NTNU

Norwegian University of
Science and Technology

Mobile Learning Ecosystem to Enhance Students Learning

Lessons Learnt from an Empirical Study at
NTNU

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Sammendrag

Teknologi utgjør en stor del av hverdagslivet. Det er stor etterspørsel etter mobile applikasjoner, også kjent som "apper". En kategori som er av spesielt økende betydning er læringsapplikasjoner. I utdanninginstitusjoner så er det økende bruk av læringsapplikasjoner som møter oppfyller studentenes behov og nødvendigheter. For eksempel så kommer det nye studenter til NTNU hvert år. Som ny student kommer man til NTNU uten noen kunnskap om hvilke studieverktøy som er tilgjengelige eller som kan være nyttige for studiet. Selv studenter som har studert på NTNU i lengre tid, er ikke klar over hvilke verktøy som finnes tilgjengelig for dem.

Denne studien tar sikte på å identifisere sammenhengene mellom ytelsesforventninger, innsatsforventninger, glede, tilfredshet for å forutsi intensjon om å bruke en mobil applikasjon for utdanningsformål. Hensikten med studien er å finne ut om en mobilapplikasjon for pedagogiske formål kan møte NTNU- studentenes behov og forbedre deres akademiske hverdag ved å gi rask og enkel tilgang til viktig informasjon og tjenester. Til dette formålet utviklet jeg en mobilapplikasjon som samler viktige tjenester for studenter på ett sted. Applikasjonen ble testet gjennom en funksjon for tilbakemelding innebygd i applikasjonen, tilbakemeldinger fra spørreskjemaer og semistrukturerte intervjuer.

Resultatene av forskingen viste hvordan brukere med ulike oppfatninger av applikasjonen kan ha enten høye eller lave til middels hensikt om å bruke den. De kvinnelige deltakerne viste en høy intensjon av bruk etter å ha identifisert hvordan applikasjonen kan øke effektiviteten deres og etter å ha oppdaget hvor nyttig applikasjonen kan være for dem generelt sett. Når det gjelder de mannlige deltakere, viste resultatene at for de som fant applikasjonens anvendelse nyttig, resulterte i en høy intensjon av bruk på den betingelsen i at applikasjonen gir dem en glede eller tilfredsstillelse av å bruke den. I det tilfellet der glede var ikke-eksisterende, ble det en lav sannsynlighet for å bruke applikasjonen uavhengig av andre forhold. Videre er det konkludert med at alle deltakerne indikerte at anvendelsen av applikasjonen var deres beste erfaring i forbindelse med deres utdannelse på NTNU opp til nå, i tillegg til andre læringsapplikasjoner. Tilfredshet og innsatsforventning var høy blant deltakerne noe som igjen tyder på at de var fornøyd med tjenestene i applikasjonen, siden de fant den nyttig og enkel å bruke. Til slutt, oppdaget vi at det var en økning av interesse for mobile PLE blant studentene, og at søkeprosessen der innhenting av ønsket informasjon og verktøy ble forbedret med applikasjonen som ble utviklet i denne forskningen.

Nøkkelord: mobil læring; kompleksitetsteori; mPLE; mobilenheter; innholdsanalyse; Android; uformell læring; læringsapplikasjon; tilgjengeliggjøring;

Abstract

Technology constitutes a huge part of our everyday lives and there has been an increased demand towards mobile applications, also known as “apps”. A category of applications that are increasing in importance are the educational applications.

Institutions are increasing their use of educational applications and applications that meet the needs of students are covered and necessary. Every year there are new students arriving at NTNU and as a new student, he or she arrives without any knowledge about what study tools are available or could be helpful for their study. Even students that have been at NTNU for some time, do not know all of the tools that are available.

This study aims to identify the interrelations performance expectancy, effort expectancy, enjoyment, and satisfaction in order to predict intention to use a mobile application for educational services. The study intends to determine if a mobile application for educational purposes can meet the NTNU student’s needs and improve their everyday academic life with easier access to important and desired content. A mobile application was developed which includes important services for students in one place. The application was tested through a feedback functionality within the application itself, feedback from questionnaires, and semi-structured interviews.

The results of the feedback showed how users with different perceptions towards the application may have either high or low/medium intentions to use it. Female participants showed a high intention of use after identifying how the application could increase their performance and discovering how useful the application can be for them. Male participants, showed that for those who found the application useful resulted in having a high intention of use on condition that the application provided them enjoyment or satisfaction. In the case where enjoyment was nonexistent, there would be a low probability of using it regardless of any factors. It is concluded that all of the participants indicated that up to now, the tested application was their best experience amongst other mobile learning applications. The satisfaction and effort expectancy was high among the participants, indicating that they were pleased with the services of the application since they found it useful and easy to use. Lastly, it was discovered that there was an increase of interest in mobile PLEs amongst students, and that the retrieval process of desired information and tools was improved with the developed application.

Keywords: mobile learning; complexity theory; mPLE; mobile devices; content analysis; Android; informal learning; learning applications; accessibility;

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Abbreviations

API	Application Programming Interface
CMS	Course Management System
fsQCA	Fuzzy set Qualitative Comparative Analysis
GPS	Global Positioning System
HiST	Trøndelag University College
ICT	Information and Communication Technology
LCMS	Learning Content Management System
LMS	Learning Management System
LP	Learning Platform
LSS	Learning Support System
MLE	Managed Learning Environment
mPLE	Mobile Personal Learning Environment
MRA	Multiple Regression Analysis
NTNU	Norwegian University of Science and Technology
OS	Operating System
PDA	Personal Digital Assistant
PLE	Personal Learning Environment
SOA	Service Orientated Architecture
SUS	System Usability Scale
UCD	User-Centered Design
UiA	University of Agder
VLE	Virtual Learning Environment

Chapter 1

Introduction

Since the first modern smartphone was launched, there has been an increased demand towards applications. The use of technology where education is the main goal is greatly increasing and educational institutes need more applications where the student's needs are covered[1]. There are many applications where other services are combined with educational services, but there are few applications that only focus on educational services. This new type of learning environment gives opportunities towards interaction, collaboration, assessment and learning objectives[1]. Moreover, it has changed the learning platform to give the students more opportunities in terms of personal learning environments.

The most widely used approach today is Learning Management Systems (LMS). These are systems for the administration of users and organizations where digital learning content is used in educational systems[2]. In relation to LMS, Personal Learning Environments (PLE) have shown to improve self-learning. PLE is where the LMS is customized according to students' needs and where the student has the ability to administer self-learning[3]. In other words, PLE can be observed as a possibility to customize the system in what way is best for the user.

1.1 Motivation

According to Martin et. al. (2013), the literature demonstrates that in technology for educational purposes, there is evidence that mobile learning is an influential approach where learners are being kept engaged and provides learning in a reliable and informal manner[4]. Consequently, the use of technology in educational institutes has been proven very positive, both for the students and the administration. As Ssekakubo et al. states (2014):

> Information and Communication Technology (ICT) has proved to be an essential component of the educational system. It has positively impacted the educational system and has played an important role in meeting challenges ranging from educational and administrative to supportive.
>
> Ssekakubo et al., 2014: p 92 [2].

Moreover, students have revealed in a study that they desire easier access to LMS information through “less clicks”[2]. In addition to this, it is preferable to have mobile phone access where the tools and information of desire is service-based[2]. Students who find it useful to use mobile LMS, or mobile PLE, to access information and tools for their needs encourages the increased usage of LMS and participation in the subject, and helps students learn[2-4]. Additionally, they do not need to use a complete desktop interface to access desired information [2]. It has been pointed out, however, that it is a complex challenge to meet different needs of the students[5]. It is especially difficult to meet student needs in large lectures with many participants[5]. As some students can often find themselves outside the “one-size-fits-all” philosophy [5].

Informal learning is stated to be the type of learning that probably occurs the most during the adult life[6]. Informal learning offers a variety of learner control and personal customization which is related to high motivation[6]. For that reason, the development of a digital tool to enable students to use it in both formal and informal learning settings is one of the main motivations for this thesis. The popularity of the usage of smartphones provides possibilities to integrate and assist mobile learning.

As student we have experienced challenges in terms of accessing important information and tools at our university. Every year there are new students arriving at the Norwegian University of Science and Technology (NTNU) and as a new student, he or she arrives at NTNU without any knowledge about what study tools are available or could be helpful for their study. Even students that have been at NTNU for some time, do not know all of the tools that are available. Some students receive information about helpful tools from others, some receive it from their mentor that takes care of them when they arrive the first weeks at campus and some finds the tools available themselves after using a large amount of time searching for it at NTNU's webpage. For instance, there is a tool for creating personal timetables according to the student’s study program, but as a newcomer, this information would be impossible to know without being provided the knowledge that this tool exists. For these reasons there is a need to improve the information flow as there is too much time spent on the universities’ webpage searching for desired content. In some cases, the search of the desired content does not give expected results, which then often leads to ‘googling’ which is neither intuitive nor practical. There are more matters to the topic, but the new students have no way of knowing what information is important without hearing about it from their friends.

This thesis creating a mobile application that facilitates easy access to important information for students who belong to NTNU. That is, a tool, which may provide desired

content, related to their studies and/or NTNU with less searching than traditional Internet search offers. Since the aim is to use mobile phones in educational environments, the plan is to use a service-based approach where only the most important services will be implemented instead of overcrowding the application with too much information. NTNU students have participated in a survey with questionnaires to get insight on what services are considered important. These services are not only adapted to students based on former knowledge, but also today's practice in accessing content. All students have individual needs and preferred styles of usage and therefore the services and content is selected to target the majority of students. This aids the educational institute to give students more alternatives in terms of accessing desired or important content. Moreover, the content is to be presented to the students as filtered and accustomed, with the purpose of only displaying the important information from a huge amount of information available. In the end, these services and content have been verified by conducting a survey of questionnaires and semi-structured interviews.

1.2 Research Questions

The appearance of the present mobile technologies and the advancement to ubiquitous technologies is viewed as key to support formal learning, and therefore it is an increasing interest in what these technologies can benefit in terms of students learning[1]. However, research on mobile applications for formal institutions reveals that there is a challenge to fulfill all students' needs and that there is an increasing demand on mobile learning applications for educational institutes. This is due to every student having his or her own method of how to learn and covering all these needs is lacking in terms of mobile applications[1, 2]. Mobile devices are used by the majority of students, which is why it is necessary to provide services to meet the modern students' needs[3]. As for the benefits of mobile learning applications, it allows retrieval processes for formal and informal resources anywhere and anytime, in addition to providing students the possibility of having information control in terms of keeping track of updates[4, 7]. Currently, instructors use computer technologies to set up lectures which may cause difficult interactions between the learners and instructors. A mobile device with an integrated learning application can change that focus and help learners have easy interactions with the instructors[8]. Students should be given the possibility to choose which tools they think are the best for their learning, and learning institutions should offer the ability of mobile learning for their students[3]. Using such mobile

learning platforms increases students' motivation to help them learn[3, 6]. Moreover, when mobile learning applications are developed, the insight from students is not always included. Their insight is highly valuable and therefore should be included in future development there is a need to decide what tools are required for their learning in any setting, anytime[1, 3].

This thesis will focus on developing an application that could be used to support students' information retrieval by integrating it into the existing educational environment. In addition, since students have different needs and practices of how to do information retrieval, the application could be promoted as an alternative to reach even a greater audience. For that reason, this thesis attempts to answer the research questions shown in Table 1.1.

RQ1	What are the current options that university students may access when it comes to mobile learning applications?
RQ2	Can a mobile application for university students increase interest and opportunities in mobile personal learning environments?
RQ3	Can a mobile application gathering important content and tools improve the retrieval process of important academic information and tools for university students?

Table 1.1: Research questions

1.3 Approach

In order to answer the research questions in Table 1.1, a research strategy, data generation method and a data analysis was selected. These are described in Table 1.2. This was created to ensure a good overview of the process on how and why this was decided as an approach to each of the objectives in Table 1.2

Objectives	Description
1. Literature review	Through literature reviews, the research questions were defined and a conceptual framework was selected.
2. Design of the application	With the aim of attaining insight on students' needs and experience, a survey was conducted with questionnaires. This, in addition to the literature review, gave insight and motivation on how to design the application. A mock-up was created to visualize the application and to detect faults.
3. Development of application	Based on the design mock-up, functional and non-functional requirements were created and organized in a prioritized list to follow. This was to ensure that a bare minimum level of functionality was created if there were to be any unforeseen time constraints. If there was extra time, then additional functionality would be implemented. The requirements provided guidelines in which was followed as an overview to implement the application.
4. Empirical study	In this phase, the application was tested by conducting a survey of questionnaires and interviews. These data generation methods were selected to provide the analysis with quantitative and qualitative data results.

Objectives	Description
5. Analysis of the Empirical study	From the empirical study an analysis was conducted which provided the empirical findings that could be discussed and compared to previous related studies. In the end, the findings provided a conclusion of our research and answers to the research questions.

Table 1.2: Approach of main objectives of the thesis

1.4 Contribution

This thesis provides the contributions that are listed in Table 1.3.

1. Shows how users with different perceptions towards the application may have different intentions to use it.
2. Shows how gender affects the evaluation and view upon a mobile application, and thus the probability to use it in the future.
3. Shows insight on the measures: intention to use, satisfaction, enjoyment, performance expectancy, effort expectancy, and learning purpose of the NTNU mobile personal learning environment application.
4. Shows insight on how high levels of satisfaction and effort expectancy can be achieved, hence increasing the interest in mobile PLEs and improvement of data retrieval of desired content amongst university students.
5. Shows that the study is one of the first in the area evaluating a mobile learning application, and has both theoretical and practical implications towards the development, design and provision of mobile learning applications.
6. Shows new data and insight for future research.

Table 1.3: Contributions of the thesis

1.5 Thesis outline

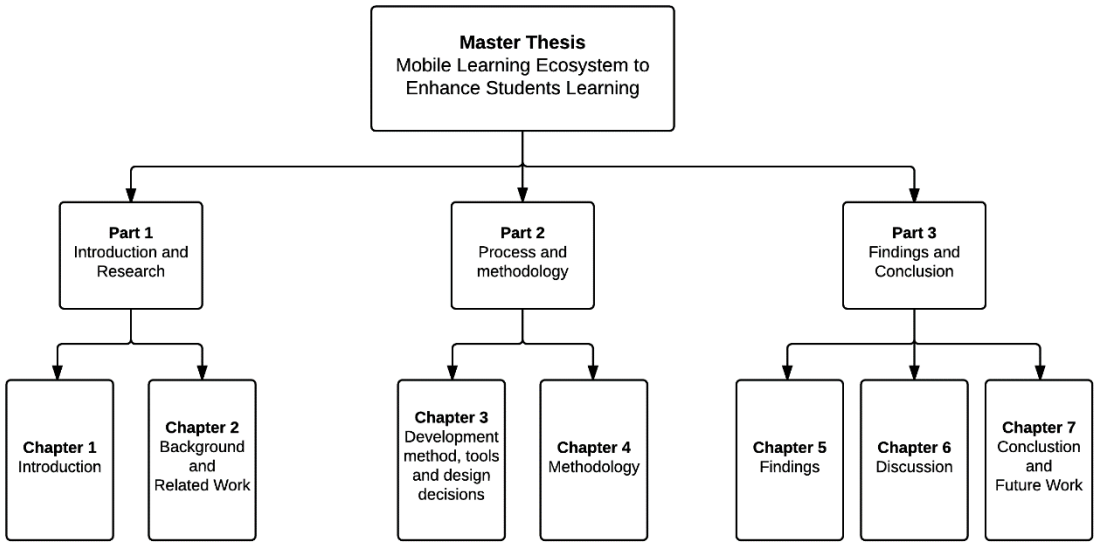


Figure 1.1: Master thesis' outline

Thesis's outline is illustrated in Figure 1.1, and all the chapters are listed below with a short description.

Chapter 1 introduces the thesis's research and motivation along with the research questions, the method that has been decided, and the contributions this thesis provides.
Chapter 2 presents the background and related work of this thesis. The chapter gives an overview of definitions, related work, and existing solutions. In the end, a summary of the chapter is presented and what we plan to do compared to the background and related work.
Chapter 3 presents the development methods and tools used to conduct the development of the application, shows the result of the design application questionnaire, and provides a detailed description of the finished mobile application.
Chapter 4 describes the research methodology done in this thesis. The chapter explains the process, data collection, measures used, results of the post testing questionnaire, constructs used, and lastly a data analysis and a fuzzy set qualitative comparative analysis.
Chapter 5 presents the empirical findings of the mobile application through questionnaires, semi-structured interviews, and the system usability scale schema.
Chapter 6 discusses the empirical findings of the tested mobile application and compares them with other related studies.
Chapter 7 presents the conclusion of the results, provides answers on the research questions, and proposes future work.

Chapter 2

Background and Related Work

This chapter presents the background and related work for this thesis. This chapter provides definitions, related work, and existing solutions. In the end, a summary of the chapter is presented and a plan of what to do compared to the background and related work. A mapping table of the literature review mapping empirical research on mobile learning applications as a learning tool can be viewed in Appendix B. The chapter is divided in four sections: 2.1 Definitions, 2.2 Related work, 2.3 Existing solutions, and 2.4 Chapter summary.

2.1 Definitions

2.1.1 Learning

Defining learning is a challenge, but many researchers have tried to list the characteristics for effective learning. Pereira and Rodrigues explains the definition of learning as quoted:

> Learning is the ability to acquire new or transform existing knowledge, skills, or behaviors. It is a relatively permanent change in behavior or knowledge that comes from experience or training. This ability involves synthesizing several types of information over a period of time. Humans, animals, and even machines can possess such ability. Learning may occur as part of school education, self-education, or any other specific training in a conscious or unconscious way.
>
> Pereira, O.R. and J.J. Rodrigues, 2013: p 27:1 [9].

Pereira and Rodrigues (2013) mention that in a learning process there has to be a minimum of two contributors, where one is a person being taught and the other is the learning content itself [9]. Attaining the learning content can be done through a visual, auditory and kinesthetic approach[9]. The visual learners learn through seeing, in terms of reading and observing. Auditory learners are people who favor learning content through hearing about it. Lastly, kinesthetic learners are those who “learn by doing”, for instance doing an activity. These three approaches are common to combine and generally one or more are favored. Learning is traditionally recognized as a formal activity in a classroom with a teacher.

2.1.2 E-learning

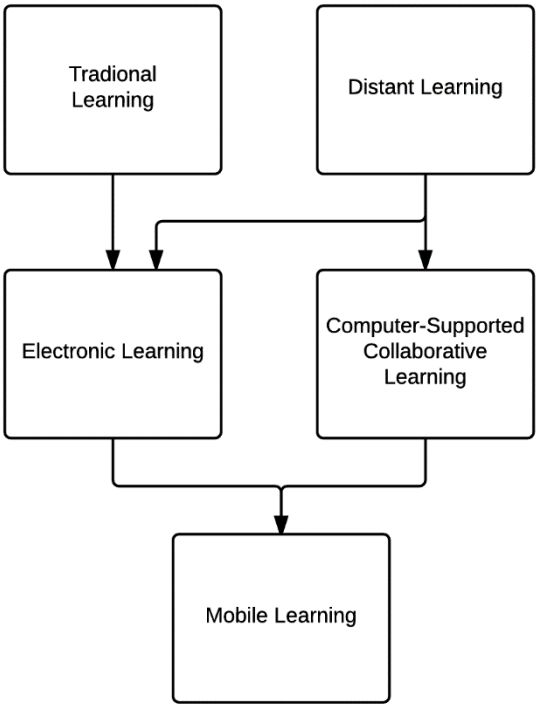


Figure 2.1: Evolution of learning models

Since the proliferating of mobile devices, another alternative to the traditional learning model has developed. This has led to the new type of learning called electronic learning, commonly known as e-learning[9]. This learning is done through computer-generated classrooms that are connected though the world wide web. The content is represented as multimedia such as text, images, animation, video and audio[9].

Current technology has evolved and made e-learning not limited to only desktop computers, but laptops, tablets, smartphones and personal digital assistants(PDAs)[9, 10]. This has allowed people another mode of learning which can be conducted anywhere at any time, this is known as mobile learning (m-learning)[10]. The learning evolution is illustrated in Figure 2.1. Communication through mobile devices has given the user the possibility to communicate personally and to a group with text messages, voice, and video communication[7]. In addition to the communication, the ability to use GPS to locate and track the user can provide customized information, needs, and preferences based on the user's location[7]. The different types of digital content such as text, image, audio, and video gives the user a vast amount of options to acquire or share information[7].

Based on all the insight mobile technology has provided us, one can indicate that this technology has a high potential to meet many needs, especially with teaching and learning,

where there is a possibility to reach out to each of the individuals of the audience. This means that one can reach out to every individual learner and customize the learning to the learner's needs and anywhere and anytime[7]. In addition, the learning can give different options for the learner:

> Mobile devices (a) can engage students to experiential and situated learning without place, time, and device restrictions; (b) enable students to continue learning activities, initiated inside the traditional classroom, outside the classroom through their constant and contextual interaction and communication with their classmates and/or their tutors; (c) support on-demand access to educational resources regardless of students' commitments; (d) allow new skills or knowledge to be immediately applied; and (e) extend traditional teacher-led classroom scenario with informal learning activities performed outside the classroom.
>
> D.G. Sampson and P.Zervas, 2013: p 4 [7].

In short, these devices can give a new experience to learners where the learning material is personalized in everyday situations. What is more, how learning is conducted can be identified and logged to give the learner adjusted response and support[7].

2.1.3 Mobile learning

Mobile learning has often been referred as Ubiquitous learning, Martin and Ertzberger explains and describes it well using five points[4]. First, is the importance of the need of learning that it is on demand. Second, the ability to request what knowledge is desired to learn. Third, learning that is possible to adapt to everyday life. Fourth, that the human machine interaction is in combination with place, time and activity. Fifth and last, the learner has the ability to regulate the process of learning. As mentioned earlier, m-learning is enabled through mobile devices such as smartphones, etc. However, these devices usually depend on an Internet connection to keep their information updated. Students also commonly require assistance and support to be able to use them properly. The learning content is generally located and distributed from a server[11]. Currently, applications for mobile devices has become very popular amongst young learners. M-learning applications are greatly adaptable and can be accommodated virtually to any environment[1].

Technologies supporting mobile learning can offer possibilities to do learning in different circumstances because of the portability[6]. The learning can take place in formal and semi-formal settings which can be of great value for students since it gives students the possibility to stay informed, get desired notifications, and keep track of personal goals[6]. This enables the learner to have more control over the learning outside the formal setting.

Social media is another aspect that is often connected with education and students often do a combination of social media and education when they study. However, some studies show that not all students share the same opinion on that matter and some look upon education more as a private aspect or recognizably different in nature from social media[12]. The distinct view of education for some students has led to them to separate their social environment and education[12]. Adapting and customizing mobile learning applications provides benefits to meet educational institution's needs in terms of communication, setting learning goals and interests, accommodation of different learning styles, and anywhere and anytime learning environments[7]. Another positive aspect of m-learning, Martin and Ertzberger's study revealed that "mobile learning keeps the learners engaged, and one is able to deliver learning that is authentic and informal via the mobile learning technologies"[4].

2.1.4 Learning Management Systems

Throughout the literature review, information has been collected about different systems where different types of approaches have been tested to fulfill the demand of tools for mobile education. Learning management systems (LMS) are the systems for administration of users and organizations where digital learning content is used in educational systems[2].This type of system is what is mostly used in a context of traditional learning or digital learning. Moodle, for instance, is a worldwide known LMS, which is open source and developed by an international community with more than 100 000 members [3]. One of the reasons why Moodle is widely known, is because of the open source platform. Generally, LMSs that are open source, have supported educational institutions that have low budgets to make use of these systems. These systems support large amounts of users where the cost of licensing is low and the systems can be customized into the needs of the institution[2].

LMS is a widespread system that is used by many universities in many countries. Studies show, however, that universities in developing countries have other challenges when it comes to implementing LMS. The major challenges are related to, electricity outages, limited computers hardware and Internet availability[2]. Analysis indicates that if LMSs are integrated with mobile phones, the challenges mentioned would be reduced to some extent. Additionally, developing a customized mobile interface provides improved access to the LMS and allows students to desired information and notification without the need of accessing a desktop interface with full functionality[2].

LMS can be described in different variations, such as Virtual Learning Environments (VLE), Course Management Systems (CMSs), Learning Content Management Systems

(LCMSs), Managed Learning Environment (MLE), Learning Support Systems (LSSs) or Learning Platforms (LPs)[2]. These systems can be developed into online platforms where digital education is the goal. In relation to LMS, Personal Learning Environments (PLE) have shown to improve learning of students. PLE is where the LMS is customized accordingly to the students' needs and where the student has the ability to administer in the direction of their own learning [3].In other words, this can be observed as a possibility to customize the system in what way is best for the user. This requires that the user learns the instructions on how the whole system works. LMSs are built upon formal learning environments, while PLE provides a more informal environment. However, it has been suggested that LMSs and PLEs could exist in parallel. This then enables the user to choose which environment is most suited for the user[3].

The LMS has dominated Internet-based education for a long period of time [13, 14], but studies indicate that the traditional LMS has become inflexible, limited, and outdated to support new technologies that emerge within Internet and social interactions[13, 14]. Therefore, it has been predicted that the era of LMS will fade and move towards service-oriented e-learning platforms[13]. As the amount of technologies and applications with Internet access are increasing, people are becoming more digitalized and connected to the Internet[13].

2.1.5 Service Oriented Architecture

Service Oriented Architectures (SOA) have been proposed as the best approach when it comes to making learning environments flexible in terms of usability and accessibility[2]. The problem with this approach is that it does not take the user as the center of attention, but rather has its focus on learning administration[2]. One point that has been made throughout the collected literature review, is that the students need easy access to the desired information. In other words, less searching and clicking before getting to the desired content. Since smartphones are popular and owned by students, the aim is to use mobile applications in educational environments. In that case, there is argued for use of service-based instead of course based LMS. Using few LMS services, the most important ones should be used instead of overcrowding the system with too many services.

2.1.6 Personal Learning Environments

Personal Learning Environments (PLE) is another alternative evolution of the LMS. In this learning environment, learners can personalize the learning content to their needs[15, 16]. It is stated that *"PLEs have a huge potential to support learners in a meaningful way or to*

support teachers to use different applications within their subjects" (Martin Ebner and Behnam Taraghi, 2010: p 1165)[15]. There are different motivations for developing PLE software for learners. One of the major motivations is to give learners a better overview and control of their learning[12]. Another motivation is that Internet access is virtually ubiquitous. This approach will reach to many learners as well as giving them an alternative to support their learning[12]. PLEs can also be made less vulnerable to loss of Internet access, allowing the learning to go on while disconnected[12]. Additionally, this also improves the structure of the educational institution as, should there be any failure with the system, learners can still access the desired information and functionality[12].

In a study at the University of Salamanca, a service-based framework approach was tested as an Android mobile PLE[17]. The result ended in learners being encouraged to participate in the subjects and additionally helped them to learn as they had access to their LMS's functions and information. This study showed that it was a success in increasing participation and as a help to learn , but it also showed that there is even more potential to the mPLE[17].PLE still needs more experimentation in terms of support of pedagogy and pedagogic approaches[18]. mPLE is designed (with the purpose) to create and structure learning goals, providing a plan of how these goals are to be reached. The learner sets and advances on educational goals, a process in which mPLE facilitates the growth of the learner's reflective skills [18, 19]. PLE is an approach that has high potential and gives students another option for studying effectively.

2.2 Related work

2.2.1 Motivation

As technology is a part of people's everyday life and increasing in demand, we need more people to fulfill the increasing demands. Especially, technology where education is the main goal, educational institutes need more applications where the student's needs are covered [1]. There exist many applications where other services are combined with educational services, but there is still lacking applications that only serve educational services.

This new type of learning environment gives opportunities towards interaction, collaboration, assessment and learning objects, which benefits students in terms of their personal learning environment [1]. One important point, is the availability of LMSs, which gives many benefits towards where and when students can use these environments [2]. There are possibilities of giving students features as forums and discussion areas, where students can

communicate amongst each other or with teachers, which allows mobile technology to support the students in a different way than only in lecture halls and classrooms. This type of information retrieval and communication, gives opportunities to have personal learning areas where they can use the tools they find necessary. Moreover, the student gets more control over his or her goals of learning and which theme is of interest.

Students study in different ways, which is why the student should be able to choose which tools they want to use. There are two major types of learning, formal and informal learning, which are placed in different settings. Informal learning is often placed in educational institutions, for example universities and schools. On the contrary, informal learning, is more natural way of learning, where it is outside of universities and schools [4]. With that in mind, it is also known that Information and Communication Technology (ICT), has an important role in the area of e-learning [20]. This technology, is constantly affecting the society with new and innovative changes that we adopt to our everyday life.

Today, the ubiquitous technologies of today, have made learning possible anywhere and anytime [21]. There are many situations it can be used, such as classrooms where discussion and collaboration often take place. Applications can contribute as a tool to enhance collaborative work, by having a work area that everybody can contribute to simultaneously and that allows for discussion, in for example, a chat room. The technologies that are collected in this thesis are aimed towards mobile learning, where Learning Management Systems are the major contributor.

2.2.2 Frameworks focused to learning applications

Analyses from other studies show that there is a lack of frameworks and middleware that focuses on developing applications for mobile and ubiquitous learning. Most development in the context of mobile and ubiquitous learning starts from scratch with self-created functionality. For that reason, many frameworks are not created for a general purpose but are created for a specific purpose or they do not support many different features[1]. If they do support a general purpose and provide a variety of features, they do not provide support for all types of platforms and operating systems and if they do they are very limited[1]. Providing frameworks for future projects involving mobile and ubiquitous learning will enhance more focus on designing and testing the application for learning. A study proposes to develop mobile learning applications based on HTML5 and Javascript as they run on all platforms, which may enable the application to run for years on any device[1].

2.2.3 Semi-structured interviews and Case studies

Throughout the collections of articles, many semi-structured interviews with teachers and students were conducted to get opinions about mobile functionalities in a learning context. In the University of Salamanca, the semi-structured interviews showed that 70% of teachers were positive to this type of change while the rest thought it would be hard to combine mobile devices with educational content. As for the students, 85 % agreed that this would be very useful[3].

In another study done by Chounta et al.(2014), there was conducted two case studies where student's knowledge had been tested before and after use of an application with the goal being to evaluate how much the application could affect the learning of the students[21]. The result showed that there was no clear answer on what is a "perfect" application, because different students have different needs and have different way of studying. Therefore, the conclusion is that you need an application that has the ability to be customized for each student.

2.2.4 User-centered design and Prototyping

User-Centered Design (UCD) is often used as an approach when creating LMS services for mobiles[2]. This is because the users are then the center of attention when the process is going through the analysis phase, design phase, implementation phase and the evaluation phase. The goal is to fulfill the necessities of the user in their needed environment[2].

At the University of Cape Town, a prototype called mVula which is a mobile based LMS, has been developed. This prototype has been through series of evaluations of usability where students have given their voice of how they would prefer the application to be designed, and the goal of the evaluations were to measure the applications' ease of use[2]. The application had to be able to be used without any tutorial or instructions of how to use it. Students were tasked with using it without having any trouble completing the designated tasks. After these evaluations, the results showed that effectiveness, efficiency and satisfaction where met between the application and user.

2.3 Existing solutions

2.3.1 ODUMobile

Based on the literature review and other applications based on their relevance with the work of this thesis, a comparison between several applications has been conducted. First, ODUMobile is an application for the Old Dominion University which links different resources that can be used on the mobile with Android and iOS anytime, anywhere[22].

2.3.2 iAchieveODU

A similar application to the ODUMobile is the iAChieveODU, which is from the same University. This application uses PLE approach, where the students can track their grades, set long term goals, take notes, and become a better time manager. In short, students can customize the application to their needs.

2.3.3 Uniby Agder

Uniby Agder is an application for the University of Agder (UiA) that can be compared to ODUMobile. This application is uniquely designed for students that study at UiA to get a full overview about what and which social activities are happening at the campus area. The application provides few but important services so as to not overload the students. Some of the services worth mentioning are the ‘student offers’, which provides offers on school equipment for the students, news about new social activities at campus, notifications news about when something new is happening, easy access to internal LMS webpages and services. There are also features that enable the students to use social media to share favorite content between each other, schedule and manage their social activities in their calendar.

2.3.4 Mobile Vula

In the University of Cape Town, a mobile LMS interface was developed where students participated in the design process[2]. The LMS that is used is named Vula and the mobile application was therefore named mVula (mobile Vula). Students were asked to draw sketches of how they visualized the interface of mVula. In the end, the application was selected to be a service-based containing few services to achieve high performance in which the students were to test out. Keeping in mind the diversity of all the different operating systems such as Android, iOS, Nokia Symbian, BlackBerry and Windows OS, mVula was developed as a cross-platform application that is very alike the LMS version which was provided on desktops[2].

2.3.5 Mobile Personal Learning Environment

In another study, there was developed a proposal for a mobile Personal Learning Environment(mPLE). This proposal contains a service-based framework which links the mPLE with the LMS[17]. The application is designed to have high effort expectancy where the learners can perform informal activities outside the formal environment. Android OS was selected due to free, open and scalable definition of the mobile PLE.

2.3.6 Mobilogue Computer Kit

Similar to the mPLE Android application, a framework named Mobilogue Computer Kit has been used to develop an Android application where students use the application to gain knowledge and guiding about different computer parts in order to build a computer[21]. The learning is done by scanning QR codes from the different parts which provides information and explains their functionality, in addition to a video-based support that gives information on how to install the different parts.

2.4 Chapter summary

Teachers and students tend to feel trapped between selecting LMS that are course-based or PLE where the environment is customized the student[12, 14]. The forthcoming learning environments in higher education are dependent on how well the balance amongst these two environments are used[12, 14]. Benefits from both environments, efficiencies of LMS and affordances of the PLE, should be used to generate and meet student and the educational needs[12]. In this thesis, I support these arguments and I think that mobile applications that are used in learning contexts such as projects, lectures, education, formal and informal learning can be simplified to increase motivation, usability, and access to desired and important content quickly.

The definitions that were described in section 2.1 provided knowledge about what previous and current approaches has been used to support students' needs of tools and information. Even though there are many different approaches to meet student's educational needs, not necessarily all of these studies and approaches responds to all students. Nevertheless, from the definitions it can be concluded that mobile learning applications is viewed upon as an element of mobile learning. The visualization of how the relations between the learning tools can be looked upon is illustrated in Figure 2.2 below.

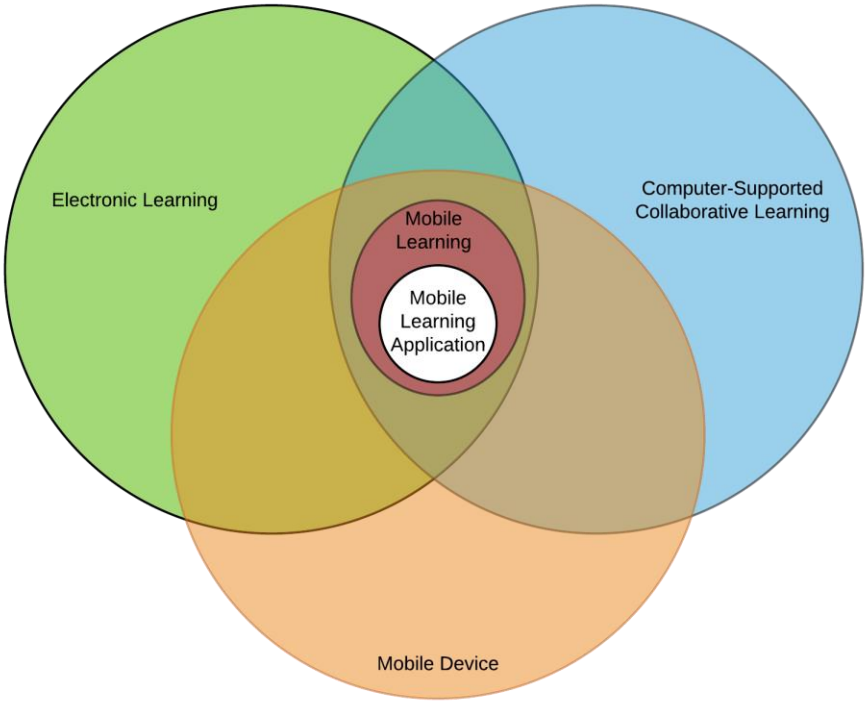


Figure 2.2: Illustration of the relations between mobile learning application, mobile learning, e-learning, mobile device, and computer-supported collaborative learning.

Nonetheless, mobile applications can often be confused with mobile learning applications. There can be a similarity with usage area and/or possibly some mechanics that can be used towards education. However, mobile learning applications should only have focus on education and communication between an educational institution and a learner. Additionally, it is important that educational institutions keep improving the learning environment to meet students need as well as having some sort of control of what students are learning.

Several studies have conducted research related to this thesis' topic. It can be concluded that the majority of studies have presented positive results towards mobile usage for educational purposes. To mention some of the positive instances; increased motivation, enhanced the ability to create learning goals and planning the schedule of reaching these goals, give learners an alternative tool for learning, individuality, flexibility, personalization, encouraging participation, learners find it helpful, and supporting learning.

One important aspect that is worth mentioning, is giving learners the opportunity to select personally what content is important and of interest. It is a step in the right direction of improving flexibility within learning environments. However, there are not many studies that research framework and middleware systems devoted to facilitating the creation of mobile

and ubiquitous learning applications. Nor is there much research on mobile learning applications for higher education. There are still other areas that should be researched more on to improve planning and designing of future mobile learning environments.

In comparison to what the other studies have conducted, in this study I planned to develop a mobile application which would be tested through questionnaires, interviews, and integrated feedback possibility within the application itself. The mobile learning application was evaluated through both theoretical and practical implications towards the development, design and provisions of mobile learning. Furthermore, the data collection was evaluated in coherence with a set of construct measurements: intention to participate, enjoyment, satisfaction, performance expectancy, effort expectance, and learning purpose. From analyzing these results, I expected to discover how users with different perceptions corresponded with high intentions to use the application. Additionally, I wanted to investigate if gender played a role in terms of evaluation and views upon the mobile application, hence showing to what degree the probability was to use the mobile application in the future.

I investigated how the participants experienced that the mobile application had the collection of important content and tools in one place, and to what degree they viewed the mobile application as attractive and useful for them. Consequently, to measure if there was an increase of interest in mobile PLEs. As for the university students, there was investigated how students learned and used mobile applications for learning in light of their experience of mobile applications. It was assumed that "tabula rasa" was nonexistent when it came to the participants' experience of mobile applications. There was not expected that the experience in mobile learning application was huge, but rather that the participants had ideas and examples of mobile learning applications. It was, however, assumed that the ideas and examples that were stated, were influenced through experiences such as fellow classmates, technology subjects, technology news, forums, or even organizations focusing on providing students with information on helpful tools and websites. This thesis' drive was to elaborate on student's interaction with mobile applications as well as concentrating on developing the mobile application for both informal and formal circumstances.

Chapter 3

Development method, tools, and design decisions

This chapter presents the development method and design decisions that were selected, and the explanation of why they were selected. First, the development methods that were used are described, then the design decisions are explained in detail and what criteria were evaluated as important for this development. Following this, all the development tools that were used are presented with a short description. Next, the design application questionnaire is described, its purpose is explained, and the results are presented. Lastly, as a response to the results of the design application questionnaire, a clarification of the design decisions and the finishing result of the mobile application is described. The chapter is divided in five sections: 3.1 Development method, Reasons for choosing, 3.3 Development tools, 3.4 Results from the design application questionnaire, and 3.5 Description of the application.

3.1 Development method

There are various methods to develop the software depending on the size and scale of the development, and the development method that I used for this study will be presented in the following section.

3.1.1 Modified waterfall model

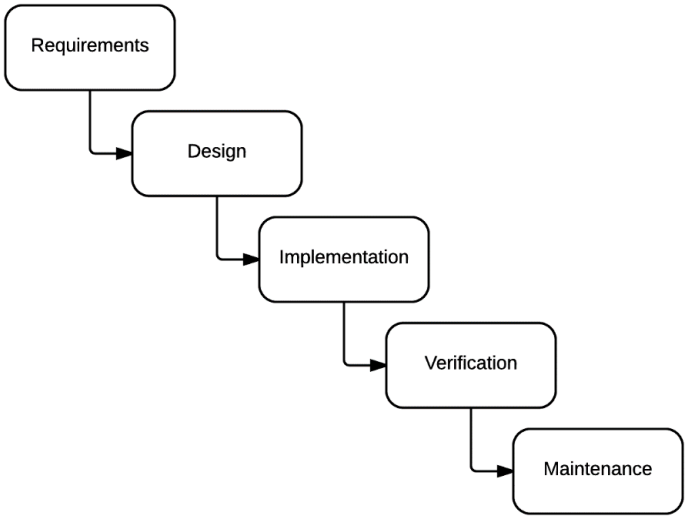


Figure 3.1: Waterfall model

In software development processes, there is a method named the waterfall model which is considered often used as a basis for software projects[23, 24]. The progress is visualized as a waterfall where each phase flows downwards to the next phase[23]. The waterfall model life cycle consists of five phases; requirements, design, implementation, verification and maintenance which are illustrated in Figure 3.1. The phases in the waterfall model move in a single direction with no overlapping of phases, which makes it easy to apply to the development process[23]. There are no feedback possibilities for any of the phases, however, the model is often adjusted to include feedback in the requirement and design phases[25]. This is illustrated in Figure 3.2.

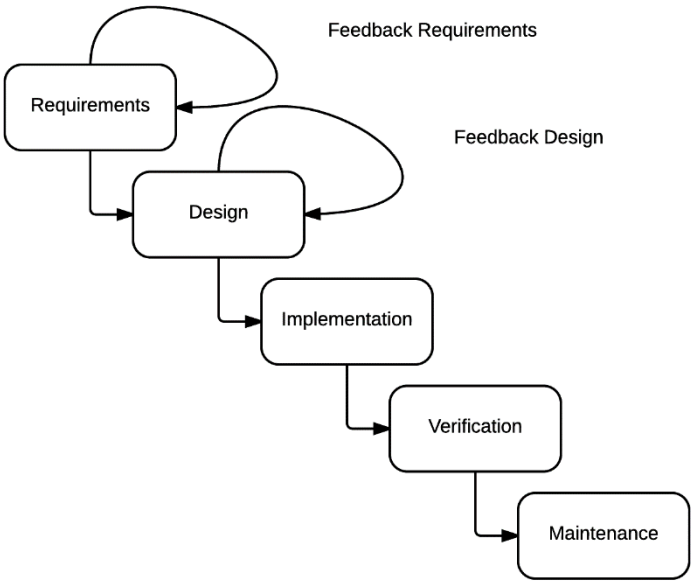


Figure 3.2: Waterfall model modified

In this thesis, the modified waterfall model was used with the exception of the maintenance phase. This model was basic and easy to implement for the development process and therefore selected as the appropriate development method. In the requirement phase, a survey with questionnaire was used to get insight on what requirements was considered important in the mobile application. These requirements provided guidelines which could be followed to design the mobile application. Subsequently, the implementation of the mobile application took place by using the design as a guide. Lastly, the mobile application went through a verification phase to ensure that the requirements had been met. In this case, the application was tested by students which provided feedback through an online questionnaire.

3.2 Reasons for choosing

3.2.1 Operating system

The phone market today has changed from simple mobile phones with low processing features, limited connectivity, small screen resolution into more advanced mobile phones providing rich, fast, dynamic, and robust applications, also known as smartphones[9]. However, since the marked has changed towards the smartphone, the two largest operating systems (OS) on the marked are Android and iOS. Therefore, it is natural to select the users of the two major operating systems for this thesis. Of these two, the Android OS was chosen arbitrarily.

3.2.2 Mobile device

The majority of users, presently, have smartphones with greater flexibility in terms of viewing multimedia content and various aspects of representing information. Before the smartphones came on the marked, the majority of users had phones which did not provide the same possibilities to show content such as animations, images, videos, and interactive content as it is with smartphones today[9]. Smartphones are used by the majority of the target audience, namely students.

3.2.3 Screen size

Screen size has been growing over the evolution of phones, which enables them to show different types of content to the target audience[9]. Smartphones' screens are large enough to show the majority of any type of content. Consequently, the smartphone is an excellent choice.

3.2.4 Multimedia contents

Almost all smartphone content is represented as multimedia which is a combination of different contents such as text, audio, images, animations, video, and interactive content. Old phones have limitations that will not provide the user with the possibility to access all these type of content[9].

3.2.5 Battery life

Battery life of a phone is a very important factor as the user has to have good battery life to be able to use the application ubiquitously[9]. Smartphones today have much better battery life than before and therefore makes it very positive to use smartphones for mobile learning.

3.2.6 Internet connection

An Internet connection is necessary to be able to give updated content and keep the mobile application up to date, and older phones do not necessarily have Internet connection or Wi-Fi capability. Consequently, to be able to provide and distribute the content of the mobile application, a smartphone is needed[9].

3.2.7 Rich content and Dynamic interfaces

In Android OS and iOS, there is a huge flexibility in terms of presenting rich content, and smartphones have the ability to show dynamic interfaces, which improves user experience[9]. Thus there is a good argument to develop an application that utilizes dynamic interface. [9].

3.2.8 Focus is on the student

Often projects and development tend to forget to focus on the user, which is the most important factor[9]. In this thesis, the focus was on students and creating a solution to their needs in terms of tools that they can, for instance: use to keep track of tasks they need to do, easily access desired content, or get an overview of what is important or not.

3.2.9 Application Programming Interface Level

A decision has to be made on what level of Application Programming Interface (API) is to be used when developing an Android application[26]. The API level provides a given version of the Android platform and the range is from 2.2 to 6.0 since August 1, 2016 [27]. Each level targets an amount of Android devices. The lower API levels are, the more Android devices it targets, but it then has fewer features available. By targeting API 15 and later

versions, the Android application will run on approximately 94% of the Android devices that are active on the Google Play Store as of this writing.

3.3 Development tools

3.3.1 Balsamiq Mockups 3

Balsamiq Mockups is a wireframing tool that helps creating sketches from ideas. Using it on the computer gives you the same experience as sketching on a paper[28]. The reason why the Balsamiq software was selected amongst other mockup software, was that it was used in a course named User Interface Design at NTNU and that previous experience

Figure 3.3: Mockup of the mobile application

with it was positive. By using the Balsamiq software, there was created an illustration of the mobile application which helped visualizing the final result of the product. A final mockup of the mobile application is shown in Figure 3.3.

3.3.2 Android Studio

The main development of the mobile application was developed in Java programming language in Android Studio. The decision on this software is due to the easy setup and flexibility in terms of designing and implementing Android applications[29].

3.3.3 GitHub

The mobile application was distributed in an open source license and that was mainly why GitHub was selected for the development process[30]. GitHub provides a fast, flexible and collaborative environment which gives the possibility of working alone or with others on a particular project. Another positive function is that it allows the ability to keep track of the code, for instance; to check update history, keep track of changes, recovery possibilities, and statistics. It is also flexible in terms of that you can work wherever or whomever as long as there is an Internet connection.

3.3.4 Pixlr Editor

Pixlr Editor is more or less an advanced browser photo editor for editing where the ease of use is high[31]. The editor provides the possibility of using layers and effects on the images. Pixlr Editor was used to create all the images, diagrams and figures in this thesis.

3.4 Results from the design application questionnaire

Before the development of the design, a questionnaire was conducted where students could give insight of what needs they had in terms of tools, services, and desired content. The questionnaire was created as an online google form and the link to this form was then shared through various local groups of the university on social media in a duration of five days.

The questionnaire consisted of three parts; demography, list of proposed services, and an optional comment. The demography entailed gender, age, study program, and school year. Whereas the list of proposed services, was a list proposed according to my experience as a NTNU student. The proposed services and their description is shown in Table 3.1. Data was collected from the questionnaire to see what the NTNU students founds missing or useful for

their education. Amongst other data, there was collected how much each of the services were desired. This section presents the results of the collected data.

Proposed services	Description
1. Faculty service	Simple access to all the information about NTNU's faculties (Name, address, workhours, other useful information)
2. Course service	Simple access to all the information about courses (Course code, Course name and Exam date)
3. Library service	Simple access to all the information about NTNU’s libraries (Name, address and Workhours)
4. News service	Get the latest news from NTNU
5. Quiz service	Ability to create a quiz for your subjects, studying for your exam, etc
6. Youtube service	Simple access to NTNU’s Youtube channel
7. To-Do list service	Simple To-do list to create a checklist of things to do or remember
8. Maze maps	Simple access to Mazemaps that helps you finding a desired room at NTNU's campuses
9. Course rating service	Give ratings and review of NTNU's subjects
10. NTNU Caching	Visit NTNU's different places/things/sculpture etc, and get more information by using QR-Codes

Table 3.1: Proposed services and their description

3.4.1 Demography results

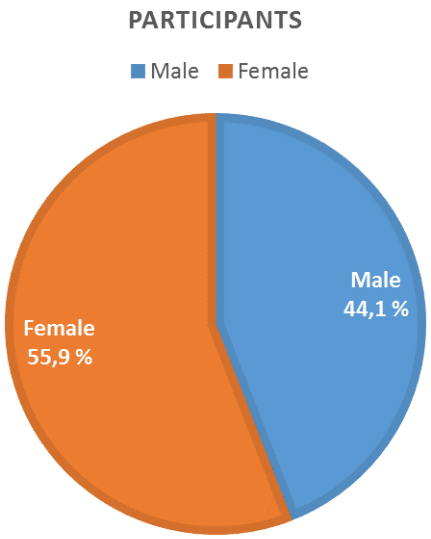


Figure 3.4: Females and males in the design application questionnaire

The participants that responded online consisted of 34 individuals. The majority of the respondents were with 55.9% female and 44.1% male which is illustrated in Figure 3.4. In retrospect this was unexpected, as a research study states that in terms of m-learning, men score considerably higher in attitudes towards computers,which also includes palm-sized computers[32]. Therefore, there was expected a male-dominant amount of participants which has often been the outcome in technologic related questionnaires. The age was between 21

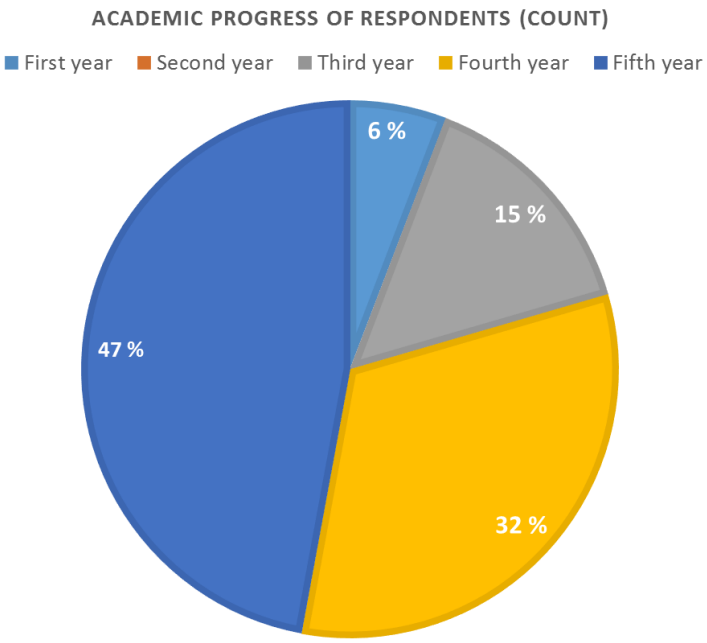


Figure 3.5: Academic progress of respondents (count)

and 31 where the average age was 25 years, and 73.5% of the particpants were between 23 and 26 years. The school year diversity amongst the participants was dominated by fifth and fourth year students as shown in Figure 3.5. The fifth year students were the majority with 47.1%, while the fourth year were 32.4%. Some of the reasons why there were so few first and second year students that answered the questionnaire, may have been due to the lack of experience or knowledge of what are actually the student's needs. Fifth and fourth year students are veterans that have been at the university for many years and have found out what enhances their learning and what tools they need to fulfill their study. Yet, the answers to this questionnaire may indicate what they would have desired if they would have started again in first year.

3.4.2 Results of tools, services, and desired content

This section shows results of what needs the students had in terms of tools, services, and desired content as shown in Figure 3.6. The participants were presented with a premade

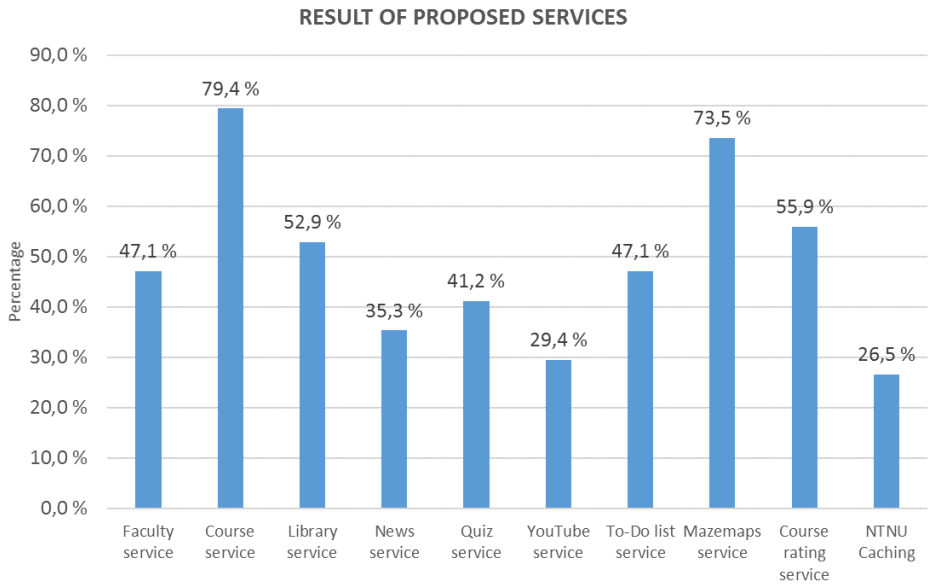


Figure 3.6: Result of services

list of possible services that could be of interest. An optional text field where missing services and other thoughts could be written was also added. The results show that the premade list was a success, all responses except from one were from the list of proposed services. Moreover, there were two major needs from the students, Course service and Maze maps. These services received the majority of votes, however there was room for more services in the Android application. Therefore, the rest of the services were evaluated according to time limits, previous experience in implementing, and what would have suited the applications the most.

1.	“Feedback”-service, student democracy organizations updates
2.	NTNU-events. Being able to “attend”-events and get updates on them (like Facebook)
3.	Student email.
4.	Room booking service with an extended functionality, so I would know if I can access to the room.
5.	Most of these services exist already – just not as an application.
6.	Something that is supported on all three major cell phone operating systems would be great. In general, I think the more information you could put in the application, the better. Also, instead of NTNU Caching, a small forum where people could post stuff/tips could be awesome.
7.	Room reservation service. A list of helpful phone numbers and opening hours for nurse, Orakeltjenesten, security, Studentservice, janitor, various SiT offices etc. Like a NTNU phonebook could be handy.

Table 3.2: Responses of services that students think could be handy or are missing in the proposed service list

Seven of the students also replied to the question about what services they think were missing or could be added, which is shown in Table 3.2. The participants’ replies pointed out some other services that was of high value. For instance, response number 7, room reservation service was something I as a student had encountered several times as not practical to access on the phone. However, I thought this was not a major issue amongst students, but it showed to be incorrect as it was discovered to be useful as the application was tested by the participants. Another response, number 6, was already considered from the start of this thesis. Creating an application to support the two major smartphone operating systems was not prioritized due to time limitations. As for crowding the application with all types of content was also dismissed from the start. This is due to the literature review proving that too many services will just overcrowd the application and losing the point of having high usability and performance expectancy. Additionally, there was mentioned a forum service, which was considered as a good idea and was added into the list of services to develop. Some of the services were not possible to do or would not fit the application’s goal. The rest of the

responses were noted down, but not prioritized, in case there was more time left for development.

Combining the proposed services with the useful or missing services ended in selecting these services for the requirement list and prioritizing them. As shown in Table 3.3, priority ‘high’ is considered the bare minimum for having the application operational and essential for the application to fulfill its goal to meet the students’ needs. ‘Medium’ and ‘low’ was consider less prioritized and viewed upon as an available option if there was time.

Priority	**Requirement**
High	Faculty service
High	Course service
High	Maze map service
High	Library service
High	To-Do List service
High	Contact service (Phonebook)
High	Room reservation service
Medium	Forum service
Low	Student email service
Low	Student organization service
Low	NTNU events service

Table 3.3: Prioritized requirements list

3.5 Description of the application

3.5.1 Clarification of the design decisions

The application was given the research name NTNU mPLE and is used to describe the application within the thesis. Specific designs have been based on responses to the results from the design application questionnaire in section 3.4. The prioritized requirements list in Table 3.3 provided the four main sections in the application: Course Help, Contact, To-Do list, and Links which was the foundation of the application. These sections were also color coded as the coloring would let the user associate each section to a color. This was to ensure that the user exactly knew where he or she was as they were browsing through the application.

As there was a possibility that this application could be a decent size in terms of services, it was decided to add a “Home” icon button in the status bar. This was done to give an option to the users that are familiar with using the “Home” button for navigating on web pages and other larger applications; in short, a shortcut to the main menu. Nonetheless, it was assumed that the veteran and the more experienced Android user uses the “back” button to go back to the previous section, however this is often used to reach all the way back to the start page. In accordance with the purpose of this research, the goal was to simplify and reduce the amount of “clicks” before reaching the desired content. Consequently, the design of the application had to be simple to not overcrowd it with too much content, have a good overview of the content, have a status bar indicating where the user was within the application, and good performance while using it. The focus was very much on the content working properly and that the titles, icons and structure of the services were strategically selected.

Icons were selected through an icon collection library with the intention of ensuring consistent icons throughout the application. As for organizations and services that already have icons to represent themselves, the same icon will be used in order to ensure that users that already are familiar with it.

In order to provide a good user experience, the background of all the sections was decided to be white, as this would give a good color contrast and affordance of the icons representing their service. The white background would also create a good amount of whitespace across each of the sections. This enhances the user experience due to letting space breathe between the elements which provides a better overview of the elements.

The following sections will describe the functionality within each of the sections in more detail. According to the results from section 3.4, there were several services that would contain a high amount of information such as: phone numbers, emails, visiting addresses, opening hours, and other important contact information. In response to these services, it was decided to create lists containing the main topic titles, and then sub lists with all the detailed and important information. This would enhance the overview and navigation through the huge amount of information and help to access the desired content quickly and with a minor amount of clicks.

3.5.2 Main menu section

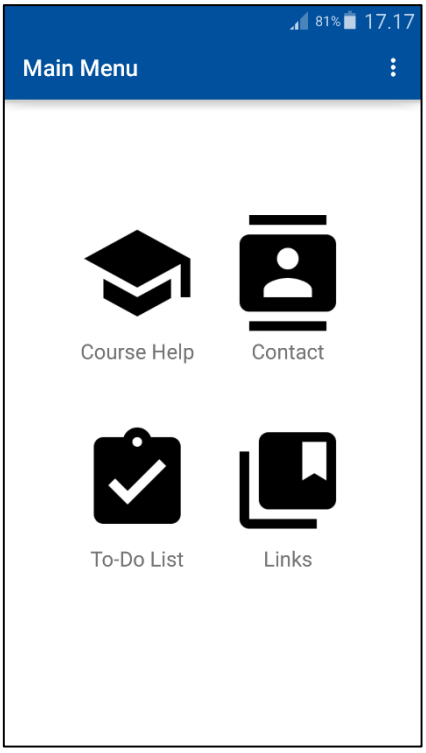


Figure 3.7: Illustration of the mobile application's main menu

The mobile application’s main menu, as shown in Figure 3.7, was designed with the intention of making a good impression of simplicity and a good overview of the application’s content. The main menu consisted of four main sections that the students asked for: Course help (courses), Contact (contact information), To-Do list (organization and guiding functionality), and Links (frequently used websites and tools). Correspondingly, each of the sections were matched with the corresponding icon. Each of the icons selected throughout the application was carefully evaluated for the purpose of selecting the one that represented the section best. Similarly, the color choice of black icons and white background was selected to present a simple design. It is worth noticing that the status bar being blue is not a coincidence, it is the same color code as the NTNU’s logo, with the intention of providing the users with something they were already familiar with and to ensure the user knows that he or she was in the main menu. Lastly, inside the status bar the user could view the title of the section he or she were in. This was similarly done as the color coding, with the intention of ensuring that the user knows exactly where he or she is within the application.

3.5.3 Course Help section

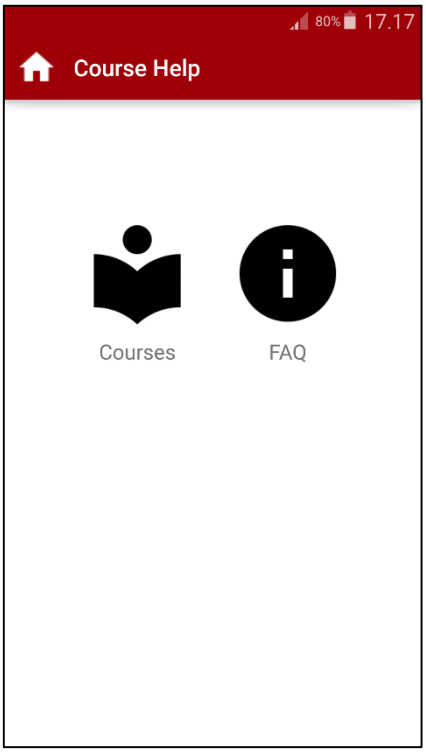


Figure 3.8: Illustration of the application's Course Help section

The Course Help section consists of two services: Courses and FAQ, as illustrated in Figure 3.8. The purpose of this section was to provide NTNU students with the most important information about courses, admission, and exams. As for the design, this section's status bar had been color coded with red to give the user the association that the Course Help was red. The color of each sections were all chosen by random. The Courses service provided access to NTNU's webpage that consisted of all the courses NTNU offered. Here the user could easily browse through the different courses and course information he or she desired, as shown in Figure 3.9. FAQ service, on the other hand, was a service where the most important information about admission and exams was collected. In both of the sections admission and exams' questions, the user could click the "+" button to extend the list in order to read the response to the question, as shown in Figure 3.10.

Figure 3.9: Illustration of the application's Courses service

Figure 3.10: Illustration of the application's FAQ service

3.5.4 Contact section

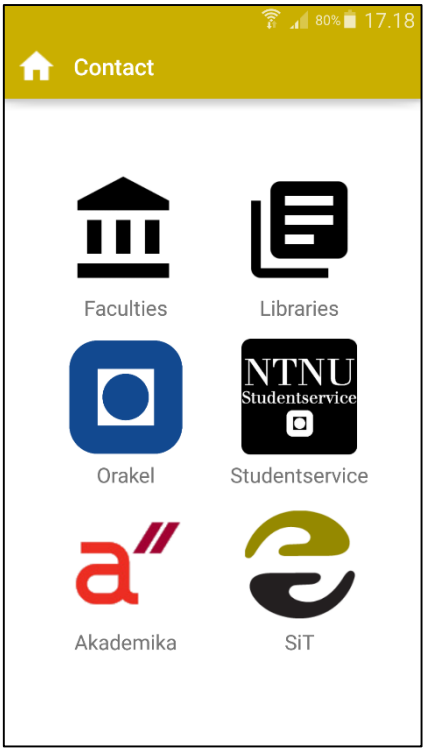


Figure 3.11: Illustration of the application's Contact section

The contact section consisted of the services: Faculties, Libraries, Orakel, Studentservice, Akademika, and SiT, which is illustrated in Figure 3.11. This section was also color coded, but similarly as the Course Help the color was randomly selected to be yellow. This section provided the most frequently used contact information such as phone numbers, email, opening hours, and visiting address about the most frequently used services at NTNU. This section can be compared to a simple phone book.

The Faculties service provided, as illustrated in Figure 3.12, a list of all of NTNU's faculties, and by clicking on each of the respective faculties' name the most basic contact information was shown. This list structure was kept consistent throughout the rest of the services as well. The Libraries service showed all the libraries at NTNU's campuses, as illustrated in Figure 3.13. Orakel service is NTNU's support service that helps students and employees with different information technology issues whose location and hours are, shown in Figure 3.14. Studentservice is similar to the Orakel support service, but their task is to answer students inquires at NTNU such as counseling, motivational counseling and supplies for the studies, an illustration is provided in Figure 3.15. Akademika service is a book store brand that is places several places at campus, as shown in Figure 3.16. Lastly, SiT service is

an organization that in collaboration with students aim to develop attractive welfare services they need such as apartments, cafés, canteens, sports for students, mental health services, counseling, and support for student clubs and associations. An illustration can be viewed in Figure 3.17.

Figure 3.12: Illustration of the application's Faculties service

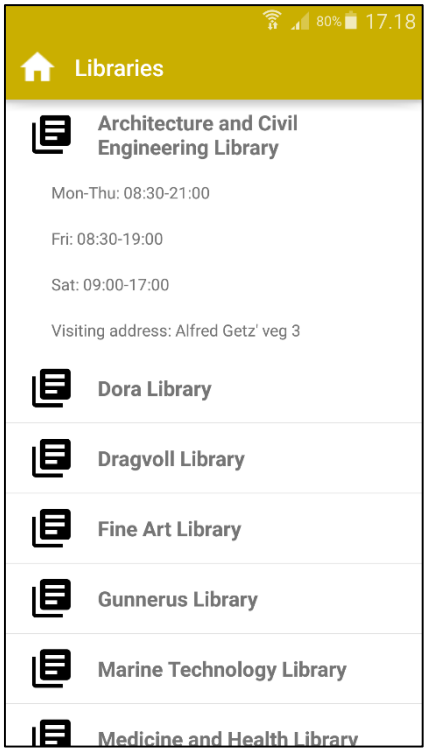


Figure 3.13: Illustration of the application's Libraries service

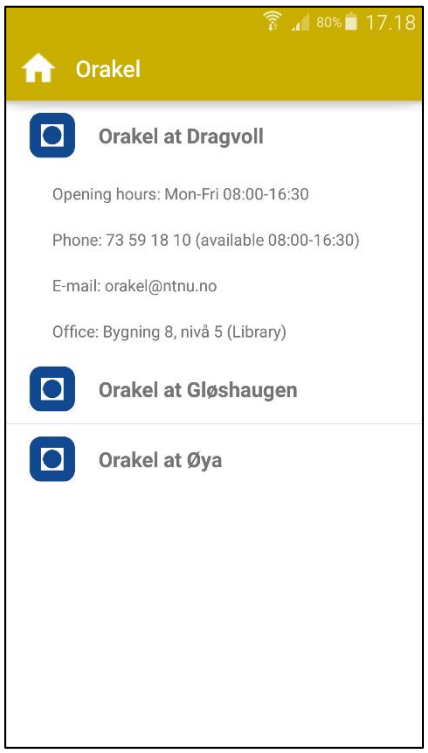


Figure 3.14: Illustration of the application's Orakel service

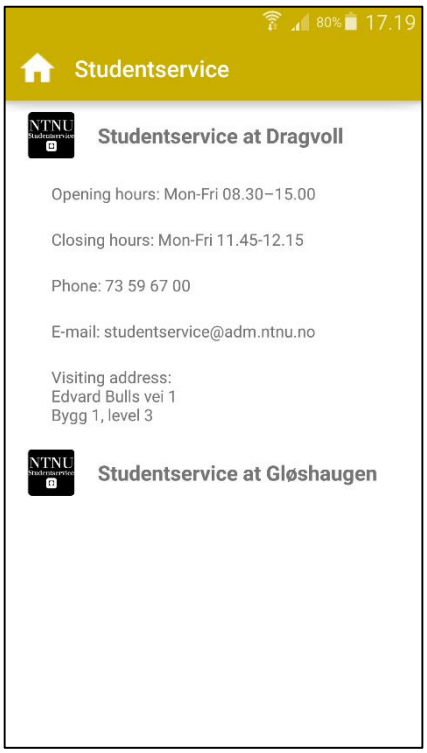


Figure 3.15: Illustration of the application's Studentservice

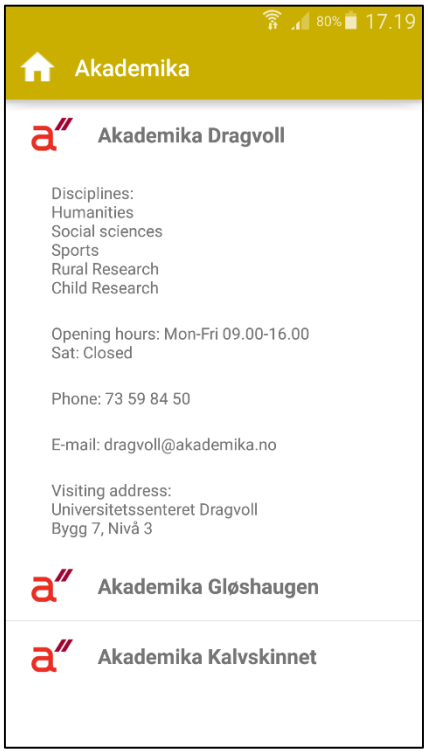


Figure 3.16: Illustration of the application's Akademika service

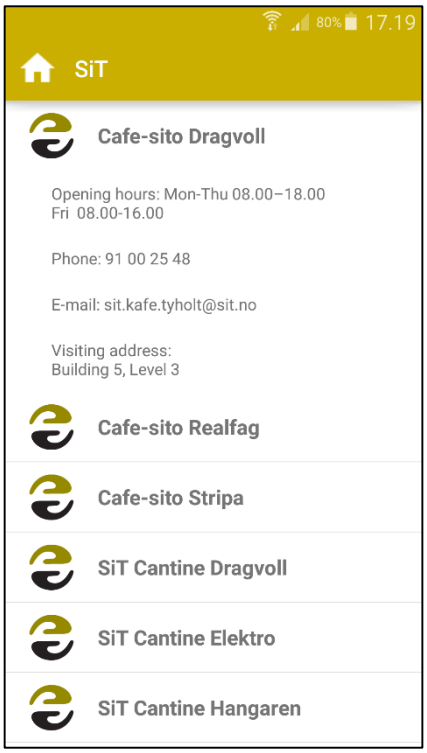


Figure 3.17: Illustration of the application's SiT Service

3.5.5 To-Do list section

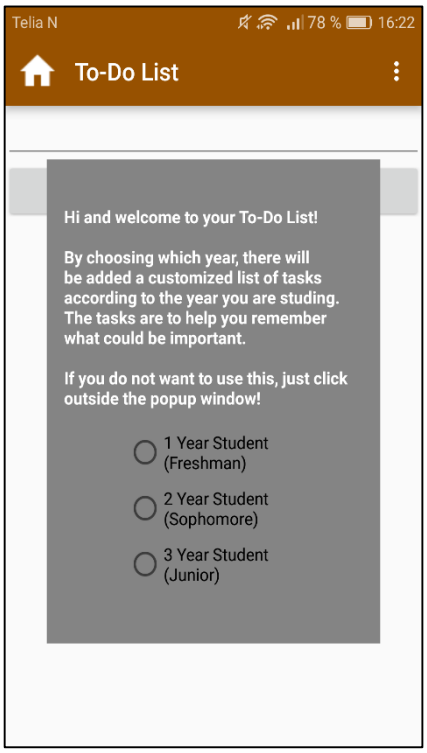


Figure 3.18: Illustration of the application's To-Do list school year selection

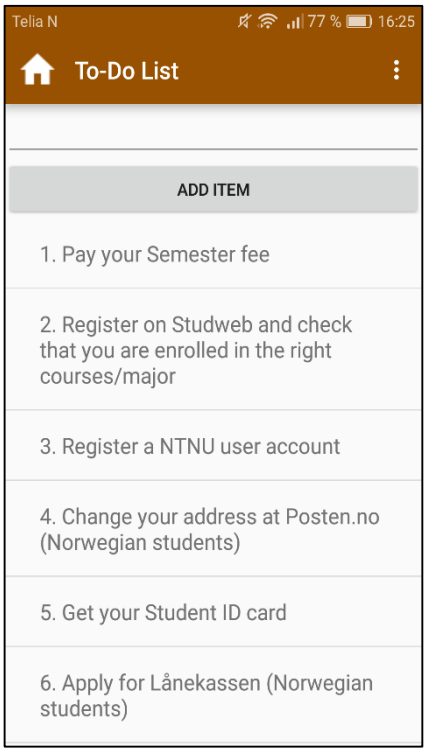


Figure 3.19: Illustration of the application's To-Do list with a customized list

The To-Do list section was where students could organize themselves by writing up tasks that needed to be done and as the tasks were finished they could be crossed off. As the user entered the To-Do list service for the first time, he or she would be presented with a popup window where the user would be given the opportunity to select what school year he or she was participating, which is illustrated in Figure 3.18. Similarly, to the other sections, the status bar was color coded with the randomly selection of brown. In correspondence with the selection, the popup window would close and the user would be presented with a customized list matching the responding school year selected, as shown in Figure 3.19. The user could also choose to not use this feature by just clicking outside the popup window, which would then result in showing an empty To-Do list. After choosing to use or not use the selection of school year feature, the user could then add new tasks by writing into the text field at the top of the screen above the “Add Item” button by just clicking it. The user would then be presented with a keyboard where he or she could write the desired task, which is shown in Figure 3.20. As the task was written, the user could then proceed by clicking on the “Add Item” button, which would result in adding the task at the top of the list. The user could press all the individual items in the list to cross them over, which is also illustrated in Figure 3.20.

The To-Do list had an alternative option menu in the top right corner of the screen, called the “Overflow menu”. In this menu the user was represented with three options: “Delete done tasks”, “Delete all tasks”, and “Student’s year of study” which is illustrated in Figure 3.21. By clicking “Delete done tasks”, all the tasks that had been crossed over would be deleted. As for “Delete all task”, it would explicitly delete all the done and undone task within the list. By clicking the “Student’s year of study” button, the user would have the option to enter the school year selection popup window, in case the user accidentally exited it or would like to revisit it again. This feature is useful when the student proceeds to his or hers next school year.

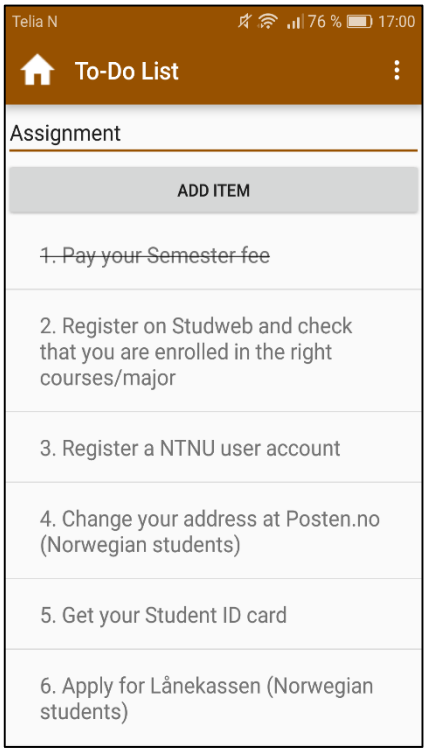


Figure 3.20: Illustration of the application's To-Do list add item and cross over actions

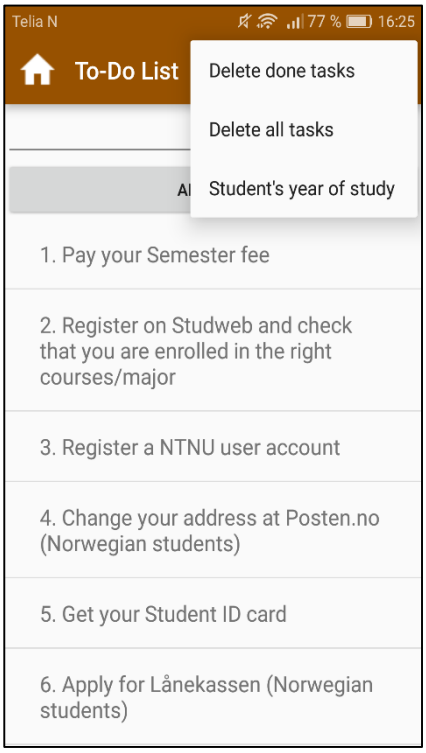


Figure 3.21: Illustration of the application's To-Do list actions in the overflow menu

3.5.6 Links section

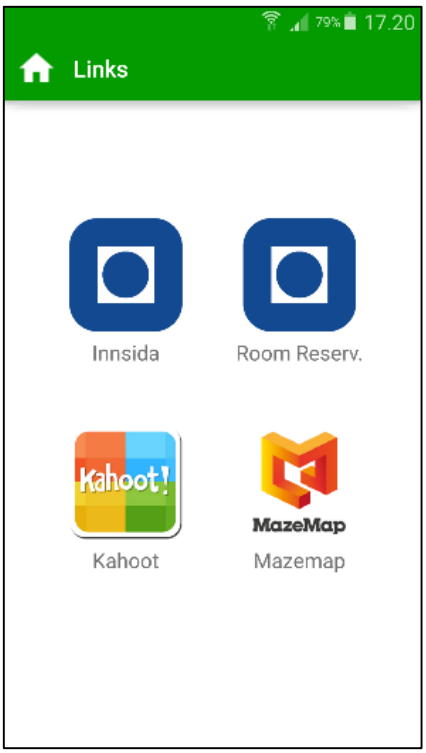


Figure 3.22: Illustration of the application's Links section

The Links section consisted of four services: Innsida, Room Reservation, Kahoot, and Mazemap. This section had collected the most frequently used web pages and tools that students used at NTNU, to give the user easier and quicker access as shortcuts. Like the other sections, the status bar had been color coded at random with green chosen in this section. As for the services, the Innsida service button served as a shortcut to the heavily used internal network of NTNU. As shown in Figure 3.23, the user would have to write his or hers distributed username and password to be granted access to other systems and services within this internal network that students used on a daily basis. Figure 3.24 below shows an illustration of what the user encountered after login. For instance, it is frequently used to access the learning platform “ItsLearning”(learning system used at NTNU) where the student can access further course information from the teacher, administrate files, and deliver assignments. Room Reservation service is basically a web page where the students logs in with his or her distributed username and password, illustrated in Figure 3.25, for reserving rooms within all the campuses at NTNU. After logging in the user would be met with several inquiries that needed to be selected in order to book the room, as shown in Figure 3.26. The Kahoot service was a shortcut to a learning application where learners could create, play and

share fun learning games for any subjects, for all ages, for free. This learning application is frequently used at NTNU in lectures and other circumstances. The user only needs to enter a pin-code, as shown in Figure 3.27, to enter an already created game, which is often done by the teacher or the administrator. The Mazemap service is essentially an indoor mapping and a wayfinding platform [33], which is regularly used as a navigation service by the students to find their lectures and booked rooms. An example view of the Mazemap can be viewed in Figure 3.28 below.

Figure 3.23: Illustration of the application's Innsida login screen

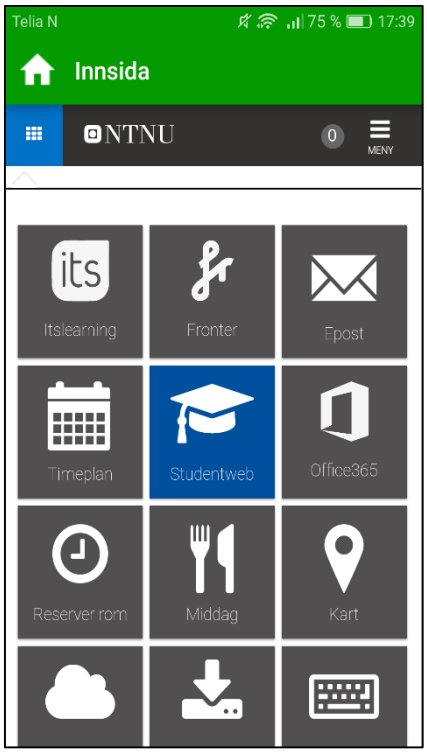


Figure 3.24: Illustration of the application's Innsida after login

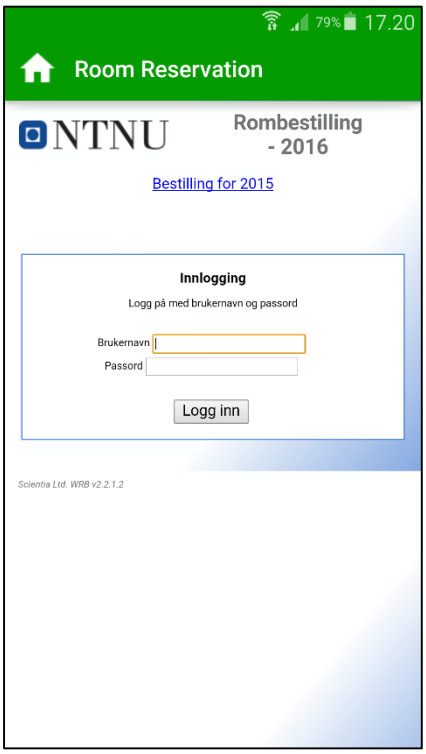


Figure 3.25: Illustration of the application's Room reservation login screen

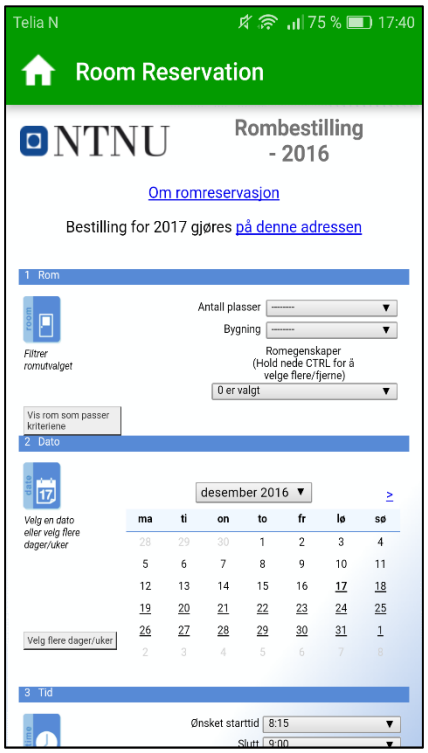


Figure 3.26: Illustration of the application's Room Reservation after login

Figure 3.27: Illustration of the application's Kahoot service

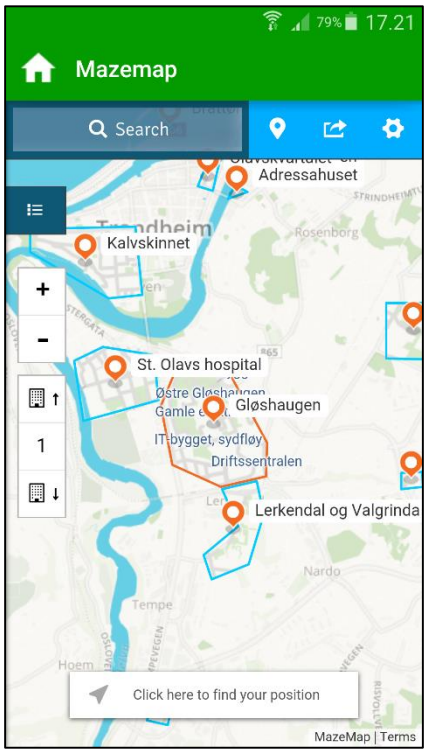


Figure 3.28: Illustration of the application's Mazemap service

3.5.7 Built-in feedback functionality

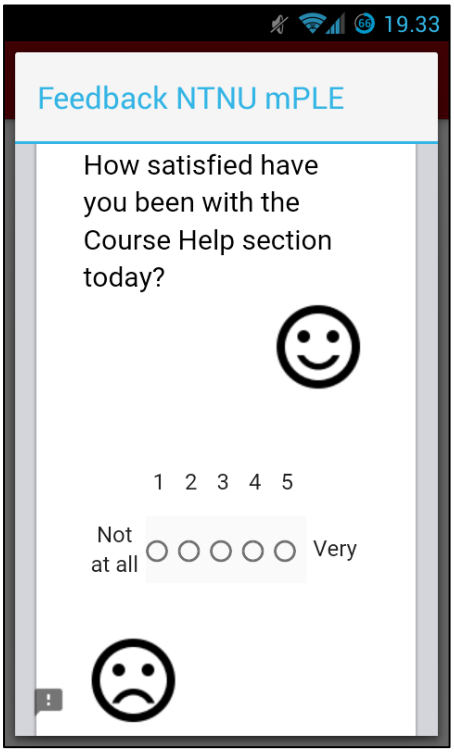


Figure 3.29: Illustration of the application's built-in feedback popup window

Within the mobile application a feedback functionality had been integrated to collect easy feedback from the participants for services of the application during this research. As the user kept testing the application, the feedback window would display every 30 minutes of usage. In the window, as shown in Figure 3.29, the user would be prompted with the question of how satisfied he or she had been with the current section that day. The user would then have the possibility to rate the section with a grading scale with a 1 to 5 points Likert-scale, where the user could rate the functionality of how satisfied he or she was from “Very satisfied” (5) to “Not at all” (1).

Chapter 4

Methodology

This chapter starts with describing the research and data collection strategies. The following section describes the data collection plan for semi-structured interviews. Next, the data collection, demography, and measures are explained. The following section, presents the results from the post testing questionnaire and constructs used for measurement. Finally, the data analysis and the fuzzy set qualitative comparative analysis of the data collection is presented. The chapter is divided into nine sections: 4.1 Process, 4.2 Data Collection plan for semi-structured interviews, 4.3 Data Collection, 4.4 Demography, 4.5 Measures, 4.6 Results from the post testing questionnaire, 4.7 Constructs, 4.8 Data Analysis, and 4.9 Fuzzy set Qualitative Comparative Analysis.

4.1 Process

In order to answer the research questions, a research strategy has to be decided and data must be generated. As shown in Figure 4.1, the research strategy has been carefully selected through Oates model where my research process has been indicated with a red frame[34]. Through literature reviews, I developed research questions and a conceptual framework to work with. To get insight on the student's needs, a survey was conducted with questionnaires and interviews. This, in combination with previous research, was used as basis for the application's specification.

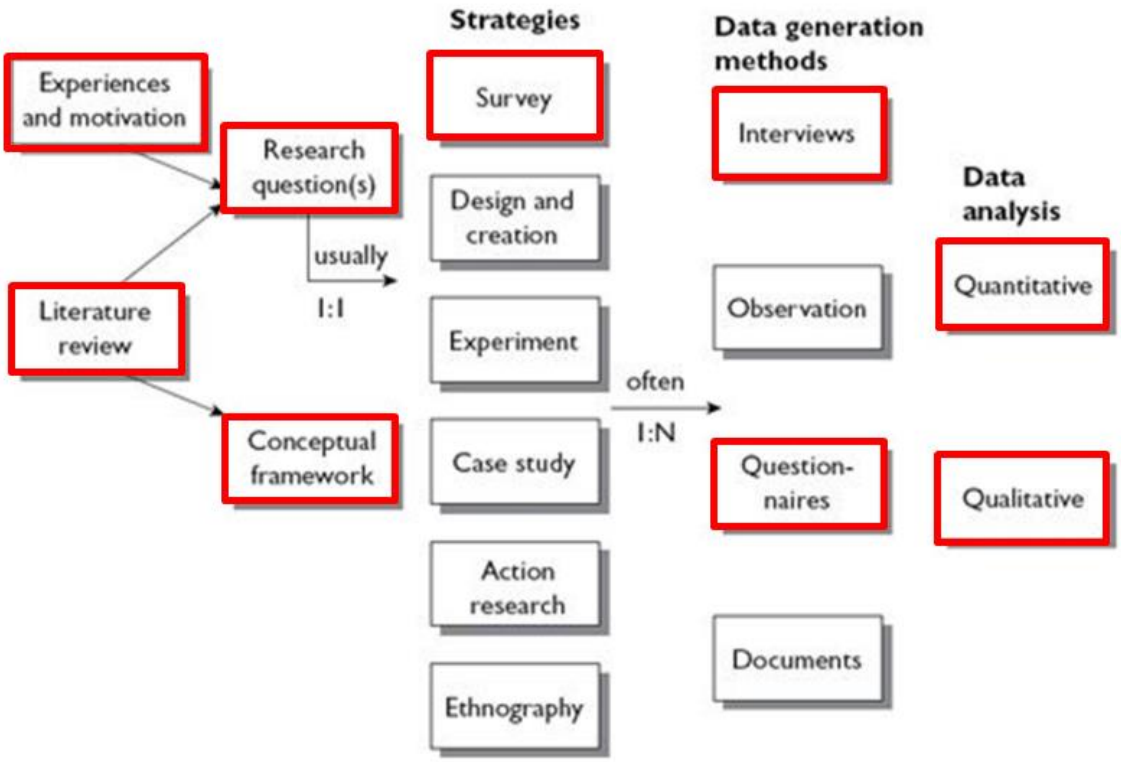


Figure 4.1: Model of the research process from Oates with my research process

Next is the testing phase, illustrated in Figure 4.2, where the application was tested by participants and then questioned with questionnaires and interviews. In total, there are N = 35 participants that tested the application for a period of 2 weeks where they would be followed up with two questionnaires that had to be within one day. First questionnaire was the post testing questionnaire and the second was a SUS schema questionnaire. Both are described more in depth in Chapter 5. As the questionnaires were conducted, 10 of the total N participants would then be selected for a semi-structured interview, which is presented in section 5.2. This research strategy and data generation provided the analysis with quantitative and qualitative results. Regarding the data results, there had to be diversity amongst the student's study programs since there were different levels of experience when it came to using applications. IT-students tend to have good knowledge on how to use and test applications while other students might not be that familiar with applications. To ensure that the questionnaire was not limited in terms of future research, the questions should adopt standardized methodology that makes comparison with other studies and technologies possible.

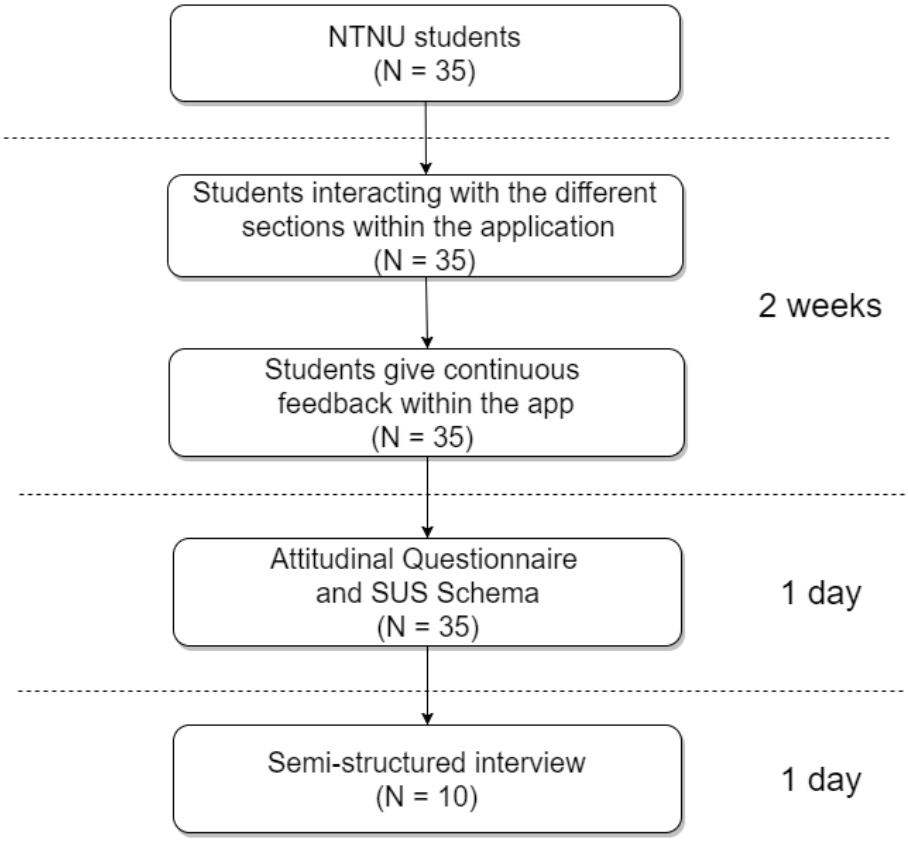


Figure 4.2: Testing process diagram

4.2 Data Collection plan for semi-structured interviews

Conducting semi-structured interviews provided qualitative data that was followed up with analysis. The data should give insight and a better idea of how the mobile learning application supports students' needs and how these applications could be improved to get all the desired services that they need. The following paragraphs describe how the semi-structured interview was planned and executed.

Research setting

Finding out how students use mobile applications for educational purpose, I interviewed NTNU and previous HiST students that used mobile applications as students. Conducting the interviews gave qualitative data which provided insight on the research objective. To be able to get qualitative data from the interviewee, a plan of preparation had to be in order first which is presented in the following section.

Preparation

The approach of using semi-structured interviews contains a list of questions and themes that are created. However, if there are other topics that arise during the interview that are interesting and related to the research problem, they should be followed up. The questions were structured with open questions starting or containing with words such as: what, why, where, how and when, to let the students speak freely.

4.2.1 The planning of the interviews

Interview preparation

The interviewees were selected according to diversity of study program, gender and availability. These students had already participated in the post questionnaire and were therefore already familiar with the topic. To ensure that the interview questions were well-structured, they were discussed with the supervisor.

Setting up the interview

The interviewees personally received an email with an invite to the interview and would be provided enough information about the interview beforehand. Time and place should be very flexible to ensure that the interviewee does not consider the interview as an obstacle in his or her everyday routine. Consequently, a time and place should be set that both the interviewer and interviewee agrees upon.

Recording the interview

Consent should be asked from the interviewee for recording the interview. The recording was done with recording software on a smartphone. This ensured that there were no distractions and that the focus was only on performing the interview. Later it was then possible to go through the recorded interview as many times as necessary to obtain all data in addition to making it easier to transcribe. Recording provides possibilities to contribute as a resource to similar projects and allowing information sharing to other researchers.

Seating and equipment

The interview should take place somewhere both the interviewer and interviewee agrees upon. The interviewee was recommended to my office with prepared equipment and seats for the interviewee and the interviewer. To be flexible, the interview took place at campus or other adequate places. If the interviewee would choose my office, it would be an unfamiliar place for some. For that reason, they were served tea, coffee, and snacks to create a relaxing atmosphere. The smartphone that did the recording was placed on a tripod holder on the table to improve the quality of the recording.

Performing the interview

As the interview took place, the interviewee was greeted and thanked for coming. The agenda of the interview was reviewed and how the questions were categorized was explained, how many questions there are and how it was to be recorded. The interviewee was reassured that this interview would only be used for research purposes and that he or she would be made anonymous.

Approval

After the recording was completed, it was checked with the interviewee to get approval from him or her for transcribing.

4.3 Data Collection

For the data collection, a survey of questionnaires and interviews was conducted. In this study a purposive sampling methodology is used to recruit participants. The decision in the choice of this methodology was the confidence of having a representative target sample. To acquire the desired results, this type of sampling focuses on particular characteristics of the target group that are of interest. In the end, the sample consisted of 35 participants where

30 responded by giving feedback about the application. In this study, interrelations were identified among performance expectancy, effort expectancy, enjoyment, and satisfaction to predict high intention to use a mobile application for educational services. In order to get the target sample in an efficient way, a reward of gift cards was announced to the participants.

4.4 Demography

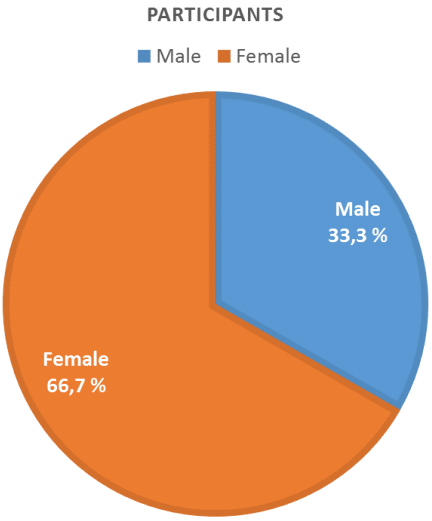


Figure 4.3: Females and males in the post testing questionnaire

The participants shared their insight by responding through an online questionnaire which was distributed through emails in a period of approximately one month. 35 participants were collected but only 30 responded. There were several attempts in contacting the absent participants, but with no reply. The sample consisted of more male (66.7%) than female

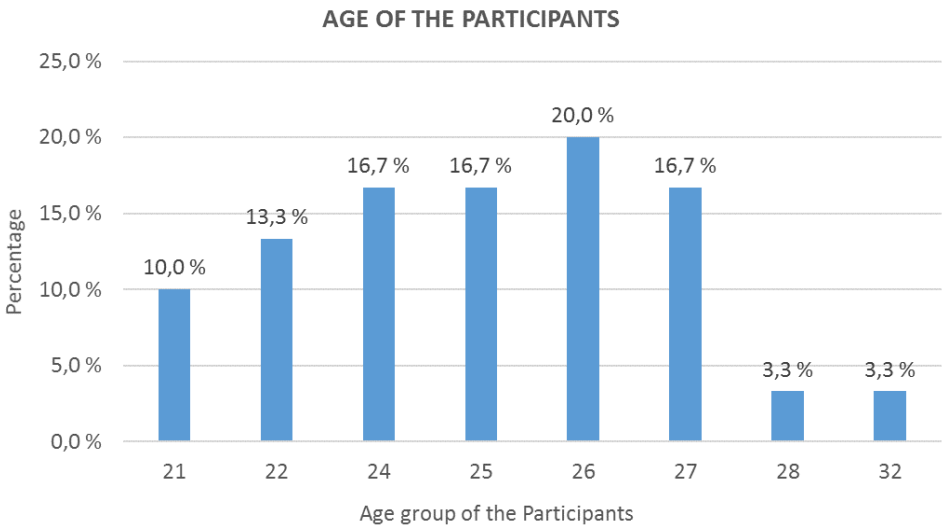


Figure 4.4: Age group of the participants in the post testing questionnaire

(33.3%), as shown in Figure 4.3. There were considerably more men than in the first questionnaire. As for the age of the respondents, the average age was 25 years and the range is between 21 and 32 years. The majority (93,34%) of the participants were between 21 and 27 years as illustrated in Figure 4.4, which was expected since the target sample were university students.

4.5 Measures

The questionnaire consists of questions about the demographics and about the constructs examined in this work. The constructs were measured with scales adopted from previous studies using a 7-point Likert scale that ranges from “not at all” (1) to “very much” (7). The constructs of used in this study are defined in Table 4.1 along with their source in the literature. A feedback possibility was implemented within the application itself. This feedback functionality was designed as a pop up window where it would automatically appear every 30 minutes in front of the user to give very easy feedback for services of the application. This feedback was formed as questionnaire with a 5-point Likert-scale where the user could rate the functionality of how satisfied he or she was from “Very satisfied” (5) to “Not at all” (1).

Construct	Definition	Source
Intention to use	The degree of students’ intention to use the mobile application in the future	[35]
Enjoyment	The degree that using the mobile application is perceived to be personally enjoyable	[36]
Satisfaction	The degree that a person positively feels with using the mobile application	[37]
Performance expectancy	The degree that individuals believe that using the mobile application is useful and will increase their performance	[38]
Effort expectancy	The degree that individuals believe that that using the mobile application is easy and free of effort	[35]

Table 4.1: Construct definition

4.6 Results from the post testing questionnaire

The post testing questionnaire is divided in two sections where the first section covers the demography such as; gender, age, and study. Moreover, it was provided questions to cover topics such as understanding of the application, was the application helpful, frequency of use, attractiveness of the design, what is good about the application, was there something not working the way they thought it should, and an optional field for other comments.

As for the other section, in order to be able to compare the results with other studies and technologies, the survey was limited to standardized questions. In order to do the comparison, constructs were created and measured with scales adopted from previous studies using a 7-point Likert scale that ranges from “not at all” (1) to “very much” (7). The constructs used in this study are defined in Table 4.1 above along with their source in the literature. There was implemented a feedback possibility within the application itself, which was designed as a pop up window, as presented in section 3.5.7.

The participants were collected through various locations, for instance student communities or groups within Facebook and student information channels. To ensure diversity, respectable and consistent data, the participants had to give contact information and details about what study and year they currently were in. This was done to make it easy for the participants and me to contact each other if necessary, and to send the post testing questionnaire and the SUS schema.

4.6.1 Frequency of use

According to the questionnaire, the frequency of use indicated that the participants found the applications useful for their needs. As presented in Figure 4.5, 96.7% pointed out that the participants would at least have used the application once a year or more in the future. A positive aspect, is that almost half of the participants would have used the application about once a week. On the other hand, this signals that there is a demand or certain needs that has not been addressed yet.

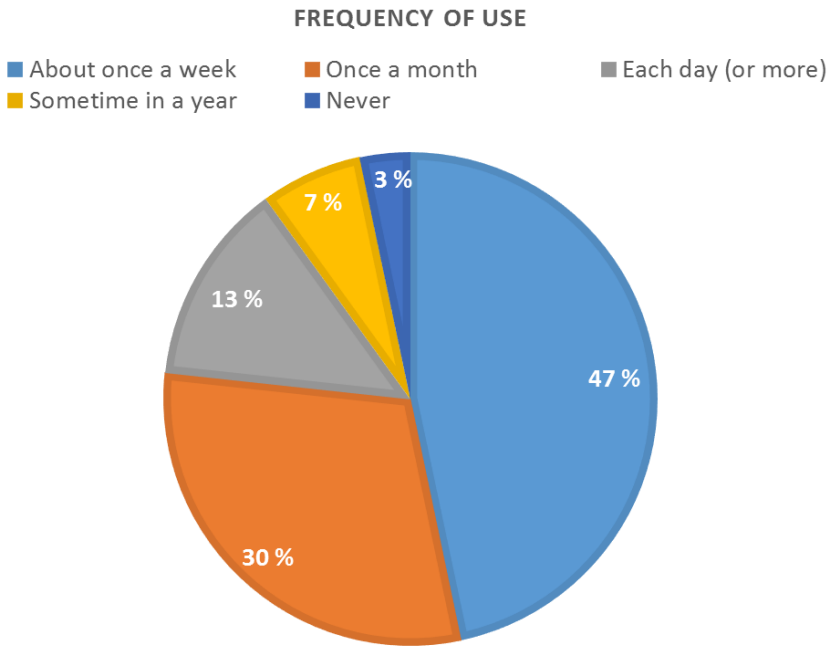


Figure 4.5: Participants' responses of frequency of use in the post testing questionnaire

4.6.2 Attractive design

The participants were questioned about how attractive the application was by voting from the range 1(Not at all) to 7(Very much). As illustrated in Figure 4.6, the majority found the design to be to a certain degree attractive. The average value was calculated to be 5 out of 7 points, which was looked upon as a very positive feedback due low priority placed on the design. It was positive that the majority felt that the design was at an acceptable level or better. If not, it may have impacted the usability and functionality of the application to some extent which would be a negative factor, since that was highly prioritized.

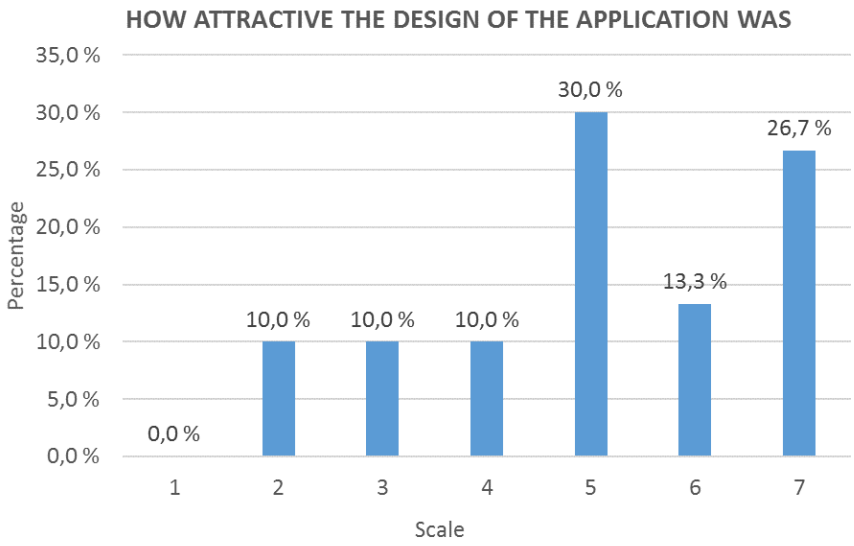


Figure 4.6: Participants' responses on how attractive the design of the application was

4.6.3 Useful/helpful application

The respondents were presented a scale between 1(Not at all) and 7 (Very much). None gave the lowest score, but there was only one participant who gave full score on this question. The average score was roughly 4 points out of 7, which was slightly above the average score. The result was expected to be much higher because of the confidence of developing the services and functionality according to the data collected at the design application questionnaire. The data was analyzed and was carefully followed to meet the students' needs. However, I found the score still satisfactory, since there might have been other factors that had an impact on this that were not yet uncovered from the questionnaire.

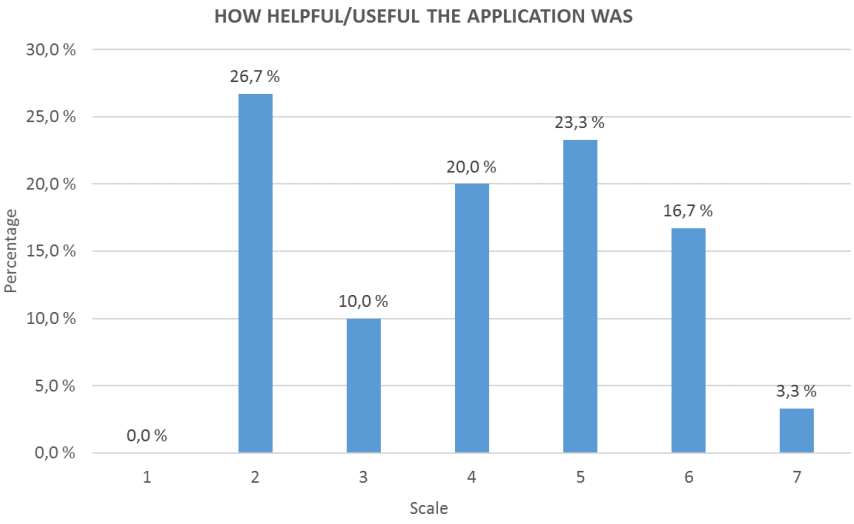


Figure 4.7: Participants' responses on how helpful/useful the application was

4.6.4 Understanding the application's idea

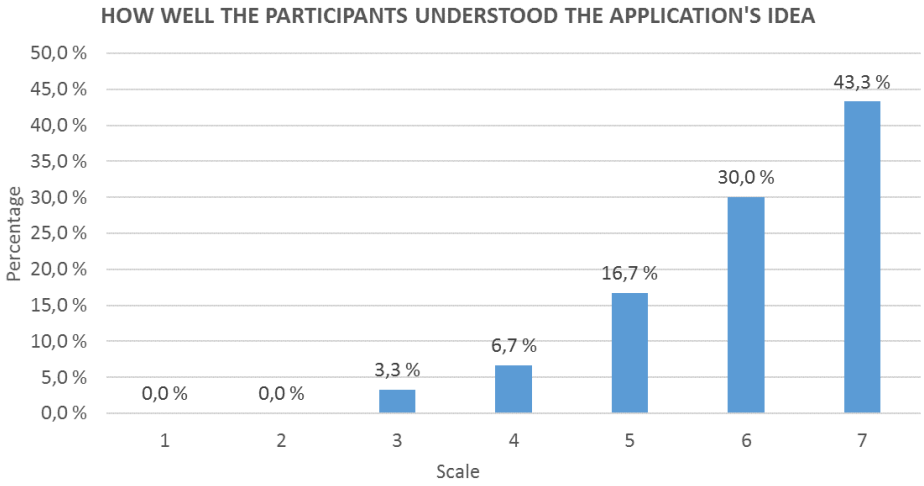


Figure 4.8: Result on how well the participants understood the application's idea.

From a scale of 1 (Not at all) to 7 (Very much) the participants where asked how well they understood the idea of the application, as illustrated in Figure 4.8. It was expected that the participants would have a clear understanding due to the familiarity with previous experience with applications, and that this application was promoted as a tool for the university they study at. There was no doubt about the participants understanding what the application's idea was, as they scored an average score of 6 out of 7. This result showed that there was neither neutral nor confused understanding of the application, but rather a united agreement towards the application's idea.

4.7 Constructs

4.7.1 Intention to participate

One of the elements that was thought to be interesting, was discovering the degree of participants' intentions to participate in a similar application in the future. Four questions with a Likert scale from 1 (Not at all) to 7 (Very much) were asked on this matter to acquire statics.

First, the intention of participating in similar applications in the future was measured. As shown in Figure 4.9, the result showed diversity amongst the responders. The result indicated a slightly positive intention, due to the average score being 4.7 out of 7. This result was found as a positive element as it encourages more development of applications for educational purposes.

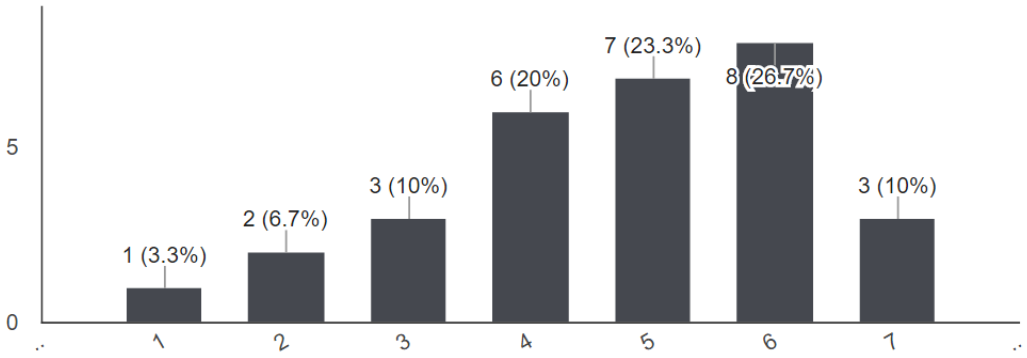


Figure 4.9: Result indicating if the participants intended to participate in similar applications in the future.

Next question involved if the general intention to participate in similar applications in the future was very high. The result, in Figure 4.10, indicates that there was a large diversity amongst the responders again. The average score is 4.3 out of 7 which is slightly above neutral. In contrast to the previous results of Figure 4.9, the results show a form of consistency.

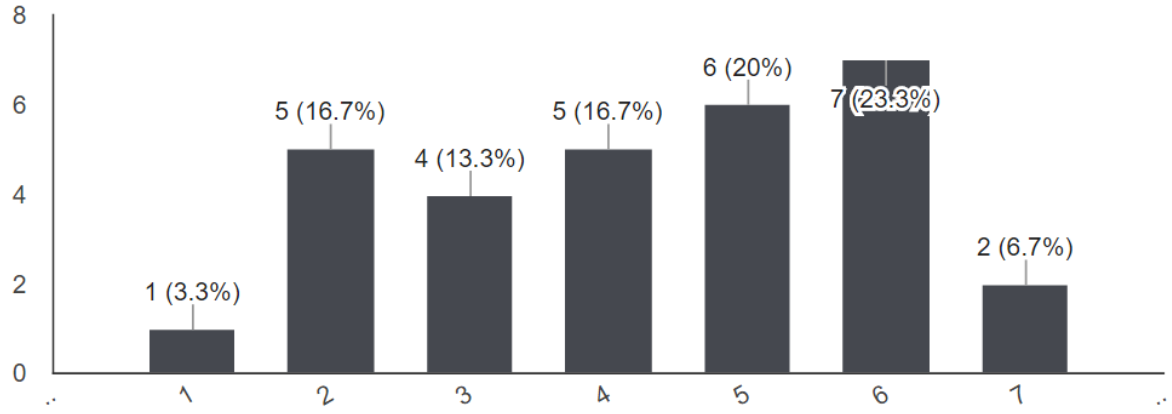


Figure 4.10: Result indicating if the general intention to participate in similar applications in the future was very high.

Third question was to discover if the participants would use similar applications in the future. The results did not have a great deviation from the previous results. The average score was approximately 4 out of 7 which was fairly close compared to the other results.

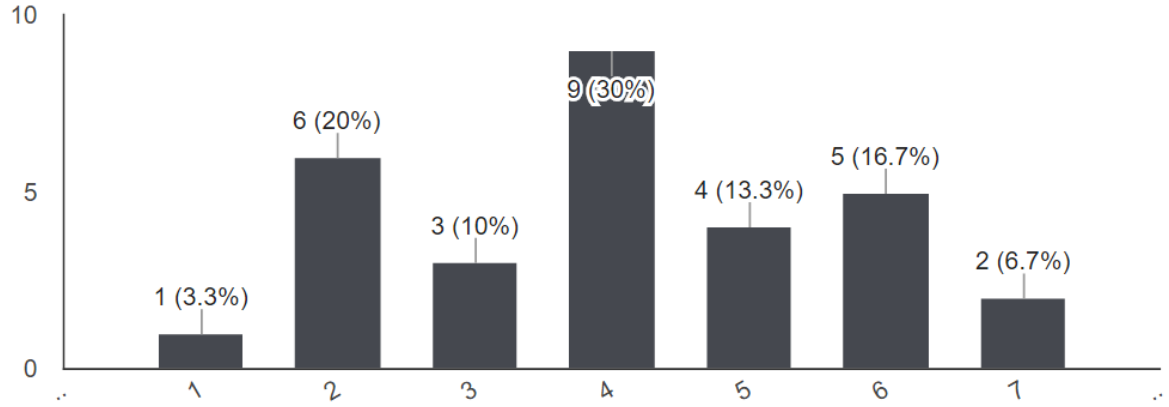


Figure 4.11: Result indicating if the participant would regularly participate similar applications in the future.

The final question asked if the participants would think about participating in similar applications. The results, shown in Figure 4.12, were slightly higher than rest of the questions in this construct. The average score was calculated to be about 5 out of 7 points which was look upon as a positive element. This score points out that there was positive thinking on participating on similar applications, which means that the tested application had some impact on their needs or was found to some extent helpful.

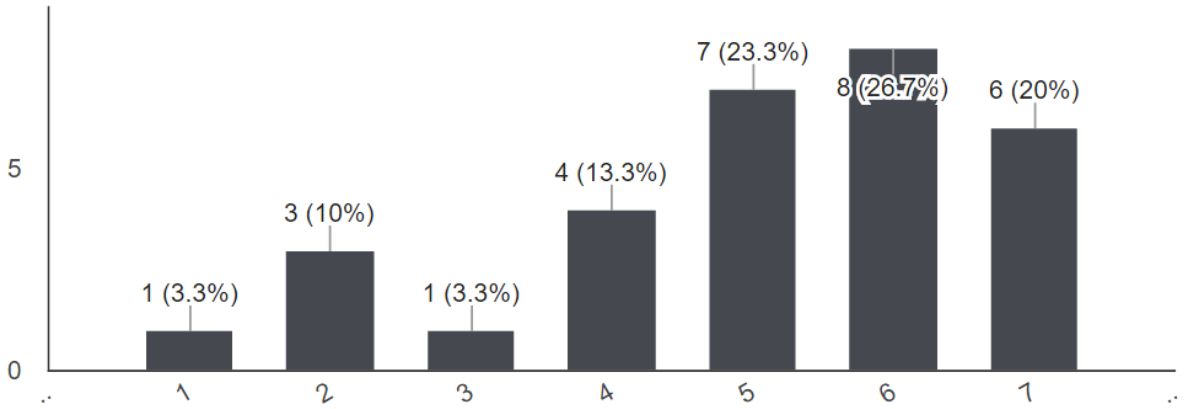


Figure 4.12: Result showing if the participants would think about participating in similar applications.

4.7.2 Enjoyment

Another construct that was created was to measure the degree to which the application was perceived to be personally enjoyable. In this category 3 questions were asked with a 7-point Likert scale, ranging from 1 (Not at all) to 7 (Very much), regarding this topic.

The first question asked if attending the application was found enjoyable. The result can be viewed in Figure 4.13, showing a very positive result with an average scoring about 5.6 out of 7 points. None of the participants gave the application a score lower than 4 and the majority gave it a full score, which is a great achievement. Additionally, this result discovered that the participants perceived the application considerably more enjoyable than neutral.

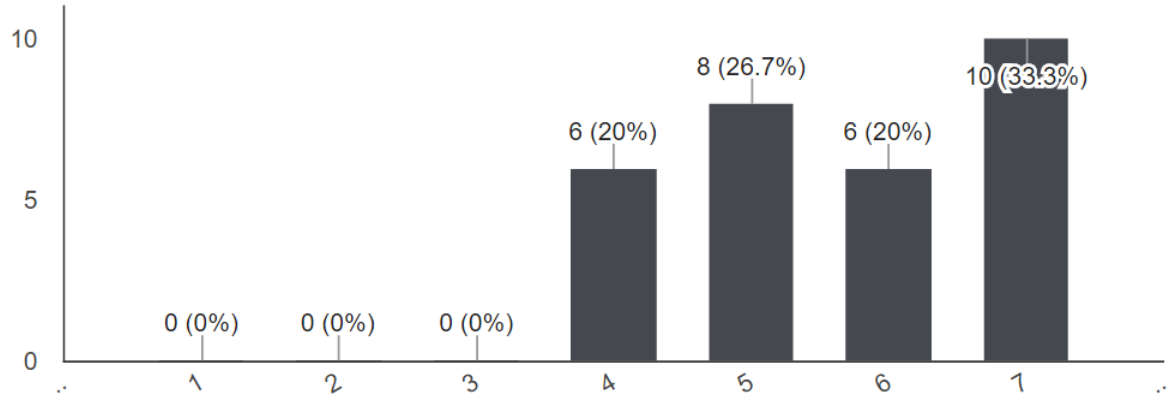


Figure 4.13: Result showing if attending the application was enjoyable

Following questioning was if using the application was found exciting. In the Figure 4.14, the result indicated a lower average score of 4.5 in comparison to the Figure 4.13 which was 5.6 points. However, this result was not expected to be high due to not having a focus on it.

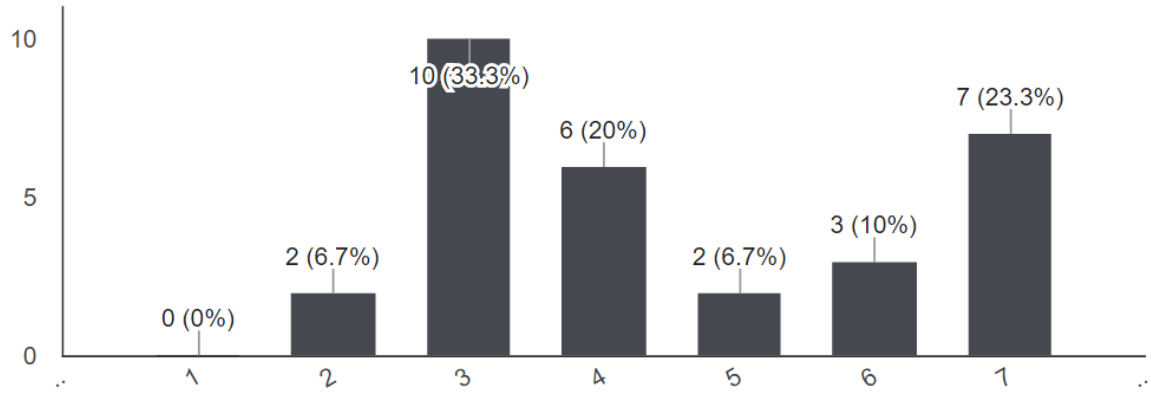


Figure 4.14: Result of how much the application was found exciting

It was desired to know if the participants were feeling good about using the application. According to the Figure 4.15, the majority had a considerably good feeling with the average score of 5.2. In addition, there was none of the participants that scored lower than 3 points which is a good feedback for the application. To summarize the 3 questions about the enjoyable construct, there was a positive outcome where the majority approved towards having the application as enjoyable.

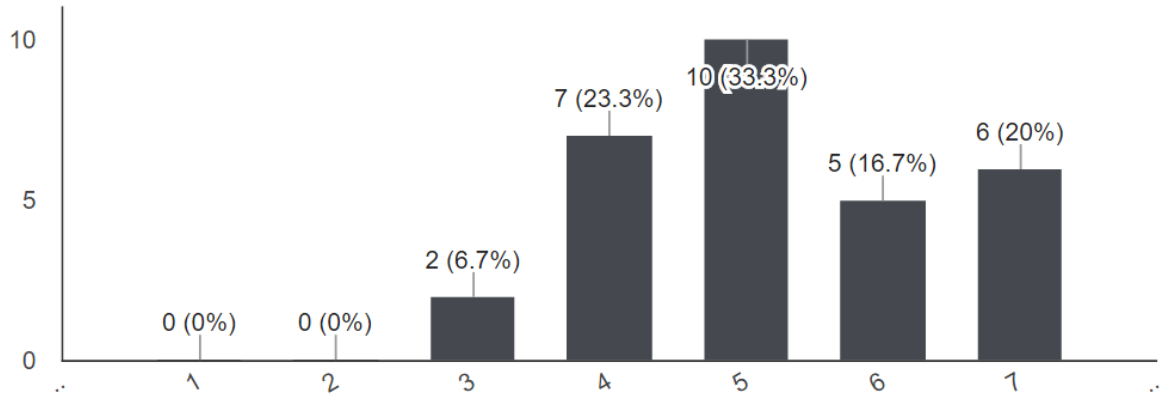


Figure 4.15: Result showing if the participants were feeling good about using the application

4.7.3 Satisfaction

What was also desirable to know was to what degree the participants felt satisfied with the application. In this construct, there was also created 3 questions with a 7-point Likert scale to determine the degree of satisfaction.

The first questioning was to discover whether the participants were satisfied with the application. Stated by the Figure 4.16, the points were trending to ‘very much satisfaction’ and none of the participants gave it a lower score than 3 points. The average score was calculated to about 5.26 out of 7 points, which is a great accomplishment. The feedback endorses the application as a positive element for the students’ needs.

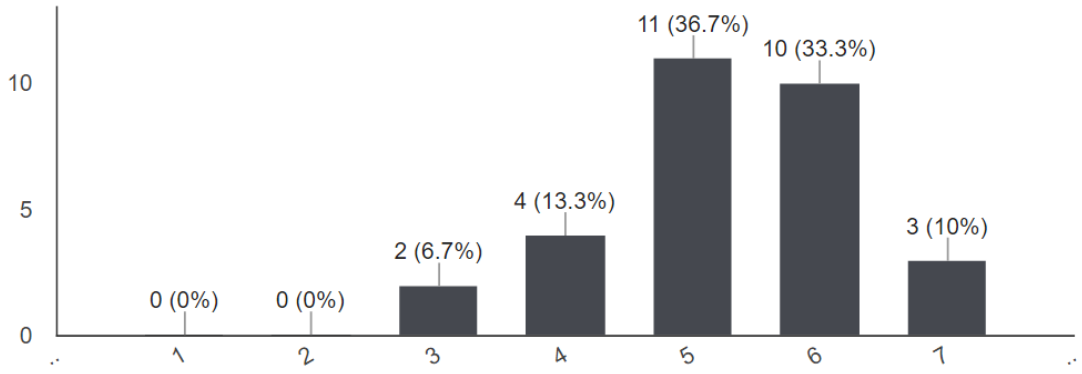


Figure 4.16: Result of what degree the participants felt satisfied with the application

Next there was interesting to discover to what degree the participants felt pleased with the application. As shown in Figure 4.17, the outcome was marginally better than the responses about the satisfaction with the average score of 5.36 out of 7 points. Up to now there has been a consistent score about the satisfaction towards the application.

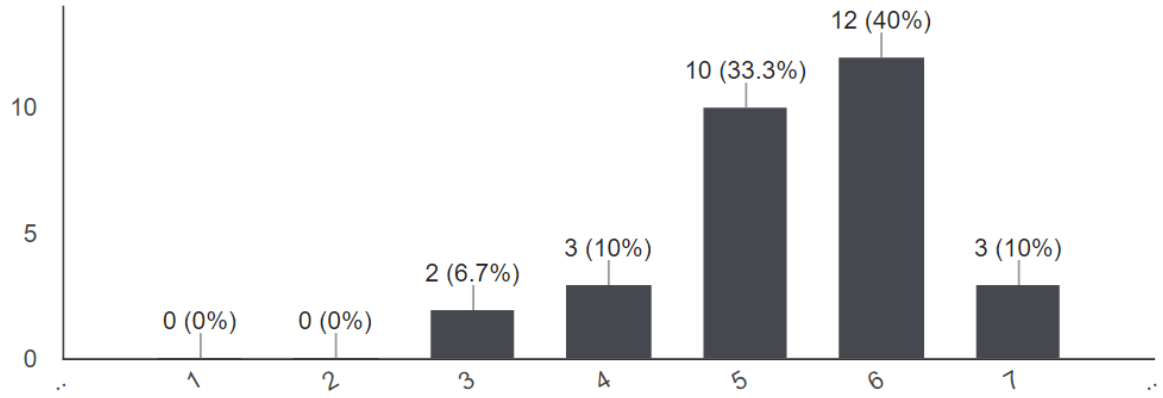


Figure 4.17: Result of what degree the participants felt pleased with the application

To close up the last construct, the participants were asked to score on how much their decision to use the application was a wise one. The average score was calculated to about 5.53 out of 7 points as shown in Figure 4.18. Yet again, the score was trending towards the positive side with a marginally better score than in Figure 4.17 and no participants scored below 3 points. As a conclusion, the satisfaction construct was found as a great accomplishment.

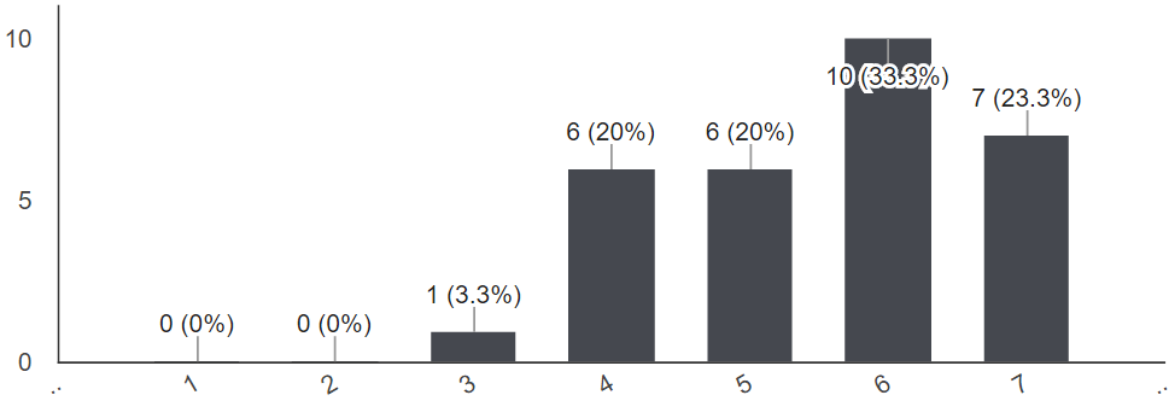


Figure 4.18: Result of to what degree the participants' decision to use the application was a wise one

4.7.4 Performance Expectancy

Performance expectancy was defined as to what degree the participants believed that using the mobile application was useful and would increase their performance. The participants were questioned with 3 questions in this construct where each question was answered by a 7-point Likert scale.

What was interesting to discover was if using similar applications improved the participants' learning performance in school related activities and technologies. As shown in Figure 4.19, the points are evenly spread across the scale with no clear majority in either direction. As for the outcome in plain numbers, the average score was calculated to be about 3.73 out of 7 points. Regarding this outcome, there is evidently a neutral view on this matter. It was expected a higher score here due to the goal of helping students in their everyday academic life.

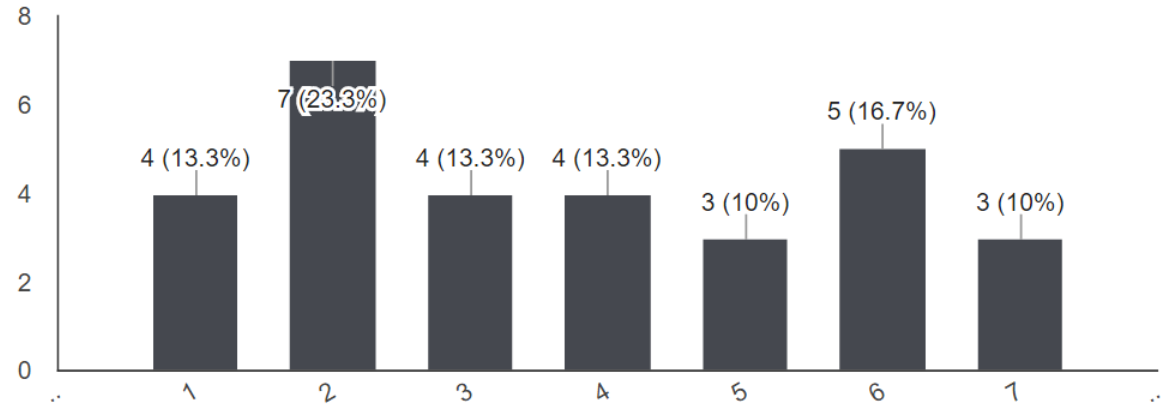


Figure 4.19: Result of the degree attending similar applications improves the participants' performance in school related activities and technologies.

Regarding the performance expectancy construct, the next question was to discover if using similar applications enhances the effectiveness in school related activities and technologies. The feedback, as illustrated in Figure 4.20, is similar to the previous question, but slightly less bottom and top scores. The average score was calculated to about 4.53 out of 7 points, which is an acceptable outcome for the application.

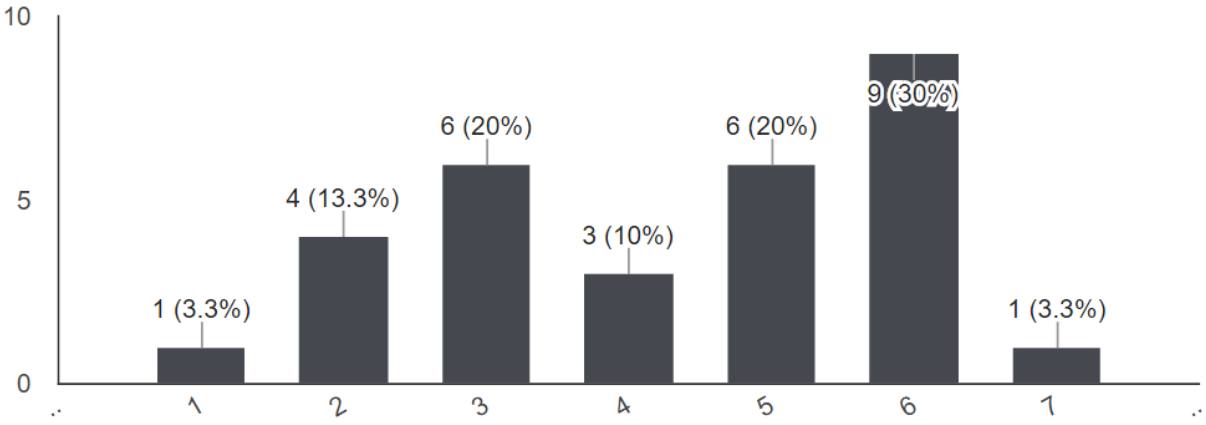


Figure 4.20: Result of the degree attending similar applications enhances the effectiveness in school related activities and technologies

To end with this construct, the participants were queried if attending this kind of application increases the participants' capabilities in school related activities and technologies, as shown in Figure 4.21. The response was very much the same as the first question. Calculating the result, it produced the average score of about 4.03 out of 7 points which puts this score between the first and second question.

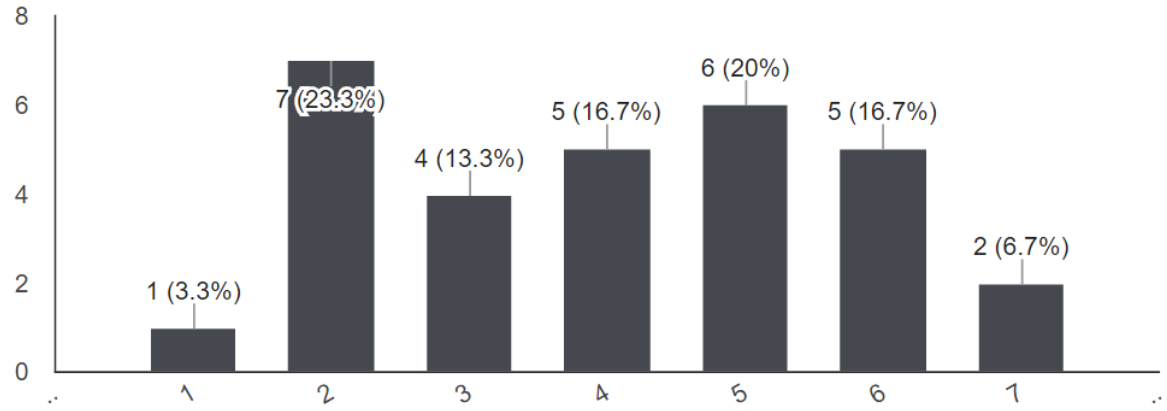


Figure 4.21: Result of what degree using this kind of application increases the participants' capabilities in school related activities and technologies

The performance expectancy reached a reasonable response and it was concluded that there was to some extent a consistency amongst the questions in this construct. The majority of the score was more in the direction of a neutral view, whereas the last question was the only one with a slightly higher score pointing out that the application had some impact on enhancing the effectiveness in school related activities and technologies.

4.7.5 Effort Expectancy

Next up, it was sought to discover the degree to which a participant believes that using the respective application was easy for him or her. Correspondingly as the other constructs, a 7-point Likert scale has been used to collect the feedback. There are 3 questions regarding this topic.

The opening question regards to what the degree the participant found the application flexible which is shown in Figure 4.22. The result displays a diversity amongst the participants where some of them score high while others much lower. This indicates that the individual person has different affiliations with flexibility and that there is a possibility that all the different needs have not been met. However, the average score is about 4.73 out of 7 points which is above average and is considered as an acceptable outcome.

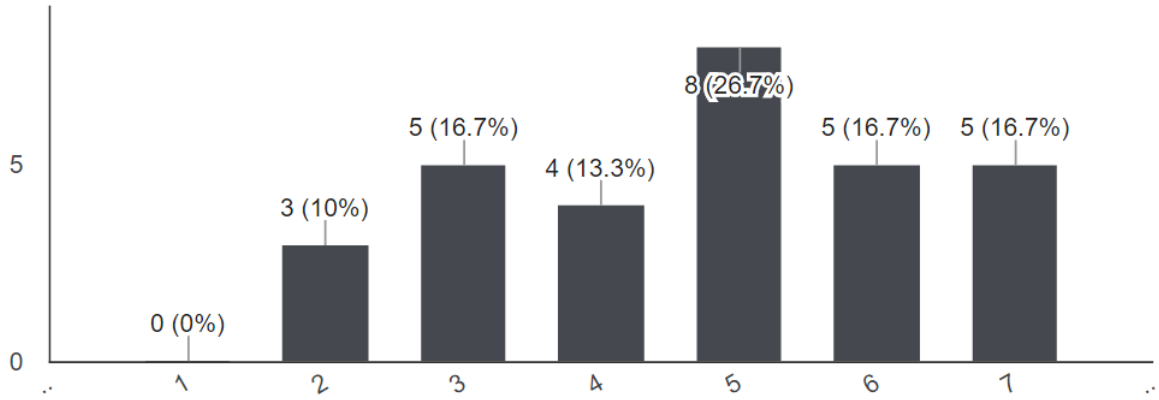


Figure 4.22: Result of what degree the participants found the application flexible

The participants were then asked to answer to what degree the process of the application was clear and understandable for them. The feedback was outstandingly positive with an average score of 6.5 out of 7. As viewed in Figure 4.23, the outcome shows that none of the participants voted for a score lower than 5, which confirms that a clear majority agreed that the application was understandable. In comparison to the flexibility from previous question, this question's result shows a significant difference. This positive result is good in terms of the thesis' goal of providing good usability for the students.

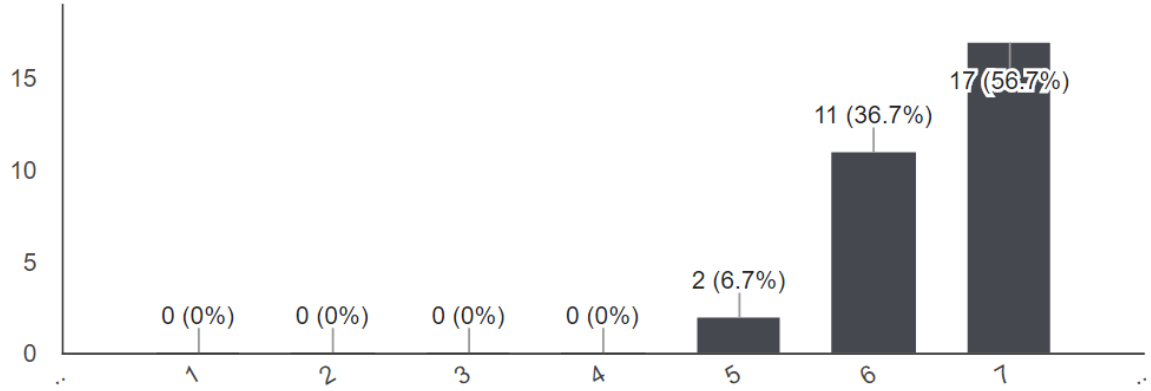


Figure 4.23: Result of what degree the participants thought the process of the application was clear and understandable

Last question concerning this construct asked if it was easy for the participants to attain skills in the application. As the Figure 4.24 shows, there is to some extent a divided scoring where 3 participants scored this question below average, while the rest scored above average. However, it should be distinguished that the majority of the participants gave this question a full score. Nevertheless, the average score amongst the participants is calculated to be about 5.56 out of 7 points which is satisfactory score. The questioning of, if the application was clear and understandable gave the highest score throughout all the constructs. It is concluded that due to the high scoring of this construct, it is clear that the participants found that using the application, is to a great extent, easy for them.

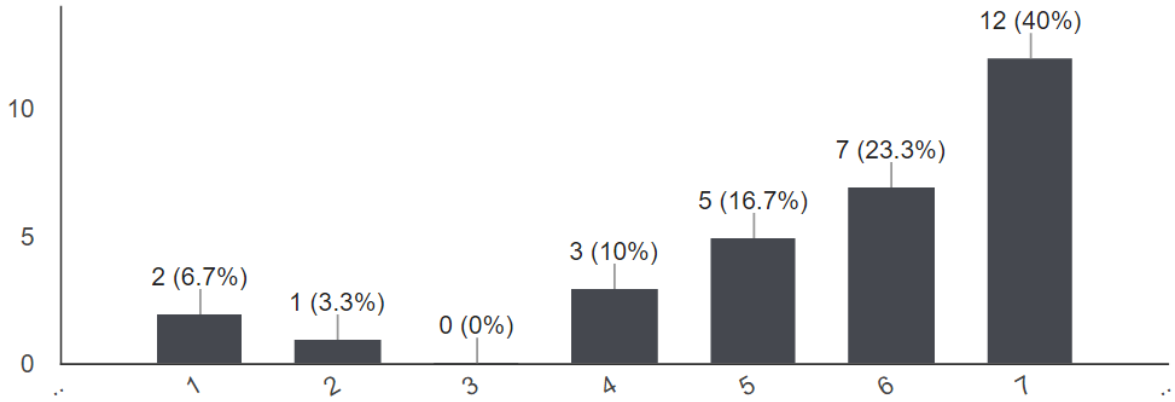


Figure 4.24: Result of what degree it was easy to attain skills in the application for the participants

4.7.6 Learning purpose

The aim of this construct was to examine the participants' intention to use mobile devices for learning purposes. The responses contributed to this research by providing useful information and insight about the participants' beliefs based on their personal experience with mobile learning. The participants were asked to indicate how much they agree or disagree with the following statements regarding the application they tested. There were four questions regarding this construct and as the previous questions, the answers were done through a 7-point Likert scale.

The first question asked if mobile devices would be easy to use for learning purposes. The answers were divided where points are scattered across the whole scale, but as Figure 4.25 shows the majority answered above average. The average score is approximately 4.76 out of 7 points which is slightly above average. The outcome indicates a split opinion amongst the participants. This indicates that the participants have different needs when it comes to learning purposes or that there is an uncertainty on how mobile devices can assist as a tool for learning purposes.

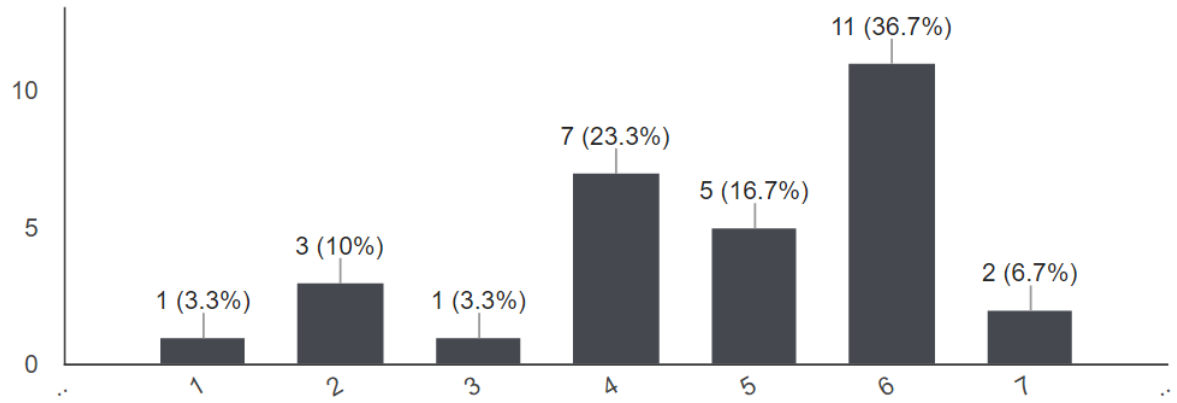


Figure 4.25: Result of the question regarding that mobile devices would be easy to use for learning purposes

The following question attempted to discover if it would be easy to access course material with their own mobile device. Even at this question there was a spread score across the scale, but only to some extent as viewed in Figure 4.26. Similar to the previous question, the majority scored above average, contributing to a slightly better average score of about 5.16 out of 7 points.

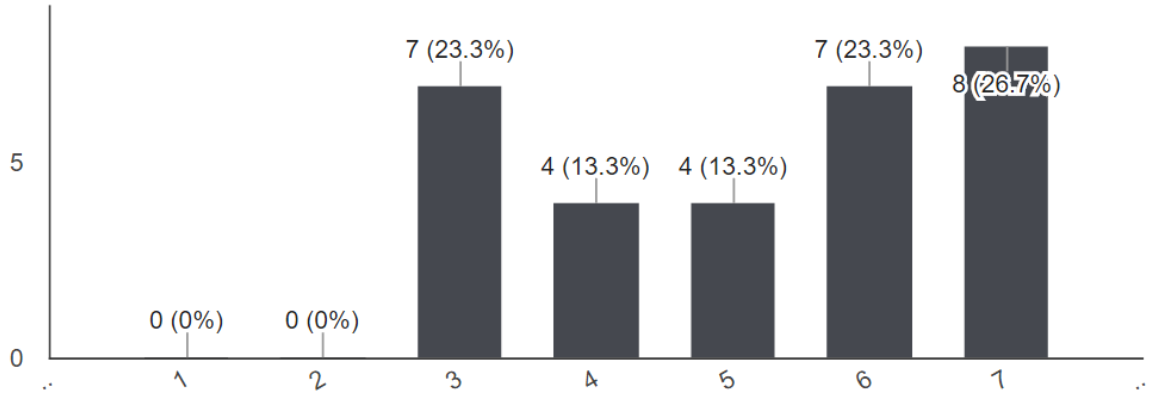


Figure 4.26: Result showing if it would be easy to access course material with the participants' mobile device

The next question asked if mobile devices would be easy to assist learning. According to the Figure 4.27, the result is spread almost throughout the whole scale, but still trending towards the positive where the majority have given it a score above average. The average score was calculated to about 5.26 out of 7 points which is similar to the previous questions' results.

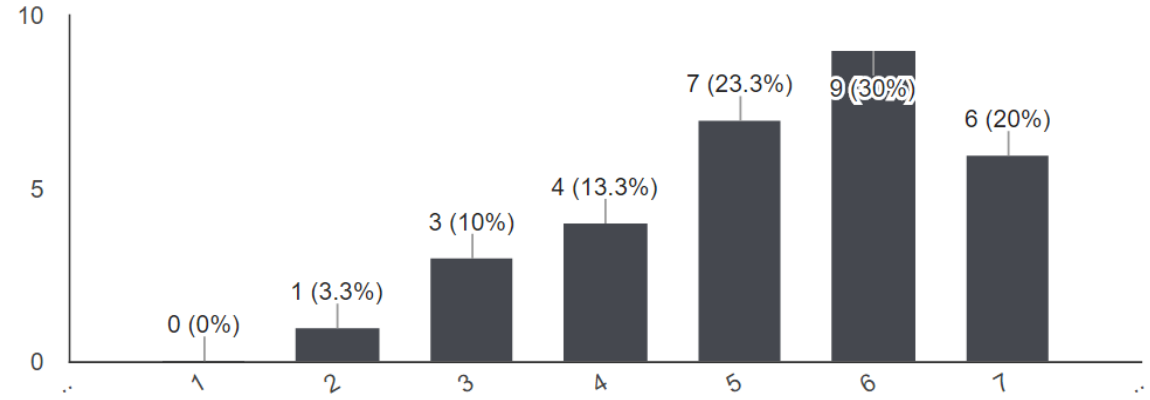


Figure 4.27: Result showing if mobile devices would be easy to assist learning

The last question concerning this construct, the participants were asked if it was easy to use mobile devices for accessing learning content, as shown in Figure 4.28. There is again a majority scoring above average and the average result ends in about 4.96 out of 7 points. To summarize the construct, it can be said that there is a consistency through the questions with only a minor difference in score and that all scores ended above average. This result is viewed upon as acceptable and as a positive contribution for future applications regarding education and learning purposes. The details on scores from all the questions and constructs are shown in Table 4.2 and all the questions asked in the questionnaire can be found in Appendix C.

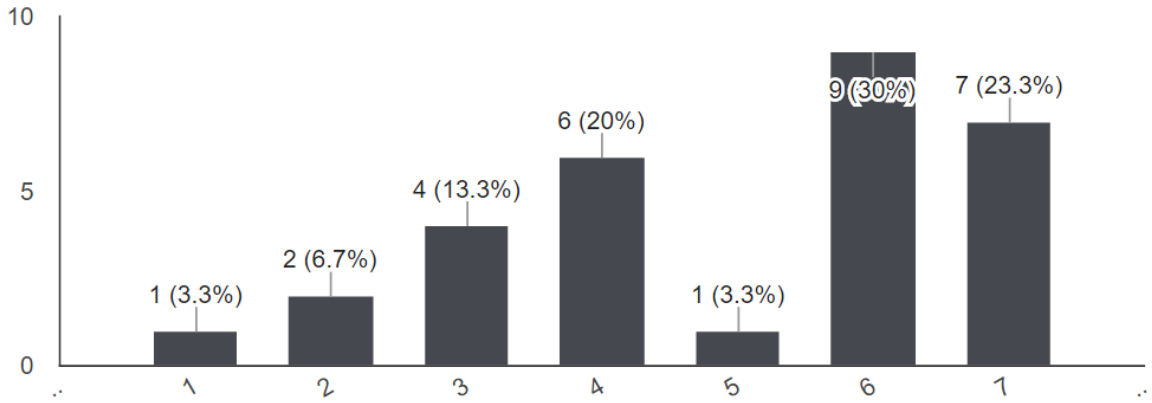


Figure 4.28: Result showing if it is easy to use mobile devices for accessing learning content

Factors	Items	Average score per question	Total average construct score
Intention to Participate	ItP1	4.733	4.533
	ItP2	4.300	
	ItP3	4.066	
	ItP4	5.033	
Enjoyment	ENJ1	5.666	5.122
	ENJ2	4.500	
	ENJ3	5.200	
Satisfaction	STF1	5.266	5.388
	STF2	5.366	
	STF3	5.533	
Performance Expectancy	USF1	3.733	4.099
	USF2	4.533	
	USF3	4.033	
Effort Expectancy	EAS1	4.733	5.599
	EAS2	6.500	
	EAS3	5.566	
Learning Purpose	LPU1	4.766	5.041
	LPU2	5.166	
	LPU3	5.266	
	LPU4	4.966	

Table 4.2: Result of the scoring on all questions and constructs

4.8 Data Analysis

The constructs of this study were first evaluated in terms of their reliability and validity. Reliability was examined with Composite Reliability and Cronbach alpha, with acceptable indices of internal consistency (>0.70). Validity was examined by measuring the average variance extracted (AVE) (>0.50), and by examining the correlations between the variables in the confirmatory models, which should not exceed 0.8 points, as exceeding 0.8

suggests low discrimination. The square root of each factor's AVE must be greater than its correlations with other factors[39]. The AVEs for all constructs ranged between 0.60 and 0.85, all correlations were lower than 0.80, and the square root AVEs for all constructs were larger than their correlations. Table 4.3 presents the findings. Also, we tested for multicollinearity [40] along with the potential common method bias by utilizing Harman's single-factor test [41]. The variance inflation factor for each variable was below 3, suggesting that multicollinearity was not an issue. The findings also indicate the absence of common method bias in that the first factor did not account for the majority of the variance and no single factor occurred from the factor analysis.

					ENJ	STF	PE	EE	INT
Construct	Mean (SD)	CA	CR	AVE	1	2	3	4	5
ENJ	5.12 (1.2)	0.86	0.91	0.78	**0.88**				
STF	5.39 (0.93)	0.84	0.88	0.73	0.66	**0.85**			
PE	4.10 (1.69)	0.91	0.94	0.84	0.39	0.59	**0.92**		
EE	5.60 (0.87)	0.84	0.88	0.60	0.08	0.34	0.47	**0.77**	
INT	4.53 (1.51)	0.94	0.96	0.85	0.58	0.62	0.44	0.27	**0.92**

Note: Diagonal elements (in bold) are the square roots of the AVE. Off-diagonal elements are the correlations among constructs (correlations of 0.1 or higher are significant, $p < 0.01$). For discriminant validity, diagonal elements should be larger than off-diagonal elements. ENJ; Enjoyment, STF; Satisfaction, PE; Performance Expectancy, EE; Effort Expectancy; INT; Intention to use

Table 4.3: Descriptive statistics and correlations of latent variables

4.9 Fuzzy set Qualitative Comparative Analysis

This study employs Fuzzy set Qualitative Comparative Analysis (fsQCA) using the software fs/QCA 2.5 [42]. FsQCA was developed by integrating fuzzy sets and fuzzy logic principles with Qualitative Comparative Analysis (QCA) [43], is appropriate for small samples [44], and it helps researchers go beyond regression based techniques by identifying multiple pathways that explain the same outcome, that are not identified by multiple regression analyses (MRA) because they influence the outcome only for a small number of cases [45]. These combinations lead to multiple solutions offered by fsQCA, and include both necessary and sufficient conditions. Such conditions may be present or absent on a solution, or they may be on a "do not care" situation. The "do not care" situation indicates that the outcome may either be present or absent and it does not play a role on a specific configuration.

All factors need to be calibrated into fuzzy sets with values ranging from 0 to 1 [46], and this may be done either directly or indirectly. In the direct method, the researcher should choose three qualitative breakpoints, while in the indirect method, the factors should be rescaled following qualitative assessments. The researcher may choose either method depending on the data and the underlying theory [46]. The direct method of setting three values that correspond to full-set membership, full-set non-membership and intermediate-set membership is recommended [46, 47]. The data calibration in the present study was done following the direct method, following the procedure employed by [48, 49], and the three qualitative anchors for the calibration were based on the survey scale (seven-point Likert scale). The full membership threshold was set at 6, the full non-membership threshold was set at 2, and the crossover point was set at 4. The values of every variable were calibrated based on a linear function to fit into the three aforementioned thresholds.

fsQCA creates a truth table of 2_k rows, where k represents the number of outcome predictors and each row represents every possible combination. Finally, the truth table is sorted based on frequency and consistency [46]. Frequency describes the number of observations for each possible combination, and consistency refers to "*the degree to which cases correspond to the set-theoretic relationships expressed in a solution*" (Peer C. Fiss, 2011: p 402) [50]. A frequency threshold should be set to ensure that a minimum number of empirical observations is acquired for the assessment of the relationships. For samples smaller than 150 cases the threshold should be set at 2 [46, 50], thus all observations with frequency of 1 or 0 are removed from further analysis. Also, the threshold for consistency is set at the recommended threshold of 0.75 [51].

Chapter 5

Findings

This chapter investigates the findings that were collected from the testing of the mobile application through questionnaires, interviews, and the SUS schema. The results are divided into five sections: 5.1 MAXQDA results of the post testing questionnaire, 5.2 Semi-structured interviews, 5.3 Results of the semi-structured interviews, 5.4 MAXQDA results of the Semi-Structured interviews, 5.5 Result of the integrated feedback functionality within the application, and 5.6 Results of the System Usability Scale questionnaire.

5.1 MAXQDA results of the post testing questionnaire

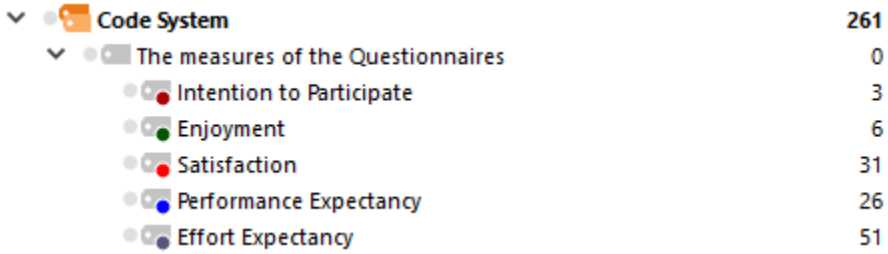


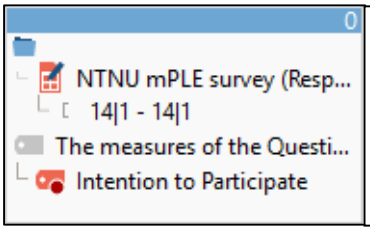
Figure 5.1: MAXQDA code system

The unstructured data from the questionnaire was analyzed and visualized into a system by using MAXQDA, as shown in Figure 5.1. The analysis identified data according to the measurements: Intention to Participate, Enjoyment, Satisfaction, Performance Expectancy, and Effort Expectancy, which are explained more in-depth in the following sections.

5.1.1 Intention to participate

The intention to participate measurement is defined as the degree of the participants' intention to participate in similar applications [35]. In this case, it also includes using the tested application in future as well. The data pointed out that only some of the participants showed an intention to participate, but only under certain circumstances. One of the cases a participant responded that the application was distributed too late into the semester due to preparations for exams, otherwise the participant would have used the application much more. If the application was distributed early into the semester, it would be mostly used in the start and end of the semester. In the start there are several questions that arise and a lot of

information to process. As for the end, such as during exam period, questions about admission and applying for exams occur which requires another information retrieval. Between the start and end of the semester there would be more of a situational usage.



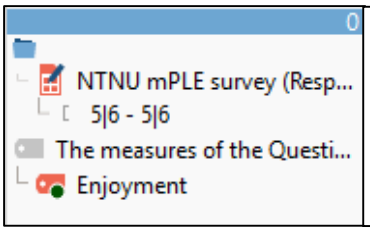
An events page that updates itself that would make me much more likely to use I more. I would use it every week if that was included

Figure 5.2: Example of MAXQDA result of intention to participate within the questionnaire

Another participant replied, as shown in Figure 5.2, that if there was a possibility of getting updates on events around campus, there would be more likely to use the application every week. In another case, a participant responded that if there were any lectures he or she had to attend to, it might have been used more. It has to be mentioned that many of the participants had few classes during their testing of the application as they were in last year of their bachelor or master degree, which resulted in less feedback on this measurement.

5.1.2 Enjoyment

Enjoyment was another measurement that was used; and is defined as the degree to which the application is perceived to be personally enjoyable[36]. Several functionalities within the application were found very enjoyable by the participants. Some of the most common phrases the participants used to describe enjoyment of the application were; “love the idea”, “felt good to use”, and “I greatly enjoyed using the application”. The last example is shown in Figure 5.3.



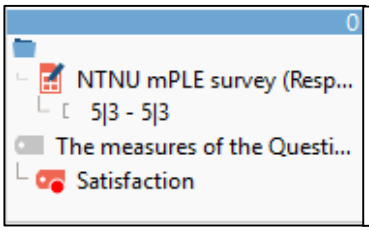
I greatly enjoyed using the NTNU mPLE app

Figure 5.3: Example of MAXQDA result of enjoyment within the questionnaire

5.1.3 Satisfaction

Satisfaction is defined as the degree to which a person feels positive with the activity[37]. Satisfaction occurred numerous times as the questionnaire was analyzed into more detail. Almost all participants found the applications satisfying in some manner.

The functionality was either found as: pleasing, mobile friendly, contained desired information on demand, or as shown in Figure 5.4, a positive experience for the user.



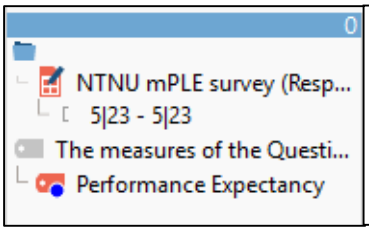
It was a positive experience, I like having easy access to services like Kahoot and Innsida which I use frequently

Figure 5.4: Example of MAXQDA result of satisfaction within the questionnaire

Some participants said that the application reduced the stress of new surroundings a lot. Others found the application appealing simply because they like technology and even for those who do not use mobile phones quite often, saw the practicality of an application like this one. What the majority of the participants had in common, however, was that they were satisfied with having all the different services and important information in one place, such as this application.

5.1.4 Performance Expectation

The performance expectation measurement is defined as the degree to which the participant believes that using the application, is useful for him or her[38]. The outcome of this performance measurement indicated to be high amongst the participants. One participant replied that useful information was available without going through the maze of the NTNU website, especially for new students who do not have a clue what to look for. Another piece of feedback was that the application made it easier to organize oneself and get formal things done. For others it just had good functionality that made life easier from time to time, as illustrated in Figure 5.5.



I felt it was very useful, I used the Course Help a lot

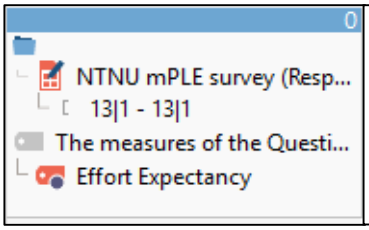
Figure 5.5: Example of MAXQDA result of performance expectancy within the questionnaire

Many of the participants specified that the application was a time saver, since it was quicker than other services they have used before. Finding desired information was fast and easy to aid the participant's studies, to quote the following: *"It gives a good guide for new students and also gives in itself hints on what is possible and useful for a student"* (Participant 28,

2016). In general cases the participants found the application very simple, responsive, useful and well integrated.

5.1.5 Effort Expectancy

Effort expectancy is defined as the degree to which a participant believes that using the respective application is easy for him or her[35]. Several of the participants reported the application as very flexible and that the process of navigating through the different categories within the application was clear and understandable. The majority found the application very intuitive and easy to use due to good overview and
its simplicity, and a good example of the effort expectancy is shown in Figure 5.6.



Easy to use, easy to understand, well organized, simple overview and elegant design.
Everything is to the point!

Figure 5.6: Example of MAXQDA result of effort expectancy within the questionnaire

5.1.6 Questionnaire fsQCA results

The results of fsQCA for high and low/medium intention to use mobile learning are shown in Table 5.1. Each possible combination is a solution that explains the outcome. Specifically, the presence of a condition is presented with a black circle (●), while its absence with a crossed-out circle (ⓧ) [50]. The blank spaces indicate a “do not care” condition (i.e., either present or absent). Table 5.1 also shows consistency values for every configuration and for overall solutions. All values are above the recommended threshold (>0.75). Consistency measures the degree to which a subset relationship has been approximated, while coverage assesses the empirical relevance of a consistent subset [51, 52]. The overall solution coverage indicates the extent to which high or low/medium intention to use mobile learning applications may be determined from the existing configurations, and is comparable to the R-square value reported in traditional MRAs[53]. Overall solution coverage of 0.59 and 0.60 indicate that the solutions account for a substantial proportion of the outcome.

fsQCA estimates also the empirical relevance for every solution, by calculating raw and unique coverage. Raw coverage is the amount of the outcome that is explained by a certain solution, and the unique coverage is the amount of the outcome that is exclusively

explained by a certain solution. The solutions identified in this study explain a vast amount of users' behavior, ranging from 29% to 49% cases associated with the outcome.

	Solution					
Configuration	1	2	3	4	5	6
	High intention			**Low/medium intention**		
Gender(Male)	ⓧ	●	●			●
Enjoyment		●			ⓧ	ⓧ
Satisfaction			●	ⓧ		
Performance expectancy	●	ⓧ	ⓧ		ⓧ	
Effort expectancy						
Consistency	.97	.83	.78	.87	.93	.94
Raw Coverage	.29	.31	.29	.40	.49	.44
Unique Coverage	.29	.03	.05	.04	.03	.07
Overall solution consistency	0.81			0.86		
Overall solution coverage	0.59			0.60		

Note: Black circles (●) indicate the presence of a condition, and circles with "x" (ⓧ) indicate its absence. Both circles indicate core conditions. Blank spaces indicate "don't care".

Table 5.1: Results of fsQCA for high and low/medium intention to use mobile learning

Solutions 1-3 presented in Table 5.1 show combinations for high intention to use the mobile learning application, and solutions 4-6 show combinations for low and medium intention to use the application. In detail, females with high performance expectancy will also have high intention to use the application (solution 1). For males, the findings offer two different solutions, (i) the combination of high enjoyment with low performance expectancy regardless of satisfaction and effort expectancy (solution 2), and (ii) the combination of high satisfaction with low performance expectancy regardless of enjoyment and effort expectancy (solution 3).

The results clearly demonstrate the asymmetrical relation between the examined variables since the configurations for high intention to use the application are not the equivalent ones for not having high intention to use the application (i.e. low or medium).

Specifically, low/medium satisfaction from using the application is enough to explain low/medium intention to use, regardless of all the other factors as well as the gender (solution 4). Similarly, for the combination of low/medium enjoyment and performance expectancy, regardless of gender, satisfaction and effort expectancy (solution 5). The findings show that males with low/medium enjoyment will also have low/medium intention to use the application, indifferent of satisfaction and performance and effort expectancy (solution 6).

The findings provide support for all three propositions. First, more than one configuration leads to high intention to use the mobile learning application, which indicates equifinality (proposition 1). Second, the results reveal configurations of high intention to use the application in which one condition could be either present or absent depending on its combination with the other conditions, indicating causal asymmetry (proposition 2). Third, the configurations that explain high intention to use the application are not perfect reverses of the configurations that explain low/medium intention to use the application.

5.2 Semi-structured interviews

Discovering insight of the participant's personal perspective and beliefs about the tested mobile application was one of the main objectives in this thesis. The semi-structured interview plan was created to ensure that this goal could be achieved, and the spontaneous questions that were asked were to enable the participants to share their experiences and viewpoints about the mobile application.

Based on 10 participants of university students, it was discovered a common opinion about the application, all of them found the mobile learning application as a useful tool to meet their needs. Further in-depth analysis indicated high levels of Performance Expectancy, Effort expectancy, and Satisfaction. The findings in this section is collected from the 10 participants' transcriptions which can be found in Appendix A.

5.2.1 Circumstantial issues

It has to be mentioned that during the process of data collection, coding, transcribing and analysis, there might have been some factors that were not accounted for at the interviews, which could have had an effect on the participants' perspectives, beliefs and experiences, and in the end that might have affect the outcome of the interview process.

5.2.2 Language

The language used during the interviews might have had an impact on the result(s). The participants had Norwegian as their native language, and as the interviews started, the participants were asked what language was preferred to be used during the interview. It could either be performed in English or Norwegian, or a combination of both depending on what the participant preferred. There was only one participant that preferred selecting Norwegian, and therefore the interview was performed in Norwegian, but the result was translated to English. All of the participants were or are students at NTNU where English is commonly used in lectures.

5.2.3 Study year

Many of the participants were in last year of their bachelor or master degree which might have had an effect on the results. In cases where the student was in his or her last year was an issue in terms of testing the application, since there was no regular schedule with subjects and lectures. In this case the student was not attending lectures but mostly worked alone, and therefore the issue was that the application could not be tested in many settings, circumstances, and interactions.

5.2.4 Time of testing

The testing of the application was conducted from mid-April to mid-May which was considered as a time close to the examination period at NTNU. As the students study for their examinations, the majority of the students do not have any lectures or there might be a few lectures to attend. These factors may have affected the usage of the application in terms of not having time to use it.

5.3 Results of the semi-structured interviews

General view on mobile devices

“R” is used for Researcher and “P” is used for participant in cases where citations are used.

5.3.1 The general view on usage of mobile applications

The majority of the participants had a positive view of the usage of mobile applications and that many applications were used in different situations for certain needs. Some participants used them on a daily basis for practical matters like buying bus tickets with the AtB application, or using a map application like Mazemap to find their way around

campus. In addition, the participants found the applications as something that could provide a supplement for things you need to find out. One of the participants stated the following:

> *P4: I use different apps the whole time, therefore I would say I am kind of addicted of them. An efficient method, instead of searching on google or Internet explorer to reach desired content, you can use apps to get to desired content. Therefore, I am very happy using apps.*

Facebook, Snapchat, Instagram were common applications that many of the participants used every day. In a few cases, there were participants that admitted using these applications maybe too much, or they experienced that applications could distract them, as this participant stated:

> *P2: They are very useful. Like, I have a lot of them on my phone. I am using them on a daily basis. Like for example the AtB app with the mobile ticket, it is very useful, don't need the bus ticket and things. Like, facebook, snapchat, Instagram, using them every day, maybe too much […]*

There was one participant that had a conflicted view about applications in general, as the view was that mobile applications provide good options in a lot of different fields, but that it was seen as a kind of subtle distraction. The participant stated the following:

> *P3: […] I think there is too much mobile use, I think people have their noses too much in phones. That does not mean that I do not want to see more apps used, but I want to see a different type of culture around the use of apps in general.*

5.3.2 General view about applications used for educational purposes

As for applications used for educational purposes, the majority of participants have had little experience with them. There were several applications such as Dropbox, Google Drive, Google Mail, and Google Document which the participants mentioned often. These were considered as popular and were mainly used in context of the participants' study for file management, sharing files and backup purposes. Many of the participants viewed these apps as an efficient way of cooperation when they were working at the same location. As one of the participants states it:

P4: […]it would make you get easier access to your desired content, for example, I have my google mail as an app which makes it much simple and easy to use.

There was one thing the majority of the participants had in common that while they had not tried many mobile learning applications, many had tried the Kahoot application. The participants mentioned that they only had positive experience with it, as the application was used for both social and learning contexts.

5.3.3 Comparison on mobile devices integrated into lectures and not

Participants found the lectures more attractive and more fun when mobile devices were integrated into lectures. Some participants found the application offering a lot of opportunities for people to stay in touch when collaborating, and it was a lot easier to access the course materials. Other participants found them distracting as we lose a sense of communication with other students and teachers. One participant had several opinions on this matter:

P3: […] I think again, that we lose a sense of community around it (the learning environment) because we do not need to be face to face with the teacher anymore, you do not need to see your classmates anymore, you do not have to do any of this communal work that used to be part of education. And I think that has a detrimental social effect. I think the use of too many apps and the way they change it, make it more, I mean sure some more great stuff like customization, personalization but also some real negative things with the social distance, the new social dimension, it is more chat based.

5.3.4 Circumstances mobile devices were used for educational purposes

The participants were asked in what circumstances they used mobile devices for educational purposes and the responses were to some extent diverse. Many participants answered that they used applications during their projects or other types of group work. A participant described this very well with the following:

P2: Especially Dropbox, you can use it for […] saving documents and editing the same document with different users. So you can kind of save it

and edit it from another person's computer. I think it is like, kind of efficient way of cooperation when you are in the same room. It can be very efficient.

One participant stated that he used podcasts as a source for learning which was mostly useful for a couple of history classes, but none of the technology classes. He mentioned Duolingo and Lingo Bee as other applications that were used in the context of learning, which helped for learning a new language. Similarly, another participant stated that he used an application to learn some Japanese on the go.

In the circumstance of finding a location, a participant shared that she used the Mazemap application as she found it helpful when you occasionally got lost trying to find a room at NTNU. Many of the Google applications such as Google Documents, Google Drive, and Google Mail were mentioned as having been used in various circumstances due to their convenient way of sharing files stored in a cloud service. In contrast to Google Drive, Dropbox application was mentioned several times as it offers a similar cloud service. Some participants mentioned Youtube as resource in context of informal learning such as group work or similar. Kahoot was mentioned several times as it was used during lectures as a quiz game to learn the curriculum, but to also measure the students' knowledge in the end of the lectures, and checking to what extent the students understood the curriculum. The participants found this particular approach with the quiz game to be fun as well as a good integration into the learning experience. The application was mentioned to be used in circumstances where students studied by themselves.

5.3.5 Experience of using applications in the learning environment

The experience of using applications in the learning environment were generally positive. In short, students were participating more and sharing information with each other. A participant discusses this topic very well:

P4: I have had only positive experience using these apps, but this is maybe because I have used very few of these apps that exist. […] because it (Google Documents) is very nice and easy method of sharing information. […] you can give access to those who you would like to have access and you can deny those you do not want to have access. You can add things that you think is relevant and others can add things they think is relevant. […]

A participant stated that using mobile application in the learning environment could provide supplements of things you need to find out. Another participant pointed out that he

overall had a positive experience with mobile applications, but that the applications have not been as effective as they could have been. One participant mentioned that applications should not be the main source of learning itself but rather a supplement or a tool to assist learning. Kahoot, yet again, was the application mentioned the most in context of a positive experience in formal settings, as it was mentioned that it increases the participation in lectures and engaging students (in the curriculum), as this participant describes it:

> *P7: […] it(Kahoot) kind of works because it sorts of gamifies the classroom in a way. It is something you kind of want to pay attention to, maybe even if the material is boring or dry or something. It does not work with everything, but when it works it works quite well, in my opinion.*

Negative aspects were also shared by some of the participants. It was mentioned that applications could create distractions where one would easily get off topic or that one may not always find answer to more specific questions or requests. To quote one participant:

> *P5: […] it (applications in general) is also negative in terms of being oversimplified. If you want to find more specific answers or specific something. Then it is maybe not the right tool.*

5.3.6 Courses where mobile devices were used for educational purposes

What was interesting to discover amongst the responses was if there were any specific courses that mobile devices were used more often or not at all for educational purposes. The results showed that mobile devices were used in several courses such as engineering, mathematics, project management, psychology subjects, informatics, biology courses, report based courses, fitness courses, statistic courses, pedagogic courses, and Norwegian language courses.

5.3.7 How are courses with mobile devices different from courses not using mobile devices

This question showed that the majority of participants were more attracted to courses with mobile devices. As one participant describes it:

> *R: Tell me how that is different from a course not using mobile devices?*
> *P10: I would say it is much more fun to use apps in lectures. And you also learn much more.*
> *R: Why would you say that you learn more?*

P10: Because when you are in class and you know in the end that there is going to be a competition where you use the app. So you have to pay attention.

One participant had a positive experience with mobile devices in lectures and commented that *"It is more like the lecturer just stands and shares information. Maybe not that easy for everybody to participate"* (Participant 1, 2016). Similarly, some participants stated that mobile devices made the curriculum more fun in addition that it is easy for everyone to participate. A possible negative impact, noted by some of the participants, was the possibility of overreliance causing laziness. One participant stated that, where in the past the student would be expected to actively 'going out looking for' class materials, today's students would expect to 'get it sent to our email account' or get a notification.

Searching in books may take time and in some cases you might not end up finding your answer or even understanding the answer. There were shared opinions towards how mobile devices in classes were a positive element due to enabling you to quickly search for words or content you do not understand during the lectures. A participant had the view that mobile devices do not improve the learning, but is rather more of a fun sidetrack such as a game. He described the following:

P5: […]it (mobile devices in courses) is positive, a fun contribution to learning but it does not improve the learning. It is more of making it more interesting […] or a lots of curriculum, you sort of make a pause or make it interesting.

One participant mentioned that there were organized competitions in some of the subjects, which made it easy to pay more attention and try to be more prepared for the subject. In cases where there was a prize in the competition, made the participant pay even more attention. It can be concluded that there were a variety of unique views were some contributed either in a positive, negative or neutral view on the topic. It shows, however, that the participants had different opinions or needs on what they think was best for them during lectures.

Results of testing the NTNU mPLE application in the context of educational purposes

5.3.8 Educational activities done during testing of the application

Due to many of the participant being in last year of their bachelor or master degree prohibited them from testing the application in all the intended circumstances like projects,

lectures, or even interactions with other students. Consequently, many of the participants spent the time mostly alone as described by this participant:

> *P4: It has been a little inconvenient to use your app since I had to write my bachelor thesis. It has been like this for my other apps as well. Therefore, I have not used the app in any other occasions than alone.*

Of those participants that had one or more subjects, some replied that they had experienced using the application at school, in breaks, during projects and other types of group work. Some participants provided a detailed description of what they tested the application for in various situations. For instance, it was described that the application was used for searching for contact information such as opening hours to the library and cafés, used for organizing oneself with the To-Do list by keeping track of tasks that needed to be done, reading about other courses or just accessing them, finding a room at campus with Mazemap, using the Kahoot shortcut, booking a room on the room reservation shortcut, and otherwise using the application as a shortcut to other desired content and services.

5.3.9 Interactions with other students about the application

Another question asked if the participants had any interactions with other students about NTNU mPLE. The majority of participants, 8 out of 10, did not have any interactions with other students while testing the application, due to being in last year of their masters or bachelors which consequently implies that they were mostly studying alone. Those who did have some interactions described it as very positive experience:

> *P2: I talked to one, he had apple, he thought it was a good idea. He hopes you will build for Apple as well. Because he liked the idea. […]and he spoke to some of his friends to find out that they had Android. But it seems like they were interested as well.*

> *P10: […] When I showed them the app. They were like "oh nice, I loved the concept of the app".*

The two participants with interactions were further questioned if they had more details on what the interacted person liked or what activity he or she would have used it for. Only participant 10 had additional comments on the topic:

P10: They said that they would probably use the Kahoot, To-Do list and that all the most important tools are gathered in one app. Because it is so much easier than the NTNU webpage. […] So everyone said that this is the kind of app they need to get through their education on NTNU.

5.3.10 Possible impact of the application on other students

After using the application for a period of two weeks, the participants were questioned if there were any impacts or changes they thought would affect other students if they were to start using it. Many of the participants replied that NTNU mPLE would especially benefit the new students or even exchange students. This was well described by the following participant:

P5: I think it is more accessible, especially for the younger students and the new students as well. Exchange students as well. So anyone who is new to the place and the university or even younger and do not know too much. Then it is very useful. I think it would take less time to get information. They will know more about what is there. If you do not know something exists, you cannot really go there or get any information from it.

Other impacts mentioned were that the NTNU mPLE would be a huge timesaver as it was easy to use and all the important information and services were in one place. Some participants thought the application would impact any other students in context of educational purposes, as described by this participant:

P6: I do not think it (NTNU mPLE) would change people's studying patterns or something. […] People would probably use it differently, of course, but I do not think it has a direct impact on studying, enhancement or routines.

Similarly, negative effects and concerns were mentioned. For instance, students could get dependent on NTNU mPLE and therefore "forget on how to perform certain tasks" in an analog matter, as this participant describes it:

P7: They might become dependent on it in a way. If they use it, they will be used to use it that way and then depend on it being that way. So they might even forget how to do it without the app.

A positive aspect was shared as well; a participant replied that the most positive impact of the application was as following:

> *P9: I think it (the NTNU mPLE) will have a quite significant impact actually. Because the information is right there and it is fast. When you are a new student, you do not know what to look for, that is one thing. I mean, you do not know what to search for. In that app, it is already listed. […] A lot of people are shy and do not want to ask people for help. So when you are stressed out and you need that information, it is right there. […] Because when you are stressed, I remember when I was, it was difficult to find this information. It was scattered all around the place because you are not structured.*

5.3.11 Frequency of use

The participants were asked on the frequency of use and the result was overwhelmingly positive as the majority found the application useful and thus thought they would use it approximately once a week if they would continue to study. Several participants replied that they would have used the application very highly in the start of the semester and similarly in the end of the semester, and would have used the application less in between. A good example was described by this participant:

> *P7: I think to me it (NTNU mPLE) would be more irrational use. I would not use every day, I would use it a lot more in the start of the year and less in the middle and then a little bit more at the end in a way. That is sort of when you need the correct information and in the middle you are just focusing on the course.*

5.3.12 What the participants liked about the application

All of the participants liked the application in general although some shared more positive experiences than others, but the outcome was definitely positive. To give an example of a response:

> *P4: What I like is that you kind of get a package with all the most important functions are to find in one app (NTNU mPLE). It is very easy to use, especially since I am not a really technical person, […] The app has a very good overview that is clear[…]. I liked that you had a possibility to add*

notes and not just functions you have to use in school related situations. […] I just think it is really great. It goes smoothly and fast and does what it is supposed to do, at least for me.

What was common amongst the participants, as also mentioned in the citation above, was key sentences such as: very easy to use, had a good overview, easy access to important information and services, and the content was categorized good.

A particular category of the application that was found popular by several of the participants, was the To-Do list, it was described as a good functionality for the startup of the semester as it provided what you had to do and that one could write up personal tasks. The ability to cross off completed tasks was described as good way of keeping track of one's progress, as well as providing a good overview of what tasks were incomplete. Another service that was valued, was the Mazemap service, where the students used it to navigate themselves around campus. A few participants commented that it is important to keep everyone up to date with information and that the application would be a good place to centralize all the important information. As one participant said *"Sometimes you do not know what you are supposed to look for" (Participant 3, 2016)*.

5.3.13 What the participants did not like about the application

There was very little about the application that the participants did not like. There were mostly some minor content or functionality missing. For instance, there was a lack of support for the previous HiST content pages, lack of direct links to ItsLearning (learning system used at NTNU) and Studentweb (student service for administration of student's study program), and the major issue was the missing functionality of having the ability to zoom on the content, which was missing in two particular places in the application. The participants were not able to zoom in on the desired information on certain webpages containing previous HiST courses. Other than that, there were some participants having minor issues as following:

P6: I disliked that I have to enter my username and password every time I use Innsida and Room Reservation. That is the biggest issue for me with this app (NTNU mPLE). […] I think it could have more links like to the library and to ItsLearning and the student mail. I think that is the main concerns I have.

Similarly, there was a participant that did not like that the To-Do list was too simple. According to the participant, an alarm function should be implemented where deadlines can

be added for certain tasks. In addition, some of the participants missed a forum functionality. Another participant replied that he was a bit confused about some of the icons that were used in one of the categories, but that was considered as a minor problem. Another participant had concerns about the application not being enough exciting and she described the following:

> *P4: I think that the app was a bit shallow, the app could be more exciting. But I do not know how to make it more exciting. I am girl, so maybe the To-do list could have had a possibility to pick colors. That would have been very fun.*

An interesting aspect was that all the women who participated, like participant 4's citation above, commented on color choices or had some comments on colors, and two women had a common idea about the To-Do list having the possibility of choosing colors on the different elements such as tasks or what gender you are. For example, if you are a girl make it pink, if you are a boy make it blue. It was concluded that there were several participants that shared the common opinion that, even though there were a small amount of hitches, there were not many negative opinions about the NTNU mPLE application.

5.3.14 Impact the application had on the participants

Perhaps what was one of the main curiosities with the application was if it had made some kind of impact or change to the participants in terms of routines or the way they access the information in their everyday academic life. For some no impact, and more or less for others as it was pointed out again that many of the participants did not have any lectures and therefore the application was not fully exploited to its potential. Even though the participants that did not attend lectures, they imagined what it would be like if they had lectures or if they had started all over again as a new student. Another student shared some positive thoughts about the application being used if he was a new student:

> *P3: […]as a student at my level, no impact. As a first year student, a wealth of information. […] I think it would be a god's gift for a totally new*

The impact that was mentioned, was pointed out to be in the context of the start of each semester, when new courses had to be selected or attended and one would have to read information about them. The participants that had been at the university for some years, the experienced students, found themselves with many unanswered questions when they started to study at NTNU and that this application helped them answer many of the questions that were

raised at that time. Especially when as a new student, one may not even know what information was important or what to look for. Several participants had the common thought that the application would have had considerably more impact on new students, as it was considered a good kick-starter for the studying life in the city of Trondheim. The following participant described this very well:

> *P9: If I was a freshman, then this app (NTNU mPLE) would be applicable for me. Because then I would not have to worry that much. Because I worry easily. So this would be a big help to get the information I need without having to go through a lot of hoots.*

Another participant replied that the only impact of the application was the following:

> *P6: Well the main argument is that it (NTNU mPLE) is saving my time. It I has not changed the way I study or when I have to look up stuff or etc. It has just saved me time when I do it*

One participant had a particularly strong opinion towards the To-Do list, as he described the following:

> *P8:[…] I think that the To-Do list is something that I would use a lot. It would make me more structured, I guess. So I know how much work I have to do that week or important meetings or something like that.*

As a conclusion, it can be said that the participants generally had positive comments on this question. There were some minor impacts for some and none for others, which was expected due to everyone having different routines and needs in their academic life. As a good example of how the application can impact students, the following participant stated a very genuine positive view:

> *P5: […] it (NTNU mPLE) has a high degree of importance despite the frequency, because it contains information that I need and that I frequently use and it is in an accessible way. So it would impact my studies in terms of, or my everyday life, that I would actually use it.*

5.3.15 If the participants would recommend the application, what would be shared

On next question, the participants were asked if they would recommend the application to other students, and if that was the case, what would they share to the other student. The outcome showed that there was a large variety in responses, which may be due to the application being helpful in different manners for each of the individuals, as for example:

> *P2: I would tell them about the pros (about the NTNU mPLE), tell them that there is an easy way to find the answers to general questions and just get them to try it out. They might have more use for it than they think.*

It can also be pointed out that all participants found the application useful in some way or another and therefore would recommend the application to others as this participant describes it:

> *P5: I would say that it has something for everyone, so if you do not use all the parts of it, you would still find it useful I think. And it is better using than the Internet or other devices.*

Some of the participants had more focus on how easy it was using the application and what information was collected within it. These participants share their thoughts on what they thought of the application:

> *P6: I would tell them this is a brilliant tool which collects a lot of the stuff you need as a student. It has links to the most essential parts of NTNU's user basis. And yes, I think it is convenient and easy to use.*

> *P7: If I would recommend the app, I would do that based on the app aggregates the information, collects it. […] it is useful because it contains the information and that is what you mostly need on the go. Like for example, when can I eat.*

There was a participant that provided good examples on how to use the application efficiently with its various functions to access desired information and for what circumstances it was good to have it:

P8: […] I would recommend them the To-Do list, I would recommend the links and the Course Help, the Contact information to the various…. like Akademika and SiT and stuff like that…When is this open and when is it closed? …. And like Mazemap […] it (NTNU mPLE) is a timesaver and it can make you more structured. It can give you more time to focus on what is important.

This application's goal was to make NTNU students' academic life easier by providing and collecting the most important information and services in one place and, to make it available on the go. The following two participants described the essence of all the participants' final thoughts about the application very well:

P9: This app has all the information you need. Almost all the information you need. All the basic the basic stuff you need to find, you get it. And you should use it. It is valuable.

P10: If you love yourself, download the app. It makes your life easier. […] Just study the app and you will see that all the tools you need is there.

5.3.16 Future usage of the applications

As the final main question, the participants were asked about the possibility of using the application in the future. Several participants thought of the application as a practical tool that would be used more in the future, especially by new students. For those who were to continue to study, were very positive towards using the application again, as these participants stated it:

P5: I would use it more; one, because I would study more so it would be more relevant for my everyday life. And, two, because I know about it and I know that it is there and it is accessible. And I could imagine tending to reaching for the cellphone and the app, rather than going the extra effort to do it online or somewhere else.

P8: If I would study, I would definitely use it more. Because it is something I wish that I had when I first started out at NTNU.

Some replied that they would definitely use it more if the application gets some of the minor issues fixed, as following:

> *P6: I think if the app gets more refined, I would use it more. As it is right now, I would use it the same amount that I am already using it. […] And if you would have added a few more fine tunings, I would use it for other things as well.*

> *P10: I would absolutely use it more. Especially if you develop a more complex To-Do list and implement a nice ItsLearning button.*

Another matter that was brought to attention, was that as the NTNU students gain more experience over the years the application would be needed less and less, and this opinion was confirmed from several of the experienced participants. Regardless if they had much experience, they mentioned the following:

> *P7: If I was still studying, I would probably use it less and less because I would need less and less information. But it would be sort of like easier to use it because I already know what is there and what is not, unless it updates and changes it all the time.*

5.3.17 Comments on elements that have not been covered

In the end, the participants were asked if there was anything that was not covered in the interview, and the majority answered no to this question as they commented that the questions had covered the most important aspects of the application. To give an example:

> *P10: I do believe that you have covered all the important aspects of the app (NTNU mPLE). It is a great app.*

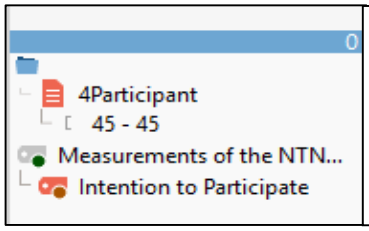
Those who answered yes, complimented the application and shared some final thoughts. Most of the responses were how to improve the application for future use, as the following participant described it:

> *P5: I find it a finished product (NTNU mPLE), and it is good, but it needs couple of version 2.0, 2.5. […] It is like a high standard for a first app. And I think that it would be smart of the university to incorporate into its information base, to reach more of its students in different ways.*

5.4 MAXQDA results of the Semi-Structured interviews

5.4.1 Intention to participate

All the participants that tested the NTNU mPLE, indicated that they would have wanted to participate in similar applications in the future. Many of the participants stated that using these mobile learning applications depended on the circumstances and study year. As stated before, several of the participants were in the last semester of their study, and the participants specified that if they were to study again, they would definitely have used a mobile learning application again. A participant stated that being introduced to the NTNU mPLE in a such an easy way, was more applicable to use mobile learning applications in the everyday academic life, as shown in Figure 5.7. The participants who did not use any kind of mobile learning application previously stated that they enjoyed using the application, which points towards an intention to participate in such applications in the future. Some even commented that they wished that they had the opportunity of having NTNU mPLE when they started studying at NTNU.



But now since I have been introduced to this app in a so easy way, then it is more applicable for me to use apps for my everyday academic life.

Figure 5.7: MAXQDA example of intention to participate

5.4.2 Enjoyment

The enjoyment measurement could similarly be compared with the high intention to participate, 8 out of 10 participants found the application very enjoying. Some of the main points why it was enjoying, was that the application was found very simple and clean in terms of representing the content, and therefore very attractive. One participant commented that it was really fun to cross tasks that were done and watch them be crossed off, as shown in Figure 5.8. There were a few more services that benefited the participants such as the To-Do list, which was considered popular amongst the participants as it was possible to add own tasks such as homework and class assignments that was to be delivered.

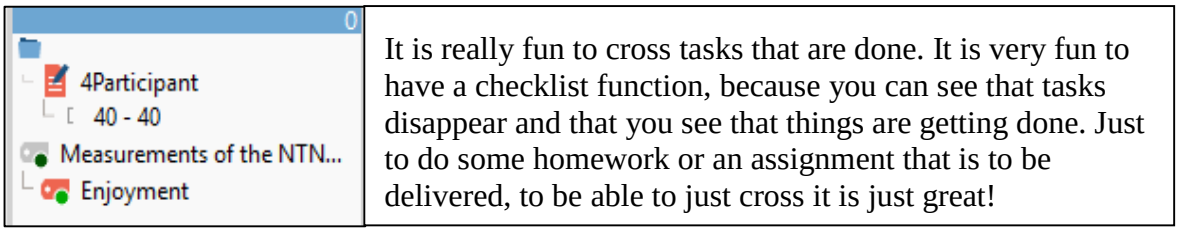


Figure 5.8: MAXQDA example of enjoyment

5.4.3 Satisfaction

The participants felt positively about using NTNU mPLE, where 9 out of 10 participants had strong comments of satisfaction about the application, the services, and the functionality. Yet again the To-Do list, as shown in Figure 5.9, was favored amongst others services such as room reservation, contact list, and course help. Other participants were very satisfied how the layout, colors, items, and menus where displayed and organized. One thing that was noteworthy was that women viewed the application in another manner than men, the women commented on use and change of color, while most of the men commented on responsiveness and performance.

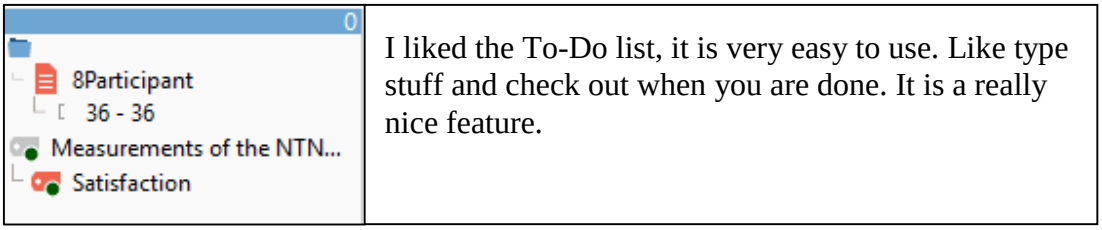


Figure 5.9: MAXQDA example of satisfaction

5.4.4 Performance Expectation

One of NTNU mPLE's goals were to design it to contain important information and services as well as being useful, fast, responsive and accessible. Based on the results of the performance expectation, 8 out of 10 participants indicated that this was the case. Figure 5.10 shows a MAXQDA example of the performance expectation. Several of the participants pointed out that the access to the information in sections Links, Contact and Course help were faster through the application than using a regular computer. In the case where the participants had to use a regular computer in order to reach some basic contact information, they would have had to links their way through quite some clicks, in comparison to the NTNU mPLE which reduces the amount of clicks.

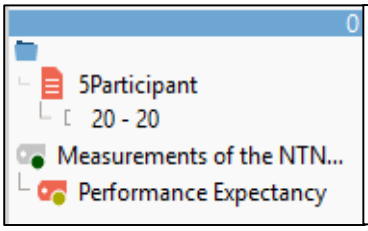
	So I really found it useful with the links. The linking to Mazemap was really useful for me, because it is such an important part of my everyday life finding my way. And it was very convenient and accessible on the app.

Figure 5.10: MAXQDA example of performance expectancy

5.4.5 Effort Expectancy

10 out of 10 participants commonly pointed out one or more comments about effort expectancy, and one word that was repeated from all participants was the word ‘easy’. This keyword was used to describe how the participants used the application to find information, gain access to the different frequently used services used at NTNU, browse through the different content, and generally to use it. The participants pointed out that the application made it very easy for the them to use it in various settings as described by two participants in Figure 5.11.

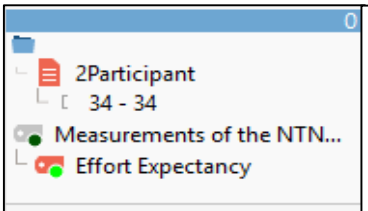
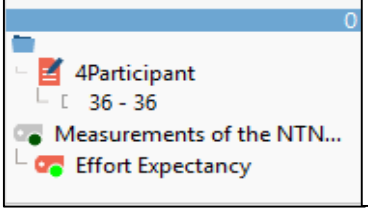
	I think it was easy to navigate and find the functions that you were looking for. It was easy overview and a very simple and nice design.
	It is very easy to use, especially since I am not a really technical person, I did not have any problems and that is very good.

Figure 5.11: MAXQDA example of effort expectancy

5.5 Result of the integrated feedback functionality within the application

In order to get more in-depth data about what the participants experienced using the application, a feedback system was implemented within the application as described in section 3.5.7. The system collected feedback from the 4 sections of the application and the result of each of the sections are presented in the following sections.

5.5.1 Result of Course Help section

The Course Help section, as described in more detail in section 3.5.3, was where the participants could search for all the courses and all the distributed courses' information for NTNU. The participants were supposed to use this section to gain important information about the various courses or just to browse. The results, shown in Figure 5.12, found that the participants felt that this section was very satisfactory with the average score of 4.36 out of 5 points. There were only two participants who scored below 4 points and out of the two, one scored below average. It is concluded that this section's positive score was seen as a success as the participants' satisfaction was high.

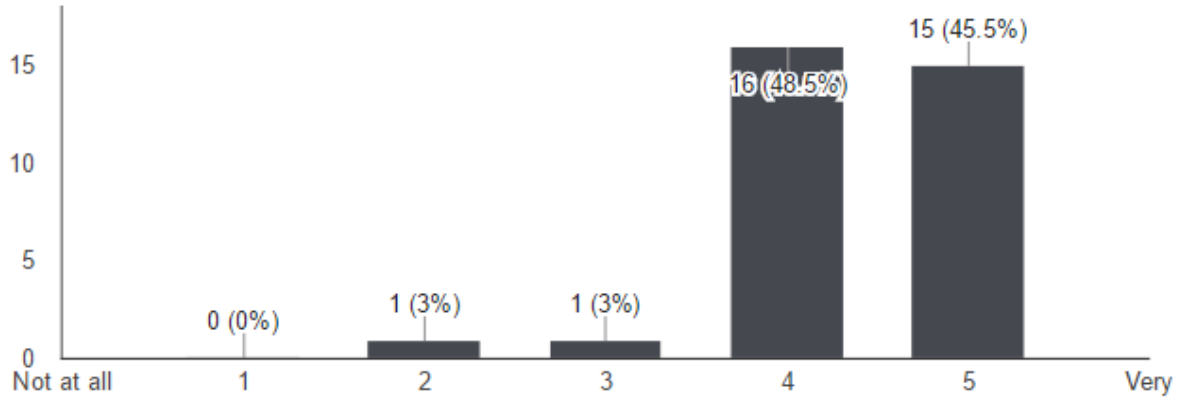


Figure 5.12: Result of Course Help satisfaction

5.5.2 Result of Contact section

The contact section, as presented in section 3.5.4, was developed with the purpose of providing students with the most important contact information about the common services used at NTNU, similar to a phonebook. The feedback that was collected was highly positive. As shown in Figure 5.13, all the participants scored above average on this section, and the final result ended in an average score of 4.4 out of 5 points. This was a great accomplishment as it showed that all participants considered this a satisfactory section.

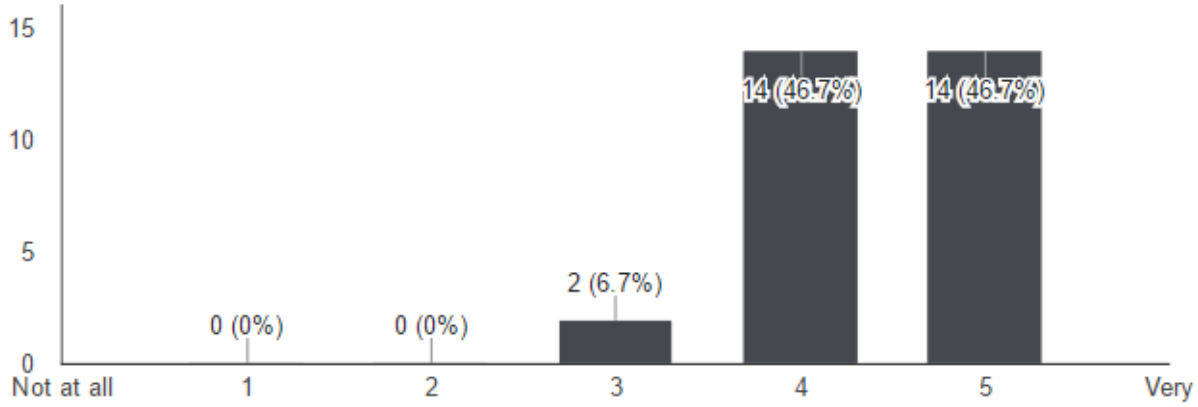


Figure 5.13: Result of Contact satisfaction

5.5.3 Result of To-Do list section

To-Do list section provided a general reminder list about what tasks the student had to complete in order to get admission to start his or her semester, which is explained in more detail in section 3.5.5.

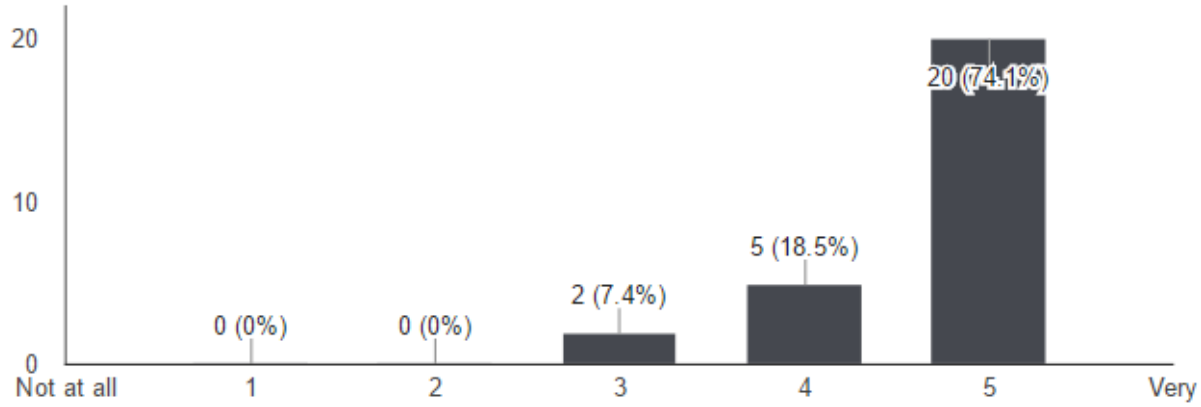


Figure 5.14: Result of To-Do list satisfaction

The result of this section, as illustrated in Figure 5.14, indicated a higher score than the two previous sections' results with the average score of 4.66 out of 5 points. All participants scored above the scale's average score, whereas the majority of the respondents gave maximum points in this section. The score shows a high satisfaction amongst the participants, thus it is concluded that this section was a success.

5.5.4 Result of Links section

The Links section, as previously presented in section 3.5.6, was where all the most important links were stored, or in other words shortcuts, that NTNU students used on a day to day basis. The average score of this section resulted in 4.71 out of 5 points which was the highest amongst all the section, as illustrated in Figure 5.15. Yet again, all the participants scored above the scale's average and the majority gave the maximum score. It is concluded that the participants found this section the most satisfactory, but only to some extent as the score was marginally better than the To-Do list's score.

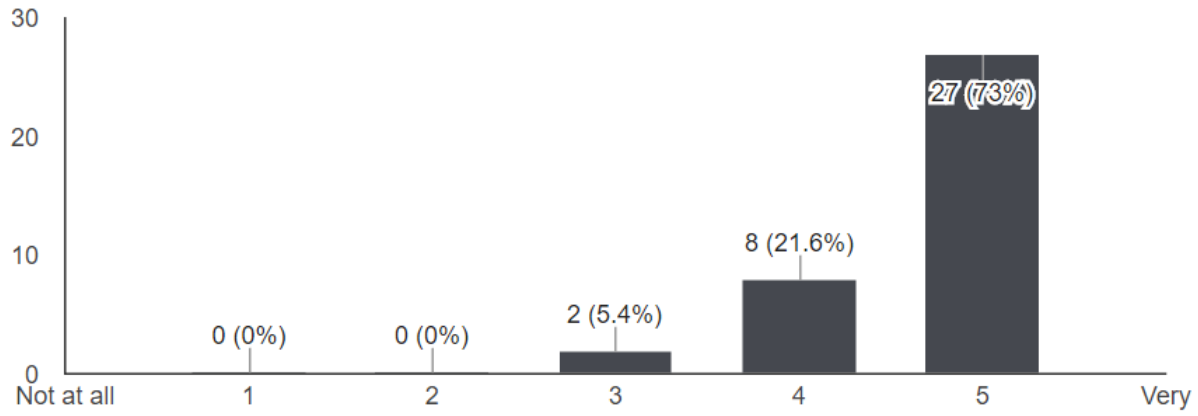


Figure 5.15: Result of Links satisfaction

5.6 Results of the System Usability Scale questionnaire

5.6.1 Introduction to the System Usability Scale

The System Usability Scale (SUS) is a simple ten-item scale giving a global view of subjective assessment of usability[55]. The scale is the most used questionnaire for measuring perceptions of usability, and the SUS is viewed upon as a Likert scale where the participant is given questions where he or she has to grade to what extent they agree on the stated question[55]. A Likert scale comes in two scales, 5 and 7-point scale, where the 5-point is from 1 to 5 and the 7-point is from 1 to 7. As for the SUS schema, the 5-point scale is frequently used, an illustration of the System Usability Scale is shown in Figure 5.16.

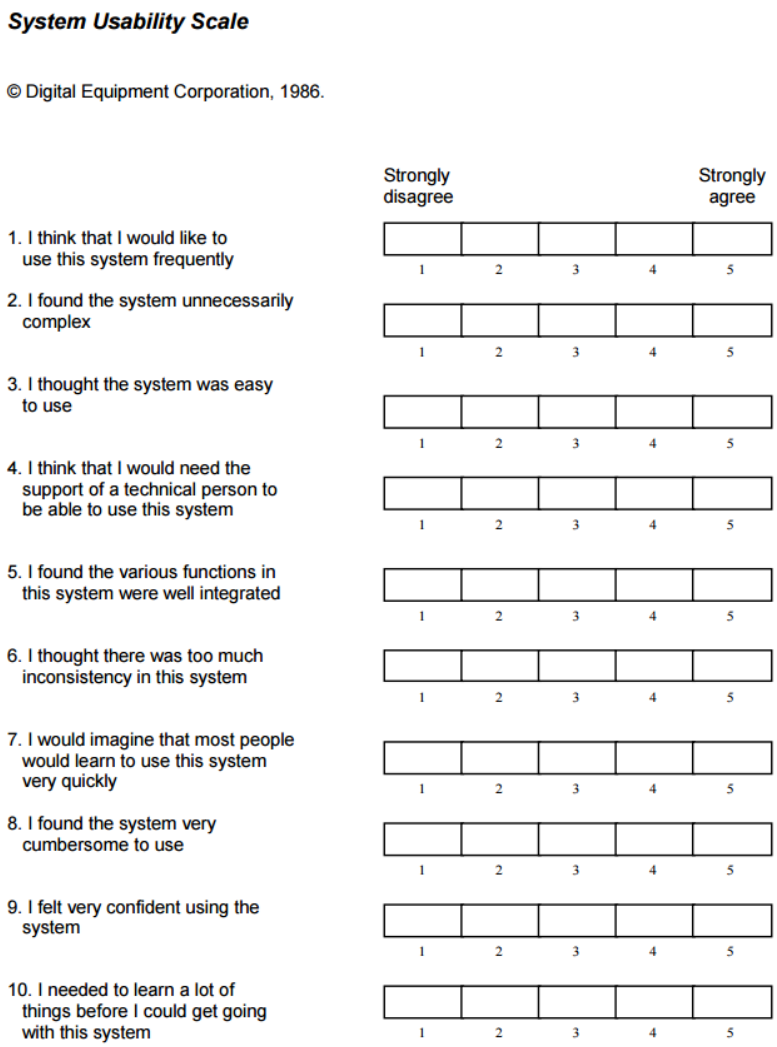


Figure 5.16: Illustration of the System Usability Scale

5.6.2 Using SUS

As the participant has used and evaluated a particular system, or in this case an application, the participant is given the SUS schema. The SUS is given right after the testing of the system is done with the intention of keeping the system fresh in mind. This is done before any dialog or questioning takes place and the participant is supposed to answer the questions without doing much thinking[55]. If there are any questions the participant cannot answer or does not know what to answer, then the question should be rated with the middle score of the scale which is 3 points[55].

5.6.3 Scoring of SUS

Scoring SUS schemas based on other research studies can be difficult to interpret and there is very little guidance about the score[56, 57]. It should be noted that every single item is not significant on their own[55]. To determine the SUS score, every question score in the SUS schema is converted to a new number, then added together and lastly multiplied[56-58]. The calculation in detail, first are the score contributions from each of the questions summed. For the questions 1,3,5,7 and 9 the score is subtracted with 1, while the remaining scores are 5 minus the score. This will ensure that all questions give a score between 0 to 4. The summed score is then multiplied with 2.5 to achieve the final SUS score[55, 56], and the multiplying is done to change the score from 0-40 to 0-100. This score has often been misunderstood as it has been viewed upon as a score of percentage[56, 57]. If you have 60 out of 100 then it is correct that the achieved score is actually 60%, however, this is misleading. If the scores are to be measured in percentage, then the average percentage score is considered 50%, which would be incorrect in terms of scoring of the SUS schema[56]. The average SUS score is 68, which means that a score close to 70% would be more accurate to consider as an average score of 50%[56].

5.6.4 SUS score results

As Brooke describes it; *"SUS has proved to be a valuable evaluation tool, being robust and reliable"* (John Brooke, 1996: p 194)[55]. In the start of this study, one of the goals regarding the design of the mobile application was accomplishing a high level of usability where students could access desired information and services. The SUS score of the mobile application was calculated from Table 5.2 and it resulted in a score of 88.4, which is a great achievement. If this SUS score was compared to industry standards the following was

stated *"You would need to score above an 80.3 to get an A"* (Jeff Sauro, 2011, September 6)[56]. It can be concluded that a high level of usability was achieved in this application.

	SUS question	Average score per question
1	I think I would like to use this application frequently.	2.23
2	I found this application unnecessarily complex.	3.77
3	I thought this application was easy to use.	3.80
4	I think that I would need assistance to be able to use this application.	4.00
5	I found the various functions in this application were well integrated.	3.03
6	I thought there was too much inconsistency in this application.	3.40
7	I would imagine that most people would learn to use this application very quickly.	3.76
8	I found this application very cumbersome/awkward/difficult to use.	3.87
9	I felt very confident using this application	3.60
10	I need to learn a lot of things before I could get going with this application.	3.90

Table 5.2: Average score per SUS question

Chapter 6

Discussion

In this chapter, the results from the tested mobile application will be discussed. The chapter is divided into the following three sections: 6.1 Expectations, 6.2 Enhanced motivation, and 6.3 Criticism of the research.

6.1 Expectations

My expectation of this study was that I would increase my knowledge and understanding of NTNU and other students' needs through literature reviews. In order to meet students' needs, it was thought that through a literature review and by conducting a survey with questionnaires would give an idea of how to adapt and design the mobile application. Based on research from the literature review and questionnaires, I expected to create a design of the mobile application with a list of proposed services which would meet students' needs. I did not expect to cover everybody's needs, which may not even be possible, but rather I wanted to provide the most important services to meet the most important needs of the students. There is no recipe for how to create the "perfect" mobile learning application, but I believe that it was possible to try and work towards perfection.

The feedback from the interview provided my research with a lot of insight into how students use mobile apps for educational purpose. I also expected to discover what kinds of activities were important and what kind of impact the application would have for the student's academic life.

As for the services, they were expected to be modified to the design or usability of the application. For instance, from the small details like changing font size, color and type, or to be able to add new services that had emerged as a need for the students. I did not expect, however, to be able to provide 'all' services that every student asked for, since that would have made the application unintentionally overcrowded. I believed that there would always be some type of complaint related to the services and the design, which was also the case here. I expected and hoped, that the application would help to uncover the "hidden", important content within the webpages and that are located in NTNU's databases and make the

information more available and intuitive for students. I can conclude that the NTNU mPLE helped the students to acquire the desired information.

6.2 Enhanced motivation

García-Peñalvo et al. (2011) states that eLearning needs to evolve, and that the focus must be more on the student. Concerns were that if the student was not centered in the process of eLearning, and if emerging technological and sociological trends were forgotten, any eLearning activity would fail[20]. In this thesis, the student was centered throughout the design process and development process, and when the application was tested with the post-testing questionnaires and interviews, there were several constructs that were measured which was thought to have an effect on the participants. Intention to participate, enjoyment, satisfaction, performance expectancy, and effort expectancy were the constructs measured and each of them provided valuable information about the application's success. It can be said that all the questions related to the measurement of intention to participate showed a consistency amongst the participants who replied.

The application scored high marks in the constructs enjoyment, satisfaction, effort expectancy, and learning purpose, which shows that the students were pleased with the it and the positive scores show the success of this application. The effort expectancy construct results distinguished themselves from rest of the questions, as the score of the three questions scored the highest midst all the constructs. The question of if the application was clear and understandable gave the highest score from all the questions. It was concluded that due to the high scoring of this construct, that the participants found that attending the application was to a great extent easy for them. The application also scored above average in intention to participate in similar applications in the future and performance expectancy. All the constructs indicated in the end a positive result of thoughts about the tested application which was viewed as a good motivation, since it indicates that there was a need for mobile learning applications that could help students.

Garcia-Penalvo conducted a similar study, just done with another researcher named Conde, where they presented a service-based framework as an Android mPLE and tested it with students of the University of Salamanca[17]. They came to the following conclusion:

> It can be concluded that, from the students' perspective and in a controlled context, the opportunity to represent students' PLE on a mobile device that includes functionalities and/or information from the LMS, which could be

> combined with other tools they use to learn, encourages them to participate in the subjects and helps them to learn.
>
> Garcia-Penalvo and Conde, 2015, p 385 [17].

Garcia-Penalvo and Conde's study was used as an inspiration for this study to develop the mobile application and to test if a similar mobile application with customized services for the NTNU students could give comparable results. Both applications include functionalities and/or information from the LMS, but the NTNU mPLE application had additionally combined these functionalities with other tools NTNU students use. It could be said that both applications ended up with similar results. Garcia-Penalvo and Conde's application stated that the application encouraged participation and helped the students to learn, while results from this thesis showed that the participants found the application's functionality highly satisfactory, and the application itself as very helpful in terms of accessing services and desired content fast and easy.

Martin and Ertzberger's study discovered that mobile learning kept learners engaged, and that one was able to deliver learning that was authentic and informal via the mobile learning technologies[4]. The results of all the constructs of the post testing questionnaire showed that the participants had intentions to participate in similar applications in the future, they were satisfied with NTNU mPLE, they found NTNU mPLE as enjoyable which may indicate that the participants were kept engaged. There is, however, no direct questioning about the participant being engaged in either the questionnaires or the interviews, and therefore it cannot be completely confirmed.

In order to reach the end users and maximize their user experience, the design and development of the application had to be evaluated by the participants. Based on the results from the interviews, the post testing questionnaire, and SUS questionnaire, there was a positive user experience towards the application, especially the results of the effort expectancy, which confirmed that the application facilitated easier access to important and desired content for the students' academic life.

Social media has a strong hold on the younger generations and social media is trending towards integration in all parts of our daily lives such as work, school, and free time. In Sclater's study, he examines whether the LMS is destined to continue as the primary means of organizing the online learning experience for university students. He points out that the facilities in the LMS are more limited and it is evident that some students do not necessarily want their education to mix with their social environment[12]. While learners would continue

to use the environments they find most engaging and useful, institutions need to be careful that they do not lose the opportunity to track what students are doing[12]. The data collected for this thesis shows that some students find social media as a distraction in both formal and informal learning. There were, however, no direct questions to the participants about their opinions on combining or dividing the social environment and learning environment. There were, however, several participants commented that students use mobile applications excessively in learning environments, which might result in losing some sort of community around it such as not communicating as much to fellow students and teachers. Another participant commented that some lectures are not to be technologized with mobile applications, due to not being as practical, efficient, and may even be more distracting than helpful. Sclater mentions that LMS is more limited, which can be compared to what the participants answered on the interviews. Several of the participants mentioned negative experiences with the NTNU's webpage and sub webpages, as the webpages are not efficient enough to find desired and important information.

According to Mott's study, he finds as quoted:

> Teachers, students, and administrators feel stuck with the either-or choice between the LMS and the PLE. The future of technology in higher education will in large part be defined by how we strike a balance between the two. We need to embrace both the efficiencies of the LMS and the institutional network and the affordances of the PLE and the web.
>
> Jonathan Mott, 2010: p 7[14].

In context of what Mott's study finds, the applications that were developed in this thesis was defined of being a mobile PLE with including some of the LMS features. Results from the interviews, post testing questionnaire, and SUS questionnaire showed that the balance between LMS and PLE was found satisfactory due to all the positive responses from the participants. NTNU's LMS and institutional network has all the content with information and easy access that students need, but it was and is inefficient to find the information due to using many clicks. The NTNU mPLE application showed good affordances in design that were helpful and flexible in giving students more efficient access to the desired and important content through few clicks. Another study, by Ssekakubo et al. which investigates students' expectations for a mobile LMS[2], mentions also the topic of too many "clicks" with the following conclusion:

> The students prefer: to go through less "clicks" before they can be able to access the desired LMS information; that access of LMS through the mobile

> phones should be service-based, as opposed to course-based; that the mobile LMS application should be made as simple as possible and non-crowded, that is, fewer LMS services (the most needed/desired services) should be made accessible through mobile phones.
>
> Ssekakubo et al., 2014, p 99 [2]

As mentioned previously, the results from the tested the application accomplished the goal of reducing "clicks" for the participants. It can be said that this thesis' result confirms Ssekakubo et al's statement that students prefer few clicks. They also mention that access of LMS through the mobile phones should be service-based, which was discovered in the literature review and used as a foundation for the application that was implemented. They also state that a mobile LMS application should contain only the most important services and information needed, to not overcrowd the application. This insight was used as a basis and inspiration for designing the application to make the application easy to navigate, finding the services easy, and avoid having redundant services that will not likely be used. Their study also points out that one of the key factors of accomplishing a mobile interface for accessing LMS services, was to have students participate and include them during the process of design and developing[2]. During the implementation of the application, however, the services and functionality was tested out only amongst close friends, where most of them were still students at NTNU. This was due to two factors, first being, the application itself was not a large project and therefore most of the issues could be discovered from a minor amount of people; second, it would take some extra time to gather participants, organize the data collection, and analyze the data, which was not possible due to time limitations.

Harmelen's study reveals that it is worth bearing in mind metacognitive skills; the ability to formulate and direct one's own learning[18]. He also states that in order to reach PLEs full potentials it should support activities or have the ability to create learning goals and plan for how they are to be realized, which Harmelen believes is a central step in the direction of reaching PLEs full potential[18]. As the application was under development, it was believed that it would be a success if the students had an advanced the To-Do list where the they could create their own learning goals and a plan of how to achieve them. Due to time limitations, there was no time to create a proper service with the needed functionality. Instead, there was created a To-Do list where the student had the possibility to choose which school year he or she was participating in and add own tasks or goals. This created a very basic functionality which was received as one of the most positive aspects of the applications according to the participants. In comparison to what Harmelen stated, this To-Do list was not

reaching the PLEs full potential, but rather provided a fragment or a taste of what the PLE could do.

Ebner and Taraghi's study presents a PLE standard that can be used as basis for all PLE and e-Learning applications[15]. They point out that individuality, flexibility and personality are central elements that should promote teaching and learning[15]. They mention that environments that are enabling learners to select desired content based on their needs and interests, would be the initial stage to reach the central elements[15]. In correspondence to what Ebner and Taraghi mentions, this thesis has taken individuality and flexibility elements into account. Flexibility has been measured in the effort expectancy in the post testing questionnaire where the result was an above average score of viewing the application as flexible. As for individuality, there was an attempt to create the application more customizable to provide individuality, but due to time limits this goal was not achieved. Through interviews it was uncovered that especially women missed more individuality such as the functionality of picking own colors for the different categories of the application. They argued for having the possibility to be able to select colors to color code towards one's own desires and needs or that the application could ask the student the gender and then let the application select a color accordingly, for example blue for men and pink for women.

Similarly to what Ebner and Taraghi mentioned, Munoz-Organero et al. states that *"although learning institutions involved in formal learning courses might prefer the merits of a centrally controlled service-oriented LMS, time-constrained users might find PLEs and learner-generated contexts more flexible and adaptable to their needs."* (Munoz-Organero et al. 2010, p 64)[59]. This statement described exactly what the foundation the thesis's application was built upon, flexibility and adaption to the NTNU students' needs. The flexibility has been measured through the effort expectancy and interviews, which correspondingly showed a result of the participants rating the flexibility as very high. Both measurements point towards the application being a success both for the research and for the participants testing it, and hopefully will be distributed by NTNU as an option to future students.

Another topic that should be brought into the discussion is how technology affects current learning and working environments and how has mobile and ubiquitous learning affected students within and outside the classroom. Saadatmand and Kumpulainen's study investigate these topics and states the following:

> As long as learning and working environments are being transformed by a variety of emerging technologies, educational institutions are facing challenges

> in delivering their programs and courses. Technology brings new possibilities for learning, including changes in learning spaces and infrastructures, new ways of interaction and collaboration, and new demands for institutional regulations that adapt to better embrace these developments. Learning does not just take place inside the formal classroom with planned activities but, a growing interest towards mobile and ubiquitous learning and student-led activities outside the formal learning boundaries. This enhances learning experiences through exploration (by seeking and experiencing things in various contexts), interaction (through connection with peers and experts), and serendipity (searching for knowledge took place as by-product of the main task in unplanned and unexpected ways)
>
> Saadatmand and Kumpulainen, 2013, p 71

In correspondence to what Saadatmand and Kumpulainen points out, especially the part where mobile and ubiquitous learning are increasing outside the formal learning boundaries, the thesis creates the mobile learning application to give students options to do learning experiences through exploration and serendipity. Since the most important information and services are collected and placed under one mobile application, the student might gain experience or gain knowledge as a byproduct of browsing for something else within the application.

In the end, this discussion has given light on how a mobile learning application had been experienced and affected by the NTNU students. It can be concluded that the knowledge collected in this study has provided an enhanced motivation in comparison to the motivation of Chapter 1. Even for those who participated in the testing of the application may have improved their motivation on what they could have more use of in their academic life.

6.3 Criticism of the research

The data collected for this thesis was conducted in a carefully planned manner. How the plan was executed, however, could possibly have also had an impact on the outcome. The goal was to create an effective and accepted application for mobile learning in higher education. As the interview was conducted, I could adjust and add questions that would fit the situation. The type of questions that were asked was an important factor to consider, since this decided what data collection I ended up with. Open questions provide one with qualitative data that would help you understand the views of another person. In contrast, having closed question provided solid answers but would not give one a general view. The majority of the main questions in the interview were open questions were the participant could go into

details. As for the impulsive questions that came as a response to the reply of the main questions, they were often closed questions or were sometimes not clear enough. This might have affected several of the responses. It has to be mentioned that a lack of experience in interviewing others might also have affected me in not seizing important moments or topics that could lead to further details and other interesting topics related to the study. Reliability was also a concern when it came to finding people to interview. The interviewee might have been affected by the situation and surroundings and thus not being totally honest. Therefore, it was good to make a decent atmosphere at the interview, where the interviewee could take place in a relaxed atmosphere. There is no measurement that can be done to know if the participants were affected in any way during the interview. For making the results of this thesis representative, I got a variety of student backgrounds to interview to get as much quality information as possible.

Another topic that could be criticized was that the mobile application was only tested on the Android platform. In the period of second quarter of 2016, the worldwide smartphone operating system market share consisted of three major operating systems; Android (the majority with 87.6%), iOS (11.7%), Windows Phone (0.4%), and others (0.3%)[60]. In Norway, however, the case is different as iOS (50.79%) is more common than Android (46.34%), which was assumed to apply for NTNU students as well[61]. During the phase of collecting participants, there were a vast amount of participants that had iOS and therefore had to decline to participate on this research. Having two operating systems to test on would have gathered more data for the thesis and provided more participants to participate on the questionnaires and interviews.

As for the background of the participants, there were two first year students and no second year students participating in this research, which was a very low representation and should be a criticism of the thesis. Instead there were a vast amount of experienced participants which were in last year of their bachelor or master degree. Due to the schedule of the thesis, the execution of the testing of the application, interviews, and questionnaires had to be conducted in the spring semester, which was why it was not easy to locate new students. If this was to be amended, the data collection should have been done in the autumn semester when the majority of the new students start. The application was intended to be for new and veteran students, but especially new students due to not having any previous knowledge of what tools and information was important for them.

Chapter 7

Conclusion and future work

This study proposes that intention to use mobile learning applications, enjoyment, satisfaction, performance expectancy, effort expectancy and gender may be combined with each other to form multiple configurations. In order to examine its propositions a mobile learning application was created and tested with students, and by employing complexity theory and configuration theory a conceptual model was constructed that serve as the basis for identifying the aforementioned configurations. I employ fsQCA, a novel analysis approach, and provide complex patterns, on which conditions are present or absent, that explain students' behavior. The findings show how users with different perceptions towards the application may have either high or low/medium intentions to use it.

When female students are able to identify the usefulness of the application and if the application is able to increase their performance, then they will have high intention to use it, without being affected by their other perceptions. Male students who do find the application useful, will still have high intention to use it as long as they enjoy using or feel satisfied. It is also interesting to note that effort expectancy is never present or absent indicating that it is not important for the students how easy or hard the system was to be used. This may be explained by the fact that the majority of the students were experienced with using mobile phones and mobile applications.

The majority of the studies in the area of mobile learning employ regression based methods and focus on the net effects among the examined constructs. Only recently literature has started examining the asymmetric relations among variables, in different areas such as information systems[47, 63], business [49] and learning analytics [64]. The different variables may coexist and different combinations may lead to the same result. For example, a very useful application may not lead to high behavioral intention depending on how gender, enjoyment, and satisfaction combine with each other. The findings extend the mobile learning literature by showcasing the necessity of examining complex causal patterns as well as asymmetric relations of m-learning behavior antecedents. FsQCA identifies combinations among variables, thus it is not able to quantify the effect of each variable independently on the outcome.

This study began with three research questions. To answer these, a thorough literature review was performed and subsequently utilized as a foundation for the development of an application in mobile learning. After completion of the mobile application, a testing phase was conducted with 30 participants in two major questionnaires regarding the experience and usability of the application. After this, 10 of the 30 participants were then selected to participate in a semi-structured interview. Finally, the result of this data collection was assembled and examined in order to provide answers to the initial research questions. This chapter concludes the findings.

7.1 Various options of mobile learning applications

In response to RQ1, the interviews provided data in order to answer this research question. It was concluded from the interviews that the NTNU students mentioned one specific application they looked upon as a mobile learning application and that was the Kahoot-application. Except for that application, the participants did not specifically have experience with other mobile learning applications. Instead, the participants had good experience on a large amount of services that were helpful for different types of educational purposes. Dropbox and Google Drive was mentioned several times as a tool for storing and managing important content on a cloud service. YouTube, Duolingo, Lingo Bee were mentioned as useful applications used for learning purposes. The applications Evernote, Google Documents, and Wonderlist were mentioned for organizing and administration of files. As for applications used for communication and group work, Google Mail and Slack were mentioned. Mazemap and AtB were mentioned as applications used for navigation and transportation. As the participants, however, tested the mobile PLE application, I conclude that all of them perceived the application, with the exception of Kahoot, as their best experience in the context of their education at NTNU up to now. The findings show that the satisfaction and effort expectancy was high among the participants, which again indicates that they were pleased with the services of the application since they found it useful and easy to use. The literature survey uncovered some alternatives for students that were popular to use such as mobile PLEs and mobile LMS. Though, none of the studies had measured the levels of satisfaction, enjoyment, intention to participate, effort expectancy, and performance expectancy on their experiments combined, as it had been done in this study.

7.2 Mobile applications can increase students' interest in mobile PLEs

To answer RQ2, data from the survey consisting of questionnaires and interviews, and the implemented application were used. After analyzing the results, I found that applications should only include the most important services to not overcrowd the application and to avoid that certain services were not used. The participants who were interviewed stated that the mobile application had just the right amount of services and information that was possible to manage. Adding a To-Do list functionality with a customized list serving as type of manual into a mobile application, provided a type of plan or overview for the NTNU students. I found that by having a type of phone book functionality gathering all the contacts into one place was especially useful, since ease of use was high made searching more organized and correct contact information was quickly reached. Adding functionality of accessing all the courses the university offers into a mobile application, provides university students with opportunities in terms of accessing desired content, which several students regarded as a success. Similarly, adding a service with frequently used websites and services at the university onto a mobile application was concluded to be highly useful for the majority of the participants. It provided university students with not only an idea of what services and websites are frequently used, but what the students should be familiar with during their education.

As mentioned previously, in this study the NTNU mPLE application was added with four service sections: course, contact, to-do list, and links. Each of the sections were highly valued as individual services, but what made the application attractive and useful in the end, was that these services were combined and put into one application. To quote a participant; *"Students would use it as a tool to save time and also I think that many people will be happy to just have it all in one place."* (Participant 6, 2016). Several of the participants stated that it was easier to know what was helpful and what was frequently used at the university versus what they should not prioritize. Due to high levels of satisfaction and effort expectancy of having the important information and tools collected into one application increased the interest of students' interest in mPLEs. The feedback was significantly positive from the questionnaires, interviews, and from the integrated feedback possibility. The results show that the application was received as very easy to use and helpful for their educational purposes, and by testing the application the participants indicated an intention to participate in the NTNU mPLE application and similar applications in the future.

7.3 Mobile applications can improve the retrieval process

As for answering RQ3, the built-in feedback within the application, interviews, and questionnaires provided the results where we concluded that the retrieval process of desired information and tools could be improved by a mobile application. I found that questioning university students about what content and tools they consider as important in advance, would be of great value when designing and developing a mobile application. Some participants stated that the information they were familiar searching for, at the NTNU's webpages and subpages, were overcrowded with unnecessary information and that the application stripped that unneeded information away. Even though all the results concluded this application to be a success in improving the retrieval process, both the participants that contributed and I believed that this application had barely scratched the surface of its potential and that the application could be improved to reach a higher purpose.

7.4 Future work

The present study has certain limitations. Firstly, using a survey to extensively test the application would require a larger sample, even though fsQCA is designed to be effective is small samples as well. Further, more predictors of m-learning behavior should be examined future studies, combined with demographic characteristics, that have been proven to influence acceptance of m-learning [32]. fsQCA does not measure the unique contribution of each variable for every solution. Instead, the goal of fsQCA is to identify combinations of the independent variables. Future work may combine fsQCA and regression-based methods to acquire a deeper insight on the data. Finally, the implemented application was distributed to only the Android OS users, which made the size of the target sample smaller and limited in this case. The application was not tested on new NTNU students which may have had valuable insight on this study, due to them not having previous knowledge of what is important to know and what tools may be needed for their education. Future work include developing a web-based application that runs across all the major OS platforms and testing it on NTNU students, with an emphasis on new students. Hence accomplishing a larger target sample and testing phase, which would give richer feedback about what students' needs are and could be. This feedback could then be compared to this study's results in order to achieve deeper insight into the topic of creating an application to meet the needs of current and future students.

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Appendix A

Interviews

1 Participant 1

1 R: What are you currently studying at NTNU and what year are you in?
P1: Engineering Bachelor Degree, buildings and stuff
R: And what year were you in?
P1: Third. Almost done.

2 R: Generally, what is your view of the usage of mobile apps?
P1: Very handy.
R: Anything else?
P1: Depends on what kind of app.
R: Do you use many apps already, generally?
P1: I use many different apps often.

3 R: And what about apps used for educational purposes?
P1: Evernote and Slack.
R: Anything else?
P1: Yours.

4 R: What are the changes to the learning environment when mobile devices are integrated?
P1: I do not know, not sure how to explain this, maybe the students are participating more in the lectures. More fun.
R: Anything else?
P1: Nothing that I can think of.

5 R: In what circumstance do you use apps for education purposes?
P1: Mostly in projects.

R: Do you use apps in the class or other places?

P1: I have used like the Kahoot and SRS application.

R: SRS what is that?

P1: It is like a quiz program.

6 R: Tell me about the experience of using apps in the learning environment?

P1: With Kahoot and the other quiz program, in lectures, you participate more.

R: Do you have any other experiences you can think of?

P1: In projects and stuff, it is easier to share information with the other people in the group.

R: Do you have any negative experience, since I guess all of these are positive?

P1: No, not really.

7 R: Can you describe a course where you used mobile devices for educational purpose?

P1: 'Engineer Professional System Thinking'. We were recommended to use like Slack and such, to share information.

R: Any other courses you can think of?

P1: In mathematics and project management, we had quizzes on the Kahoot app.

R: Any other?

P1: No.

8 R: Tell me how that is different from a course not using mobile devices?

P1: It is more like the lecturer just stands and shares information. Maybe not that easy for everybody to participate.

R: Is it anything else you think is different?

P1: Not that I can think of right now.

R: So you say that in those courses you use mobile devices is better than those that do not have it?

P1: Yes, for the most part.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?

P1: I have only been writing my bachelor degree.
R: Is it any other places that you have used this app?
P1: At home while I have been writing.
R: You have not used it in any project or anything else, to look up something or anything else?
P1: No, we just have that one course (the bachelor's thesis)

10 R: Have you used the NTNU mPLE in a course?
Skipped this questions, because the person answered it in the previous question Q4. (the bachelor's thesis)

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
P1: To check when things were open. Like the library and such. The To-Do list. Yes, I think that is just what I have been using it for.

12 R: Have you had any interactions with other students about the NTNU mPLE?
P1: No.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Based on previous question, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P1: Especially new students, like in the fall or after Christmas, they would be using the map to find where which room are, so that they know where to go.
R: Anything else?
P1: Not that I can think of.

15 R: How often do you use the NTNU mPLE app?
P1: Maybe like once a week, but I think it would be more often if it was the start of the semester.

R: Anything else?

P1: No.

16 R: What do you like about the NTNU mPLE app?

P1: It is easy to use, you get a good overview. Easy to access what you are looking for.

R: One question when you said overview, is it anything particular thing you were thinking when you said overview?

P1: That you get like a few buttons on each side. So that you do not have to search very long.

R: So kind of the design of the app?

P1: Yes.

R: Anything else you can think of?

P1: No.

17 R: What do you not like about the NTNU mPLE app?

P1: Just that it is missing the old HiST.

R: Anything else that was frustrating or irritating or anything, any functions you were missing?

P1: Not that I can think of. But one thing that would be handy, if there was a direct link to ItsLearning and maybe Studweb. I do not know, maybe that is already.

R: Well, in the app you have those links about Innsida. When you go into Innsida now, you get ItsLearning and Studweb, already there. But you could have a direct link to ItsLearning as well because people use it more often than Innsida I guess, that is true. Anything else you can think of?

P1: No, not that I can think of.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P1: No it did not. But I think it would have if it was the start of the year or start of the semester.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?

P1: I do not know. It is so easy to find out the information on your own.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?

P1: If I was to go back to school again, I think I would use it more.

21 R: Do you have anything else to add that has not been covered?

P1: No.

2 Participant 2

1 R: What are you currently studying at NTNU and what year are you in?

P2: I am finishing up my bachelor degree in economics, so I have one exam left and then I am finished with my studies here in Trondheim.

R: So you are in your third year right?

P2: Yes, that is right.

2 R: Generally, what is your view of the usage of mobile apps?

P2: They are very useful. Like, I have a lot of them on my phone. I am using them on a daily basis. Like for example the AtB app with the mobile ticket, it is very useful, don't need the bus ticket and things. Like, Facebook, Snapchat, Instagram, using them every day, maybe too much, hehe.

R: Anything else you would like to add?

P2: No, not that I could think of.

3 R: And what about apps used for educational purposes?

P2: I have the one you made (NTNU mPLE), of course. I have not used so many for studying purposes. Mostly it has been like going on to the internet, via ItsLearning or just checking up on stuff on google, but I have not used so many apps for specific studies. It is more that I have used the Internet for.

R: Do you use for example Dropbox or something like that?

P2: I used when we wrote the bachelor degree, but then I only used it only on my computer, but I have not used it since then. That was probably a year ago.
R: Anything else that you have used of apps for your education?
P2: No, not that I can think of. Mostly computer. The phone is good when you are in lectures and stuff. You can check up on things that you might not find on your computer.

4 R: What are the changes to the learning environment when mobile devices are integrated?
P2: It can be a good thing, you can use if for like… I am not studying at Gløshaugen, but especially finding my rooms for my lectures, like the Mazemap. Can easily guide us to the right room. At our campus, we don't kind of need it, since it is kind of small. But I don't know how it changes the environment.

5 R: In what circumstance do you use apps for education purposes?
P2: Especially Dropbox, you can use it for, it is very easy for saving documents and editing the same document with different users. So you can kind of save it and edit it from another person's computer. I think it is like, kind of efficient way of cooperation when you are in the same room. It can be very efficient.
R: If I understood you correctly, it is very efficient using it in projects and group work. Is it any other circumstances you would use these type of apps. On the go or somewhere else?
P2: Probably, Dropbox is saving in the cloud, so it is good have like a backup. I should start using it more, but I have not used it a lot now. But it is a smart way of having a backup of your document you don't want to lose.

6 R: Tell me about the experience of using apps in the learning environment?
P2: A bad experience is that you can kind of get of topic. It is easy to... Like an easy distraction? Yeah, it could be, but it can also provide supplements of things you need to find out. I mean…I cannot find any good examples...
R: We can come back to that.
P2: I will keep it in mind. But it could be, as I said earlier, it could be an easy distraction.

7 R: Can you describe a course where you used mobile devices for educational purpose?

P2: Yeah, Kahoot, we used it in a psychology subject, this semester, were the teacher used Kahoot. It was a good way of learning and a fun way of learning, I think. You ask questions and kind of compete about being on the top. That is a good example of using it for learning.

R: Do you have any other courses you have done something similar?

P2: We had some, with companies, don't know exactly what it is called, but "Bedpress" in Norwegian, they used the same function. They spoke for about 30-40 minutes and then they had like a test afterwards, where they had a Ipad as a prize. Kind of big prize, so people wanted to pay attention to what they said.

R: That is a very good prize!

P2: Yeah absolutely, I finished second I think.

R: Congratulations.

P2: No, no, it is the first loser, hehe.

R: Close though, hehe.

P2: Companies use it when they present themselves for students, it is a fun way of doing it.

R: Any other experiences or courses?

P2: I think there was some last year where they used the same function, with Kahoot, but I was not there. I think some of my study buddies mentioned it that they had it one of the subjects. Seems like it is going to be more common in the future.

R: Anything else you would like to add?

P2: I think that many teachers like to stay to their, like what they have done the whole time…

R: Old habits?

P2: Yeah, old habits, so it could be easy for them to kind of stick to what they do and not try something new. So they should be more open for new experiences and learning methods.

R: Anything else you would like to add?

P2: No.

8 R: Tell me how that is different from a course not using mobile devices?
P2: I have not thought about it how it could be different. But I guess, when you have these sort of competitions it is easy to pay more attention and try to be more prepared. You kind of have a gain in your own experiences. Kind of makes you more aware of what you are doing the whole semester. If you know that it is coming a test with kind of prize or something, it should not be a prize for yourself, you should pay attention to your studies anyway, but it can be a good way of learning.
R: Do you think it is a good way of learning?
P2: I thought it was a good way of learning especially when I almost won the Ipad. But I think it can be efficient, maybe in the future the teacher will use it more often.
R: Anything else you would like to add?
P2: No, not that I can think of.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?
P2: I have not done so much, because I started using it maybe too late in the semester. So I should have started using it like before, in January or February maybe. The subject was almost halfway through, when I started using it. I think that, if I had gotten it now and started using it for the next semester, I would have had more value of it.
R: If you would have started using this app in January, where do you think you would have used it as a help for something?
P2: I think the, especially the to-do list, is a good like startup for the semester, what you have to do and you can write up your own things, a good way to cross of what you need to do and what has to be done. And also reading about the subjects, you can easily find them through the app, it is easy to kind of know, a fast way to access the courses. And also the Mazemap, not maybe for me, but especially for Gløshaugen-student, who need to find their rooms. Also, I needed to contact or find the, what you call it, the libraries.
R: Would you have liked to use this app in any group work or projects?
P2: Yeah, I think so.
R: Anything else you can think of?
P2: No, that I can think of now.

10 R: Have you used the NTNU mPLE in a course?

P2: No, to be honest, I have not been to that many lectures this semester. I went to, in the start of the semester, to couple of lectures and I went to the summary lectures. It has been a very busy semester with a lot of things, but school. I have tried to combine it.

R: Have you used it maybe at home, if you had to use kind of information for a course?

P2: Yeah I have, I think it is easier to gain access through the app than go through websites.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?

P2: Did not do any courses.

12 R: Have you had any interactions with other students about the NTNU mPLE?

P2: I talked to one, he had apple, he thought it was a good idea. He hopes you will build for apple as well. Because he liked the idea. I talked to him, and he spoke to some of his friends to find out that they had Android. But it seems like they were interested as well.

R: Was it anything specific he was interested in this app?

P2: He did not mention so much about it. No, I do not think so.

R: Any other interactions you had with the app?

P2: Only with my girlfriend, I have not spoken to so many others.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?

P2: No, he did not mention anything.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?

P2: I think the most impact the app will make, is on new students especially. It is a good kick-start for the studying life in Trondheim. Then you can kind of start using more as you are further and further into the semester.
R: Anything else?
P2: Especially for myself, I had a lot of unanswered questions in the beginning. What to do, where can I find stuff and now you can easily find them through like the Questions and Answers function, that would have helped me and saved me a lot of time, especially if I had this app in the beginning.
R: Do you think this will help other students as well?
P2: Yes, definitely.
R: Anything else you would like to add?
P2: No.

15 R: How often do you use the NTNU mPLE app?
P2: I have used it, not every day but 2-4 days a week. And, it depends on where I am going study next year, but I think I will use it 2-4 times a week in the future as well, if I continue to study in Trondheim.

16 R: What do you like about the NTNU mPLE app?
P2: I think it was easy to navigate and find the functions that you were looking for. It was easy overview and a very simple and nice design. Kind of has what it takes to use it, you do not need so much help while using it. That is a good thing!
R: Anything specific you liked about the design?
P2: Just that it was simple, I liked it. Don't need to be extraordinary. Better to have it simple and clean, I think.
R: Anything else you liked about it?
P2: I can open it and see if I can think of anything. I liked the logo! You were saying that you are going to change the name?
R: Yes, it is more of a research name, since I do not want to be official yet.
P2: I think that is something you could work on, at least. Because it is the first thing you see and it is catchy. If it is a good name, you can then easily attract more people to use the app. The logo is fine, that one you should keep, I think. That is my opinion. About the exams, the most of the function I have talked about, the

questions and answers. I think it is fine, I do not have anything more to add right now.

R: If I can summarize, you like the navigation about the app, it was very helpful for you to find the information you needed, and you had a good overview because it was a simple design and it was really clear, you liked the logo and of course the name could be changed. You had very good help with the questions and answers function. Otherwise it was a really fine app.

P2: You missed the, as I mentioned earlier, the economic faculty now that it is a part of the NTNU, because it was previously HiST. So that kind of has not been updated yet. Because that one is not in contact. But I guess that would be there eventually. That is the one thing I missed.

17 R: What do you not like about the NTNU mPLE app?

See previous question. *

P2: That was kind of those things I had in mind was the name and the economic faculty.

R: That was the only two things, nothing else was missing or annoying about the functionality?

P2: No, I don't think so. And of course, the room reservation was good to fast access to.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P2: It does not have that much, because I have not attended to so many lectures, but I guess it could have had a better impact if I attended to lectures.

R: Yes, I understand your position during the last year, that you have more projects than subjects, still it is good input that I am getting from you. But I guess you already have imagined what it could help you with if you had regular courses?

P2: Yes, definitely.

R: Anything else that you say that might change your study at NTNU?

P2: I think in the next year, it will be more coordinated with the lectures and stuff, because of the fusion of HiST and NTNU. There will be more students in all faculty,

and we will have lectures not only our faculty, but we have to move around a bit more. I think this app will help guiding around, at least.
R: Anything else?
P2: No.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?
P2: I would tell them about the pros, tell them that there is an easy way to find the answers to general questions and just get them to try it out. They might have more use for it than they think. And especially for the new students, as I mentioned. It will have a bigger impact on them than a student in his fourth year, I think.
R: So, new students you think are the most important here?
P2: Yes, especially to have a good start of your Trondheim-studying life.
R: Anything else?
P2: No, I don't have anything more.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?
P2: I think more. I think it will be, as I mention, better to start of earlier in the semester and then you can have more usage of it.

21 R: Do you have anything else to add that has not been covered?
P2: No, not that I can think of.

3 Participant 3

1 R: What are you currently studying at NTNU and what year are you in?
P3: I am in the last of Master in Informatics.

2 R: Generally, what is your view of the usage of mobile apps?
P3: I have conflicted view about them. I think mobile apps offer fantastic options in a lot of different fields but I also see them as a kind of subtle distractions. I think there is too much mobile use, I think people have their noses too much in phones.

That does not mean that I do not want to see more apps used, but I want to see a different type of culture around the use of apps in general.

R: Anything more you want to add?

P3: I think apps given a lot of affordability, especially the students, I think when it comes to information exchange which is what, that is how we do our business, students. I think that has been extremely beneficial or apps have been extremely beneficial in every regards to stuff like Kahoot, for classroom learning, some of the apps I have researched that has to do with language learning, such as Duolingo for example, is a great app. When it comes to learning, there is whole new world of possibilities in apps and I think that is very positive thing.

3 R: And what about apps used for educational purposes?

P3: Again, I think that they offer more uses than we know yet. We are still doing the research to figure out what can we do apps and not just apps, mobile technology in general. We do not really know yet the full range of possibilities that are open to us. We are exploring them and I think that research what you are doing is helping us find out what works and what does not work. And I think it is central question in education when it comes to apps is, do they distance us from other classmates, how much independence does it give us and is that a good thing.

R: Anything else?

P3: No.

4 R: What are the changes to the learning environment when mobile devices are integrated?

P3: These learning environments, they offer a lot of opportunities for people to stay in touch with the material and is a lot easier to access material. Comes easier for learners to make material available to students. The good thing is the amount of options that affords us, I mean we can do more with less time. This is a way to sum it up. We have more options with less time. But I think again, that we lose a sense of community around it because we do not need to be face to face with the teacher anymore, you do not need to see your classmates anymore, you do not have to do any of this communal work that used to be part of education. And I think that has a detrimental social effect. I think the use of too many apps and the way they change

it, make it more, I mean sure some more great stuff like customization, personalization but also some real negative things with the social distance, the new social dimension, it is more chat based.

R: So you would say the communication is kind of different?

P3: Yes, changed, which is what the question was. So yes, some pros and some cons.

R: Anything else you would like to add?

P3: No.

5 R: In what circumstance do you use apps for education purposes?

P3: Depends on how you define education, do you mean education as in a system or informal learning in just learning things?

R: Anything.

P3: Anything, cause man, podcast is my world. I have used podcast so much, I do not think there is any single day that goes by without at least an hour of podcast. I do it in the morning and I use it when I travel from A to B. That is the main thing. It has been useful for a couple of history classes that I have taken but none of my technology classes. So it has been useful for the informal learning.

R: So mostly it has been informal learning?

P3: Yes sir, I have used Duolingo, which is a language learning app, as well as Lingo B which is also similar but more about culture. But it is also a language learning app. But more to see what it was like, so I have not really gained anything from it. My French got a little better. I do not use the learning environment apps, that might be because I did not have the ItsLearning or whatever it is called or anything similar such as your app when I was using the learning environment, when it was relevant for me. Because for the last couple of years I have been a master student so there has been no use for it. But I do not think I will be using apps for my education the formal kind of like, class room learning.

R: So you have not used any apps for projects or group work or anything else?

P3: Cellphone apps, no, but I might have used Dropbox once or twice just to check a file… no is the answer.

R: Anything else you would like to add?

P3: The answer is no, I guess. Maybe bit of file sharing, but that is it.

6 R: Tell me about the experience of using apps in the learning environment?
P3: I think Kahoot is fantastic, I think it is a great app. Great way of involving students. So I guess that sort of interaction apps. I cannot really remember any else. This one is that comes to mind mostly. Again, a couple of times, I have not used it but asked a buddy and said “can I use your ItsLearning really quick?”, I just wanted to check really quick when your classes were out. This is familiar to your app. Some of your function in your app, I guess we are going to get to that, would be very useful for this case. Sort of a catching up the information, the administer information around like classrooms. When is the report due, what articles has been released for this next project, that kind of stuff. But no, other than that and Kahoot, I do not think I have used educational apps. And the kinds that I have used for podcast and language learning, I do not use them at all in the classroom.
R: Would you say the most of your experience is been positive?
P3: Yes, I would say I do not use a lot of apps, because I think a lot of them I do not have interest in. But those I do use, are very positive.

7 R: Can you describe a course where you used mobile devices for educational purpose?
P3: A class called Web technologies used Kahoot as a sort of interactive quiz and I think that was beneficial.
R: Any other classes?
P3: No, not specifically mobile apps.

8 R: Tell me how that is different from a course not using mobile devices?
P3: I think that stuff that is practically hard becomes easier with apps, like sharing or making sure everyone has the right article, stuff like that. Without that, I think I am back to being fifteen, getting handed out papers, you know what I am saying. Back in the day, you check if you had all the short stories for the literature test. It was more complicated and stuff like that. Like ease of use, I guess. Practical things become a lot easier, but I think the negative side is the lose that personal contact. And also, I have noticed that, this is just general observation of mobile use, people become lazier because of it. They are used to have the thing in the pocket they can

just pull up and check. To have to go to the library and looking up an article and use an extra hour to do that, no, people do not want to do that at all anymore. So like all of the things that maybe before you were expected to step up as a student and go find and go look for, now we are sort of more expecting to get it sent to our account. We are expecting it more like a notification. Like, where it the article, you were supposed to send the article, instead of us going out there looking for it. So I feel again, it has made everything more practical and time efficient but in return it has made us a bit more lazy.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?
P3: Again, I want to specify this for the interview. I am not a regular student anymore. I am master degree student, so my time is spent alone, I do not attend classes. I am very familiar with some of the application provides information for, since I have been a student here for 6 years now. So, none.

10 R: Have you used the NTNU mPLE in a course?
Question skipped. The participant answered in question 9.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
Question skipped. The participant answered in question 9.

12 R: Have you had any interactions with other students about the NTNU mPLE?
P3: No, I was just alone.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Question skipped. Based on what the participant answered in question 12.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?

P3: If we forget that I am a master student and pretend that I am a first year student, I think it would be very beneficial to keep everyone up to date with information. And it is a good place to centralize all the information there is. Sometime you do not know what you are supposed to look for. Like for example the to-do list where you select which year you are from, I selected the first year student to see what was there. And man, this checklist is great, there is so much stuff here that would have benefited me hugely when I was new. It would have been, not only to see what I had to do, what options there were, but also to keep tabs on how far I was on those tasks. So this is one of the better function that would change my student life a lot when I was new. It would make information much more sensible.
R: So that is your main topic when it comes to impact?
P3: Yeah, not just accessible, but not just where do I find it, but also what information is there to find. I think it is great for that.

15 R: How often do you use the NTNU mPLE app?
P3: In the context of being a fifth year student. When I first downloaded it, I checked the functionality out and I saw that there is not much that is going to be handy for me. I believe I checked it again, casually, about a week later.
R: So once a week?
P3: Yeah, but I would not use it as a master student. I would not download it then, but as a first year student, that would be different brisket. I would then take it out whenever someone was wondering about something. I would then take it out to look at it.

16 R: What do you like about the NTNU mPLE app?
P3: In general, the layout is great. I love the way menu is, the top is very clear, I love the way it changes colors. I love the whitespace, I love the clear and concise icons. Could get picky on that they are in sort of different sizes and looks a little goofy, could get picky on that, but that is getting picky. I think the titles are concise and I like that you just do not have the logo or not just the title, you have both. I think I would like to see, is a… you know on forums, when you go deeper and deeper in a forum, you can see which was the last thread post and just click back. I would like to see a little icon where am I in the app. I do not think it would be a

problem if I use it daily, I would be very familiar with it. I think that there are nice shortcuts, and oh, I have to give you credits for the room reservation thing. A lot of students do not know about that. Straight up, they do not know you can reserve rooms. You got to hear about it. Fourth year students are like; "you can do that?" Yes. So, this sort of comes back to the first functionality I was talking about, it tells you what information is good to know. Kahoot and Mazemap on it…sure it is nice to have it gathered. But it seems a bit out of sync like the rest of the app. I would rather have an extra menu that said other stuff, or miscellaneous, or like classroom or like other apps. Or even that the student can customize. I do not use Mazemap and I do not need it, but I might need Kahoot so then I can put it in. Have like a centralized app that again redirects them for school related apps. Which would also be great for, we as IT-students, we have to use a whole bunch of different small apps for just one class. Download this and use this. Great place to keep all that stuff assembled, so you know this is a school thing. Let me see what else I would to say. To-do list, I think that is one of the best things about the app, hands down. Contact list again, it is good to have all the information gathered in one place. Do not know if it is a huge use but, like for the opening times and so on, I do not know. I love the lists the way it is built. You can clearly see what is a menu item and what is a part of the entry, again the nice little icon that tells me that I can click and that there is information here. I think this is very well used. Same with the faculties obviously, and I think this is a bit more useful than the libraries. But again, as a student, I do not know why I would be, if I was a medicine student, why would I be looking for the architecture and fine art. I do not know why I would be needing that. Maybe in the future some kind of functionality that detects if you are a master student of informatics and it streamlines the stuffs you need. But that seems like a more complex task that would be long term. I mentioned the changing color menu, I that is very nice. The courses overview, I do not know when I would casually on my cellphone looking at this. If I am looking at courses I am on the computer; I am making decisions about which classes I am going to take, I am usually settled, but that is just me. I do not use my cellphone that much. The FAQ is fantastic; I think this is really good. Just the functionality itself is fantastic.

17 R: What do you not like about the NTNU mPLE app?

18

P3: I would just say that there is stuff here that is not useful for everyone and that in itself can be like… I think we discussed this in a design class where they said an app should not solve too many problems. If it has too many functionalities, people are going to use two percent of it and the rest is just going to be annoying, it is going to be in the way. I do not know how to trim this app even more but maybe if you remove like Kahoot and Mazemap and sort of centralize some of the other stuff. So that there are two or three icons maybe that had information.
R: So you would simply this app even more?
P3: Oh yes. I would simply it.
R: Anything about the functionality or anything you did not like or was there a problem with anything?
P3: Things worked, but Kahoot was a bit slow but it worked. Same with Mazemap, but that might just be with my phone, since it is old and slow. Mostly my comments are also about the design about that it seems a bit empty, I would say. Seems like there is supposed to be more here. There is not much to say about it really.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?
P3: Again, as a student at my level, no impact. As a first year student, a wealth of information. There is a big difference here being me, like very experienced after this time and someone that is totally new. I think it would be a god's gift for a totally new, but for me, I did not use it all.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?
P3: I would tell them exactly what I told you now, first year student or second year student who has not gotten their feet under them yet and still being confused. This is a databank of not only where to find what you need to know but what there is to know. I think you can maybe expand it to include more the cultural and social events like; "Studentersamfundet". A section or something like that. I am looking for a menu that will show what is being served today. That kind of stuff, I would expand it for day to day use of a new student. That is what I would expanded it for.
R: Anything else you would tell to somebody, to recommend this app?

P3: No, I think the information is the alpha omega. Oh, it needs to be said that since I did not use the its learning function much, since there was no reason for me to do it.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?
P3: I will not be using it. So less.
R: If you were a first year student you would?
P3: Oh yeah, I would recommend it to my friends.
R: If you would take new a bachelor degree after your master, would you use it then?
P3: Yes, I would. Especially if I was new in Trondheim.

21 R: Do you have anything else to add that has not been covered?
P3: No, not that I can think of.

4 Participant 4

1 R: What are you currently studying at NTNU and what year are you in?
P4: I am studying bachelor in Human Movement Science and I am in my third year.

2 R: Generally, what is your view of the usage of mobile apps?
P4: I use different apps the whole time, therefore I would say I am kind of addicted of them. An efficient method, instead of searching on google or Internet explorer to reach desired content, you can use apps to get to desired content. Therefore, I am very happy using apps.
R: Is it anything else you would like to add?
P4: It is very addicting using apps, especially social media apps. But it is a very easy solution when it comes in educational context. I experienced this during the testing of your app.

3 R: And what about apps used for educational purposes?
P4: I have not really been using those types of apps earlier. This is because I have not been introduced to any educational apps early enough into my study time. So I

have not had any experience with these type of apps before I got to try out yours. But it would make you get easier access to your desired content, for example, I have my google mail as an app which makes it much simple and easy to use.
R: Anything else you want to add?
P4: Yes, I think this will maybe make people use even more of these type of apps or information.

4 R: What are the changes to the learning environment when mobile devices are integrated?
P4: It gets maybe more interesting immediately, for those of us who use a lot of social media. And it will make, in context of group work, easier update each other fast. Instead of meeting each other to do updates. It will also make it easier for the group to click into the app to see what the other members have done or to get an overview. I think this will give people a very simple and easy solution instead of turning on the computer and then do the tasks.
R: Anything else you would like to add?
P4: Not at the moment.

5 R: In what circumstance do you use apps for education purposes?
P4: I have used Mazemaps and it was great. I am really satisfied with that one. You can occasionally get lost when you are trying to find a room at campus. Other than that I have been my google mail for school related things and for anything else. Mostly I have used these type of apps during group work. Especially google documents, since it is very convenient way of sharing information and having it stored on disk. All group members can then write comments and such. Then you only need to click on the app to see what the others wrote.

6 R: Tell me about the experience of using apps in the learning environment?
P4: I have had only positive experience using these apps, but this is maybe because I have used very few of these apps that exist. Like google documents, I have just had positive experience with it, because it is very nice and easy method of sharing information. And, you can give access to those who you would like to have access and you can deny those you do not want to have access. You can add things that you

think is relevant and others can add things they think is relevant. This is the same with Google Calendar too, here I can add other people's time schedule to get an overview. So I have only positive experience from those apps I have used at least.
R: Other experiences that crosses your mind?
P4: Mazemap, it works, but it could be even better. It could be even more simplified and easy to use. I do not think there is something negative about other apps that I have used. Only thing that I can think of, is that it is complicated to edit files on google docs on mobile. But it is very nice to just read and view. One more thing I forgot, I have kind of a notice book app that I use to add notes and such.
R: Do you remember the name of the app?
P4: It was Wonderlist. Let me check my phone if I have some more. Oh yes, and one more thing that I forgot, I have used a student ID app, it is worth gold!
R: As I have understood, you have had generally a positive experience using these apps. There has not been any negative experience in terms of distractions?
P4: I have been thinking about it, there was a period that I had notifications turned on. You should not have that turned on.
R: So that was kind of a distraction for you?
P4: Yes, it is very easy to just go through all the apps you have to check if there is some new happening. But I see that more as a positive thing, since I get more benefits from it than cons. It is just that you have to restrict yourself.

7 R: Can you describe a course where you used mobile devices for educational purpose?
P4: The courses I have are in context of the human body and research. In that context, we have had much group work. So all my subjects have been science subjects.
R: So there no specific courses that you have used the phone more than others?
P4: We had a course this spring where I used my phone much more, it was a report based course. The course name was "Evaluation of physical fitness and health". We had a previous course called "Research methods" and it was built upon this where it went more into depth. In these course we wrote many reports where there was very nice help to use google docs, since we were in a group.
R: This was an evaluations course right?

P4: Yes.

R: Was it a statistical evaluation or anything else?

P4: Yes, we were doing statistics where we did measurements of different sorts to report.

8 R: Tell me how that is different from a course not using mobile devices?

P4: I have not used the mobile much in a course named Biomechanics. There I did not use any apps at all. It was more individual tasks and it was mostly calculations. Therefore, it was about doing it the old fashioned way by using the calculator and paper.

R: How is this different from courses where you have used apps?

P4: As mentioned earlier, we used Google Documents in the group work subject, and I have had more subject where I have had group work where I have used google docs. So in subjects where I have not used google docs, it gets inconvenient to share documents since you have to send back and forward the different documents that you create. Generally, you write everything on one computer and you have it on the big screen. But if you have it on google docs, then everyone can see it the whole time. You can then sit at home and write it. In the context of group work, I have experienced that this saves us a lot of work. Especially since people have different operating systems, different computers and different brands. It then gets very inconvenient when a person from a Mac is sending a document to me that I cannot receive since I have windows.

R: Subjects that has not had this opportunity to use apps, you find it the work more individual, inconvenient and harder to share work?

P4: Definitely when it comes to group work subjects. When it is a subject where it is much more individual work and you have to do many calculations then it is very inconvenient using the apps I have at least. But I guess there are apps that can be used there as well, but I have not checked more on that matter. Another thing I have forgot, if you want to share something and you have forgotten it on the computer, it is then very easy to just go on your phone and send it or share it from there. That is sometimes a very good benefit.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?
P4: It has been a little inconvenient to use your app since I had to write my bachelor thesis. It has been like this for my other apps as well. Therefore, I have not used the app in any other occasions than alone.

10 R: Have you used the NTNU mPLE in a course?
Skipped question. Based on question 9.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
P4: First I used it to access "Innsida" because I have never used an app to access Innsida. It was really fast. In addition, I used the Mazemap.
R: Did you use the app to gain access to some sort of information or was it just to test it?
P4: The main reason was to test the app out and see how it works.

12 R: Have you had any interactions with other students about the NTNU mPLE?
P4: No, did not have any interactions since I have mostly been at home working with my bachelor's thesis.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Based on previous question 12, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P4: I think that is a nice and easy app where you have everything school related in one app. It is very fast to switch between Innsida, Mazemap or to notes. So I think students will be left with a positive feedback about the app. If I had been introduced this app from the beginning of my study, I would have used the whole time. When I first get introduced to these types of apps I tend to use them very much. It would be great to place all the other school apps into one app, to have everything in one place.

R: Anything else you think that might impact or change other students?
P4: I think that when a new student gets this app on the lap, it will give the student a good overview over everything what the student needs to know. But on the other side, after getting this app on the lap, the student might also not know what for example Innsida is and what all these other functions are for. And then it would be good to have a little tutorial or instructions that tells what the different functions do.
R: Anything else you would like to add?
P4: No.

15 R: How often do you use the NTNU mPLE app?
P4: Right now I have just tested the app, but otherwise if I would have regular classes, I would have used it every day. I have tested the app like three times a week just to check the different functions to see if they worked for me. And I think that it would absolutely work for me.

16 R: What do you like about the NTNU mPLE app?
P4: What I like is that you kind of get a package with all the most important functions are to find in one app. It is very easy to use, especially since I am not a really technical person, I did not have any problems and that is very good. The app has a very good overview that is clear, I had no problems with it at all. I liked that you had a possibility to add notes and not just functions you have to use in school related situations. I do not know, I just think it is really great. It goes smoothly and fast and does what it is supposed to do, at least for me.
R: In the section where you had contacts about libraries and faculties and such, do you have any comments on that?
P4: I liked that you had added the contact section, since much of that information is not so easy to find. I have tried many times using NTNU's webpage to get that information without any luck and it takes extra time to find the correct person you want to find. So I think that was a really great function to have. Do you think the information that was shown to you was what you expected or was it something missing or was it too much? I did not see that there was anything missing and I thought it was not too much either. I think the most important ones was there. Those times I contact someone, like the library, the most important ones, those you had

added. But if you would have added more than this, it would have been too much. As for the to-do list, I think it was great that you had made a customized list of task that gives you an overview of what is important to do the first semester. But I would have had more descriptions on some of the task just to make sure everybody understands it. When I started, it was really much to have in mind, but this gave me a good overview of what I need to do. And if there was something I did not understand, I could then just ask a supervisor.

R: What about the links section, any comments on that?

P4: This is the function that I used the most in addition to the To-do list. Kahoot is something we have been into a time at school and those times I had to use it, I had some difficulties accessing it on the browser. It is very new for me, this with Kahoot. But it is a very easy to go to it through your app. The same is with Innsida. It is inconvenient to do with through the browser, I noticed that at least. It takes some time to upload the page. And I think that Mazemap is really great to have. Room reservation was also used many times, especially in the context of ISFiT event. Previously, I did not know about the Room reservation before some weeks ago. So it was great, it is good to know where you are supposed to be and where it is enough space to be. The only thing, since I use google docs so much, it would have been great if that was a part of the app.

R: Anything else you would like to add?

P4: No, I do not have anything else to add.

17 R: What do you not like about the NTNU mPLE app?

P4: I think that the app was a bit shallow, the app could be more exciting. But I do not know how to make it more exciting. I am girl, so maybe the To-do list could have had a possibility to pick colors. That would have been very fun. The logo of the app is just nice, it describes the app very well and what the app should be used for.

R: Anything else you did not like about the app?

P4: No, not really.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P4: I would say that this app has to come to iPhone, then I would be really certain that would use it very actively if it comes early in the next semester. Because I have noticed that this app makes it much easier for me. I found out that there were apps for things I did not there was an app for. I think all the functions would help me in my everyday academic life. But, as mentioned earlier, I think it would help new students that arrive for the first time to Trondheim even more.
R: If I understood you correctly, it would have made your everyday easier and it would have helped you much in terms of finding the desired information, generally made it easier for you?
P4: Yes, it saves time. At least for me.
R: Anything else you would like to add?
P4: Yes, since you have the functionality to cross of tasks in the to-do list, I think that I would have had much better overview of what task I should do and it is really fun to cross tasks that are done. It is very fun to have a checklist function, because you can see that tasks disappear and that you see that things are getting done. Just to do some homework or an assignment that is to be delivered, to be able to just cross it is just great!
R: Anything else you would like to add?
P4: No.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?
P4: I would have told them that here you have an app with everything you need that is school related. All the information you need to manage your everyday academic life without problems. And that it is a very nice and easy app to use in practice. I would also tell them about my experience about the app, that it is easy to use and that it is very tidy. Because, when I first hear about your app, I thought this might easily get messy. But you did that job well by dividing it in four categories that are very natural. It is very easy to navigate to the functions that you want. I would also have mentioned the contact section, since I know some would really appreciate that.
R: Anything else you would like to add?
P4: I would say that to go on the Internet on the phone and do a room reservation without an app which I have done, that takes much time. To be able just to click on

the app instead of turning on the computer to get an overview, that saves you for much time. The same is with Mazemap, when you walk around at campus, you do not want to turn on your computer just to find out where you are supposed to go, it would be nice if you just had an app to click on. And updates on Innsida.
R: Anything else you would like to add?
P4: No.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?
P4: I would use it more; one, because I would study more so it would be more relevant for my everyday life. And, two, because I know about it and I know that it is there and it is accessible. And I could imagine tending to reaching for the cellphone and the app, rather than going the extra effort to do it online or somewhere else. And it is already like just sitting on my couch and I can use it. Because I know about it, and because I study more.
R: Anything else?
P4: No.

21 R: Do you have anything else to add that has not been covered?
P4: I think you have covered all areas. I cannot think of anything that has not been covered.
R: Anything else that has crossed your mind that you wish to comment?
P4: No, I do not think so.

5 Participant 5

1 R: What are you currently studying at NTNU and what year are you in?
P5: So now I am doing my master is neuroscience and finishing up. So it has been a two years' study and I am finished in the start of June.

2 R: Generally, what is your view of the usage of mobile apps?
P5: I really appreciate apps. I think they are convenient to use and we are now in an era of technology where apps are very prominent and a very central feature in the everyday life. So I think it is a powerful tool to reach out to many people across

large demographics. So that you can reach out young audience and also a degree of other audiences as well. And it is very easy to perceive. So visually they are easy, they have to be easy so that they can get information from them, fast and easily would be the word that comes to my mind.
R: Anything else you would like to add?
P5: No.

3 R: And what about apps used for educational purposes?
P5: I have not used that many apps for educational purposes. I imagine that they would consist more of games that are educationally useful like for languages or like learning to drive. I have not come across apps that I have been using for school or educational purposes. It is mostly entertainment or use like email or bus schedules and stuff.
R: Anything else you would like to add?
P5: No.

4 R: What are the changes to the learning environment when mobile devices are integrated?
P5: I think the classes that manages to use cellphones. First time they were used at NTNU when I was in a class, which was a surprise. Because this was usually forbidden to use cellphones or computers during class. So I think, again, it is powerful because you reach out to the back pocket of the audience. So you just go straight to their personal gadgets. The cellphone is very central in their lives, so manage to use that as a tool very clever. I think that if you do it right it can be a good thing, but I cannot be used like my imagination prevents me from thinking that it cannot be used for more serious task like writing. Because the cellphone is not a good apparatus to do that one. So I think for more easy tasks, it would be good and it needs to stimulate the person who uses it, so that people do not go on the Internet doing something else. It has to be very specific for their task they are doing. I think my main point is that if it is a simple or a fun task, you can use it very dynamically and interactively, but it cannot be used for writing long texts or like more serious thinking tasks. Because I think it is not made for that.
R: Anything else you would like to add?

P5: No.

5 R: In what circumstance do you use apps for education purposes?
P5: For educational purposes, I cannot think about any of my apps. The only thing I have been using is like email. So it is more like organizational.
R: You are maybe thinking of file sharing as well?
P5: Yes, for instance Dropbox and file sharing and that sort of organizational. And I use YouTube to frequently checkup videos of things I want to learn and do not understand. And those kind of uses.
R: And these things, do you use them kind of when you are doing informal learning like more at home or anywhere you are or is this more in projects or group work or anything else?
P5: Both I would say. When I need them, I sort of use them, I am not scared of using YouTube during informal learning such as group work and stuff. If you count Internet apps, it is frequently used for educational purposes. Because it is so easy and convenient.

6 R: Tell me about the experience of using apps in the learning environment?
P5: Again, I have not experienced that much. Because I have not touched upon apps that are made for learning purposes. So it is not that has been in my knowledge that even exist. And I have not like sought after them as well, so I have not looked up if there are any. You have said that you have not done so many, but those you have done.
R: Would you say that it was a positive or a negative experience?
P5: It is easy to use, it is there and you can just use it. But it is also negative in terms of being oversimplified. If you want to find more specific answers or specific something. Then it is maybe not the right tool. I would then use the Internet or some broader hardware.
R: Anything else that crosses your mind?
P5: No.

7 R: Can you describe a course where you used mobile devices for educational purpose?

P5: Yeah, so I did this chemistry course at NTNU where they actually used Kahoot for educational purposes and that was brilliant. It has also been used in the neuroscience courses that I have been taking to interact with the students and test us, both test us and for us to see where we are, inducing a competitive environment. But also for them to recognize how the students are doing with the curriculum. Kahoot is the one most used during class.

R: Were there any other courses you have been using mobile devices?

P5: No, when I did math and biology, cellphones were not used in the teaching. So you had to put away your cellphone. So the only time I was actually available to use them were during those other kind of situations where we were promoted to use cellphones.

8 R: Tell me how that is different from a course not using mobile devices?

P5: I do not think that it makes a big contribution. It is more of a sidetrack, so it is more of fun…

R: So like a distraction?

P5: No, it is positive, a fun contribution to learning but it does not improve the learning. It is more of making it more interesting or maybe just before a break or if it is tough a lots of curriculum, you sort of make a pause or make it interesting. It also prepares students… like the Kahoot I am talking about, that is preparing people for exams. I do not see it affecting the subject itself, I do not feel it has a big effect the way I have used cellphones.

R: So if you could choose a class with or without cellphones, what would it be?

P5: It cannot be based on cellphones, I feel like it is based on curriculum and the way they teach. I do not feel like the cellphone makes a difference. It depends on the Professor and the subject itself as well. If I had to choose, I think it is a positive attribute. I do not feel it is negative if it is use properly. And I feel there is so much potential in apps and cellphones to be used in learning. Because we are only on the brick of understanding or start to use them. So I feel there is a lot of niches for the apps in teaching, but I have not experienced any to say better or worse. I imagine that it would be more according to the development of technology in learning and teaching as it goes now. Not to be stuck in the past like overheads and stuff, but that it is more in the future or now in the present.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?

P5: Yeah, so first time I downloaded it was quite a while ago. Maybe two or three months ago and I used it frequently at school then. So I really found it useful with the links. The linking to the Mazemap was really useful for me, because it is such an important part of my everyday life finding my way. And it was very convenient and accessible on the app. Contacts I have used several times, just checking up library opening times or café opening times or stuff like that.

R: What kind of activities were you doing when you were checking this?

P5: I was at school, reading, even by myself, during class or during brake I needed to check something or how long the book shop was open or how long is the library open so I can go and get this book before anyone else. When I am at school, not at home because then I am on a computer.

R: So you have not used it in any group work or projects, just for yourself?

P5: No, because I do not have that in my education.

10 R: Have you used the NTNU mPLE in a course?

P5: No, I do not think so.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?

Skipped question. See previous question 10

12 R: Have you had any interactions with other students about the NTNU mPLE?

P5: No one has seen me use it, but I did try and tell other students about it. Because I found it useful and I wanted people to know it. Maybe they did not know about so I wanted to spread it out. But I have not used it at school because I am in my masters, meaning that I do my own work and I do not have classes and I am just doing my master's thesis.

R: If you could position yourself, if you were a new student or having classes, how would it be for you then?

P5: To have the app you think?

R: Yes.

P5: That is one of the biggest assets of this app. I think that it is so good for new students, because when I was a new student, you do not know anything. And it puts everything into one place. If a new student knows about this app, it would make his or her life so much easier.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?

Based on previous question, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?

P5: I think it is more accessible, especially for the younger students and the new students as well. Exchange students as well. So anyone who is new to the place and the university or even younger and do not know too much. Then it is very useful. I think it would take less time to get information. They will know more about what is there. If you do not know something exists, you cannot really go there or get any information from it.

R: So you are saying it is like timesaving?

P5: Timesaving and awareness. It restricts the mistakes, maybe. So if you have the list of the things you need to accomplish for semester start. Then you might forget to do something if you have not had the list. It sorts of limits the faults you can do.

R: Any other impacts or changes you can think of?

P5: No, not for now.

15 R: How often do you use the NTNU mPLE app?

P5: Yeah, so in my situation I used it more frequently in the beginning because then I still had some courses. So I used it maybe once a week. But during the last one or two months I have been at home, just writing. I have not had any contact with anyone. I have to add, I remember a couple of times sitting in my sofa and having my cellphone, and I need to check something school related. It was easier to use this app than go to the Internet or something or going to my computer. So that is the

only cases I have actually used it. But as long as you know about it and you know it is there and you know what it contains, it is very easy to use.

16 R: What do you like about the NTNU mPLE app?

P5: Let us start from the beginning, first I really liked the logo. It is so good and I find it funny, because it plays on the graduation ceremony in America and it makes it easy to spot, even among my five blue apps. Completely blue apps on my phone. I can see it immediately because of the hat. So it is very easy to see. So that is one of my favorite things, the logo. Then I like the design of some of the icons. So like the Course Help, you get the hat again, and Contacts is easy, and To-Do List. Links, the bookmark, but I do not get it. I am not used to seeing bookmark, so it does not appeal to me. So that is good, the icons. And I like the organization. So that I know in the Contacts there are contacts or information regarding contacts. In the links are any external pages not related to NTNU. I like that you have included some essential aspects that need to be there. That you have thought about all the different things that need to be included. It has a broad specter. So it can reach many people. Course Help for instance, is very universal amongst students. It is not specific for anyone, it is very general. That is really good. It is in English, so it is for English people, very good. Different colors in each menu makes it color coded. So if you do not know where you are, you can look at the colors. That is small things that I notice and they are very refreshing. I think that is the majority, for me the most important things are like; you have included important links that I need to use and that I like the logo so I can find it. I know it is just silly to think about, but if you cannot find an app then you have to look for it and that is irritating.

R: I have an addition question to the To-Do List. Did you get the customized list when you started the app for the first time?

P5: Yes, I got it.

R: What do you think about it?

P5: I think that you have thought through the order of things that need to be done, which is really important. And you have everything in one place. But I have to look at this as a freshman student or a new student, because I know what needs to be done and does not need to be done. So for me, this has no point, but the first thing I thought when I saw it was wow, I wish I had something like this when I started

studying. Because this is the hardest thing as a new student, you do not know everything that needs to get fixed and when and everything. And that you can modify according to where you are. Even though they are a bit similar, you still get a personal touch to it. But again, it does not apply to me directly, but that is a positive thing about it.

R: Anything else you would like to add?

P5: No, not that I can think about.

R: If I could ask about something under Contacts, when you were for instance having this information, would you say it was too much information, was it ok, what do you think about it?

P5: I think it is appropriate because people do not know what they are looking for. So if someone a foreign number, a fax number, for me it does not appeal but it is very organized. It is not too much information in regards to information that there actually is. So it is compact. And you can find what you want to find without having to regard the other irrelevant information for you. So yes, I like it the way it is because you never know what people want to find.

R: What do you think about the FAQ under the Course Help section?

P5: I do not like it. So it would not be under the positive section.

R: Then we can just proceed to the next question.

17 R: What do you not like about the NTNU mPLE app?

Let us start at the beginning. It is not much that I do not like about the app. It is more of possible improvements. It is not that affects me negatively about the app. I do not feel like, ah this should not be there, I get irritated. For instance, the facts questions, I have not used it because I personally do not like to set places and look for questions and find answers anywhere or help places on the Internet stuff, I do not go and do that. It does not speak to me. I would just type in the question rather than look for the question. It is not a negative per say, for the app. It is just completely irrelevant for me. It is hard to find stuff about the app that is bad, that is a positive thing, you can add it as positive. I do not know, maybe I have been saying it is easy all the time, it might be me but I find the first page harder amongst the easiness. I know the icons are nice, but maybe I am just used to mainstream apps where you have, for instance, color codes. Like you have red around this one and

yellow around here. It just laziness, but it is not a negative thing for me. I cannot really explain exactly. It could be easier for me. Courses, I think the negatives are the app parts that I do not use. For instance, I would never go in here. Because if I am looking up courses I usually do a huge research on them and I do not use my cellphone for that. Nothing negative about the contacts, I love them. In the future it is possible to expand and more, include more different. Links, I love them. Again, Innsida, I do not use that frequently, because the stuff I use on Innsida is email. I would for instance prefer an email link in itself for me. Or an ItsLearning link, instead of going into Innsida, and logging in again. Or more links in the future as well. I cannot think of any now that I would need, but just for the future, maybe for corporation you could use bus schedules. Or when something students would like site where you can give away stuff or you know, some kind of…

R: Kind of events, some sort of events you can organize amongst students?

P5: I was thinking more of sites that are more appropriate for students, what would students look for, where to get cheap stuff. Like Finn.no. Food offer app or other stuff that students use. But that does not bother me, it is just more for the future. To-do list, again, I like it but it does not appeal for me and you do not need anyone from masters either, because we know what to do so we would not use it.

R: Anything else you would like to add?

P5: No.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P5: So now, I am still going to study after my master and I know it is not frequently used for me, but it is an important tool still. So it has a high degree of importance despite the frequency, because it contains information that I need and that I frequently use and it is in an accessible way. So it would impact my studies in terms of, or my everyday life, that I would actually use it. Like I said, less time to use on other stuff. Because if I really needed information, I would get it regardless. But using this app, it is just easier. And even if I would start again, I think it would be used more frequently with the same level of importance or even more. Because then I feel like this app appeals more to the newer students.

R: Would you say that you would even use it more if you would have like regular courses?

P5: Probably or most certainly, because I then need to get more information.

R: Anything else you would like to add?

P5: No.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?

P5: I would say that it has something for everyone, so if you do not use all the parts of it, you would still find it useful I think. And it is better using than the Internet or other devices. It is also easy to have on your phone so you can just use it and it is more like present-friendly, if that is a word.

R: Could you describe that more?

P5: Like using this app would be something in the present. Like you could use technology as technology is used today. You can use this app now and it is adjusted to how life and stuff are now.

R: So it is adjustable to today?

P5: Yes. Present-friendly.

R: Anything else?

P5: I would just say it is good as it is now and I feel like it would be useful. I would tell them to download it. Even if they think they do not need it, they should download it and look it up. Because it is there, for me it is there on the phone until I need it and then I use it. So it is not something that I incorporate by force.

R: Anything else?

P5: No.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?

P5: More definitely, if I will study more in Trondheim. As mentioned, I have not been good to use apps for school related purposes in general. I used just google disk and such. But now since I have been introduced to this app in a so easy way, then it is more applicable for me to use apps for my everyday academic life.

R: So definitely more if you continue to stay in Trondheim?

P5: Yes, yes, there is no doubt in that.

21 R: Do you have anything else to add that has not been covered?

P5: No, I feel that you have covered the most of it. Both positives and negatives. Maybe future, if you want to develop it in the future. That would be interesting because I find it a finished product, and it is good, but it needs couple of version 2.0, 2.5. You can always update everything all the time, but it is a really good first app. It is like a high standard for a first app. And I think that it would be smart of the university to incorporate into its information base, to reach more of its students in different ways. Not only through brochures or Internet or whatever they do. This would be additional point to reach out, not necessarily to what you intended the app to be. If you make it larger and bigger it could be much more. So it is a very smart concept.

R: So you would say it has a potential to be bigger?

P5: Oh yes.

R: Anything else you would like to add or that crosses your mind?

P5: No.

6 Participant 6

1 R: What are you currently studying at NTNU and what year are you in?

P6: I am first year student in bachelor of English. It is not my first year as a student in Trondheim.

2 R: Generally, what is your view of the usage of mobile apps?

P6: In general, I think that they are very good ideas and tools for people. I strongly believe that they are quickly becoming a second part of the human nature to use mobile phones, smartphones and therefore all the apps on these phones. So that is kind of the second nature for people, I would say.

R: So you are saying that it is more and more natural to have these tools, we are kind of evolving into them?

P6: I think so, and I do not think people consider whether or not they should use apps. They consider apps which they should be using.

R: Anything else you would like to add?

P6: No.

3 R: And what about apps used for educational purposes?

P6: Like if you have an educational plan or curriculum. I believe you can use apps as a supplement. And I strongly disbelief that you can use it as, that alone, as a way of learning things. I do not believe that is possible at the moment.

R: Anything else you would like to add?

P6: No, that is it.

4 R: What are the changes to the learning environment when mobile devices are integrated?

P6: I think you should be careful which group of people you integrate it with. I do not think children would benefit from it. I think that young adults and adults might be able to zone out the different aspects of what a mobile phone is. As an adult you might just be able to use it for the educational purpose and not as much games and Facebook and such. So depending on the group, I think it could be a good thing.

R: When we use mobile phones in, for instance in projects and classes or anything else, what do you think happens when we learn? Do you think we improve or is it distracting?

P6: I think it can be a tool, in the same way as the computer is a tool and a book is a tool. I do not believe you learn necessarily more or less by using it. It is more how you utilize it.

R: Anything else you would like to add?

P6: Not that I can think of.

5 R: In what circumstance do you use apps for education purposes?

P6: I have an app that I tried to learn some Japanese and I used it primarily on the go or when I am in bed before I go to sleep. Like in brakes, not as a main source of learning, but just in between.

R: So like informal learning?

P6: Yes, indeed.

R: Would you say that is where you use the educational app at the most?

P6: Yes.

R: Anything else you would like to add here?
P6: Well I could add that I have not experienced any courses that has integrated mobile phones as a part of their educational plan. And therefore, I have not experienced it in a formal setting, only used it myself in informal and such.

6 R: Tell me about the experience of using apps in the learning environment?
P6: I think this question could be singled into one specific app. I do not feel that everything can be called general here. I will only be commenting the ones that I have been using myself. Overall I have had positive experience with it but they have not been as effective as they could have been, I think. As I have said earlier, they should be a supplement or a tool to assist learning. Not the main source of learning itself.
R: Any other experiences that crosses your mind?
P6: Well, it is easy to use, compared to dragging along books and such. You can use it offline, you have your cellphone with you always, so that is a giant plus.

7 R: Can you describe a course where you used mobile devices for educational purpose?
P6: No, I cannot. As previously said, I did not have any.

8 R: Tell me how that is different from a course not using mobile devices?
P6: Well since I have not had a course with it. I cannot compare it, but I think that I can only think what it would be. I think the phone will serve to replace other aspects of courses that do not use the phone at the moment. And I would not necessarily add something new, they would just replace the old one. Which can be a good thing, I think. Depending on what is being replaced.
R: Let us say that a course has apps that they use, Kahoot or something else they can use a mobile for, would you say that for instance it is better learning with a class that has mobile phone as a usage or not? Would it for instance be more boring or fun or positive or negative?
P6: Programs like Kahoot are definitely more fun, so yes, I think that might serve as a… again it depends on the content of the learning app and what it is replacing. Because if it is replacing hangman then it is probably not going to be as fun. But if it

is replacing… analyzing pictures with actually looking at pictures on the phone and describing them using or multiple choice. I think that would be more fun, I guess.
R: Do you consider apps as a distraction in a class for instance?
P6: Apps like Facebook, Instagram, Tumbler and Tinder and gaming apps, yes definitely.
R: Anything else you would like to add?
P6: No.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?
P6: I have had a few projects where I did not necessarily use the app for it but I have been needing some of the functions. Specifically, Mazemap to find a room that had been booked. I think that is the only experience I have had in a group context.
R: Any other context you have been using it?
P6: Yeah well, I have obviously used it a few times to go on ItsLearning through its learning.
R: The link section. So you have used it on the go?
P6: Yes.

10 R: Have you used the NTNU mPLE in a course?
P6: Not necessarily in a course per say. But it has been more useful for me as a shortcut to websites that I would normally spend more time to accessing. Like Mazemap for instance, like I said earlier. And Room Reservation, that was much faster as well.
R: When you used the app was it any specific courses that you used it in, more than others?
P6: No, it was probably between courses.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
Question skipped, already answered that question 9.

12 R: Have you had any interactions with other students about the NTNU mPLE?

P6: I have not showed it to anyone, I think. No, unfortunately.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Based on previous question, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P6: I think people will save a lot of time using it. That would be number one. Students would use it as a tool to save time and also I think that many people will be happy to just have it all in one place.
R: Anything else?
P6: I do not think it would change people's studying patterns or something. I do not think it will have an effect on that. People would probably use it differently, of course, but I do not think it has a direct impact on studying, enhancement or routines.
R: Anything else?
P6: I think that is it.

15 R: How often do you use the NTNU mPLE app?
P6: I think maybe twice a week, approximately.
R: Have you used it more frequently sometimes than others?
P6: Well I have definitely used it more when I am at campus. I do not need when I am at home, if I am studying at home. As I have said earlier, I have mostly used it on the go.

16 R: What do you like about the NTNU mPLE app?
P6: Number one, it is quite easy to use. I like to point that out. It is a convenient tool, it has everything. Well, many things in one place. Easy accessible and I also like that some these links are significantly easier ways of getting to the content you want than the traditional methods. By saying that I mean, Course Help has been great and also the Links, for me. Like with Room Reservation and Mazemap, they have been great. I think the Contact list is a nice touch. However, I would not be

certain when to use it myself like opening libraries and checking opening hours and such. Because I know that even their webpages are not always up to date and I would be concerned that the app was not up to date as well. I could not be certain, I would have to go to the library and check out the door. But that is not necessarily an issue with the app, more a thought that crossed my mind. I think that is it, that covers it.

17 R: What do you not like about the NTNU mPLE app?
P6: I disliked that I have to enter my username and password every time I use Innsida and Room Reservation. That is the biggest issue for me with this app. I think if that was different, I would use it more often. The traditional way of entering these pages are faster, if that would be fixed, the app would be faster. I think it could have more links like to the library and to ItsLearning and the student mail. I think that is the main concerns I have.
R: One question about the To-Do List, did you it out?
P6: I have checked it out, but it does not really apply to me. I have just looked over it and I think it is a good concept for new students. I do not think like master students or even second year bachelor students would need it that much. So yes, I think it is a good tool for the first year students, I think. But it would have been advertised in the letter students get, otherwise they will do all the stuff and then they find out later that, oh there is an app for this, and go; I could have known this earlier.
R: Anything else you did not like?
P6: No

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?
P6: Well the main argument is that it is saving my time. It I has not changed the way I study or when I have to look up stuff or etc. It has just saved me time when I do it, I think.
R: Anything else?
P6: No.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?
P6: I would tell them this is a brilliant tool which collects a lot of the stuff you need as a student. It has links to the most essential parts of NTNU's user basis. And yes, I think it is convenient and easy to use.
R: Anything else?
P6: Yes, Course Help is awesome. Finding courses on the webpage is a harder, it is very easy in the app, I love it.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?
P6: I think if the app gets more refined, I would use it more. As it is right now, I would use it the same amount that I am already using it. I would use it for the same things I am using it for now. And if you would have added a few more fine tunings, I would use it for other things as well.
R: Anything else?
P6: No, I think that is it.

21 R: Do you have anything else to add that has not been covered?
P6: I do not think so. No, I cannot say that I have.

7 Participant 7

1 R: What are you currently studying at NTNU and what year are you in?
P7: I am technically not at the moment; I am at work. I started working since January but before that I was studying Master in Informatics, fifth year.

2 R: Generally, what is your view of the usage of mobile apps?
P7: I think they can be useful; I think there is way too many of them. I like apps that basically when I search for an app that does that functionality, I will get that app because that is how I use them. If I want the app that will record sound, I will search for that and I will find that. I am not the kind of guy that actively like pays attention to the market. I just take what I need in a way, I do not really actively look for something that is useful. A lot of them are good for entertainment but I do not really

use them like that. I am pretty sure other people do, play games on their cellphones. That is probably my opinion of it in general.

R: Anything else you would like to add?

P7: It is sort of interesting to have software in your pocket. It opens up for a lot of opportunities as a developer.

3 R: And what about apps used for educational purposes?

P7: I think they have potential; I think education is a good investment after all. And anything that would help that is a good idea.

R: Anything else you would like to add?

P7: No, as long the question was general.

4 R: What are the changes to the learning environment when mobile devices are integrated?

P7: They do open up some possibilities because it does mean that for example you can expect everyone to have an app or a smartphone in modern Norwegian sociality at least. Probably not in all countries, but in Norway you could kind of expect everyone to have a smartphone which means everyone has a small computer that can run these things in class. And you do not actually have to bring a computer when they need to do a simple thing. So, I think it can be used more, potentially. But people are not used to it and probably the ones who could benefit the most, which would be the actual professors. Teachers and professors who are probably lacking most in the technically ability to use this technology are the one that could probably benefit the most from them. For example, if they could ask; “does anyone not understand this?”. They could basically ask everyone to like answer that on the phone and then people would answer anonymously and do not have to say that I do not understand this. Which a lot of the time people would not say even if they do not know because they do not dare. Sometimes the entire classroom does not understand a thing and the professor asks these questions but no one dares to answer. Information back and forward between teacher and student.

R: Like information sharing?

P7: Yes, in the classroom in a way. There are plenty other opportunities, this was just an example I came up with now actually. It can also be a distraction, obviously,

I mean if you have a computer with you and you sort of check your Facebook. The technology is sort of neutral it is more how you are using it.
R: Anything else that crosses your mind?
P7: Not at the moment

5 R: In what circumstance do you use apps for education purposes?
P7: I suppose I do play for example puzzle games. It is sort of educational but in a different way, more like mind exercise. When it comes to education, I mostly use the Internet when it comes to that. Because there are not really that many apps will do the things that I am interested in. I know a lot people that use timing apps that will help them study and stuff like that. But I have never really liked to structure myself too much with these things. So I almost only use the calculator and the Internet.
R: When you have used these apps, is this like informal learning you have been using them or formal learning?
P7: No, never formal. Almost never formal. I never used apps, at least native apps. I have used like webpage apps like Kahoot for example.
R: So you have never used apps like for projects or group work or anything else?
P7: Personally not. I know other people do, but I do not. I kind of just like to not distract myself, to me they are a bit of a distraction.

6 R: Tell me about the experience of using apps in the learning environment?
P7: I mean, I like the Kahoot thing. That is kind of an app, at least in my opinion. Could be made into one. As a classroom thing, it kind of works because it sorts of gamifies the classroom in a way. It is something you kind of want to pay attention to, maybe even if the material is boring or dry or something. It does not work with everything, but when it works it works quite well, in my opinion. I suppose it is kind of nice to always have a calculator in a math class. But usually you bring your calculator anyways. You have also access to more powerful things with a cellphone than you do with just the calculator. For example, wolfram-alpha, that is sort of a webpage and not an app. I think there is probably potential for growth in it. Apps is a modern thing, smartphone is a modern new thing. So it has not really been fully explored yet. And I always found education to mostly be a traditional thing. They

would probably work well together but they are usually not well introduced, I find it to be.

R: But do you experience this like a positive or negative thing to have these apps?

P7: Mostly positive and as I said I do not use them as much as other people, but I do not see any problem with people using it.

7 R: Can you describe a course where you used mobile devices for educational purpose?

P7: It was an algorithm class that sort of used Kahoot to see if everyone has gotten the material. It is good feedback for the teacher and that is for sure. It is a bit entertaining and you sort of get a review of the key points of the lectures, I think it works in such a setting.

R: Any other classes?

P7: For example, if there is an abbreviation that I do not understand, I would bring up the cellphone and actually search for it. Mainly I have had IT courses, mostly used cellphones for searching and sometimes it is good to get the updated information if there actually is a class today because a lot of the times it apparently is not, the information may not be updated but at least you can check.

8 R: Tell me how that is different from a course not using mobile devices?

P7: There are a lot of traditional classes where the material is sorts of, too obscure to actually search for or Wikipedia would not help you. Then you usually go to book based learning and use those as references where the Internet does not help you that much. So usually it becomes a little bit harder to, after class, review the material. You do not really get that option because you cannot find the information you have to look for your book, you cannot actually search for the information by actually searching, you have to manually search. Look for the content and then like hopefully it will be mentioned there. A lot of the time I do not find it, maybe it is experience based learning because I am not really good at it. And it sorts of becomes harder for that reason, it becomes harder to actually get the right information. Even though the information you get, you can sort of trust a little bit more.

R: So you are saying that it is not an easy way to access content?

P7: Not easy to access but once you access it, you can sort of trust it more because you found it in a book that the professor has read and therefore would sorts of endorses that this information is correct, you can trust this information. While as looking at Wikipedia you cannot necessarily trust that it is necessarily true, it might probably be and it might probably even be simplified too much or something.
R: Would you say that those classes that do not have mobile devices integrated into the class are more boring or more distraction or?
P7: Not distracting, maybe less different. Maybe boring, that depends a way lot on the professor, I suppose. It is more dependent on how he as an orator. You are kind of more dependent on him in a way, since if he does not express himself well, you are sort of stuck in the water. You cannot really look at the similar thing on Internet, you cannot go to YouTube and find someone speaking about it there. Usually it is a positive thing in the modern technology.
R: Anything else you would like to add?
P7: I think I had something earlier, but I forgot it.
R: We can come back to that.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?
P7: I would have probably been most useful when I was a fresh student, to be honest. Because it has the hints of what you need to know in a way. Sort of just being there you know that it is probably useful. Then I should sort of have a thought about that while without it, the webpage has too much information to actually filter through, you cannot really read it all so you have to base it of your own assumptions about what you need to know. The problem there is that you do not know what you should need to know. So here it sorts of gives you hints as to what you could find to be relevant information or something to have an opinion about.
R: The question is more like where would you use this app, on the go or project or group work?
P7: I would probably use it personally, to sort of find the information that I need.
R: Anything else?
P7: Might be good way to get quick into the webpages I need in a way rather than like what was the URL for that and then I have to type that into google. I have an

example that I can use in the app. If I want for example to have course information and it sorts of gets me into the course information here, I do not actually have to go into google and search course information and NTNU. Much quicker to get there. Saves you a bit of time, because you can then bother doing it on the bus for example. So yes, I would use it a bit more on the run.

10 R: Have you used the NTNU mPLE in a course?
Question skipped since he was working, he did not participate in a course.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
Question skipped based on previous question 10.

12 R: Have you had any interactions with other students about the NTNU mPLE?
P7: No.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Based on previous question, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P7: They might become dependent on it in a way. If they use it, they will be used to use it that way and then depend on it being that way. So they might even forget how to do it without the app. But I think they would after the experience know what information was there, not necessarily the information but they know what they could actually find on the app and what they cannot because it does not contain all the information. For example, what is the email address for that faculty, I need to contact my faculty. So I go contacts, faculties and find my faculty. While if they were completely fresh, they would sort of think does it have that information, where would I find that?
R: Any other impacts or changes you can think of?

P7: Hopefully they would be more aware of the information that is necessary like for example the FAQ. Maybe they would be more aware of the deadline for when picking subjects. Because there is a problem with the information flow in NTNU, that is for sure.

15 R: How often do you use the NTNU mPLE app?

P7: I think to me it would be more irrational use. I would not use every day, I would use it a lot more in the start of the year and less in the middle and then a little bit more at the end in a way. That is sort of when you need the correct information and in the middle you are just focusing on the course. But at the start and the end is when you need the other information. That is when you need contact people and find out which courses you need and when do I apply for them and how do I apply for them.

R: So you would rather say in the start and in the end?

P7: In the start I would use it every other day, in the middle I would probably never use it at all or maybe just see when the library was open, but not every day.

16 R: What do you like about the NTNU mPLE app?

P7: It starts quick which is nice. I do not have to log into anything or anything like that was just nice. It is easy to install. It is quick. It has a simple overview. When I get in there, I can sort of like mostly guess what is under the different things. It has most of the relevant information. Cannot have all the relevant information, because that depends on who you are. Generally, it has a very good overview, it is very easy to use, flows well and it is responsive in that sense that it sorts of like just works how you expect it to. Sometimes it surprised me a bit that I suddenly was in a browser in an app. A bit unexpected there. I expected that I would open my Android browser and sort of run from there. So unexpected, but it is mostly ok if I wanted to go beyond here. For example, if I access the URL bar I could go further. I would probably like it the other way around, personally. Mostly of the visual is pleasing, nice color scheme not too fancy. It changes based on where you are which is nice, make the user remember a bit more, associate in a way.

R: So like color coding?

P7: Yes, exactly.

R: Anything else?

P7: No, that is it.

17 R: What do you not like about the NTNU mPLE app?

P7: It is a little bit confusing that you sort of have black and white icons mixed with the company icons. For example, in contacts, faculty has black and white, libraries have black and white while Oracle service, student service, Akademika are sort of like mismatched in a way. Other than that, I had problems finding the delete button in the To-Do list. The options thing, I did not know it was relative to the content. Because seeing it as it is in the menu, I am used to that being a general context. Anything that is in the menu bar is only a header or general operations. If it is outside, it then I would think it would be. If it was just moved a line down or so or used an Icon, I might have found it directly. Because it is in the menu bar and it is actually context based, I did not think it would be there. Other than that, I think I have said it.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P7: If it was like a last year, a little bit less. But if I was a bit earlier, a bit more. As I said earlier, I find this much more useful when I was a new student than an old and experienced student. I mean it would have access to the information a little bit simpler, just makes it easier for me to actually do it. It is so easy that I actually would do than rather not.

R: So if you were on the couch, you would rather use the app than use the computer?

P7: Yes, for example can I make it to the library now and I do not want to search for it.

R: So it is easy just to reach out for the app?

P7: Yes, it makes it much more accessible.

R: Any other impacts that you can think of?

P7: If I was in my first year, it might have helped me stay informed. For example, some of the information from the FAQ is something that I probably would have

used. I think that I managed mostly through people telling me, but word of mouth and you know that is never a guarantee.

R: Was that all?

P7: I think so.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?

P7: If I would recommend the app, I would do that based on the app aggregates the information, collects it. Sort of like, I do not really like the NTNU webpage because as I said it is too much information there and I cannot really search for it, because sometimes I cannot really find the relevant information. So it sorts of that I would say, it is useful because it contains the information and that is what you mostly need on the go. Like for example, when can I eat.

R: Any other recommendations?

P7: That is pretty much it.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?

P7: If I was still studying, I would probably use it less and less because I would need less and less information. But it would be sort of like easier to use it because I already know what is there and what is not, unless it updates and changes it all the time. I would probably use it less because I need it less, just for that reason. But it would be easier to use. I might use it to remind myself sometimes, like what was the date for that again? Maybe I would use it more because I would not bother remembering more.

R: Anything else you would like to add there?

P7: No, I think that is fine.

21 R: Do you have anything else to add that has not been covered?

P7: Probably not, no I think it is good.

8 Participant 8

1 R: What are you currently studying at NTNU and what year are you in?

P8: I am finished studying informatics. I got a bachelor degree in informatics and that is my study history.

2 R: Generally, what is your view of the usage of mobile apps?
P8: I only have good experiences with mobile apps. They make things way more convenient because I usually carry my phone around all the time. And most of the apps that I have used have not been very intrusive or knowing. I do not use the Facebook app because then it would be pestered by notifications every time someone gives me a message and stuff like that. But most of the apps I have been using have no similar functions, so I am really happy about my apps.
R: Do you use apps generally very often?
P8: Yes, but mostly like game apps. I use like AtB bus and tram service app.
R: Like a transportation app?
P8: Yes, and I use SleepBot, which is an app that makes me able to see how much sleep I get. That is the most important apps that I use.
R: Anything else you would like to add?
P8: Not really.

3 R: And what about apps used for educational purposes?
P8: I have not really been using that many apps for educational purposes. There was a time when I was studying Japanese and I installed some apps for that purpose. But I did not really use them enough to make good use of them. I do not have any education apps other than your app.

4 R: What are the changes to the learning environment when mobile devices are integrated?
P8: I would say it is either easier to come involved or it is easier to be distracted by other things happening on the phone. One way I really like the inclusion is Kahoot. I think that is a really nice educational way of getting people using their own devices in the learning courses.
R: So you are kind of saying, since you said it is easier and Kahoot was very good, do you see it as a positive thing to the learning environment?

P8: Yes, I think it is a positive thing as long as the people are using them for the right reason. If they are involved and the apps they are using are actually educational, then yes that is a positive thing.
R: Anything else you would like to add?
P8: No, not really.

5 R: In what circumstance do you use apps for education purposes?
P8: I think that I would use them for remembering stuff. Like the To-Do list on the NTNU mPLE, I think that would be something I could use. I check my phone very often, so there is a way easier for me to just go to that app and look up what I am supposed to do or stuff like that. I think I would use an app like that on like during public transportations that would be very good to use educational apps. Maybe less so when I am actually studying like in a group or something then it would be like trying to have more focus on studying, I guess. I think I would use them more in on the go environment. Not as much in the classroom unless it is like Kahoot or something that is very much integrated into the learning experience.
R: Anything else or any other places you would use it? Like any apps, does not need to be that app.
P8: Like more when I do not have a very long time. I do not sit down and study for 20 minutes but I could use an app for 20 minutes for when I am on a bus or a tram or if I am 10 minutes on the toilet or something.
R: So, it is more like that. So it is kind of when you would like to save time?
P8: Yes, otherwise I would spend that time doing stuff that is not as productive.

6 R: Tell me about the experience of using apps in the learning environment?
P8: The only one that I can think of is Kahoot and I have had a very nice experience with that. Because it has been something that works right out of the box and it is very fun to do a quiz in that sort of environment. I kind of like how you get points for answering correct, and the fastest and getting the score board. It is like a competitive gaming experience of it, and I kind of like that in certain cases. I kind of would not have that as if I would get an A or B, I would not have Kahoot grade me like that. It is just for fun. I try to remember key questions and key concepts.
R: Anything else?

P8: I have not really used that many educational apps. Like I said, I tried out some let us learn some Japanese stuff and I did not really get a hang of it. I was kind of hoping to use them for drawing Kanji to recognize for me, but it did not really work out. So I did not use them.

7 R: Can you describe a course where you used mobile devices for educational purpose?
P8: Kahoot was mostly used in Web Technologies and it was used in information security. That is about it.

8 R: Tell me how that is different from a course not using mobile devices?
P8: In a classroom setting, depending on the size and how interested the students are in the subject or how interesting the teacher is or professor. It really depends on the setting. But in the experiences that I had, I found out that everyone has used the app or tried to participate in the quiz and there is less of that when there is a regular class. Like more people get easier distracted by other stuff, myself included.
R: So you believe it depends very much but it can be a distraction as well?
P8: I do not think educational apps can be a distraction, but I think it really depends on if the whole class is doing it, then it is not a distraction. If the class is just disinterested then it is not the fault of the mobile app, just that the class is disinterested.
R: Would you say that a class that do not use mobile devices in a class is more boring or less attractive?
P8: It really depends on what they are using it for. I have really only used Kahoot and that is a quiz and that is a very fun thing in certain areas. So that is a very fun experience, it is a gamified quiz and there is a competition and stuff like that. So I would say the classes that I have been in that did not use Kahoot have been less exciting but I would guess that they have been more about the actual learning. Kahoot has been more, what have you learned. So it is kind of different.
R: Anything else you would like to add?
P8: No, not really.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?

P8: Since I am not a student right now. I have not had the need to use it for actual educational purposes. I have mostly been using it to see like what kind of services it includes. It has been more like to explore the app and during the exploration, I kind of found that there is a lot of stuff I wish I knew when I was starting.

R: If you were a student, what would you use the app for? Where do you think you would have used it? Group work or like projects?

P8: I guess I would use in stuff like groups or projects. Maybe homework assignments and stuff like that. Because I was never good at using ItsLearning, I was not a fan of that or Innsida. I was not a fan of logging into that and spending time there because it was not really anything interesting there, it was more like a chore to go through every page and find out what was I supposed to do and stuff like that. So I really think that I would use it more for like keeping track of what I am supposed to do and stuff like that.

R: Anything else?

P8: Not really.

10 R: Have you used the NTNU mPLE in a course?

Question skipped since he was not a student this semester, he did not participate in a course.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?

Question skipped based on previous question 10.

12 R: Have you had any interactions with other students about the NTNU mPLE?

P8: No, not really. I have not talked to any other students using the app because I am not a student. I guess if I was a student, then I maybe would have recommended it to others. At least to newcomers because I think it would be kind of helpful.

R: Something else you would like to add?

P8: No.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Based on previous question, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P8: I guess, for me, it is possibly that it could have made me be more structured and given me a better heads-up. Mostly the To-Do list because the other stuff is more like something that I would use maybe once or twice.
R: Just to keep in mind, it was impacts or changes other students would have.
P8: Yes of course, I think it would make them maybe a bit more structured if they were not already. It would give them more information than what they had before if they spend a little time with it. So yes, I think most people would do that.
R: Anything else?
P8: No, just that it would change them to a bit more structured.

15 R: How often do you use the NTNU mPLE app?
P8: I downloaded it in early April or late March. I have not been using it every day. There has not been any point for me using it every day, so it has been more like that I have used it a few times. Maybe like 40 minutes in total over of a month, I guess. It has been used to find out what is available to me.
R: If you were a fresh man, how often do you think you would have used it, like once a week or less or more?
P8: I think I would have used it more than once a week. Mostly to check the To-Do list and update that. The first week I would probably use it a lot to figure out where stuff is and what the courses is about. I think I would use that a bit.
R: How about later in the semester?
P8: Later in the semester, I would have used the To-Do list and I guess when remember the finals. Then I would use it a bit more to read up about the courses and stuff like that. I am not really sure how much, like in the middle of the semester, other than the To-Do list that I would use very much.

16 R: What do you like about the NTNU mPLE app?

P8: I like the color scheme. I like the clarity. It is very easy to see what the app does and where to go to figure out stuff. Contact gives me faculties, libraries, Oracle service and stuff like that and that is useful. Links, I was not sure what that would be about, by clicking it gives me very relevant links and that is appreciated. Course Help is really useful and of course the To-Do List. I really liked the simple layout of it all and how each different main page has a different styling in colors. So that you can see in which page you are in. I am really happy with the style of it all and the text is very clear, the icons are very big. I liked the To-Do list, it is very easy to use. Like type stuff and check out when you are done. It is a really nice feature. The Course Help is very helpful; it gives a lot of information that would be tedious to search normally. I liked the Contact page, I really like that it is all right there and that I do not have to go to different pages or different subpages. Like SiT, if I would like to find a nurse on Gløshaugen, it just says right here. If I were to go to sit.no, I would have to browse around to like nursing and then Gløshaugen and then if I want to find what the contact is for the "SiT Canteen Hangaren", I would have to go back or something like that. So yes, this is just easy to just press once and read the stuff and then go back. Links, more than being nice information style thing, I am not sure how much I would use it.

R: Excuse me, are you talking about what do you not like about it now?

P8: I am not sure. It is kind of both. It is not that I do not like it, just more that I would not use it that much. I liked that they are there, it is nice to have those link, but at the same time I do not really think that they are as simplified as the like SiT example which is way clearer in how much help it gives, how much simpler it is to use your app instead of using their page. It is very nice to have them, so I guess it is a positive thing. I like the responsiveness. You get A+ for that, I have not noticed "laggy" stuff, it all works. Yes, that is the most what I can say about the app.

17 R: What do you not like about the NTNU mPLE app?

P8: There was not much that I do not like about the app. I do not really think any of it is annoying or there is nothing I really did dislike about the app. It is all very clear and there is nothing that I can complain about. It is all very relevant stuff. The most that I can say about is the color choices. Some of the choices I am not a fan of but

that is basically it. I do not really view it as anything that is very negative, it is just the most negative I can think about.

R: Anything else?

P8: Not really.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P8: I would probably use it a lot for the To-Do list. For this was something I have been thinking of having when I was studying. I was thinking of making my own, like having a desktop notification or something like that and linking it up with a phone or something like that. But I really never did. I think that the To-Do list is something that I would use a lot. It would make me more structured, I guess. So I know how much work I have to do that week or important meetings or something like that. Other than that, the links and course help and the contact information is very helpful, when and if I would need such information or links. So I would probably use like the Room Reservation in Links maybe, if I was using the phone. Because it would probably be easier than using the web browser. So I kind of like that.

R: If I can ask, do you think it would change kind of your behavior by using the app?

P8: Maybe I would be more structured. Like knowing how much work I have to do would make me more like "oh shit, I have to do this and this". So I would have to set up some time for it and then I could just go to Room Reservations and reserve a room. I guess that could have a positive impact on my structure.

R: Anything else?

P8: Not really. I think it would be positive overall.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?

P8: I would tell them it is not going to be like everything you want in an app but it is going to be what you need in a basic app. I would recommend them the To-Do list, I would recommend the links and the Course Help, the Contact information to the various…. like Akademika and SiT and stuff like that…When is this open and when

is it closed? …. And like Mazemap. I would recommend it to any student going to NTNU, at least here in Trondheim. I would recommend it, because it is a very nice app to get information from. The To-Do list is very nice and handy.
R: So generally, you would tell them it is kind of timesaving, to find everything in one place?
P8: Yes, it is a timesaver and it can make you more structured. It can give you more time to focus on what is important.
R: Anything else?
P8: Yes, it is easy to use, you do not need a tutorial to use it. You can instantly figure out what the different stuff do and it is not really resource heavy. It does not use much resources and it does not have annoying notifications or ads or stuff like that. It is very easy and simple.
R: Anything else?
P8: That is about it.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?
P8: If I would study, I would definitely use it more. Because it is something I wish that I had when I first started out at NTNU. Because it is a very nice app and I would definitely have used it more.
R: Anything else you would like to add to that?
P8: Not really.

21 R: Do you have anything else to add that has not been covered?
P8: Other than what I think could improve the app, then I do not really think there is much other. I think the questions have covered the most that I can say about the app as it is.

9 Participant 9

1 R: What are you currently studying at NTNU and what year are you in?
P9: Electrical engineering and I am doing my bachelor thesis by now.
R: And what year are you in?
P9: Third year.

2 R: Generally, what is your view of the usage of mobile apps?

P9: It is our standard interface, mobile devices. That is kind of necessary. The option is a website but now you have to go through a browser. There is not everything you can program to run in a browser or make sense running in a browser. It is hard to get your hands on the google API and stuff. I mean that is why you use apps. That is my argument or against apps basically.

R: Do you consider apps as a positive thing?

P9: Well yes, it enables you to tailor your mobile device to your specific needs.

R: Like a customization?

P9: Yes, instead of having a giant operating system with built in applications.

R: Anything else you can think of?

P9: I think it is an improvement because we do not have to go to a website to download and install all programs on a desktop computer or a laptop. It is just through google play or apple store.

R: Do you consider it more in general like a practical thing?

P9: Yes, it is a practical thing. For me, I do not care about esthetics when it comes to mobile apps. Sure, there are limits, but in general the concept of an app is not an esthetical thing.

R: Anything else you would like to add?

P9: Not really.

3 R: And what about apps used for educational purposes?

P9: I have not used that many. There are certain tools, I am in engineering and there are certain apps that you can download and do a lot of calculation for you. Makes stuff a lot easier. But it also hinders your academic development because you are supposed to learn all the calculations that lie beneath the app. Until now, I have not really used an app for education. Until your app.

R: Anything else you would like to add?

P9: When I am trying to study something, I am usually at a desktop. A desktop is a lot easier to interface with when learning. A mobile app, I do not find that convenient.

R: Anything else?

P9: No.

4 R: What are the changes to the learning environment when mobile devices are integrated?
P9: It is a benefit that you can do it wherever you are. If you got the time and you need to do some quick study tests. Then you could pull up an app. In a classroom, I do not know. It would be difficult to make something that really works with the pedagogy. I do not know, I have not used apps in a learning environment. So I can only imagine. I do not think a mobile device is that of a good interface. It is what we got now but with the VR technology and stuff, now it makes a lot more sense for applications for learning.

5 R: In what circumstance do you use apps for education purposes?
P9: I used an app to engineering calculations in a project. But that was not related to school work and it is a lot easier, you save a lot of time and you do not need to wait through a lot of long pages looking for the information you need. It is just there, it is condensed and kind of have all the calculators you need. So yes, it works good but inside academia it is a bad idea. Outside it is a really good idea.
R: Any other circumstances you have been using apps for educational purposes?
P9: No, not really.

6 R: Tell me about the experience of using apps in the learning environment?
P9: I do not really know. I have not used so many mobile apps. I am so accustomed to just go online on a laptop or desktop. Because I find reading a lot easier on a larger screen.
R: So you would say it is inconvenient as you are telling me now?
P9: Yes.
R: Anything else you experienced?
P9: No.

7 R: Can you describe a course where you used mobile devices for educational purpose?
P9: Not in academia, no.

8 R: Tell me how that is different from a course not using mobile devices?

P9: It is probably a lot easier to keep the attention of the users. Because as the education is today, you are dependent on really good educators to be able to hold the attention of students. And if you have a well-developed app, that could work.

R: So classes using good apps keeps the attention of the students and you are not so dependent on the professor?

P9: Yes, it is a bit of a weak statement, but yes that is what I am saying. If you have an average teacher and a good app, I am hoping that the good app could pull up the level of education to a higher standard. And especially if you have poor teacher because you have to go elsewhere to get the knowledge you need.

R: Would you say that the course, using mobile apps, could give more distractions?

P9: Yes, absolutely. If it is not really good design it is easy to make a distraction out of it. But I mean, if it is an app for education purposes you could make a distraction but it could be a good thing too. The best kind of learning is you are just off on your own and learning by yourself, not getting the information fed through a teacher. I mean, if that teacher does not interact with the student then you could just as well watch a boring video or read some text.

R: Do you consider, using apps or not in the classroom, a possibility to some kind of information sharing or other types of communication or something?

P9: I guess if the students have assignments where they gather data or they have to output data and they can share it and see that it could be valuable information. You now have a sample size of a class, so you have data.

R: Anything else you would like to add here?

P9: I do not know. What we are trying to achieve is to get the students to interact with each other. But I do not think a mobile app is the portal to do that. I think standard social network sites does that job better because if you are not interacting, like person to person, then you could be drafting across Internet with a person in France or Spain or Germany. And then it does not make sense to use an app anymore. Depends on what the app does.

R: You have actually summarized very much of it, do you have anything?

P9: Honestly, I do not think it is a valid question because whether a course is good or bad is not really dependent on if you use an app or not or if the course is good or

bad. If you have a bad course and have a really good app, then yes the app is going to help a lot. But if you already have a good course, I do not think it is going to help. It could be worse.

R: So it is very dependent?

P9: It is dependent, I mean. You need to really tailor an educational app into the learning environment.

R: Anything else?

P9: No.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?

P9: I have to be honest, I have not used it that much for the education because I am now at the end of my education. All that information that is stored, well most of the information that is stored in the app, I have learned or have used. But I can imagine as a new student. It would be a lot of help. On the first day, when you do not know up from down and left from right, you got that beautiful app to navigate all that important information. The due dates for the semester fees, on when you can enroll in the classes. The current system of websites, it is not that easy to navigate. It is a lot of information that is spread across a lot of pages.

R: Just one thing, we were talking about educational activities, if you would have used it as a freshman, would you use it in a project, group work or any other circumstance?

P9: No, not really. It is an information gathering app or an informational relaying app. So I would not directly use it to learn something other than course information. It is that information that you need.

R: Anything else you would like to add?

P9: No. I guess we will get to it in the next questions.

10 R: Have you used the NTNU mPLE in a course?

Question skipped since the participant was just writing the Bachelor's thesis. The participant did not have any courses.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
Question skipped based on previous question 10.

12 R: Have you had any interactions with other students about the NTNU mPLE?
P9: No. But I can see myself doing it if I was a first year student.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
Based on previous question, there was no interactions.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P9: I think it will have a quite significant impact actually. Because the information is right there and it is fast. When you are a new student, you do not know what to look for, that is one thing. I mean, you do not know what to search for. In that app, it is already listed. So you see, ok this is the information that could be useful for me to learn. Or read, so I can just read it. On websites full of information that is scattered all around. I mean, it is difficult to get an overview of what information there is. And A lot of people are shy and do not want to ask people for help. So when you are stressed out and you need that information, it is right there. If you are wondering what courses you need to take and everything, it is there.
R: So you are saying that the students could be more structured or have more control?
P9: Yes, more structured. Especially with the To-Do list and the overview of the information that is available and the contact information is also important. It means that you are three clicks away from a phone number you can call and talk to somebody. If you wonder if the library, a certain library has a certain book, that is a just few clicks away.
R: Any other impacts or changes students will have?
P9: Well yes, I think reduce stress as a physiological change. Because when you are stressed, I remember when I was, it was difficult to find this information. It was scattered all around the place because you are not structured.

R: Anything else?

P9: I think I summed it up.

15 R: How often do you use the NTNU mPLE app?

P9: Once a week.

R: Do you think you would have used more in the start of the semester?

P9: Definitely. At the start of the semester, the first year. Probably would use it a few times a day and then it would taper off afterwards.

R: So like in the end of the semester you would not use it so much?

P9: Well then I would use it again because then you have all these questions about the exams and stuff and rules around the exams.

R: So like very important in the start and then maybe in the middle it is not so much, but in the end it would be used more often?

P9: Yes, but it is still useful in the middle, but not that much.

16 R: What do you like about the NTNU mPLE app?

P9: I like the Course Help, the FAQ page. Which is really good. You have summed up the most useful questions and answers and it is three clicks away. So that is really great. It works fast. The Course Help when you reach the courses, it is slow but still you have access to all the courses on NTNU. Which is often useful. You need to look up the course code, that can be hard to find. The Contact page, I really like because these are the domain of student life basically when it comes to the university. The Contact page, you do not need to go to the browser and search for stuff, it is there. You get it fast, so I like it. It works. The To-Do list, I really like that it is filled up with the 5 most important things you need to get done in the start of the semester. I do not think I would use the To-Do list that much after I am done with these four or five things. I do not know if the item 5 “check your assignment deadlines on ItsLearning”. I think I would have used another to-do list.

R: Let us talk about the positive things first.

P9: Positives, yes. The To-Do list is a good idea. It works. I just figured out a new feature. Yes, I would definitely use this more if I had it when I needed it. I just figured out that you could check off which student year you are in. The Links, I

have not used Kahoot and Mazemap and I have never used Innsida either. But the Room Reservation that is a nice touch.

R: Anything else you like?

P9: Well, it is esthetically pleasing. It is simple and elegant and it is fast, which is exactly what you want with this kind of app. There is no unneeded information, it is all stripped away. I think that is it.

17 R: What do you not like about the NTNU mPLE app?

P9: At the courses section. Subjects from previous HiST, if you click on that you will have a hard time because you cannot zoom in on the page. And when you go to a course you cannot zoom there either.

R: You are the first one that has actually mentioned it, this is very interesting, tell more.

P9: I mean, you need to be able to zoom in on the information, otherwise I could barely make it out if I put the phone to my eye.

R: This is actually the most major issue so far. I have not actually tested that out.

P9: Also, it is not divided into sections like the different programs like electrical engineering and all the engineering courses or the humanities courses and stuff like that. But it is alphabetical, but it should be sorted according to the campuses and stuff because usually you do not really know exactly what the courses are called.

R: One thing, I do not actually code how that should be stored because this is directly from the NTNU page. So I cannot do anything there.

P9: I see.

R: But of course, I agree that you should be able to zoom there at least. Anything else you found that was annoying or that you did not like?

P9: No, not really. Other than that bug, there was nothing that I found annoying.

R: Is it anything missing that you think should be there?

P9: There is a lot more information that students could use. The different programs that exists for students that need extra help, that suffer from like bad mental health and stuff. There is a lot of programs for them. The different programs that SiT has that is available. And more information on SiT. And maybe some way to get access to other student's experiences because you learn stuff and you learn what corners you can cut, what part of the system that is not that rigid and not that scary.

R: So you would request more like a review system or something?

P9: I do not know, what would a review system do?

R: Like you can rate the course, you can actually describe the course or the experience.

P9: That is a good idea. Just so you can get another student telling you, sharing their information and their experiences.

R: Anything else you did not like or was missing?

P9: I do not know if this is the app should do this, but the ability to ask more complex questions. Like a portal where you could ask other students if you have a problem.

R: I had a plan to have a forum, would you like that?

P9: Yes, sort of forum. I do not know if the old style forum is applicable or the newer kind of news feed style. Or any kind, that would be a good idea.

R: Anything else?

P9: Not really. Oh yes, the ability to cache information, I guess. Yes, that is it.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P9: If I was a freshman, then this app would be applicable for me. Because then I would not have to worry that much. Because I worry easily. So this would be a big help to get the information I need without having to go through a lot of hoots. The easier it is to get the information the more likely it is that I will go look for it, which is really important. When you are down and you need the kind of help that this app can give you, then you are more likely to use it.

R: Any other impacts or anything else that could change after you have used this app? You mentioned something earlier about being more structured in your everyday life?

P9: The structure would probably come from you actually knowing the information that is there because you bother to read it. So you can get more structured. Anything that you need to do in the beginning of each semester, but usually it is only the first one or two semester you need it. But it can answer a lot of the questions you have about the exams. I mean, the first semester you have so many questions.

R: Anything else?

P9: Well, I would a lot less stressed.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?

P9: This app has all the information you need. Almost all the information you need. All the basic the basic stuff you need to find, you get it. And you should use it. It is valuable.

R: Anything else you would like to tell them or recommend?

P9: No, just use it. Download and use it, right now.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?

P9: I do not think, maybe I would use it if I were to continue to a masters. But I am at that point where I probably will just go…I am now more inclined to just go look after and seek after the persons, the professors or whoever it is directly. Just call them or whatever. When I was a first year student. I was all nervous and stuff and did not want to talk with the professors and stuff. Then this kind of app would be really useful. So probably not.

R: So if you would go to a master, maybe more or not?

P9: Yes, to check out the courses and stuff. That kind of standard information. But all the questions that I have had that are answered in this app, I already have the answer.

R: So for every year that goes, you would use it less?

P9: Yes, probably. Because then your questions are more complex and you will not be able to fit them usually inside this app. Unless you have a forum.

R: Anything else?

P9: No.

21 R: Do you have anything else to add that has not been covered?

P9: No, I think I got it. It was the bug with the courses and the forum where you can ask questions or get other student's experiences.

R: Anything else?

P9: The To-Do list, I would probably not use it outside the listed items. Other than that, I mean it looks good and it is simple to use. So that is it.
R: Anything else you think I should ask you or that has not been questioned in this interview?
P9: The typical question “how did you feel when using it”.
R: How did you feel when using the app?
P9: I mean, I would say I feel good because there was not any like, other than the courses, there was not anything that would give me any negative emotions. I was not annoyed about anything other than that bug.
R: Anything else then?
P9: No.

10 Participant 10

1 R: What are you currently studying at NTNU and what year are you in?
P10: I am in the second year, at the teacher education.

2 R: Generally, what is your view of the usage of mobile apps?
P10: In general, I think it is very both time-consuming and you can save time by using it. It depends what kind of apps you are using, of course. If it is a well-made app. You will save time by using it, for example.
R: Anything else?
P10: I think it is handy because you can always make plans for example. It is easier to work for any location. Yes, and I think mobile apps are going to be more and more used in school because I can see more of it in my profession. That is it.

3 R: And what about apps used for educational purposes?
P10: I think there is a lack of apps for educational purposes. I think there are a lot of apps that you can plan your education and study time. But now actually how to study or find material, to memorize things. For me, for example, there is no app for Norwegian grammar, Bokmål and Nynorsk. So I think the future holds a lot of educational apps. That is it.

4 R: What are the changes to the learning environment when mobile devices are integrated?

P10: I am not sure how to answer that question. I think it is more about self-learning. You have a responsibility to find the right app that suits your learning. I would say it depends on how old the students are. If you are using an app from 1-10 grade, for example. Then it would become a disturbance. But after 10 grade, the students are more caught up in getting good grades and will therefore use the mobile device that they are allowed to use.

R: Anything else?

P10: I think with the right mobile device or app, it would definitely be a positive influence on the learning environment. The problem is just that there does not exist really good programs yet.

R: Anything else?

P10: No.

5 R: In what circumstance do you use apps for education purposes?

P10: I would say I use it for my personal study. When I am studying by myself. Because then I make plans or lists about what I am going to study. And I also use the app, for example, after a lecture. When the teacher uses the Kahoot app. I think that is it. Personal and at school.

R: Would you say that you use apps for educational purposes more on the go or in school?

P10: Both.

6 R: Tell me about the experience of using apps in the learning environment?

P10: I think perhaps the best memory of using an app in a learning situation, is actually Kahoot after a lecture. Because then you can repeat what have been said and that leads to discussion on a question that has been asked.

R: Anything else?

P10: I have had good experiences with apps that are created to organize. Because that makes it easier to delegate to different tasks when you are in a group assignment. Yes, that is it.

7 R: Can you describe a course where you used mobile devices for educational purpose?
P10: We used Kahoot in two subjects, that is pedagogic and Norwegian. And yes, that is it. We do not use any apps in other courses.

8 R: Tell me how that is different from a course not using mobile devices?
P10: I would say it is much more fun to use apps in lectures. And you also learn much more.
R: Why would you say that you learn more?
P10: Because when you are in class and you know in the end that there is going to be a competition where you use the app. So you have to pay attention.
R: Courses using mobile apps, do you find them more distracting than courses that do not use mobile apps?
P10: It depends on the age group. I think the younger the students are the more time you would use, to start the competition or the Kahoot. But if the class is used to using different apps, then it is kind of a routine, then you it would not be as a distraction.
R: Anything else?
P10: No.

9 R: What kind of educational activities (projects, group work, etc.) have you done with the NTNU mPLE?
P10: I have used the To-Do list to make plans for my own study. I have used Kahoot in the classroom with my fellow students. Yes, I think that is it.
R: So you have not used it in a project or group work situation?
P10: No, but I would have. For example, Room Reservation is excellent because then I can make a room reservation for the group. And I also used it also to find the information when the library was open, because I had a book that I was supposed to deliver and pick up. Yes, that is it.

10 R: Have you used the NTNU mPLE in a course?
P10: Yes, I did. I have used it in my pedagogical courses.
R: Any other?

P10: No.

11 R: What type of activities (projects, group work, etc.) did you use the NTNU mPLE app for in your course?
P10: I did it in a class when we used Kahoot. I used it in a pedagogical lecture. That is the only time.

12 R: Have you had any interactions with other students about the NTNU mPLE?
P10: Yes. I told everyone about the app. It is a really nice app. When I showed them the app. They were like “oh nice, I loved the concept of the app”.
R: Anything else?
P10: No.

13 R: Tell me about the student interaction with the devices — what educational related activities did they use it for?
P10: They said that they would probably use the Kahoot, To-Do list and that all the most important tools are gathered in one app. Because it is so much easier than the NTNU webpage. I do not like that page. So everyone said that this is the kind of app they need to get through their education on NTNU.
R: Is it anything else that crosses your mind?
P10: Yes, there is actually one more thing, the people that I was speaking with told me that NTNU should give you money support to complete the app.

14 R: After using the NTNU mPLE yourself, what impact/changes do you think other students will have after using the NTNU mPLE app?
P10: I think this app is mainly targeting the first or second year students. It is a lot of information that the teachers do not tell you. But you have to learn by yourself through your life experience. But with this app you learn everything from day one. Because you have all the tools that you need.
R: Any other impacts or changes you think other students will have after using the app?
P10: I think this opens the door for using apps active in the courses.
R: Was there more?

P10: No.

15 R: How often do you use the NTNU mPLE app?

P10: I did not use the app a lot. Perhaps twice a week. I think if you made the To-Do list more advanced with an alarm or deadline. Then I would use it probably every day.

R: Would you use it more in the beginning of the semester than the rest of the semester?

P10: Probably more often in the beginning, but I think also if you make those changes that I was talking about. Then I would use it every day, no matter what.

R: More that you want to add?

P10: No

16 R: What do you like about the NTNU mPLE app?

P10: I like that it is simple. It is very easy to maneuver in. It has all the tools that you need. It responds very well. The design is very clean and simple. Yeah, that is it.

17 R: What do you not like about the NTNU mPLE app?

P10: I do not like the To-Do list, it is too simple. I would like to have an alarm function. Like deadlines that I can add. And I would like an ItsLearning button. Perhaps, just for fun, you can make your own personal NTNU mPLE colors. For example, if you are a girl, make it pink. If you are a boy, make it green.

R: Anything more?

P10: No, I think that is it.

18 R: What kind of impact does the NTNU mPLE app have on you in your everyday academic life?

P10: Well, I think if I got it the first year that I was studying. Then I would rely more on it. But I have already a routine on my academic life and it is hard for me to change. I think at the start of the next semester, I will use it more regular. So yes, that is my answer.

19 R: If you would recommend the NTNU mPLE app to other students, what would you tell them?

P10: If you love yourself, download the app. It makes your life easier. I am going to tell everybody to use the app.

R: What more would you tell them?

P10: Just study the app and you will see that all the tools you need is there.

20 R: Do you think you will be using the NTNU mPLE for educational purpose more or less in the future?

P10: I would absolutely use it more. Especially if you develop a more complex To-Do list and implement a nice ItsLearning button.

R: Anything more?

P10: No.

21 R: Do you have anything else to add that has not been covered?

P10: I do believe that you have covered all the important aspects of the app. It is a great app.

R: Anything more?

P10: No.

Appendix B

Mapping Table of the Literature review

Mapping Empirical Research on Mobile Learning Applications as a Learning Tool

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Sclater (2008)	Examines whether the LMS is destined to continue as the primary means of organizing the online learning experience for university students.	Mobile learning, Ubiquitous learning	PLE comprises a piece of coordinating software seen by the learner that interacts through web services with a variety of educational tools and data sources inside a service oriented architecture.	A conservative technology for managing groups, providing tools, and delivering content.	Higher Education, Personal learning Environments.	Quantitative research based on arguments emerging in the blogosphere and elsewhere.	They point out that the facilities in the LMS are more limited and it is evident that some students do not necessarily want their education to mix with their social environment. Moreover, while learners will continue to use the environments they find most engaging and useful, institutions need to be careful that they do not lose the opportunity to track what students are doing.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Mott (2010)	That we can bring together — or mash up — the best of both the LMS and the PLE paradigms to create a learning platform more ideally suited to teaching and learning in higher education.	Ubiquitous learning, Personal learning	As students complete assignments and projects for courses, they are increasingly using a variety of online tools, such as YouTube, Flickr, and Google Docs. A central notification service might also permit students to specify how they want to be notified (via e-mail or SMS, for example). Stand-alone Syllabus Builder that directly incorporates program-level learning outcomes into course syllabi. Semester calendar and up-to-date textbook information (including pricing and availability)	LMS is a central to the business of higher education. LMSs have dominated the teaching and learning landscape in higher education for the past decade.	Higher Education, Environments, Business of higher education. Open learning networks	Quantitative research on different articles	Teachers, students, and administrators feel stuck with the either-or choice between the LMS and the PLE. The future of technology in higher education will in large part be defined by how we strike a balance between the two. We need to embrace both the efficiencies of the LMS and the institutional network and the affordances of the PLE and the web.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Dagger et al. (2007)	Explore e-learning platforms' evolution and illustrate some key challenges to information interoperability in next-generation platforms.	Distance Learning, E-learning	Open source initiatives include Moodle (www.moodle.org), Sakai (www.sakaiproject.org),ATutor (www.atutor.ca), and Whiteboard (http://whiteboard.sourceforge.net). Proprietary solutions include WebCT/Blackboard (www.blackboard.com), Gradepoint (www.gradepoint.net), Desire2Learn (www.desire2learn.com), and Learn.com (www.learn.com).	LMS has dominated Internet-based education for the past two decades.	Higher Education, Ubiquitous learning, Learning Management Systems, E-Learning Framework, Open Knowledge Initiative	Quantitative research on different articles	As designs became more modularized, it was easier for platforms to integrate new functionality as it arose. Next-generation e-learning platforms introduce several key challenges for information interoperability. Defining rigid frameworks and boundaries for e-learning platforms doesn't fit with the free model of the Internet.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Harmelen (2008)	Shows how the PLEs have increasingly provided support for the activities of self-directed learners.	Support for the activities of self-directed learners, Personal Learning.	Provide a PLE that students could use while disconnected from the Internet.	To allow individual learners and groups of learners to formulate their own learning goals, to express plans to realize those goals, and to incrementally transform plans into material that expresses the state of learners' knowledge as learning progresses.	Environment of self-directed learners, Higher education.	Quantitative research on different articles, Field Experiments on Personal Learning.	It is worth considering metacognitive skills; the ability to formulate and direct one's own learning. Support of activities to formulate learning goals and plan for their realization as provided by mPLE is an important step towards this larger aim.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Govaerts et al. (2011)	To enrich or replace traditional learning management systems (LMS) with mash-ups of widgets and services that can be easily combined and configured to fit the learner needs.	Personal Learning Environment , Responsive open learning environment s(ROLE).	To solve the usability issues with multiple accounts and logins, it is proposed to use a central identity provider for Single Sign On, using OpenID in combination with OAuth.	LMS is a traditional system.	Business and an educational case study. Higher Education.	Case studies	Future work will integrate the infrastructure with the psycho-pedagogical integration model (PPIM) for self-regulated learning. The learning process in the model is described by a four-phase cycle based on work by Zimmermann, where the learner: (1) (re-)defines his profile information, (2) finds and selects learning tools, (3) uses learning tools, (4) reflects and reacts on strategies, achievements and usefulness.
Ebner and Taraghi (2010)	Based on Personal Learning Environment, Graz University of Technology has developed a PLE that bases on mashup of widgets following the W3C specifications, a standard that can be used as basis for all PLE and e-learning applications.	Personal Learning Environment . Learning Management Systems	TODO widget: This widget manages the TODO lists of the users with various features such as deadlines, priority and different TODO types. Furthermore, the TODOS can be assigned to a group of students i.e. for some team works or collaborative activities.	LMS is a traditional system.	Personal Learning Environment. Higher Education.	Prototype Testing	Learning and teaching of tomorrow should foster individuality, flexibility and personality. A first step will be to develop environments, which allow the learners to choose the content of their interests and needs.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Li et al. (2008)	To point out several emerging issues and technologies that they believe are promising for distributed and collaborative learning.	Mobile Learning and situated learning. Learning Management Systems.	ATutor. ATutor (go online to http://www.atutor.ca/index.php) is an open source Web-based learning content management system (LCMS) designed with accessibility and adaptability in mind.	Not Specified	Collaborative Learning over the Internet, Distance Education.	Quantitative Research based on articles	Location flexibility is an advantage of mobile learning. With an optional global positioning system (GPS), location context can be acquired and predicted. With sensors, user positions can be precisely identified in a museum or gallery such that location-aware information can be presented.
Conde et al. (2012)	Explores the integration of Web 2.0 tools in traditional learning environments, the various possibilities and their advantages and drawbacks.	Learning Management System	Not Specified	It is a traditional system.	Educational environments. Interactive Learning Environments.	Quantitative Research based on articles	Using 2.0 tools students' activity can be applied from institutional context. The idea is to facilitate carrying out external learning activities based on 2.0 Web tools in their personal learning environments in order to improve their learning.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Saadatmand and Kumpulainen (2013)	To find out how participants create and utilize their PLEs for searching, aggregating, creating and sharing content and learning resources, and being engaged in online learning networks and communities.	Nature of learning and interactions in open online courses in terms of online tools and services used by the participants.	Daily Newsletter has been one means of content aggregation used to send the updates and materials to the participants.	Not Specified	Content Aggregation, Knowledge Sharing, Personal Learning Environment.	Quantitative research on different articles	For learners to make the most of emerging technologies they need to take an active role in shaping their own learning environment and in controlling information stream and communication tools. A growing interest towards mobile and ubiquitous learning and student-led activities outside the formal learning boundaries. This enhances learning experiences through exploration (by seeking and experiencing things in various contexts), interaction (through connection with peers and experts), and serendipity (searching for knowledge took place as by-product of the main task in unplanned and unexpected ways)

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Brown (2008)	Reflects on the current position of virtual learning environments (VLEs) in universities and speculates about likely future directions for e-learning.	Environments for managing the ‘‘online’’ interactions of various kinds which take place between learners and tutors and the components through which learners and tutors participate in such interactions, including online learning	Not Specified	To include a wide range of institutional information processing systems to create a managed learning environment and more recently to support individualized, personal learning as personalized learning environments.	Higher Education. Learning and teaching	Quantitative Research based on articles	It has been argued here that VLEs have had only a relatively slight impact on pedagogy in higher education, despite their commercial success; that VLE development has peaked in any case and that VLEs are likely to be replaced by Web 2.0, which is more suited to the individualistic temperament, skills, and requirements of teachers and learners.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Palmer and Dale Holt (2008)	To evaluate the effectiveness of Deakin Studies Online's commitment to online education.	Distance and online education	Course Experience Questionnaire (CEQ)	Centralization of a range of different systems used in different academic departments of the university.	Higher Education.	Quantitative Research based on articles	There was a high degree of consistency between the results obtained for 2004 and 2005. The most used and valued elements were core LMS functions, including accessing unit information, accessing lecture/tute/ lab notes, interacting with unit learning resources, reading online discussions, contacting lecturers/tutors and submitting assignments online.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Lee et al. (2008)	RSS and content syndication can be used to deliver rich, active, social learning experiences that promote a high degree of learner personalization, choice and autonomy.	Just-in-time learning. Peer-to peer learning	Really Simple Syndication (RSS). RSS feeds may be offered at varying levels of granularity, thereby further enhancing learner choice and flexibility in specifying what content they wish to receive in their PLE to suit their needs and interests. For example, a university might offer a feed at the institution level to provide university-wide information; separate feeds might be established for each faculty, school, department or discipline, and by academics, researchers and students within these organizational units.	Traditional usage	Higher Education.	Quantitative research on different articles	RSS and syndication technologies can assist educators in moving away from didactic modes of teaching and transmission of content, to enable greater student agency in the learning process, increased recognition that learner-generated content is a form of knowledge creation, and the development of peer-to peer learning.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
McLoughlin and M. Lee (2010)	To argue for personalized learning spaces, resources and environments to be developed, supported and created through systematic design as well as by inclusion of both instructor and learner perspectives, as well as for the integration of Web 2.0 tools and strategies.	Personalized and self-regulated learning	Not Specified	Not Specified	Higher Education	Quantitative research on different articles	The challenges for educators are complex and multifaceted, and include the provision of personalized learning experiences using suitable technologies that cultivate independent learning skills, while also scaffolding learner reflection and the development of generic competencies.
Munoz-Organero et al. (2010)	To present an additional way to combine the benefits from centralized service-oriented LMSs and PLEs by defining a service-oriented personalized e-learning environment.	Personalized Service-Oriented E-learning Environments.	The E-Learning Framework (ELF; www.elframework.org) illustrates e-learning systems' common functionalities	Centralisation	Educational, Learner-generated contexts	Quantitative research on different articles	Although learning institutions involved in formal learning courses might prefer the merits of a centrally controlled service-oriented LMS, time-constrained users might find PLEs and learner-generated contexts more flexible and adaptable to their needs.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
McLoughlin and M. Lee (2007)	This paper investigates the affordances of Web 2.0 and social software and the choices and constraints they offer to tertiary teachers and learners.	Participatory Learning	Wikis and collaborative writing and editing tools such as Writeboard and Google Docs and Spreadsheets are useful extensions to conventional writing approaches.	To integrate geographically dispersed learners in asynchronous educational interactions have been widely available for a number of years.	Higher Education. Social software.	Quantitative research on different articles	Social software allows learners choice in controlling their own learning, mediated by a raft of tools, including the voice and direction of the group. Web 2.0 software such as blogs, folksonomies, peer-to-peer (P2P) media sharing, and of course the increasingly popular freely editable wiki, are providing students with unprecedented learning opportunities.
Casquero et al. (2009)	Tries to plot an architecture to be put in practice by universities to give learners the control of their learning processes by using eLearning 2.0.	eLearning.	eXtensible Markup Language (XML), Really Simple Syndication (RSS) and Atom	Not Specified	eLearning 2.0 and European Higher Education.	Quantitative research on different articles	There has been proposed a conceptual architecture where PLEs constitute the single interface window for users so they interact with institutional and external web services; traditional CMS are enforced by wikis and blogs; Web 2.0 resource repositories are seamlessly integrated in the routine of content generation by learners and teachers, and learn-streaming is a new concept that gives the control of the learning evidences to the learner.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Garcia-Penalvo and Conde (2014)	Presents a service-based framework to make this type of interaction possible, the communication of mobile PLEs with the institutional learning platforms.	Mobile learning, mPLE	Mobile information and learning platform (MILP), (CONTSENS Project) Mobile personal environment helping students to communicate among themselves and with experts by using their mobiles; and experiences of learning languages by using mobiles and taking into account the context of the user. Quiz-based activity, and the learner can access it through his/her mobile and complete the quizzes.	Very popular and common solution in both industrial and academic contexts	Different educational contexts	Quantitative research on different articles. Experiments with experimental groups.	It can be concluded that, from the students' perspective and in a controlled context, the opportunity to represent students' PLE on a mobile device that includes functionalities and/or information from the LMS, which could be combined with other tools they use to learn, encourages them to participate in the subjects and helps them to learn.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Martin et al. (2011)	This study analyzes the state of the art of frameworks and middleware devoted to simplifying the development of mobile and ubiquitous learning applications.	Mobile and ubiquitous learning	Existing learning platforms, such as Moodle. Learning applications should interact with each other in a digital ecosystem of mobile applications and services through accepted standards, fostering interoperability and easy extension. Context acquisition. Uncertainty of context data. Representation of context data. Privacy. Scalability. Synchrony. Extensibility and reusability. COMTEXT framework. ATOM is used for the Internet domain.	Not Specified	Educational. Facilitate the development of mobile and ubiquitous learning applications.	Quantitative research analysis	Analysis indicates a lack of frameworks and middleware systems devoted to facilitating the creation of mobile and ubiquitous learning applications. Although some frameworks are designed for general purposes and implement a wide range of features and functionalities, they do not offer support for all current mobile platforms and operating systems, i.e., iPhone OS, Android, RIM and Symbian.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Ssekakubo et al. (2014)	Presents a user-centered design process of mobile LMS interfaces for accessing selected LMS services on mobile phones, and a user experience evaluation for a mobile LMS application implementation.	mLMS (mobile LMS), E-learning	Learning Objects are presented in the various service components such as: announcements, assignments, resources, forums, chat rooms, course outlines and wikis. There are Cross-platform Mobile Development tools (XMTs) that can be used to create apps for different smart phone platforms from the same code base. Strongest candidates for cross-platform mobile application development tools are Application Craft and jQuery. User experience evaluation. ISO FDIS 9241-210	Most widely used tools for the support of blended learning and learning that is entirely delivered online.	Higher Education.	Quantitative research, prototyping, and analysis.	Understanding students' expectations for a mobile LMS, and involving the students in the design process of the mobile LMS interfaces is key to designing and developing usable mobile interfaces for accessing LMS services. The students prefer: to go through less "clicks" before they can be able to access the desired LMS information; that access of LMS through the mobile phones should be service-based, as opposed to course-based; that the mobile LMS application should be made as simple as possible and noncrowded, that is, fewer LMS services (the most needed/desired services) should be made accessible through mobile phones.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Conde et al. (2013)	Proposes a service-based approach to defining mobile personal learning environments that facilitates communication with institutional learning platforms.	Mobile Personal Learning Environment.	CONTSENS Project, MOLLY project, mobile communication features such RSS clients or SMS. Elgg (easy way to build PLEs and access them through mobile devices). Webinos	Most representative eLearning solution. Provides students and teachers with a set of tools for improving and managing the learning processes.	Teaching and learning processes	Proof-of-concept, evaluated via a pilot study. Quantitative experiment.	The pilot study shows that from the students' perspective and in a controlled context, it is possible to represent the students' PLE in a mobile device that includes functionalities and/or information from the LMS that could be combined with other learning tools; this approach encourages them to participate in the subjects and helps them to learn.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Chounta et al. (2014)	Describes the analysis of collaborative mobile learning activities. Exploring the use of learning analytics for the evaluation of the performance of students as individuals and the performance of teams.	Collaborative Activities Based on a Mobile Learning Scenario for Real Classrooms	Scanning QR codes attached to computer parts, reading background information, watching instructional videos and assembling the computer step by step. (Mobilogue) a flexible tool for authoring and conductiong mobile learning field trip scenarios. Computer Kit case - simply represented by physical objects. FreeStyler- graphbased modeling environment.	Not Specified	Educational. Mobile learning context.	Case studies	Analysis of the results revealed that the scenario application was more effective for students of weak and medium knowledge background. The knowledge gain in the case of teams of weak and medium performance was bigger and the students of such teams also perceived it as a helpful experience. On the contrary, strong teams showed little or no knowledge gain at all on a group level
García-Peñalvo et al. (2011)	The different problems that LMS present have been explored.	Personal Learning Environments.	LUISA project, MUPPLE, Moodbile	With Learning Management Systems (LMS) users have reached a plateau of productivity and stability.	Educational.	Quantitative research on articles.	eLearning needs evolve, and this evolution must take the student into consideration. If students are not placed at the centre of the eLearning processes, and if emerging technological and sociological trends are forgotten, any eLearning activity will fail.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Martin and Ertzberger (2013)	To investigate the effects of here and now mobile learning on student achievement and attitude.	Mobile learning.	Informal learning refers to learning that takes place naturally and without directed effort.	Not Specified	Higher education.	Quantitative research on articles and quasi-experimental study.	The study revealed that mobile learning keeps the learners engaged, and one is able to deliver learning that is authentic and informal via the mobile learning technologies. The study revealed that computer based instruction can still be effective especially in situations where the novelty of mobile technologies distracts the users from the task.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Jones et al. (2013)	The paper examines two case studies of inquiry learning in contrasting settings in order to understand more about learner control and how technology can support learners' inquiries.	Mobile learning.	Geocaching.	Not Specified	In whichever context the learner is in. Informal and semiformal contexts.	Two case studies. Quantitative research on articles.	Findings indicate that the software and technology were able to support (1) a (limited) range of inquiries that the learners chose themselves; (2) the learners working in an informal context without teacher support and (3) that being able to choose their inquiry was very important to the learners: they welcomed taking control of the process and viewed the inquiries as personally meaningful.
Boticki et al. (2013)	Describes the design of a technology platform for supporting content-independent collaborative mobile learning in the classroom.	Content-Independent Collaborative Mobile Learning	mobile Computer Supported Collaborative Learning (mCSCL), Design-based Research methodology	Not Specified	Education in classrooms.	Experimental design.	Experimental design was taken to a new level by having included a card group as a control group into our experiment. The card group mimicked the software design and allowed them to closely examine the affordance of both card and phone modes, and this guided them to a new cycle of software redesign.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Sampson and Zervas (2013)	Introduction to the field of context-aware adaptive and personalized mobile learning systems.	Mobile Learning	mCALS, PCULS, TenseITS	Not Specified	Context-Aware Adaptive and Personalized Mobile Learning	Quantitative research on articles.	This book chapter can facilitate (a) educational systems developers during the process of developing new context-aware mobile learning systems by providing them an overview of current developments in the field, (b) instructional designers during the process of selecting appropriate context-aware mobile learning systems for designing personalized learning experiences for individual learners, and (c) researchers in the field of context-aware mobile learning for researching and providing solutions to open research issues

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Dodero et al. (2014)	Summarizes and confronts these points of view: 1) automated approaches; 2) combination of different methodologies; 3) emphasis on human and social aspects; 4) domain-specific development approaches, 5) model-driven/language-driven development and system integration approaches, and 6) grammaroriented development.	E-learning	Moodbile project, ProleTool	Not Specified	Conception, development, and maintenance of e-Learning solutions. Educational.	Quantitative Reasearch based on articles.	The main objective of software engineering for e-Learning is the design and development of usable and accessible systems and services, in order to reach end users maximizing their user experience and facilitating the teaching and learning.

Appendix B Continued

Author(s) and year	Research purpose	Learning usage	Mobile features and other tools	Why LMS	Context	Research design and method	Findings
Lee (2015)	To propose the method of mobile learning support system based on e-learning that is reduced the phenomenon of delay due to the amount of traffic and the consumption of storage space, when you continue to play downloadable videos.	Mobile learning	jQuery Mobile, Gnuboard projects	Supports and manages all items in the learning environment of learners and all items in the teaching environment of instructors, and refers to a remote learning management system on web-based.	Educational	Quantitative research on articles and proposed method and system design.	FLV and WMV seem to have a similar size, it suggests a relatively large reduction results that the file size of the video file conversion compared to the original video lectures. If the quality of the online video does not make a lot of differences, it is advantageous to use the FLV file instead of WMV.

Appendix C

Post testing questionnaire questions

1. Demography

1	Age?
2	Gender?
3	Your study?

2. Personal experience with the application

1	How did you feel your experience was after using the NTNU mPLE application?
2	In your opinion, how can the NTNU mPLE application get more interesting for the students?
3	What are the strengths and weaknesses of NTNU mPLE application?
4	How has NTNU mPLE changed the way you are studying?
5	What type of help/tutorial would you like to have when you use the NTNU mPLE?
6	What obstacles remain for you to be able to fully engage in the NTNU mPLE?
7	How would other students benefit from the NTNU mPLE?
8	Was it something you did not understand about the NTNU mPLE?
9	What is good about the application?
10	What is missing from the application?
11	Is something not working the way you thought it would?
12	How often would you use this service? Participants were presented with the options: Each day (or more), About once a week, Once a month, Sometime in a year, Never

13	How helpful/useful do you think the application is for you? 7 point Likert scale was presented. 1 (Not at all) to 7 (Very much).
14	How attractive do you think the design is? 7 point Likert scale was presented. 1 (Not at all) to 7 (Very much).
15	How well do you think you understand what the idea of the NTNU mPLE is? 7 point Likert scale was presented. 1 (Not at all) to 7 (Very much).
16	Other comments?

3. Usage of the NTNU mPLE application

All the following questions have been presented with a 7-point Likert's scale with the range 1 (Not at all) to 7 (Very much).

A. Learning Purpose

Please indicate how much you agree or disagree with the following statements regarding the NTNU mPLE application. I believe that...:

1	mobile devices would be easy to use for learning purposes.
2	it would be easy to access course material with my mobile device.
3	mobile devices would be easy to assist learning.
4	it is easy to use mobile devices for accessing learning content.

B. Intention to Participate

Please indicate how much you agree or disagree with the following statements regarding the NTNU mPLE application. I believe that...:

1	I intend to participate in similar applications as NTNU mPLE in the future.
2	my general intention to participate in similar applications as NTNU mPLE in the future is very high.
3	I will regularly participate in similar applications as NTNU mPLE in the future.
4	I will think about participating in similar applications like NTNU mPLE.

C. Enjoyment

Please indicate how much you agree or disagree with the following statements regarding your attitude towards NTNU mPLE application:

1	Attending the NTNU mPLE application was enjoyable.
2	Attending the NTNU mPLE application was exciting.
3	I was feeling good in use of the NTNU mPLE.

D. Satisfaction

Please indicate how much you agree or disagree with the following statements towards the NTNU mPLE application:

1	I am satisfied with the NTNU mPLE application.
2	I am pleased with the NTNU mPLE application.
3	My decision to attend the NTNU mPLE application was a wise one.

E. Performance Expectation

Please indicate how much you agree or disagree with the following statements towards the NTNU mPLE application:

1	Attending similar applications as NTNU mPLE improves my performance in school related activities and technologies.
2	Attending similar applications as NTNU mPLE enhances the effectiveness in school related activities and technologies.
3	Attending this kind of NTNU mPLE application increases my capabilities in school related activities and technologies.

F. Effort Expectancy

Please indicate how much you agree or disagree with the following statements towards the NTNU mPLE application:

1	I found the activity flexible.
2	The process of the NTNU mPLE app was clear and understandable.
3	It was easy for me to attain skills in the NTNU mPLE app.