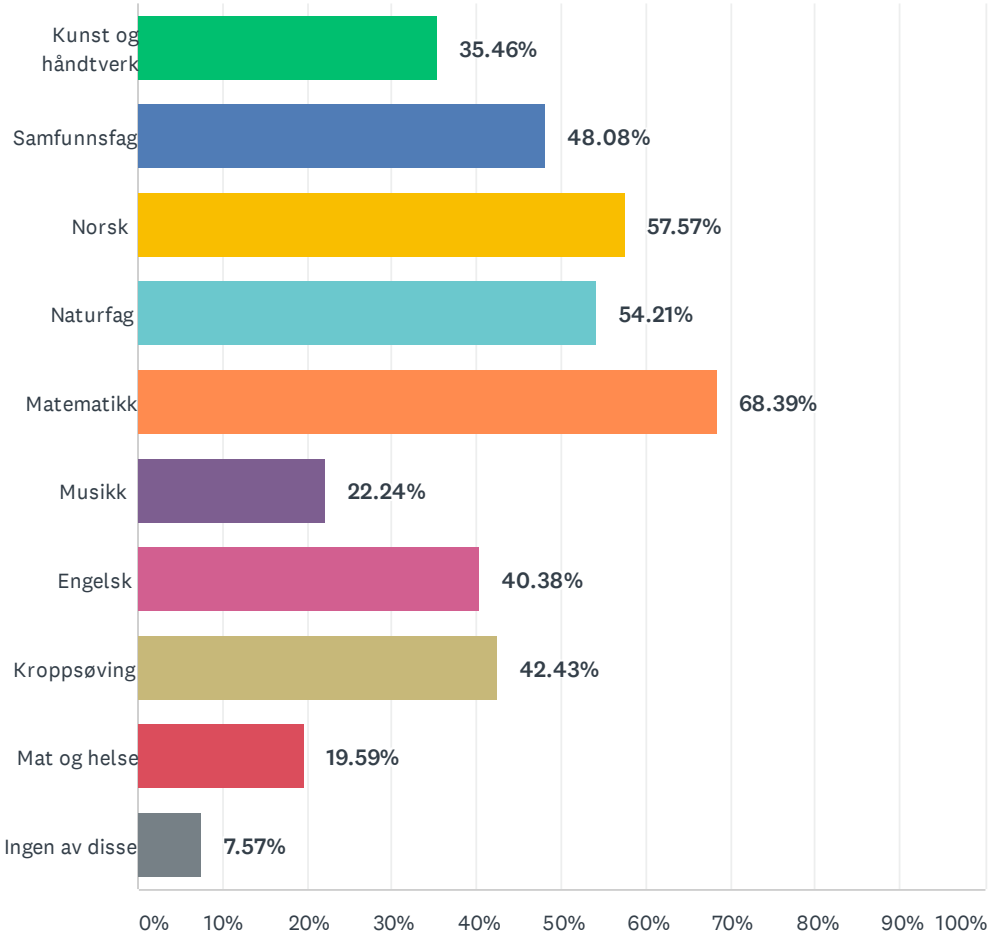
Besvart: 833 Hoppet over: 0



	SVÆRT MOTIVERT	GANSKE MOTIVERT	HVERKEN ELLER	LITE MOTIVERT	SVÆRT LITE MOTIVERT	TOTALT	VEKTET GJENNOMSNITT
(ingen etikett)	66.99% 558	30.13% 251	2.28% 19	0.36% 3	0.24% 2	833	2.37

SP9 Hvilke fag underviser du i?

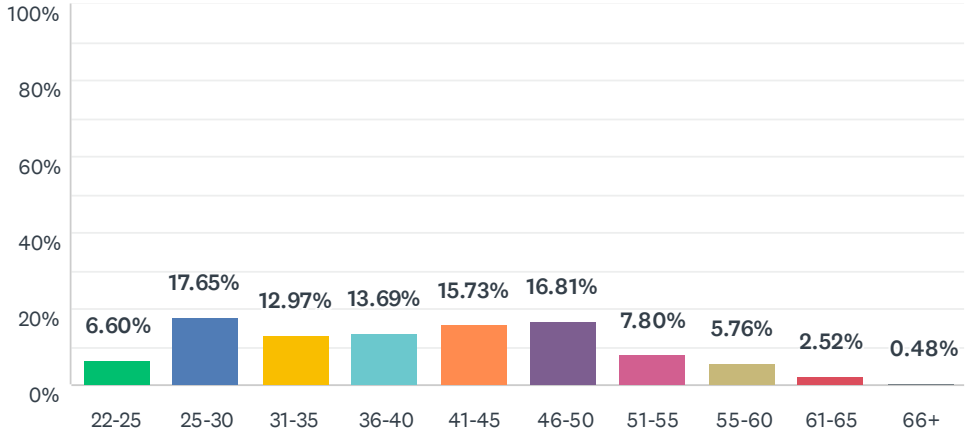
Besvart: 832 Hoppet over: 1



SVARVALG	SVAR	
Kunst og håndtverk	35.46%	295
Samfunnsfag	48.08%	400
Norsk	57.57%	479
Naturfag	54.21%	451
Matematikk	68.39%	569
Musikk	22.24%	185
Engelsk	40.38%	336
Kroppsøving	42.43%	353
Mat og helse	19.59%	163
Ingen av disse	7.57%	63
Totalt antall respondenter: 832		

SP10 Hvor gammel er du?

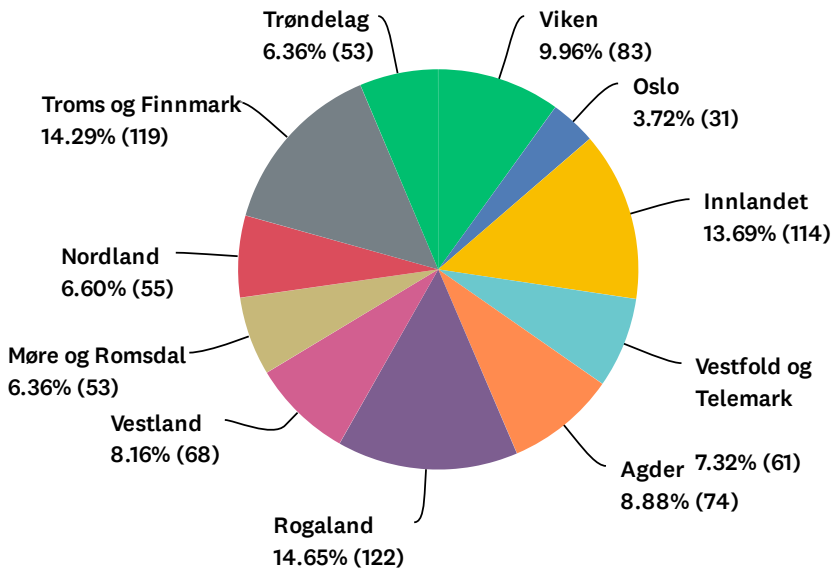
Besvart: 833 Hoppet over: 0



SVARVALG	SVAR	
22-25	6.60%	55
25-30	17.65%	147
31-35	12.97%	108
36-40	13.69%	114
41-45	15.73%	131
46-50	16.81%	140
51-55	7.80%	65
55-60	5.76%	48
61-65	2.52%	21
66+	0.48%	4
TOTALT		833

SP11 Hvilket fylke kommer du fra?

Besvart: 833 Hoppet over: 0



SVARVALG	SVAR	
Viken	9.96%	83
Oslo	3.72%	31
Innlandet	13.69%	114
Vestfold og Telemark	7.32%	61
Agder	8.88%	74
Rogaland	14.65%	122
Vestland	8.16%	68
Møre og Romsdal	6.36%	53
Nordland	6.60%	55
Troms og Finnmark	14.29%	119
Trøndelag	6.36%	53
TOTALT		833

Appendix E

Observation template teacher training

Observation notes - template

0. Observation ID: 1

Background Information

1.01 **Observer(s):**
1.02 **Observation date:**
1.03 **Length of the Observation(Minutes):**
1.04 **Observation start time:**
1.05 **Observation end time:**
1.06 **School name:**
1.07 **Teacher name:**
1.08 **Subject matter/topic:**
1.09 **Number of students:**
1.10 **Class level:**
1.11 **Activities that are performed**: *refer to the activities of the scenario that are planned to be performed during the observation*
1.12 **Related observations**: *Refer to observation notes that are related. In particular, it is important to relate observations done with the same class as part of repeated interventions*
1.12 **Physical arrangement:** *Draw or describe the physical arrangement of the classroom*
1.14 **Resources**: *Describe the resources present in the classroom, including technology but also relevant analogic tools*

1.1 Free notes

Write a detailed narrative of what is happening in the classroom. Try to distinguish between individual comments and ideas from what you observe.

In order to support triangulation with other data:

- Use time stamps to identify the timing of important events
- Use group or student IDs to identify specific actors

Write here:

1.2 Things you might look out for (These are not questions that you should try to answer but triggers to guide your observation):

1. Identify the main topics of the seminar

a) Micro:bit
b) Technical (programming)
c) Pedagogical (how to teach programming)
d) Preparation for the pupil session
e) Motivational focus
f) Something else
g) Mixed

2. ***Teaching method(s) used***
    a) Method(s)
        - Classic lecture style
        - Group based
        - Working in pairs
        - Individual working
        - Other
    b) Mix of teachers
        - Are teachers from different schools being mixed together?
            - For some minutes or a longer period?
            - Could it potentially be the start of creating a community of teachers with common interests in learning more about programming and how to teach it?

3. ***New curricula***
    a) Context
        - Focusing on programming alone
        - Focusing on programming as an integrated part of other subjects
            - Which subjects
    b) Curricula
        - Competence goals from specific subjects
        - Superior part
        - Which subject(s) should the super:bit mission be a part of

Appendix F

Observation template pupil training

Observation notes - template

0. Observation ID:

Background Information

1.01 **Observer(s):**
1.02 **Observation date:**
1.03 **Length of the Observation(Minutes):**
1.04 **Observation start time:**
1.05 **Observation end time:**
1.06 **School name:**
1.07 **Teacher name:**
1.08 **Subject matter/topic:**
1.09 **Number of students:**
1.10 **Class level:**
1.11 **Activities that are performed**: *refer to the activities of the scenario that are planned to be performed during the observation*
1.12 **Related observations**: *Refer to observation notes that are related. In particular, it is important to relate observations done with the same class as part of repeated interventions*
1.12 **Physical arrangement:** *Draw or describe the physical arrangement of the classroom*
1.14 **Resources**: *Describe the resources present in the classroom, including technology but also relevant analogic tools*

1.1 Free notes

Write a detailed narrative of what is happening in the classroom. Try to distinguish between individual comments and ideas from what you observe.

In order to support triangulation with other data:

- Use time stamps to identify the timing of important events
- Use group or student IDs to identify specific actors

Write here:

1.2 Things you might look out for (These are not questions that you should try to answer but triggers to guide your observation):

1. What is the role for the teachers

a) Taking a active part in the teaching or more passive

b) Do they present something themselves

a. Some theory

b. Something on micro:bit

c. A exercise

d. Something else

c) When helping pupils

    a. Comfortable

    b. Able to provide help and explain

    c. What do they do if not

2. Pupils reaction to the training session

a) Do they seem to master the exercises?

b) Do they seem to have fun?

c) Do they get engaged and work well?

Appendix G

Questionnaire with consent form

Spørreundersøkelse super:bit - lærere

Vil du delta i forskningsprosjektet

«The super:bit project: a model for introducing programming to teachers and pupils - from the teachers perspective »?

Introduksjon

Jeg studerer lektor i realfag og holder nå på med min masteroppgave som skal undersøke om super:bit-prosjektet er en god måte å introdusere og forberede lærere på å undervise i programmering. I dette skrivet gir jeg deg informasjon om målene for prosjektet og hva deltagelse vil innebære for deg.

Formål

Super:bit er en del av satsingen «den teknologiske skolesekken» fra UDIR. I masteroppgaven vil jeg fokusere på vitensentrenes arbeid mot landets skoler og da spesielt lærere. Jeg vil samle informasjon fra lærere som har deltatt på super:bit-prosjektet og analysere dette opp mot relevant litteratur for å undersøke om super:bit modellen er en god måte å introdusere og forberede lærere på å undervise i programmering.

Hvem er ansvarlig for forskningsprosjektet?

Masteroppgaven skrives av student Atle Vågen Svendsgaard (meg), under veiledning av professor Monica Divitini. Den ansvarlige institusjonen er Institutt for datateknologi og informatikk ved NTNU.

Masteroppgaven blir skrevet i samarbeid med Vitensenteret i Trondheim og biveileder Ola Kleiven.

Hvorfor får du spørsmål om å delta?

I prosjektet ønsker jeg å samle informasjon fra lærere som har deltatt på super:bit-prosjektet.

Hva innebærer det for deg å delta?

Hvis du velger å delta i studien innebærer det at du svarer på en kort spørreundersøkelse. Spørreundersøkelsen vil hovedsakelig omhandle dine erfaringer rundt super:bit og din opplevelse av å skulle undervise i programmering i etterkant av deltagelse. For spørreundersøkelsen brukes den digital tjenesten Nettskjema som driftes av Universitetet i Oslo.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine opplysninger vil da bli slettet.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil ikke samle inn noen personopplysninger i spørreundersøkelsen, og ingen vil dermed kunne identifiseres direkte i materialet. I spesielle tilfeller kan det være mulig at en deltager identifiseres gjennom en kombinasjon av variabler. Derfor innhenter vi samtykke til deltagelse og informerer om rettigheter.

Vi vil bare bruke opplysningene til formålene vi har fortalt om i dette skrivet.

- Kun jeg og min veileder Monica Divitini vil ha tilgang til opplysningene.
- Deltagere vil ikke kunne gjenkjennes ved publikasjon.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Masteroppgaven skal etter planen leveres den 15. desember 2020. Ved levering av oppgaven vil opplysninger i Nettskjema slettes.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra NTNU har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- NTNU, Institutt for datateknologi og informatikk ved masterstudent Atle Vågen Svendsgaard (tlf: [redacted], e-post: [redacted]) eller professor Monica Divitini (tlf: [redacted], e-post: [redacted])
- Vårt personvernombud: [redacted] (tlf: [redacted], e-post: [redacted])

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:

- NSD – Norsk senter for forskningsdata AS på e-post (personvernтjenester@nsd no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Prosjektansvarlig	*Student*
Monica Divitini	Atle Vågen Svendsgaard

*

- [ ] Jeg bekrefter å ha lest gjennom og forstått informasjonsskrivet og samtykker til å delta i spørreundersøkelsen

Hvilke fag underviser du i? *

- [ ] Matematikk
- [ ] Naturafg
- [ ] Musikk
- [ ] Kunst og håndverk
- [ ] Norsk
- [ ] KRLE
- [ ] Kroppsøving
- [ ] Engelsk
- [ ] Mat og helse
- [ ] Samfunnsfag
- [ ] Ingen av disse

Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter? *

- ( ) Ja, har deltatt på begge
- ( ) Ja, har kun deltatt på elevkurs

- ○ Ja, har kun deltatt på lærerkurs
- ○ Nei, har ikke deltatt på noen

ⓘ Dette elementet vises kun dersom alternativet «Nei, har ikke deltatt på noen» er valgt i spørsmålet «Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter?»

Denne undersøkelsen er for lærere som har deltatt på minst ett av kursene, så du som ikke har deltatt på noen kan bare avslutte undersøkelsen

Hvilket Vitensenter var ansvarlig for dette kurset? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, har kun deltatt på lærerkurs» eller «Ja, har kun deltatt på elevkurs» er valgt i spørsmålet «Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter?»

- ○ Vitensenteret Sørlandet
- ○ INSPIRIA science center (Sarpsborg)
- ○ Vitenparken (Campus Ås)
- ○ VilVite (Bergen)
- ○ DuVerden (Porsgrunn)
- ○ Oslo vitensenter
- ○ Jærmuseet (Sandnes og Nærbø)
- ○ Nordnorsk vitensenter (Tromsø og Alta)
- ○ Vitensenteret i Trondheim
- ○ Vitensenteret Innlandet (Gjøvik)
- ○ Vitensenteret Nordland (Mo i Rana)

Hvilket vitensenter var ansvarlige for disse to kursene? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, har deltatt på begge» er valgt i spørsmålet «Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter?»

- ○ Vitensenteret Sørlandet
- ○ INSPIRIA science center (Sarpsborg)
- ○ Vitenparken (Campus Ås)
- ○ VilVite (Bergen)
- ○ DuVerden (Porsgrunn)
- ○ Oslo vitensenter
- ○ Jærmuseet (Sandnes og Nærbø)
- ○ Nordnorsk vitensenter (Tromsø og Alta)
- ○ Vitensenteret i Trondheim
- ○ Vitensenteret Innlandet (Gjøvik)
- ○ Vitensenteret Nordland (Mo i Rana)

Når deltok du på lærer- og elevkurs i regi av Vitensenteret? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, har deltatt på begge» er valgt i spørsmålet «Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter?»

- ○ Høst 2020
- ○ Vår 2020
- ○ Høst 2019
- ○ Vår 2019
- ○ Tidligere enn dette

Når deltok du på elevkurs i regi av Vitensenteret? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, har kun deltatt på elevkurs» er valgt i spørsmålet «Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter?»

- ○ Høst 2020
- ○ Vår 2020

- ○ Høst 2019
- ○ Vår 2019
- ○ Tidligere enn dette

Når deltok du på lærerkurs i regi av Vitensenteret? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, har kun deltatt på lærerkurs» er valgt i spørsmålet «Har du deltatt på lærer- og elevkurs i regi av ditt lokale Vitensenter?»

- ○ Høst 2020
- ○ Vår 2020
- ○ Høst 2019
- ○ Vår 2019
- ○ Tidligere enn dette

Hadde noe erfaring med programmering før deltagelse på super:bit? *

Her er det mulig å velge flere alternativer

- ☐ Nei
- ☐ Ja, jeg har brukt det i undervisningen min tidligere
- ☐ Ja, har utdanningen min innen programmering/IT
- ☐ Ja, har lært meg litt programmering på egenhånd
- ☐ Ja, annen erfaring

Hvordan synes du denne undervisningen gikk? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, jeg har brukt det i undervisningen min tidligere» er valgt i spørsmålet «Hadde noe erfaring med programmering før deltagelse på super:bit?»

Altså undervisningen du hadde på egenhånd før deltagelse på super:bit

- ○ 1- Dårlig
- ○ 2 - Ganske dårlig

- ○ 3 - Nøytral
- ○ 4 - Ganske bra
- ○ 5 - Bra

Merket du noen endringer i holdningen din til at programmering er inkludert i de nye læreplanene etter deltagelse på super:bit? *

- ○ 1 - Mye mer negativ
- ○ 2 - Litt mer negativ
- ○ 3 - Samme som før deltagelse
- ○ 4 - Litt mer positiv
- ○ 5 - Mye mer positiv

FRIVILLIG: Hva tror du er årsaken til denne holdningsendringen?

ⓘ Dette elementet vises kun dersom alternativet «1 - Mye mer negativ», «2 - Litt mer negativ», «5 - Mye mer positiv» eller «4 - Litt mer positiv» er valgt i spørsmålet «Merket du noen endringer i holdningen din til at programmering er inkludert i de nye læreplanene etter deltagelse på super:bit?»

Merket du noe forskjell i din motivasjon til å lære mer om programmering etter deltagelse på super:bit? *

- ○ 1 - Mye mindre motivert
- ○ 2 - Litt mindre motivert
- ○ 3 - Samme motivasjon som før deltagelse
- ○ 4 - Litt mer motivert
- ○ 5 - Mye mer motivert

FRIVILLIG: Hva tror du er årsaken til denne endringen i motivasjon?

Dette elementet vises kun dersom alternativet «5 - Mye mer motivert», «2 - Litt mindre motivert», «1 - Mye mindre motivert» eller «4 - Litt mer motivert» er valgt i spørsmålet «Merket du noe forskjell i din motivasjon til å lære mer om programmering etter deltagelse på super:bit?»

Har deltagelse på super:bit påvirket din faglige programmeringskompetanse? *

Her er faglig programmeringskompetanse ment som hva du kan om selve programmeringen.

- 1 - I svært liten grad
- 2 - I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Har deltagelse på super:bit påvirket din pedagogiske programmeringskompetanse? *

Her er pedagogisk programmeringskompetanse ment som hva du kan om å undervise i programmering, som å legge til rette for tilpasset opplæring, bruke ulike metoder for vurdering, lage varierte undervisningsopplegg osv.

- 1 - I svært liten grad
- 2 - I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Merker du noen endringer i hvordan du føler deg rustet til å bruke programmering i undervisningen etter deltagelse på super:bit? *

- 1 - Mye dårligere rustet
- 2 - Litt dårligere rustet
- 3 - Nøytral

- 4 - Litt bedre rustet
- 5 - Mye bedre rustet

Føler du deg rustet til å gjenbruke opplegget fra Vitensenteret i andre klasser etter deltagelse på super:bit? *

- 1 - I svært liten grad
- 2 - I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Føler du deg rustet til å kunne finne og bruke andre ferdiglagde opplegg som inkluderer programmering etter deltagelse på super:bit? *

Gjerne opplegg med micro:bit, men dette må ikke være tilfellet

- 0 - Vet ikke hvor jeg kan finne slike opplegg
- 1 - I svært liten grad
- 2 - I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Føler du deg rustet til å lage egne undervisningsopplegg som inkluderer programmering? *

- 1 - I svært liten grad
- 2 - I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Hvis du har noen spørsmål eller ønsker å diskutere noe rundt micro:bit eller bruk av programmering i undervisning, i hvilken grad føler du at deltagelse på super:bit har vært med

på å skape en arena for dette? *

- 1 - I svært liten grad
- 2- I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Jeg har i etterkant av deltagelse på super:bit videreført noe av det jeg lærte eller erfarte til andre lærere på skolen min. *

- 1 - I svært liten grad
- 2 - I liten grad
- 3 - I noen grad
- 4 - I stor grad
- 5 - I svært stor grad

Var du tilstede under elevkurs? *

- Nei
- Ja, var tilstede under 50% av kurset
- Ja, var tilstede over 50% av kurset
- Ja, var tilstede hele tiden

Har skolen din brukt programmeringsutstyret dere mottok i forbindelse med super:bit? *

- 0 - Utstyret har ikke vært i bruk
- 1 - Utstyret har vært svært lite brukt
- 2 - Utstyret har vært lite brukt
- 3 - Utstyret har vært litt brukt
- 4 - Utstyret har vært mye brukt
- 5 - Utstyret har vært svært mye brukt

Har du gjennomført super:bit oppdraget med andre klasser eller jobbet videre med super:bit oppdraget med den samme klassen etter deltagelse på super:bit? *

Super:bit oppdraget er undervisningsopplegget Vitensenteret gjennomførte med elevene.

- ○ Nei
- ○ Ja, har jobbet videre med det samme klassen
- ○ Ja, har brukt det samme opplegget i èn annen klasse
- ○ Ja, har brukt det samme opplegget i flere andre klasser
- ○ Ja, har gjort begge deler

FRIVILLG: Er det noen spesielle årsaker til at du ikke har bygget videre på super:bit eller brukt det samme opplegget i en ny klasse?

ⓘ Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «Har du gjennomført super:bit oppdraget med andre klasser eller jobbet videre med super:bit oppdraget med den samme klassen etter deltagelse på super:bit?»

Hvordan synes du det gikk å jobbe videre med super:bit oppdraget med den samme klassen? *

ⓘ Dette elementet vises kun dersom alternativet «Ja, har jobbet videre med det samme klassen» eller «Ja, har gjort begge deler» er valgt i spørsmålet «Har du gjennomført super:bit oppdraget med andre klasser eller jobbet videre med super:bit oppdraget med den samme klassen etter deltagelse på super:bit?»

- ○ 1 - Dårlig
- ○ 2 - Ganske dårlig
- ○ 3 - Nøytral
- ○ 4 - Ganske bra
- ○ 5 - Bra

Hvordan synes du det gikk å bruke super:bit oppdraget i andre klasser? *

Dette elementet vises kun dersom alternativet «Ja, har brukt det samme opplegget i èn annen klasse», «Ja, har brukt det samme opplegget i flere andre klasser» eller «Ja, har gjort begge deler» er valgt i spørsmålet «Har du gjennomført super:bit oppdraget med andre klasser eller jobbet videre med super:bit oppdraget med den samme klassen etter deltagelse på super:bit?»

- 1 - Dårlig
- 2 - Ganske dårlig
- 3 - Nøytral
- 4 . Ganske bra
- 5 - Bra

Har du brukt programmering i undervisningen din i etterkant av deltagelse på super:bit? *

Her menes andre aktviteter enn super:bit oppdraget (opplegget laget av Vitensentrene).

- Ja, jeg har brukt det mye
- Ja, jeg har brukt det litt
- Nei, jeg har ikke brukt det

Hvorfor har du ikke inkludert programmering i undervisningen din? *

Dette elementet vises kun dersom alternativet «Nei, jeg har ikke brukt det» er valgt i spørsmålet «Har du brukt programmering i undervisningen din i etterkant av deltagelse på super:bit?»

- Jeg føler meg fortsatt ikke i stand til å bruke programmering i undervisningen min
- Jeg skal gjøre det senere dette skoleåret og føler meg rustet for det
- Jeg skal bruke det senere dette skoleåret, men må sette meg mer inn i programmeringen først
- Annet

Hvordan synes du det gikk å bruke programmering i undervisningen? *

Dette elementet vises kun dersom alternativet «Ja, jeg har brukt det mye» eller «Ja, jeg har brukt det litt» er valgt i spørsmålet «Har du brukt programmering i undervisningen din i etterkant av deltagelse på super:bit?»

- 1 - Dårlig
- 2 - Ganske dårlig
- 3 - Nøytral
- 4 - Ganske bra
- 5 - Bra

Har du fått noe form for oppfølgning fra Vitensenteret i etterkant av lærer- og elevkurs? *

- Nei
- Ja, har vært i kontakt med Vitensenteret èn gang.
- Ja, har vært i kontakt med Vitensenteret flere ganger

FRIVILLIG: Har du noe annet du vil dele som du tenker kan være relevant?

Appendix H

Interview guide

Intervjuguide

Info

Velkommen og takk for at du tar deg tid til å delta i dette intervjuet, det setter jeg pris på.

Intervjuet vil bli tatt opp og lagret på en kryptert minnepenn som vil være innelåst når den ikke er i bruk. Under transkriberingen vil jeg anonymisere navn med bruk av koder. Ved prosjektslutt vil personopplysningene bli slettet. Deltakere vil ikke kunne gjenkjennes ved publikasjon.

Er det noe du lurer på før vi begynner?

Intro

Jeg er lektorstudent ved NTNU og disse intervjuene er en del av datagrunnlaget for masteroppgaven min. Temaet for oppgaven og disse intervjuene er å undersøke hvorvidt super:bit prosjektet og super:bit modellen er en god måte å introdusere og forberede lærere på å undervise i programmering på.

Jeg har fokus på Vitensenteret i Trondheim sitt arbeid mot skoler og da spesielt lærere i oppgaven min.

Bakgrunn

1. Hvilke fag underviser du i?
    a. Hvilke fag ser du for deg å undervise programmering i?
2. Hvilke trinn underviser du på?
3. Når deltok du på lærer- og elevkurs?
4. Hvilke erfaringer med programmering hadde du før deltagelse på super:bit?
    a. Har du undervist i programmering før? *Hvis ja:*
        i. Hvordan følte du det gikk?
        ii. I hvilke fag var det?
    b. Har du noe form for utdanning eller tatt andre kurs innenfor programmering eller IT?
    c. Har du gjennomført nettkurset om “programmering og algoritmisk tankegang” fra UDIR (kompetansepakke)?
    d. Eventuelle andre erfaringer?

Super:bit - før, under og etter

Nå ønsker jeg å undersøke litt nærmere hva du synes om de forskjellige delen i super:bit prosjektet og hva du har gjort i etterkant av deltakelse

5. Hvorfor meldte du deg på super:bit prosjektet?

Før Kurs

6. Hva synes du om den praktisk informasjon i forkant av kurset?
7. Hva synes du om forarbeidet?
    i. Gjennomført?

Lærerkurs

8. Hva synes du om lærerkurset?
    a. Varighet
    b. Nivå

Elevkurs

9. Hva synes du om elevkurset?
    a. Tilstede under hele kurset?
10. Hva tror du elevene synes om elevkurset?
    a. Hva tror du de likte best?
    b. Hva du de opplevde som mest utfordrende?

Etter kurs

11. Har du brukt programmering i undervisningen din etter deltakelse på kurs?
    a. Har dere jobbet noe videre med klassen som hadde elevkurs?
    b. Har du gjennomført super:bit oppdraget med en annen klasse?
    c. Hvordan har dere brukt programmeringsutstyret dere mottok i forbindelse med super:bit?
12. Har du brukt nettressursene til super:bit?
    a. Hvis ja:
        i. Hva synes du om dem?
    b. Hvis nei:
        i. Hvorfor ikke?
13. Har du eller noen andre på skolen hatt noe form for oppfølging fra Vitensenteret i etterkant av lærer- og elev-kurs?
14. Er du medlem av facebook gruppen “super:bit lærerforum”?
    a. Hvis ja:
        i. Har du fått noe hjelp eller hjulpet noen andre der?
    b. Hvis nei:
        i. Visste du om denne facebook gruppen?
15. Hvis du skulle ha noen spørsmål eller ønsker å diskutere micro:bit, programmering eller lignende, synes du super:bit har vært med på å skape en arena for dette?
    a. På din skole
    b. På tvers av skoler
        i. Hvordan komme i kontakt med disse?

Holdning til programmering i skolen

Nå ønsker jeg å undersøke litt nærmere hvordan deltakelse i super:bit prosjektet har påvirket din holdning til innføringen av programmering i skolen

16. Før du deltok på super:bit prosjektet, hva var dine tanker rundt at programmering er inkludert i de nye læreplanene?
    a. I dine fag
17. Hva tenker du nå, i etterkant av prosjektet, om at programmering er inkludert i de nye læreplanene?
    a. I dine fag
    b. Hvis endret: Hva tror du er årsaken til at du tenker annerledes nå?

Motivasjon

Nå ønsker jeg å undersøke nærmere hvordan super:bit prosjektet har påvirket din motivasjon for å lære mer om og undervise i programmering

18. Merker du en forskjell i din motivasjon til å lære mer om eller undervise i programmering etter deltakelse i super:bit?
    a. Melde deg på andre kurs?
    b. Etterutdanning?
    c. Gjennomføre UDIRs kompetansepakke “programmering og algoritmisk tankegang”?
    d. Selvstudie?

Kompetanse

Nå ønsker jeg å undersøke hvordan din deltagelse på super:bit prosjektet har påvirket kompetansen din

19. Merker du noe forskjell på programmeringskompetansen din nå etter deltakelse i super:bit?
    a. Tilstrekkelig til å kunne undervise?
        i. Teknisk kompetanse
        ii. Pedagogisk kompetanse
            1. Følge læreplan
            2. Lage varierte undervisningsopplegg
            3. Tilpasset opplæring
            4. Ulike metoder for vurdering
            5. Forklare konsepter på ulike måter, om elever sliter med å forstå noe

Mestringstro

Nå ønsker jeg å undersøke hvordan din deltagelse i super:bit prosjektet har påvirket mestringstroen din

20. Merker du noen endringer i hvordan du føler deg rustet til å undervise i programmering etter deltakelse i super:bit prosjektet?
    a. Ser du noen utfordringer?
21. Føler du deg rustet for å gjennomføre undervisningsopplegget fra elevkurset (med andre klasser)?
    a. Ser du noen utfordringer?

Annet

22. Før vi avslutter, har du noe annet du har lyst å dele som du tenker kan være relevant?

Tusen takk for at du ville delta i dette intervjuet og dele dine erfaringer. Ha en fortsatt fin dag!

Appendix I

NSD approval interviews (not carried out)

Det innsendte meldeskjemaet med referansekode 753015 er nå vurdert av NSD.

Følgende vurdering er gitt:

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 06.10.2020, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:
nsd.no/personvernombud/meld_prosjekt/meld_endringer.html

Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 15.12.2020.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: [redacted]
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix J

E-mail to all teachers who had attended the super:bit trainings directed by the science centre in Trondheim

Lærerintervju - Masteroppgave programmering i skolen og super:bit

AS **Atle Vågen Svendsgaard** [redacted]
12.10.2020 15:40

Til: [redacted]

Samtykkeskjema.pdf
99,17 kB

Hei!

Jeg studerer lektor i realfag med matematikk og informatikk på NTNU og er nå i gang med masteroppgaven min. Masteroppgaven skal undersøke hvordan super:bit har påvirket læreres evne til å undervise i programmering, i henhold til den nye læreplanen. I den forbindelse ønsker jeg å intervjue lærere som har vært med på super:bit (lærerkurs og elevkurs).

Jeg er fleksibel på gjennomføring og tidspunkt for intervjuene. Gjennomføring kan skje digitalt (telefon, zoom, teams eller annen plattform) eller fysisk, etter deres ønske.

For mer informasjon om oppgaven, hvordan dine personopplysninger vil bli ivaretatt og dine rettigheter, se vedlagt samtykkeskjema. Dette vil jeg ta med til intervju for signering.

Hvis du er interessert eller har spørsmål, ta kontakt med meg på:

e-post: [redacted] / tlf: [redacted]

så kan vi avtale nærmere.

Med vennlig hilsen

Atle Vågen Svendsgaard

Appendix K

Consent form teacher interview

Vil du delta i forskningsprosjektet

«The super:bit project: a model for introducing programming to teachers and pupils - from the teachers perspective »?

Introduksjon
Jeg studerer lektor i realfag og holder nå på med min masteroppgave som skal undersøke om super:bit prosjektet er en god måte å introdusere og forberede lærere på å undervise i programmering. I dette skrivet gir jeg deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
Super:bit er en del av satsingen «den teknologiske skolesekken» fra UDIR. I masteroppgaven vil fokusere på vitensentrenes arbeid mot landets skoler og da spesielt lærere. Jeg vil samle informasjon fra lærere som har deltatt på super:bit prosjektet og analysere dette opp mot relevant litteratur for å undersøke om super:bit modellen er en god måte å introdusere og forberede lærere på å undervise i programmering.

Opplysningene som blir samlet inn vil kun bli brukt i masteroppgaven.

Hvem er ansvarlig for forskningsprosjektet?
Masteroppgaven skrives av student Atle Vågen Svendsgaard (meg), under veiledning av professor Monica Divitini. Den ansvarlige institusjonen er Institutt for datateknologi og informatikk ved NTNU.

Masteroppgaven blir skrevet i samarbeid med Vitensenteret i Trondheim og biveileder Ola Kleiven.

Hvorfor får du spørsmål om å delta?
I prosjektet ønsker jeg å samle informasjon fra lærere som har deltatt på super:bit prosjektet. Det vil si deg som har deltatt eller skal delta på lærerkurset og elevkurset i regi av Vitensenteret i Trondheim.

Hva innebærer det for deg å delta?
Hvis du velger å delta i studien innebærer det at du deltar i et intervju. Det vil ta deg i underkant av èn time. Intervjuet vil hovedsakelig omhandle dine erfaringer rundt lærerkurs, elevkurs, oppfølgning fra Vitensenteret og din opplevelse av å skulle undervise i programmering etter å ha deltatt på super:bit prosjektet. I intervjuet vil det bli tatt lydopptak som vil bli transkribert og senere slettet.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

- Kun jeg og min veileder Monica Divitini vil ha tilgang til opplysningene.
- Lydopptakene vil bli lagret på en kryptert minnepenn. Denne vil låses inne når den ikke er i bruk.
- Navn vil bli anonymisert med bruk av koder. Kodene vil lagres i en navneliste adskilt fra resten av dataene.
- Deltakere vil ikke kunne gjenkjennes ved publikasjon.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Masteroppgaven skal etter planen leveres den 15. desember 2020. Ved levering av oppgaven vil personopplysninger og lydopptak slettes.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra NTNU har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- NTNU, Institutt for datateknologi og informatikk ved masterstudent Atle Vågen Svendsgaard (tlf: [redacted], e-post: [redacted]) eller professor Monica Divitini (tlf: [redacted], e-post: [redacted])
- Vårt personvernombud: [redacted] (tlf: [redacted], e-post: [redacted])

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:

- NSD – Norsk senter for forskningsdata AS på e-post (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Prosjektansvarlig

Monica Divitini

Student

Atle Vågen Svendsgaard

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet *The super:bit project: a model for introducing programming to teachers and pupils - from the teachers perspective*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- □ å delta i intervju

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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(Signert av prosjektdeltaker, dato)

Appendix L

E-mail to teachers at the school where the observations were done

Til deg på Frol barneskole

AS **Atle Vågen Svendsgaard** [redacted]
23.10.2020 11:21

Til: [redacted]

Samtykkeskjema.pdf
99,17 kB

Hei!

Jeg studerer lektor i realfag på NTNU og er nå i gang med masteroppgaven min. I den anledning har jeg og en medstudent allerede vært hos dere på Frol barneskole og observert undervisningsdelen av super:bit i regi av Vitensenteret. Nå ønsker jeg å komme i kontakt med deg som har vært med på super:bit prosjektet.

Kort om masteroppgaven og intervju:
I masteroppgaven skal jeg undersøke om super:bit-modellen er en god måte å introdusere og forberede deg som lærer på å bruke programmering i din undervisning. For å finne ut av dette er jeg avhengig av å høre om dine erfaringer gjennom et kort intervju. Intervjuet krever ingen forberedelser eller kunnskap om programmering utover deltakelse på super:bit.

Intervjuet vil gjennomføres på dine premisser. Jeg er fleksibel på gjennomføring og tidspunkt for intervju. Intervjuet kan foregå digitalt (telefon, zoom, teams eller annen plattform) eller fysisk, etter deres ønske.

Ved å dele dine erfaringer med meg bidrar du til forskning som kan gjøre programmeringsopplæringen for lærere enda bedre i fremtiden.

For mer informasjon om oppgaven, hvordan dine personopplysninger vil bli ivaretatt og dine rettigheter, se vedlagt samtykkeskjema.

Jeg håper dette høres interessant ut, ved interesse eller spørsmål ta kontakt med meg på:

e-post: [redacted] / tlf: [redacted]

Med vennlig hilsen

Atle Vågen Svendsgaard

Appendix M

Approval NSD questionnaire

Det innsendte meldeskjemaet med referansekode 753015 er nå vurdert av NSD.

Følgende vurdering er gitt:

NSD har vurdert endringen registrert 29.10.2020.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 29.10.2020. Behandlingen kan fortsette.

Noen av intervjuene med utvalg 1 vil gjennomføres som elektronisk spørreundersøkelse ved hjelp av Nettskjema. Disse deltakerne ble registrert som utvalg 2 og Nettskjema ved UiO ble lagt til som databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

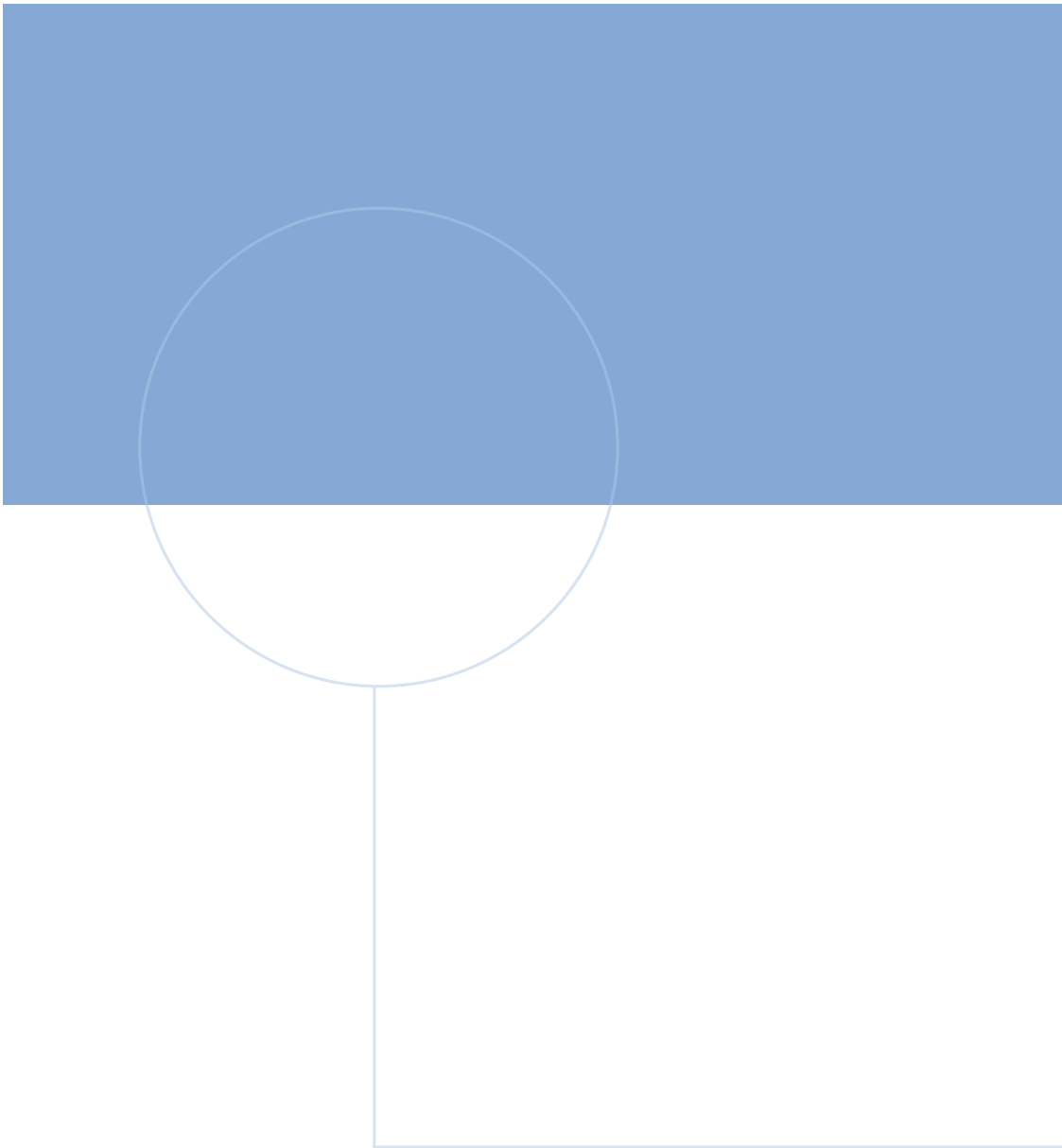
Prosjektet vil innhente samtykke fra de registrerte i utvalg 2 til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: [redacted]

Tlf. Personverntjenester: 55 58 21 17 (tast 1)



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