NTNU – Trondheim
Norwegian University of
Science and Technology

Use of mobile devices to support learning

A multiplatform quiz application

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Abstract

One of the most stressful period of student life, is the hours spent to prepare for exams. Today we have many instruments to streamline this work. Internet is a huge source of information that provides students with sufficient educational materials. However, occasionally it takes time to find curriculum relevant data. Therefore, the process of searching for and reading through information might be boring and time consuming some at times.

The goal for this paper is to present a StudTest; a game-based multiplatform quiz system with curriculum related questions, which aims to support students with their studies. This thesis contains of theoretical background, implementation details, test and evaluation of the system. It is a continuation of a research project made by me in spring 2014.

StudTest was built using web technologies and is supported by variety of devices such as personal computers, smartphones and tablets. The system categorizes multiple choice questions into different school levels and subjects. Hence, students from different grades are able to use it. User submitted questions give StudTest a potential for being a content rich application.

The test was done with the help of a user group. They gave me feedbacks through questionnaires and discussions. These made a basis for a broad evaluation of the system. The last part of the paper discusses the strengths and the weaknesses of the system. Results showed that the users appreciated the idea, which gives a motivation for a further work.

Preface

This thesis was written during my final semester in the Computer Science master's program at the Norwegian University of Science and Technology. It contains theoretical background, implementation details and evaluation of a multiplatform quiz application, created to support students' learning.

I would like to thank everyone that helped me in this project work, especially to my supervisor, the proof readers and the testers.

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PART I

Introduction

1. Chapter Introduction

The aim of this thesis is to present a multi-platform quiz application which aims to help students with their schoolwork. This thesis is a continuation of a research study performed in spring 2014 at Norwegian University of Science and Technology. The previous research presented the idea and the possible technical solutions for the application. In this thesis I will summarize some relevant information from the previous project, explain the theoretical background, write about the implementation and evaluation of the system.

1.1 Motivation

Today we have computers and smart devices that are simplifying many of our everyday tasks. One of the inevitable tasks students have is the schoolwork. There exist many different kinds of applications and games, intended for education and for supporting students in their studies. With this work I want to participate in the framework of helping students in their school life.

The goal is to create a content rich system that is useful for students and easily accessible from any kind of device. The system will give users a possibility to solve multiple choice questions related to the school subjects. Through this method it aims to be a useful tool for repetition before exams or test.

1.2 Research Questions

1. Is StudTest useful system for students?
2. What kind of similar projects exist and what is the distinction of StudTest?
3. How is it possible to make StudTest available in multiple platforms?
4. Can it be used without internet connection?
5. Is it necessary to include reward system to motivate users?

To answer these research questions I will first make a prestudy. This will include a section where I will go through theoretical topics relevant to the application. There will be a presentation and comparison of similar applications and games; and the technological solutions will be researched. After the study, the application will be implemented and afterwards tested by users. The last part of the thesis will be an overall evaluation of the system based on the received feedbacks.

1.3 Development

Development will use an iterative approach since I am the only developer working on the application. During the implementation of the system, I will get some feedbacks from technically skilled people. Final product will be a testable system where the most important functions take place. Additional functions and further work will be discussed at the end.

1.4 Evaluation

The evaluation will be done to determine strengths and weaknesses of the system. A group of users will utilize the system, answer a questionnaire and rate usefulness and usability. In addition to that, discussions with a (specific) group of users will be held to get more in depth feedback about the system.

PART II

Prestudy

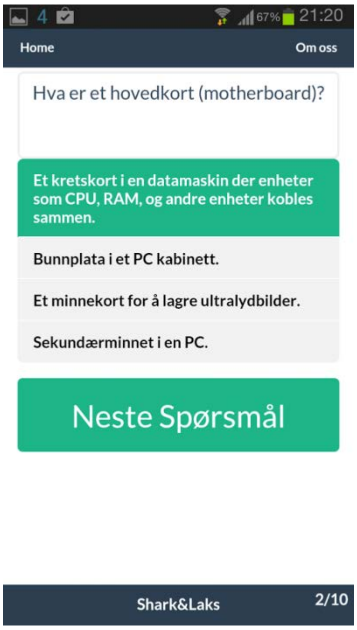
2.Chapter

Similar Projects

In this section I will present some Quiz applications that are comparable with StudTest. This section will also help us understand why StudTest is different from other apps in this area. Some of the systems described here were systems I was familiar with from earlier, whereas others were found while searching on the net.

2.1 ITGK and exPhil by Shark&Laks

ITGK and exPhil are two quiz applications available in Google Play and App Store. The applications are intended to be used by students in order to help them with the subjects. The ITGK application contains multiple choice questions from the subject “IT Grunnkurs” in NTNU and other app from Exphil. Both systems run as a native application that can be used without internet access.



Hva er et hovedkort (motherboard)?

Et kretskort i en datamaskin der enheter som CPU, RAM, og andre enheter kobles sammen.

Bunnplata i et PC kabinett.

Et minnekort for å lagre ultralydbilder.

Sekundærminnet i en PC.

Figure 1: Shark&Laks

These applications can be described as a limited version of StudTest for two reasons; they are developed only for two subjects and users are not able to add questions. Moreover, users without Android or iOS device cannot use the applications.

2.2 IT Grunnkurs and Exphil by Amendor As

These two applications are very similar to the previously described systems by Shark & Laks. In addition it includes level-ups, which means that by solving questions you will earn points and be able to solve harder questions. By this way it also adds some competition to the game, as you can share your points on Facebook or Twitter comparing them with other students.

2.3 PocketExam

The PocketExam application give users a broader subject selection. It is an Android application created by some students at NTNU. It gives users a possibility to solve multiple choice questions related with different subjects in NTNU. There are 5 subjects available with possibility more to come. It is also possible to report questions in case there are some mistakes. However, this is not a free application, users have to pay a small amount for each subject.

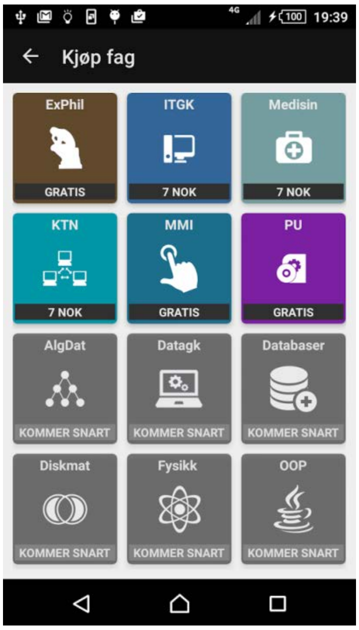


Figure 2: PocketExam

Compared with StudTest, it is still limited to the few subjects provided by the developers so users can’t actively contribute to the system.

2.1 Kahoot

Kahoot is a game-based classroom response system, which aims to make education in the classroom more attractive. It can be played in the classroom or any place where necessary equipments are available. It's usage in the school is as follows:

1. A teacher creates a quizz
2. The quizz is being launched on a screen visible to all students.
3. Students join the quiz from their devices.
4. Questions are being displayed on the screen, so the participants chose answers from their device by selecting one of the alternatives.
5. Based on their earned points, students are ranked.

Kahoot can be used with any device having a web browser and internet connection. Any user can create quizzes and make these available for other users. This system can also be used in different occasions.

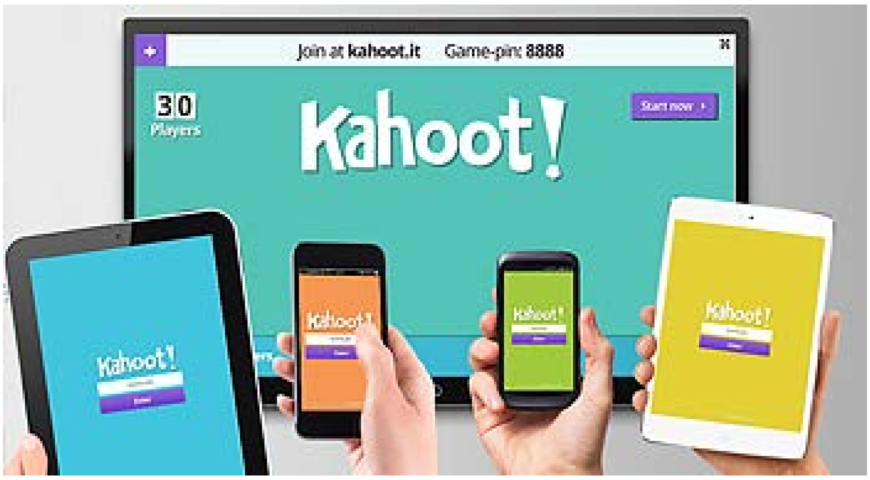
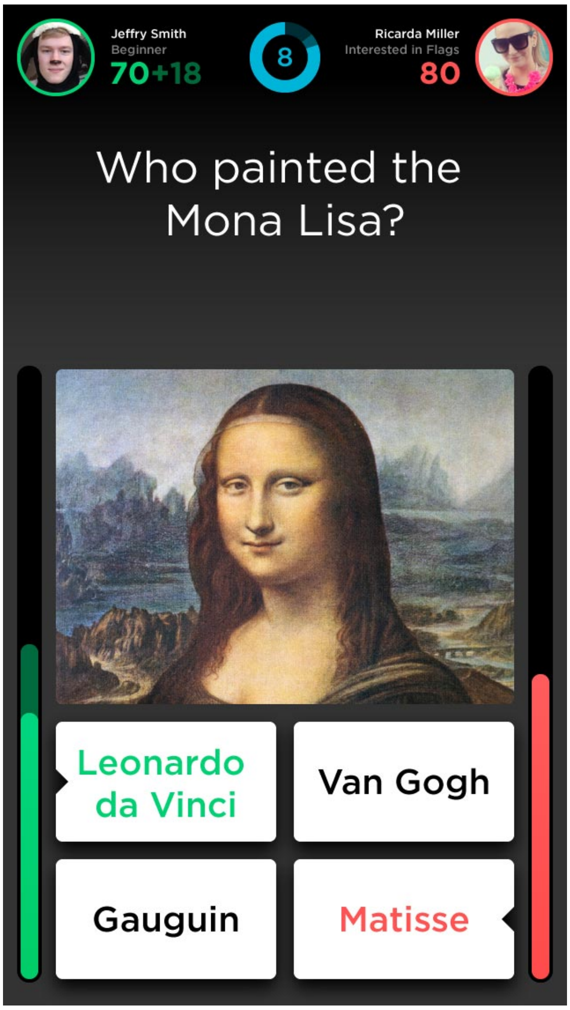


Figure 3: Kahoot

Kahoot is designed to be used during the lessons or similar situations. Focus is on learning in a social and competitive environment. Therefore, it is not suitable for individual usage. Since the system is used worldwide, it contains a huge variety of quizzes from many different academic and non-academic topics. Thus, makes it difficult to find questions relevant for a specific subject.

2.4 QuizUp

QuizUp is a game where users can solve quizzes in many different topics, both academic and non-academic. Main goal of the game is to compete against other users with your knowledge, hence I will say that QuizUp is more entertainment based game but still suitable for learning. System finds an opponent for you to compete against, furthermore with starting a quiz, the one who make the correct answer first will get more points. Users that reach a certain level are able to submit questions to the system. These are being validated by the administrators before being accepted. QuizUp is available both iOS and Android application.



Who painted the Mona Lisa?

Figure 4: QuizUp

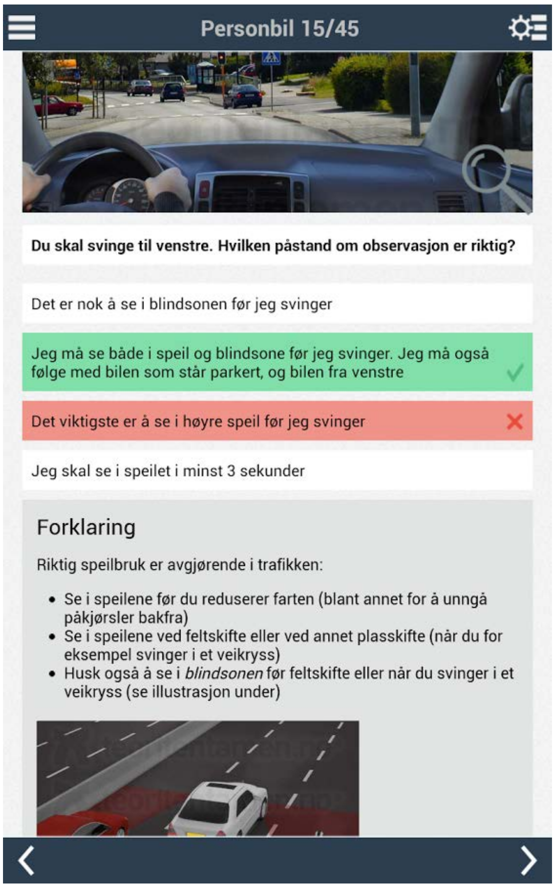
As mentioned above, this quiz game is mostly intended to be used for entertainment therefore is not a good exam support system for students.

2.5 Wikipendium

Wikipendium is a system available at wikipendium.no. On this web page there is a list of compendiums from different subjects at NTNU. Each of them contains notes and explanations of the subject topics. Wikipendium is not a quiz application like the other systems I presented, but still has some similarities with StudTest. The compendiums in Wikipendium are written by users, so everyone can create a username and participate to improve content. It is especially useful before exams. I have used this web page several times before my exams, founding it very useful. Content is currently limited to NTNU subjects and many realms are not listed although it has a potential to increase and offer compendiums to many more topics.

2.6 Teoritentamen

Teoritentamen is a system created for practicing driver license theory test in Norway. It contains a huge collection of questions relevant with the examination. The system is giving explanations after every question, in order to increase respondents' knowledge. It saves users test history, so they can see their progress.


Personbil 15/45

Du skal svinge til venstre. Hvilken påstand om observasjon er riktig?

Det er nok å se i blindsonen før jeg svinger

Jeg må se både i speil og blindsone før jeg svinger. Jeg må også følge med bilen som står parkert, og bilen fra venstre ✓

Det viktigste er å se i høyre speil før jeg svinger ✗

Jeg skal se i speilet i minst 3 sekunder

Forklaring

Riktig speilbruk er avgjørende i trafikken:

- Se i speilene før du reduserer farten (blant annet for å unngå påkjørsler bakfra)
- Se i speilene ved feltskifte eller ved annet plasskifte (når du for eksempel svinger i et veikryss)
- Husk også å se i *blindsonen* før feltskifte eller når du svinger i et veikryss (se illustrasjon under)

Figure 5: Teoritenamen

Teoritentamen is having the same goal as StudTest, which is to help exam takers to prepare themselves. Method is also very similar, but this system is intended only for the driver license test being a commercial product.

3.Chapter

Previous Research

In this chapter I will present some points from my previously done work [1]. It was a research project about StudTest, where I did present the idea, functional requirements and went through different technical approaches. I will briefly describe some of conclusions I made in that project.

3.1 Functional and Nonfunctional Requirements

The functional requirements were prioritized by their importance.

High (H) - Crucial requirements that needs to be met for the system to work properly,

Medium (M) - Important requirements that will increase user satisfaction, but not critical

Low (L) - Less important requirements, but good to have in the system.

Req. ID	Requirement	Prioritization
FR1	Users will be able to solve tests	H
FR2	Users will be able to create tests	H
FR3	Tests are going to be categorized by level	M
FR4	The system will have a login function	M
FR5	Users can edit their tests	M
FR6	Users can add subjects and sections	M

FR7	Users can vote the tests with scores	L
FR8	The system shall have a search function	L
FR9	Users can add images to the questions	L
FR10	Users can write explanations to the questions	L
FR11	Users can view their solved test history	L

Table 1: Functional Requirements

This was the initially functional requirement list of StudTest, but I did make changes on some of these points during the implementation. Not all of these requirements have been met.

The nonfunctional requirements are as follows:

Performance and reliability

- The system should not be slow so that adversely affects the user experience
- The system should contain reliable data/knowledge

Usability and interface

- The system must be flawless and avoid errors
- The system must be easy to use
- The system must be easy to learn
- The system must be optimized for devices with different screen size
- The system must run smoothly on all platforms

3.2 Prototype

This section contains images from the prototype of the mobile and the web version of StudTest. The prototype was designed with the open source application Pencil, by Evolus.

The color usage has not been taken into account, only the layout has been considered. Although this prototype has been a basis for the implementation, finished product has some differences.

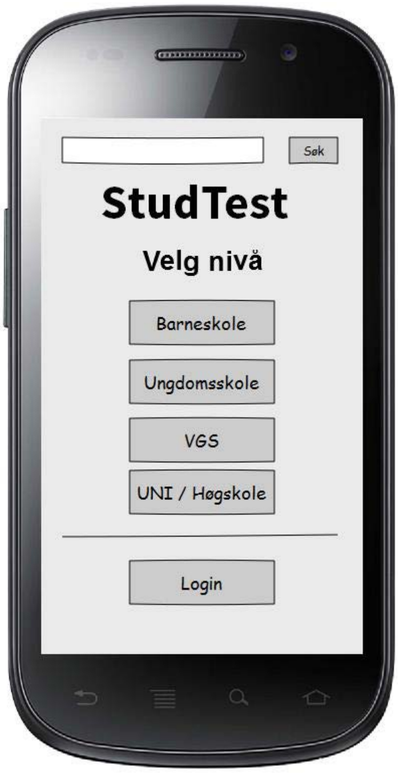


Figure 6: Prototpe Mobile 1

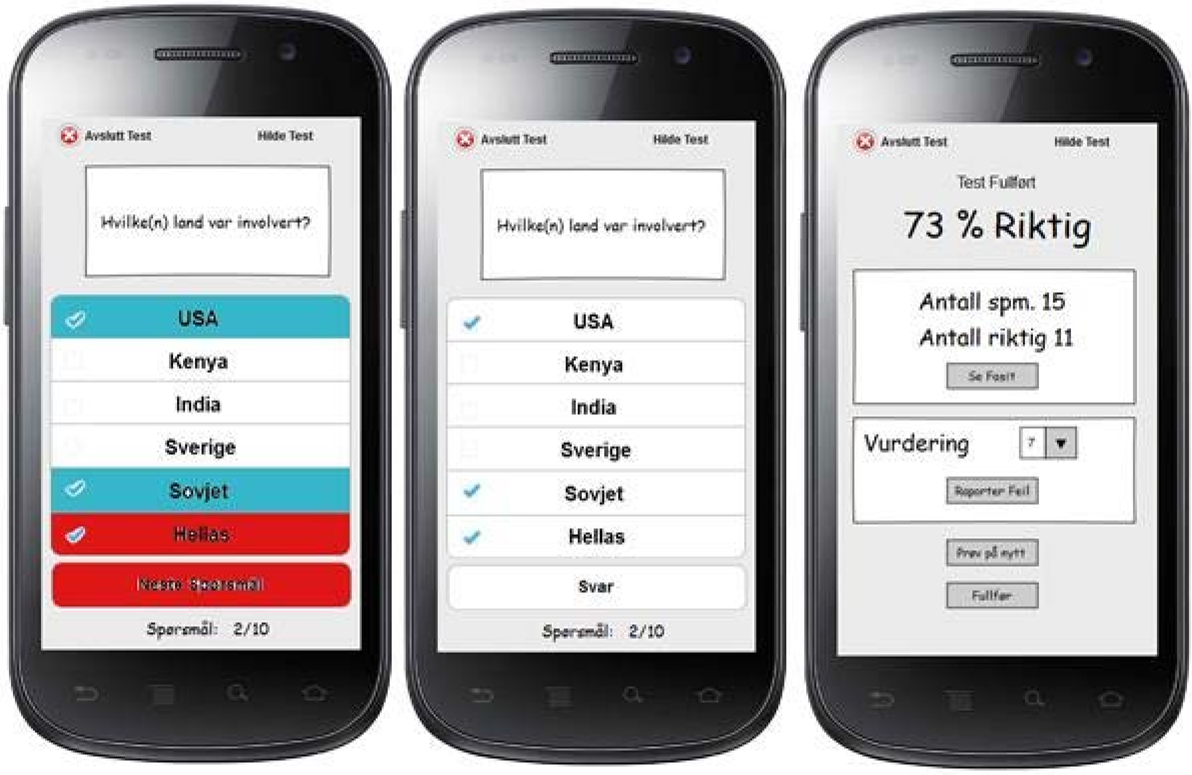
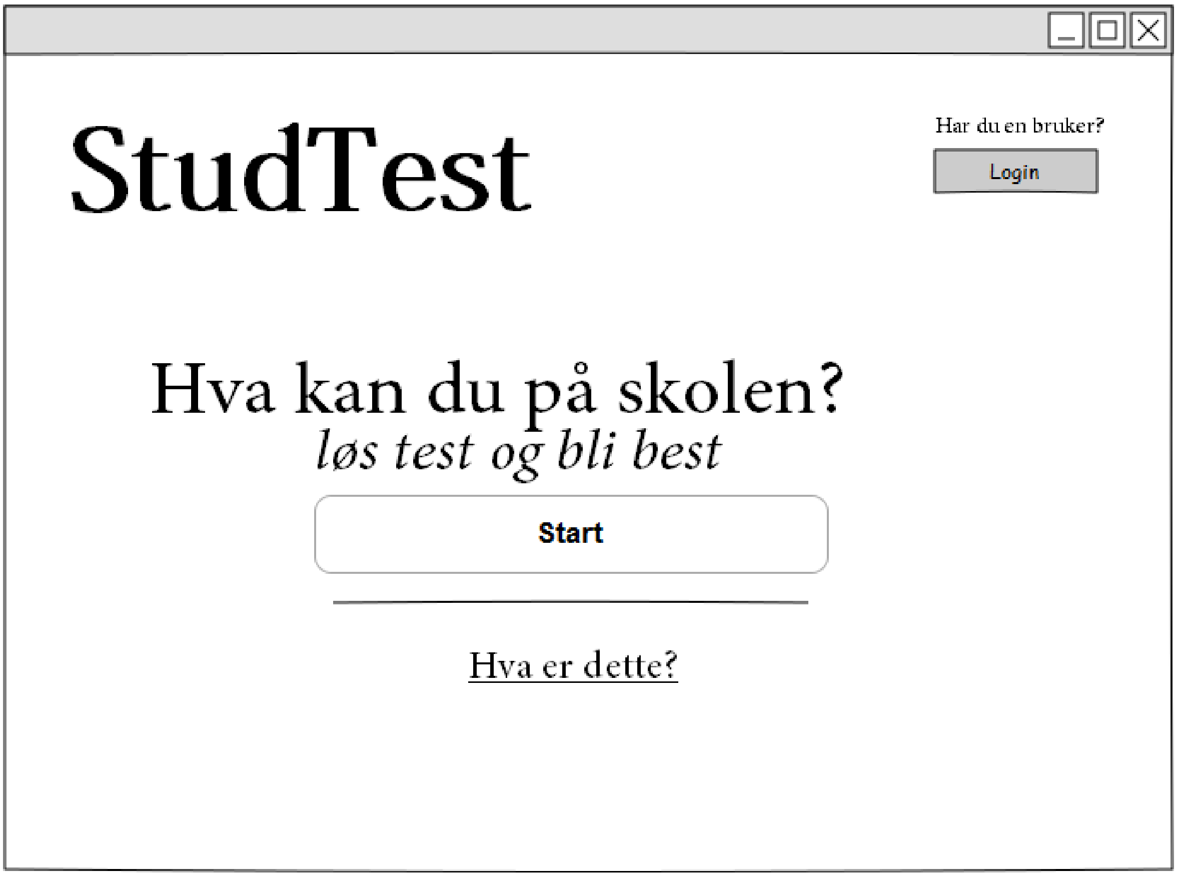


Figure 7: Protope Mobile 2



StudTest

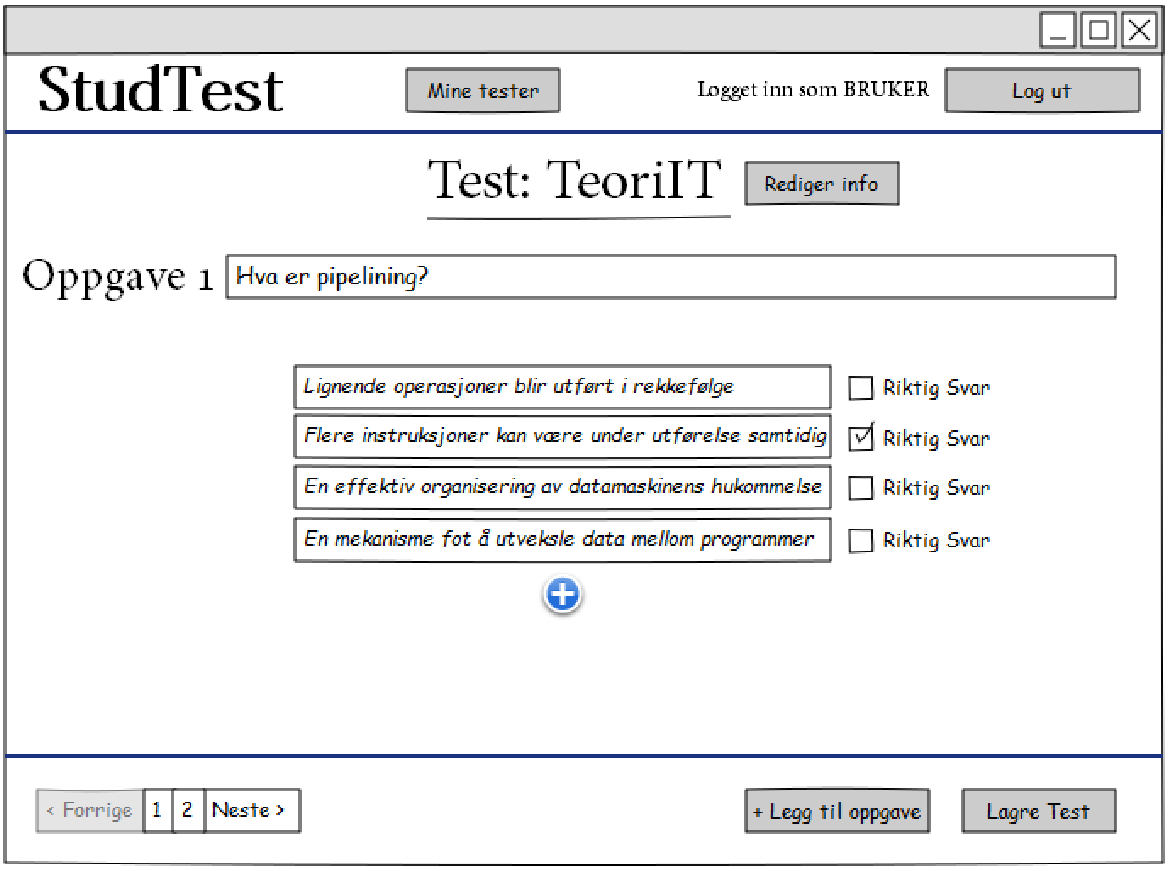
Har du en bruker?

Hva kan du på skolen?

løs test og bli best

Hva er dette?

Figure 8: Prototype Web 1



StudTest

Logget inn som BRUKER

Test: TeoriIT

Oppgave 1 Hva er pipelining?

Lignende operasjoner blir utført i rekkefølge □ Riktig Svar

Flere instruksjoner kan være under utførelse samtidig ☑ Riktig Svar

En effektiv organisering av datamaskinens hukommelse □ Riktig Svar

En mekanisme fot å utveksle data mellom programmer □ Riktig Svar

Figure 9: Prototype Web 2

3.3 Mobile Platforms and Implementation

It was important to consider different mobile platforms and different methods to implement applications targeting these devices. Three most popular mobile operating systems are Android, iOS and Windows Phone. Based on International Data Corporation, Android has 78%, iOS 18,3% and Windows Phone 2,7% market share [2]. Based on that, it is possible to conclude the following: “If one application is available for all three mobile platforms then almost every smartphone user is reached”. The challenge was to find a way to implement it. There exist several solutions.

3.3.1 Native Mobile Applications

Native applications are applications that are developed to a certain platform, programmed in a specific programming language and development environments (IDE). This kind of applications can only run in the targeted platform, which means that application has to be implemented separately to every platform.

Native applications have the benefits of being able to use the devices specific hardware and functionalities, such as menu buttons in some Android devices and multi touch functionalities in iOS devices. In many cases they have better performance compared with the other type of applications. Native apps can also be placed in the applications stores.

	Google - Android	Apple - iOS	Microsoft - Windows Phone
Programming language	Java	Objective-C	C#
IDE	X Code	Eclipce, ADT	Visual Studio
App Marked	App Store	Google Play	Windows Store

Table 2: Mobile Platforms

3.3.2 Multiplatform Mobile Applications

A multiplatform mobile application is an application that can run in multiple operating systems. This eases the developers work, because they don't need re-implementation for each platform. There are two different methods to develop multi platform applications: web applications and hybrid applications.

3.3.3 Web Applications

A web application is simply a web page, which is customized to be used in mobile devices, with its functionality it works more like an application rather than a web page. It is a multiplatform application because it can run with any device that contains web browser. Web technologies HTML5, CSS3 and JavaScript are used to implement web applications. This is a good opportunity for developers who are not so familiar with the native programming environments.

Web applications require internet connectivity to run, since they are not stored locally in the device. They don't have access to device specific functionalities and can't be placed in application stores.

3.3.4 Hybrid Applications

Hybrid apps are a combination of web and native applications. They are often implemented with web technologies, acting like a native application. They can benefit from the advantages of the two types. Like native applications, hybrid applications can access the devices special functions and hardware. They are stored locally in the device and can be placed in the application stores. To create hybrid applications a third party framework is needed. Several different frameworks are available for this purpose.

3.4 Conclusion

I have chosen to create a hybrid application for the following reasons:

- To reach many users as possible
- Support offline usage
- To ease the implementation process
- Penetrating application market

After comparing four different frameworks, I selected PhoneGap to do this job. More detailed description of this framework is available in section 6.1.2.

4.Chapter Theory

In this chapter I will present literal research related with the StudTest system. I will touch upon benefits and drawbacks. It is important to have overview before building the system.

4.1 Multiple choice

Multiple choice is an assessment method where respondents are being asked to select one or more answers to the question. This kind of assessments are often used in education and researches. In multiple choice tests there are different ways to calculate the result. Often a respondent gets a number of points for each correct answer, and nothing for an incorrect answer. In some cases wrong answers leads to loss of points, so the respondent may leave it blank instead of guessing the answer.

4.1.1 Advantages of Multiple Choice

Multiple choice tests can have many advantages, if the questions are well prepared it can be a very good assessment method. The results of a test will give the respondent a measure of his or her level in the test topic.

It is also an efficient way to measure knowledge, compared with tests that require written answers. The test taker will get his/her response and results very quickly in multiple choice tests. This is especially a case if the test or quiz is done from a computer system, because it will give feedback to the respondent either after each question or when the test is finished.

4.1.2 Disadvantages

One of the disadvantages of multiple choice assessments is the limited amount of knowledge that is being measured. The respondents’ knowledge will be better expressed with written short answers. For instance, a student may know something about the question, but will not get any credit for it in case he/she selects the wrong answer. The test taker may also get higher score in a test by guessing the answers. The result of a test solved by this way will not show a reliable overview of the respondents’ knowledge.

4.2 Rote learning, Learning by Repetition

Rote learning is a technique to memorize information by making repetitions. The point is that a person will recall the meaning of something by repeating it multiple times. This method is often used to learn or memorize something quickly. It is frequently used in math and science to memorize multiplication table or science formulas. It is a good method to learn something in a short time, but not quite good way to get a broader understanding.

This method can also be used to prepare to exams, especially exams with multiple choice questions. By solving the same questions again and again, a student will memorize the information and success in the exam. In Norway, it’s very common that this method is used for preparation to the driver license theory test. According to a study, this method reduces the amount of details a person knows about the memorized information. [4]

4.3 Spaced repetition

Spaced repetition is a learning technique based on repetition, but there is a period of time between each repetition. Because we can forget information after some time, we need to be reminded. This technique is often used by people learning a new language, and is an effective method to learn new vocabularies.

4.4 Game Based learning

Game based learning is a type of a game that has learning outcomes. This can be an alternative and more attractive method to teach subjects. Typical games in this category are *serious games*, which are games that simulate real life situations. For example, a flight simulator game, where the players are trying to fly a plane.

4.5 Gamification of learning

Gamification is a method of applying game-mechanisms and game design thinking into a non-game environment. The main purpose of gamification is to increase the audience engagement and perceived enjoyment. *Gamification* can be used to motivate the students to learn subject matters. The motivation can be increased by adding fun, competition, collaboration and reward into the learning.

The main difference of game-based learning and gamification is that game-based learning aims to teach something through the game, while in gamification the purpose is to make a non-game activity to be more fun.

StudTest uses the *gamification* approach, because it is not a game but a learning tool that aims to make exam preparation easier and less boring. The main reason for its usage is the need for preparation before school tests or exams. This need is itself a motivation factor for the users. For this reason, I have chosen to exclude other motivation factors like reward and competition from the implementation.

4.6 Crowdsourcing

Crowdsourcing is a process where the source of the content, idea or service is a group of people. With the participation of many people, the system grows and offers a wide variety of knowledge. Wikipedia is one example, which is an online encyclopedia where everyone can contribute.

With this method is it possible to collect much information together in a very efficient way, but it has some challenges as well. Quality of the data provided might be very different. Therefore, received information should be validated and incorrect information should be corrected or removed. Validation can be done by the contributors as well.

As more people join the crowd, content will be reviewed and mistakes will be reported or changed. Another method is to give the users a possibility to comment or rate the added content, like in Stack Overflow. Stack Overflow is a website where users ask and answer questions related to computer programming. Questions and answers are ranked based on ratings by the users.

The *crowdsourcing* approach is also used in StudTest. The system is dependent of content from the users. No questions will exist in the system without the users' participation. The validation of the provided data should also be taken into account, because incorrect data could have negative outcomes for the users. The possible solutions for the data validation are discussed in chapter 8.

PART III

The StudTest System

5.Chapter

Presentation of StudTest

In this chapter I will introduce the curriculum related multiple-choice quiz system, StudTest. I will present its main functionalities and describe the different versions. The interface is also presented with some screenshots from the application.

5.1 System description

StudTest is a multiple-choice quiz application, created to support students in their education. It gives the users the possibility to solve multiple-choice questions that are related with the school curriculum. It aims to help them to improve their knowledge prior to their exams. The content of the application (i.e. the questions) is added by the users, which means that the availability of different school subjects is dependent on the input from the users.

StudTest is a game-based learning system that also tries to involve enjoyment. Since it is more related to education than entertainment, I will call it a system or an application rather than a game. The word game is therefore not used for StudTest in this thesis.

StudTest is currently available through my personal NTNU page, *http://folk.ntnu.no/gunadin.*

5.2 The Idea

Alongside my studies, I have been voluntarily involved in teaching by helping secondary school students with their school work. By this way I gained more interest in teaching and education. As a student in Computer Science at NTNU, I wanted to combine my computer skills with my interest in education to create something useful. Together with that, my experiences as a student show me that during the exam preparations many students search for additional support material on the internet. In some subjects I find it very instructive to solve quizzes or multiple choice questions available on the web. Therefore, I thought it would be useful if I could create a quiz application where only school related subjects existed.

The factors described above, ended up with the idea of StudTest.

5.3 The Name

I gave the system the name StudTest, which basically is the verb *study* merged with the word *test*. The name gives the users a clear understanding of its main functionality.

5.4 Target Group

The main target group is students studying in the lower secondary schools, upper secondary schools and universities in Norway. Non-students can also use this system for entertainment or learning purposes, or to contribute by adding questions. Targeting only Norwegian schools makes it easier to find relevant school topics.

5.5 Categorization of the content

The questions are categorized based on the school level, subjects and topics. For example, if a user wants to solve questions related to the subject *IT Grunnkurs* in NTNU, he or she has to select the *University* level, and chose *NTNU* and then chose the subject *IT Grunnkurs.* This will list up different topics in that subject (if available). The user can chose to get questions from a specific section (e.g. Hardware, Digital Representation) or from all the sections. This categorization method makes it easier for the users to find their subjects.

5.6 Adding New Categories

The different classes, schools and subjects are added by the users. This gives the opportunity to have many different subjects in the system. With increased contribution, more schools and topics can be covered. Adding content to the system requires login.

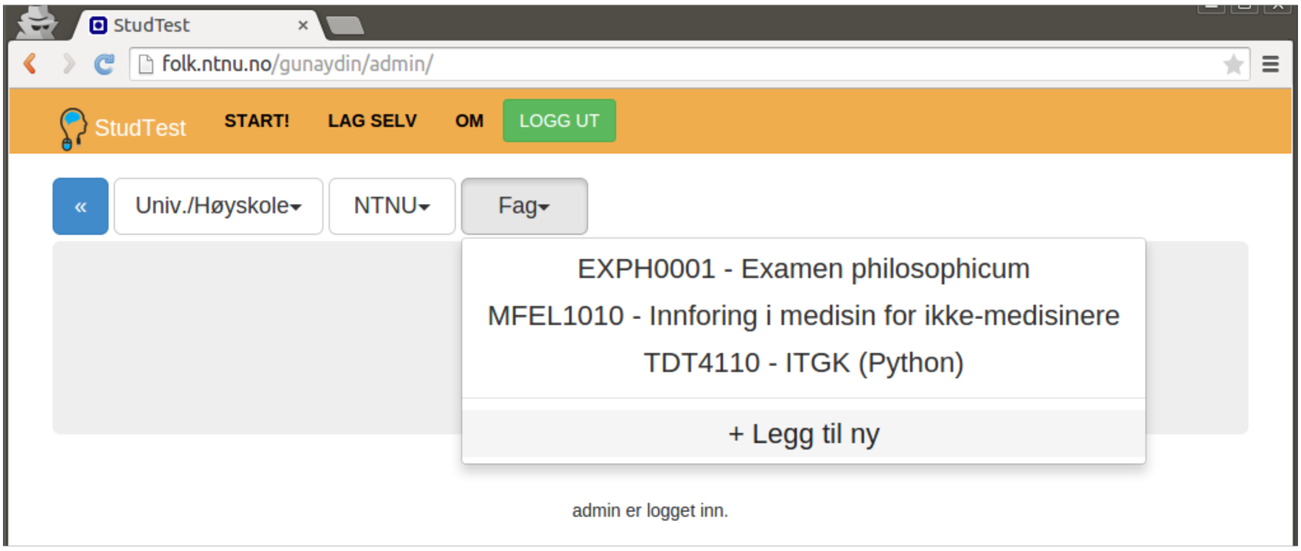


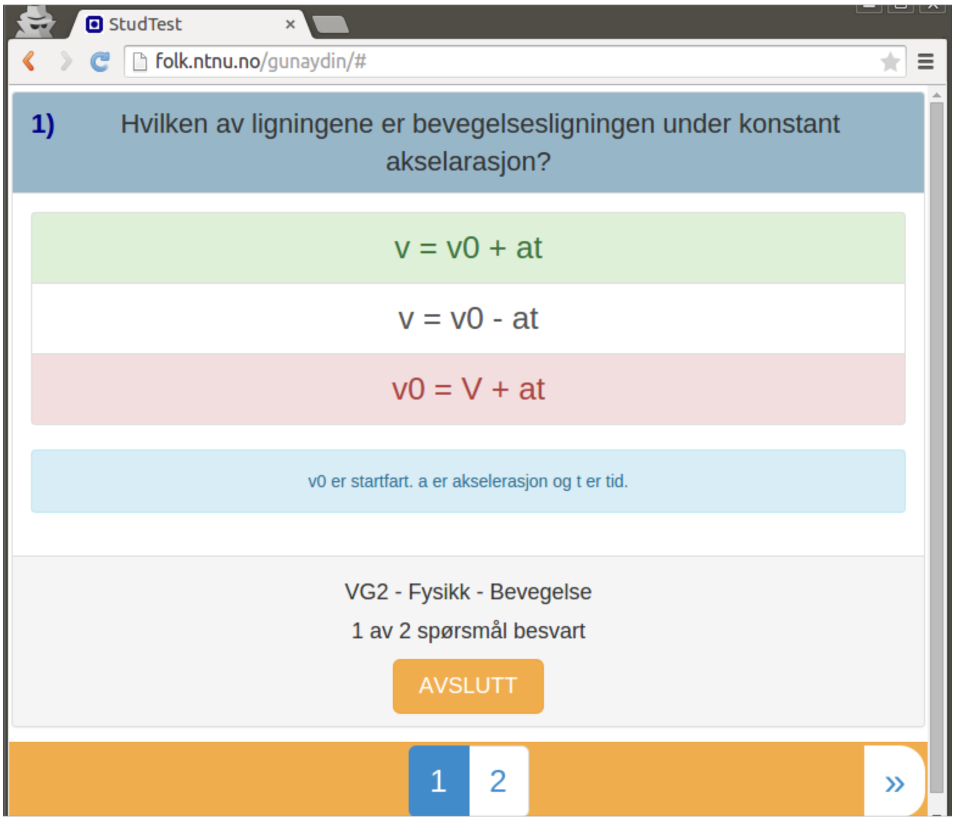
Figure 10: Adding New Category

5.7 Solving and Adding Questions

There are two main functions in the system; adding questions and solving questions. All the questions consist of a question text, answer alternatives and an optional explanation text. One question can have between two and six answer alternatives where only one of them can be correct. Currently there is no possibility to use images or photos in the questions.

5.8 Solving Questions

When the subject and the section are chosen, all the related questions will be listed. With the pagination menu on the bottom of the window, the users can navigate between the questions. To solve a question, users select one alternative. It becomes green if it is the correct one. Otherwise, it will become red to indicate that it was incorrect, and the correct one will turn green. If the question has an explanation text, that will be displayed after the answer. This gives a more detailed description to the user. When the user is finished, a score will be displayed to show the amount of answered questions and correct answers.



StudTest

folk.ntnu.no/gunaydin/#

1) Hvilken av ligningene er bevegelsesligningen under konstant akselarasjon?

v = v0 + at

v = v0 - at

v0 = V + at

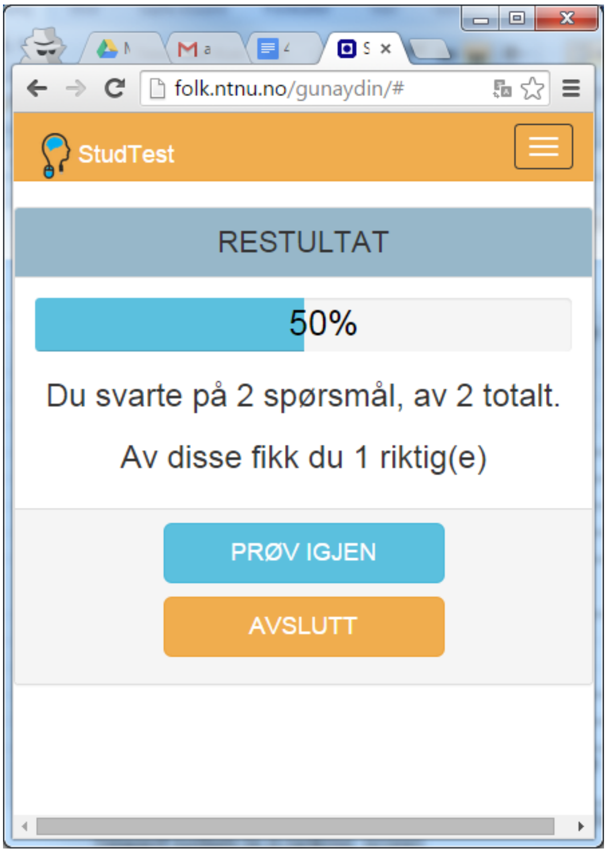
v0 er startfart. a er akselerasjon og t er tid.

VG2 - Fysikk - Bevegelse

1 av 2 spørsmål besvart

AVSLUTT

Figure 11: Solving Question



folk.ntnu.no/gunaydin/#

StudTest

RESTULTAT

50%

Du svarte på 2 spørsmål, av 2 totalt.

Av disse fikk du 1 riktig(e)

PRØV IGJEN

AVSLUTT

Figure 12: Test Result

When the users start the quiz, the questions are randomly ordered. This is to avoid getting the same questions frequently. To improve the learning, I have also chosen to change the order of answer alternatives. The answers are randomly ordered every time, because after many repetitions students might solve the questions by memorizing the place of the correct answer. Reordering ensures that the answer itself is memorized.

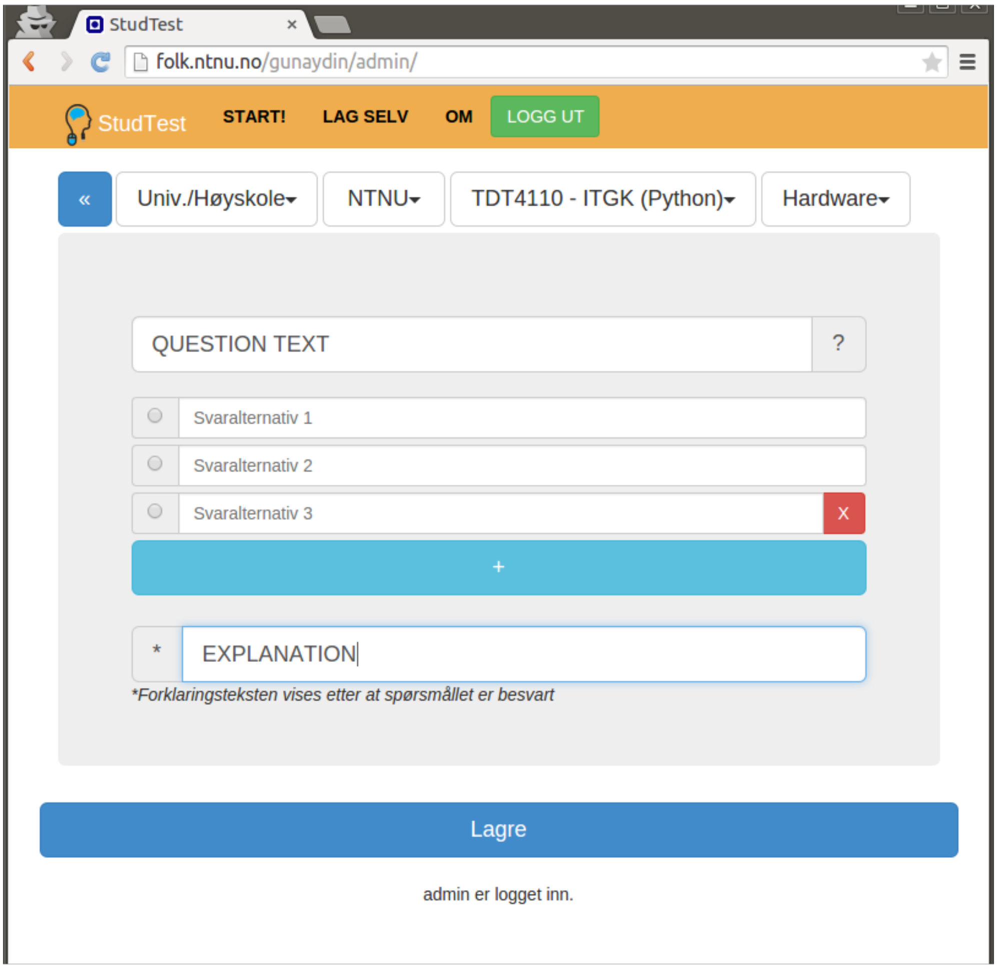
5.9 The Login System

Adding question requires a user account, which can easily be created by pressing *register* button and filling out the form with username, email and password. The login system is made to keep track of the question adders. This opens several possibilities for the system, like editing or deleting previously added question, ranking the question adders, avoid spamming, etc. These extra functionalities are not implemented in this version, because of time limitations.

5.10 Adding Questions

By logging in to the system, users can create questions for any subject they want. The question form will appear after section selection. The form has the necessary question fields; question text, answer alternatives and explanation text. It is possible to add up to six alternatives by using the plus button. The correct answer needs to be checked with the checkbox. When fields are filled out and the save button pressed, the question will be saved in the database and be available for the other users.

The form makes validation of the entered data and ensures that obligatory fields are filled. If save button is pressed with incomplete form, the system will inform about the missing parts. Current implementation does not enable question editing. Thus, the added question can only be edited or removed by the administrators.



QUESTION TEXT

○ Svaralternativ 1

○ Svaralternativ 2

○ Svaralternativ 3

EXPLANATION

*Forklaringsteksten vises etter at spørsmållet er besvart

admin er logget inn.

Figure 13: Adding Questions

5.11 The different versions

To reach larger amount of users I wanted the system to be available on different platforms and devices. The web application ensured the wide availability, because it is accessible from any device with a web browser. Additionally, I implemented a mobile app version to enable users using StudTest without internet connection and be able to distribute the application from the app distribution platforms of the mobile operating systems iOS and Android.

The mobile applications are not going to be published in Google Play or App Store. They are implemented in this thesis to test the possibility of multi-platform support and offline usage. Because of some technical choices I made (see section 6.1.3), current implementation only supports Android and iOS.

5.11.1 Android application

The android application has the same interface as the web version. The main difference is the offline support. While the StudTest on the web gathers data from the online database frequently, the Android application downloads the whole database once and stores it locally in the device. This gives us the possibility to solve the quizzes without having an internet connection. On the main screen of the application there is button to update the data. The data is being downloaded from the online database when it is pressed. If new questions are added to the database, the user has to manually update the database again to get the new ones.

It is not possible to provide questions from the mobile app. The application will direct the users to the web-version if they want to insert questions. There is also a button named *WEBAPP* on the main screen that opens the browser and goes to the web application.

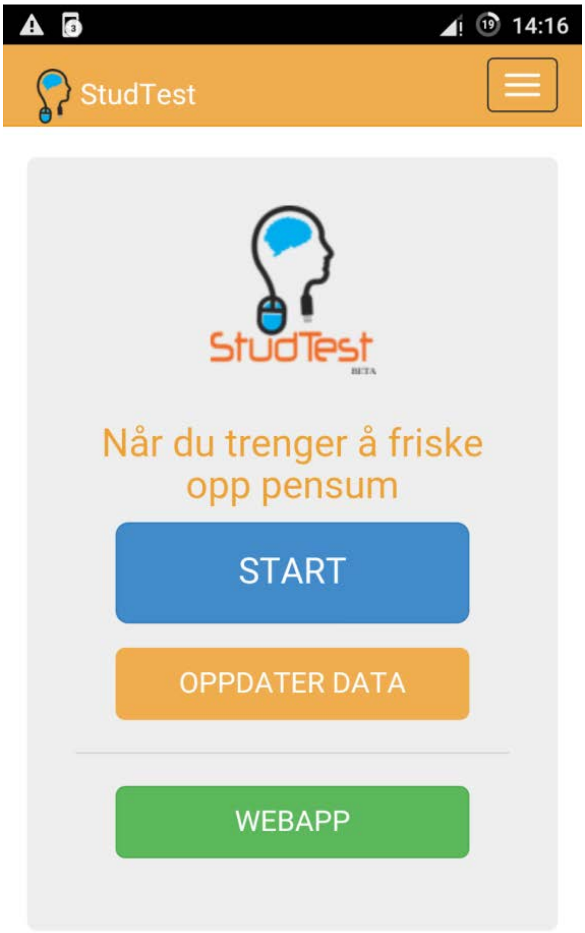


Figure 14: Android Application

5.11.2 iOS Application

StudTest is ready to be published for iOS, but for several reasons this is not done

These are:

- Its underlying code is 100% the same as the Android version, and there would not be any difference in their behaving.
- The reason to create mobile versions was to test the offline support, which is already tested with the Android version. Based on the PhoneGap documentation the applied technology will also be supported in iOS. [10]
- It is no significant for the evaluation
- To produce and test the iOS application a Mac computer and iOS developer account is required. [11]

6.Chapter

Technical Description

In this chapter I will present the technical part of the system. Based on the previously done research, I will briefly give an overview of the technologies that I used to implement the system. I will also describe the reason for my choices.

StudTest is available in two different versions. One of them is the web-version which is accessible on internet with any web browser and the second one is the Android version. The main difference between the web and the mobile version is that the mobile app can run locally on the device, and needs to have internet connection only to download the database from the server.

The reason why the mobile app was implemented was to increase the availability of the system and give the users possibility to use it offline. This also gives the opportunity to distribute the application in platforms like Google Play and App Store.

6.1 Technological Choices

In the research project I did earlier, I went through possible technological solutions to implement StudTest. In this section I will only present the technologies I have used, as the alternative methods which I did not chose to use is already described in the previous work.

Several factors were considered when making the choices, such as:

- Multiplatform support
- Availability of documentation/tutorials
- My knowledge and experiences
- Convenience
- Technical requirements of StudTest

6.1.1 Web Technologies - HTML5, CSS3 and JavaScript

In order to make the system available in the different mobile and desktop operating systems with less work, the simplest solution was to use the web technologies. The whole StudTest system (except the server side) is made of pure HTML5, CSS3 and JavaScript codes.

An alternative way to implement the mobile versions, would be to create a platform specific API for every available platforms (e.g. Android with Java, iOS with Objective-C), which would be a much more time-consuming solution. Choosing web technologies did also simplify my work of creating the Android version of the system. With some help from the PhoneGap framework and minor changes in the code, the system was ready to be executed in the mobile phones.

6.1.2 Mobile Development Framework - PhoneGap

The web technologies alone are not sufficient to create mobile applications to the mobile operating systems. The PhoneGap framework is a framework that allows developers to create mobile apps with HTML5, CSS3 and JavaScript. After setting up the PhoneGap environment, the framework produces the application file for the specific platform you want.

I am familiar with PhoneGap from earlier projects in NTNU and it meets my technical requirements. It supports many different platforms and has lots of documentation available on internet. Based on these factors, I chose PhoneGap framework to build my application.

6.1.3 Local Storage - Web SQL Database

Local storage is something new with HTML5, it gives us the possibility to store data locally on the users' browser. The application data was stored in cookies before HTML5 was launched, with local storage in HTML5, it became possible to store larger amounts of data and in a more secure way. The possibility of local storage was important for the mobile versions of StudTest, because the questions were going to be stored locally on the device and be accessible without an internet connection. There are three different local storage options available with HTML5; Web Storage, IndexedDB and WebSQL Database.

On the server-side I did save data on a MySQL database, and this was one of the reasons why I chose the local storage option WebSQL. WebSQL gave me the possibility to store data on the browser with the SQL relation database structure, and thus I could use the same data structure in the client as in the server. The second and more important reason for my choice was WebSQL's supportability in PhoneGap. Mobile applications created with PhoneGap are able to use WebSQL local storage, but with the one disadvantage, not all platforms are supported. WebSQL is not supported by all browsers and platforms. An overview of supported platforms are listed in the table [12]

					iOS		
4+	-	3.1+	10.5+	-	3.2+	2.1+	-

Table 3: WebSQL, Browser Support

Even though WebSQL is not a W3C recommendation anymore, it is still supported by variety of platforms and is useful. Because iOS and Android is supported, I chose to use WebSQL.

To support devices using Windows Phone, another local storage method called IndexedDB needs to be used. Because of this technical issue, I have chosen to exclude Windows Phone. But it is possible to support Windows Phone devices, by making some changes in the JavaScript functions.

6.1.4 Responsive Web Design - Bootstrap 3

We have many different types of devices available today, and they have different screen sizes. This was something I had to consider before implementing StudTest. I wanted to avoid re-implementation of the code to adapt the system into different screens. By making a research of available frameworks for responsive design, I found Bootstrap.

Bootstrap is a HTML, CSS and JavaScript framework to create responsive web applications. By using it, the application will respond to different screens and make sure the content fits the screen so the users don’t have to resize it. It also have some great looking components like different type of menus, buttons, navigation bars etc. A person who is familiar with bootstrap will easily recognize that it is used in StudTest.

6.1.5 jQuery

jQuery is the most popular cross-platform JavaScript library, which is designed to simplify the client-side scripting. It can be used to make easier navigation, create animations, communicate with a server and handle events. I used this framework which I already had experiences with, to simplify my implementation.

6.1.6 PHP

PHP is a server-side language designed for web development. I used this technology in the server, to manage the communication between the database and the client, and to handle the login function. There exists other server side technologies as well, but my PHP knowledge is much more than the alternatives.

6.1.7 MySQL

MySQL is one of the world's most popular open source SQL relational database management systems. I have used this technology to manage the all the data in the system.

6.2 Implementation

In this section I will describe the implementation of StudTest. There will be technical descriptions and screenshots about the different aspects of the system.

Before the implementation I did some changes on some functions of the system. The difference happened in the way of categorizing the questions. Instead of having different user created tests, I found that it would be better to bring together questions about the same topics regardless of the users who added them. So under a section you could get questions from many different users. This also makes it easier for the question adders, because they now add single questions instead of creating tests.

6.2.1 The Architecture

The project consists of three main parts

1. The server-side
   a. The MySQL database
   b. PHP functions
      i. Database communication
      ii. Login system
2. The web client
3. The mobile client

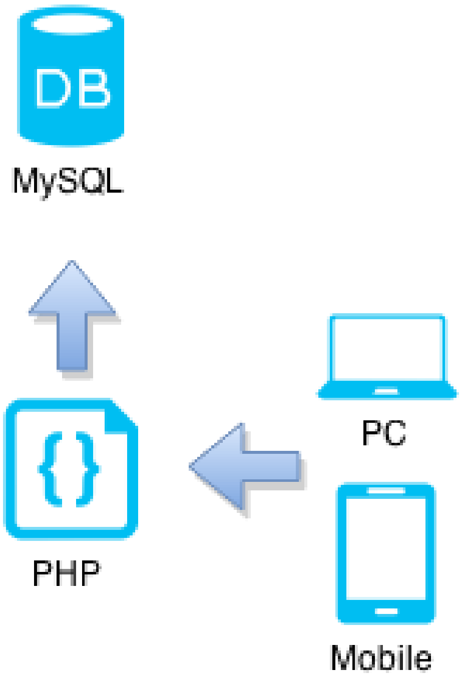


Figure 15: Sytem Archiecture

6.2.2 MySQL Database

The database contains following tables:

level	Contains the different schools levels (e.g. *University, VGS, Ungdomskole*)
id	The auto assigned unique primary key
name	The name of the level

class	Contains sub-level categories (e.g. *NTNU, UIO, VG3)*
id	The auto assigned unique primary key
name	The name of the class
level_id	The id of the level it belongs to

subject	Contains subjects (e.g. *Math, History, Exphill)*
id	The auto assigned unique primary key
name	The name of the subject
class_id	The id of the class it belongs to

section	Contains sections (e.g. *Algebra, Cold War, Sokrates)*
id	The auto assigned unique primary key
name	The name of the section
subject_id	The id of the subject it belongs to

question	Contains the questions and the explanations
id	The auto assigned unique primary key
text	The question text
description	The explanation
(subject_id)	
section_id	The id of the section it belongs to
user_id	The id of the user who added it
date	The date it was added

answer	Contains all the answer alternatives to the questions
id	The auto assigned unique primary key
text	The answer text
correct	This field is either 1 or 0, and tells us if the answer is correct or not.
question_id	The id of the question the answer belongs to

users	Contains the user profiles
id	The auto assigned unique primary key
username	The username
email	The email
password	MD5 hashed password
salt	The hash salt

The entity relationship diagram is illustrated in figure 16.

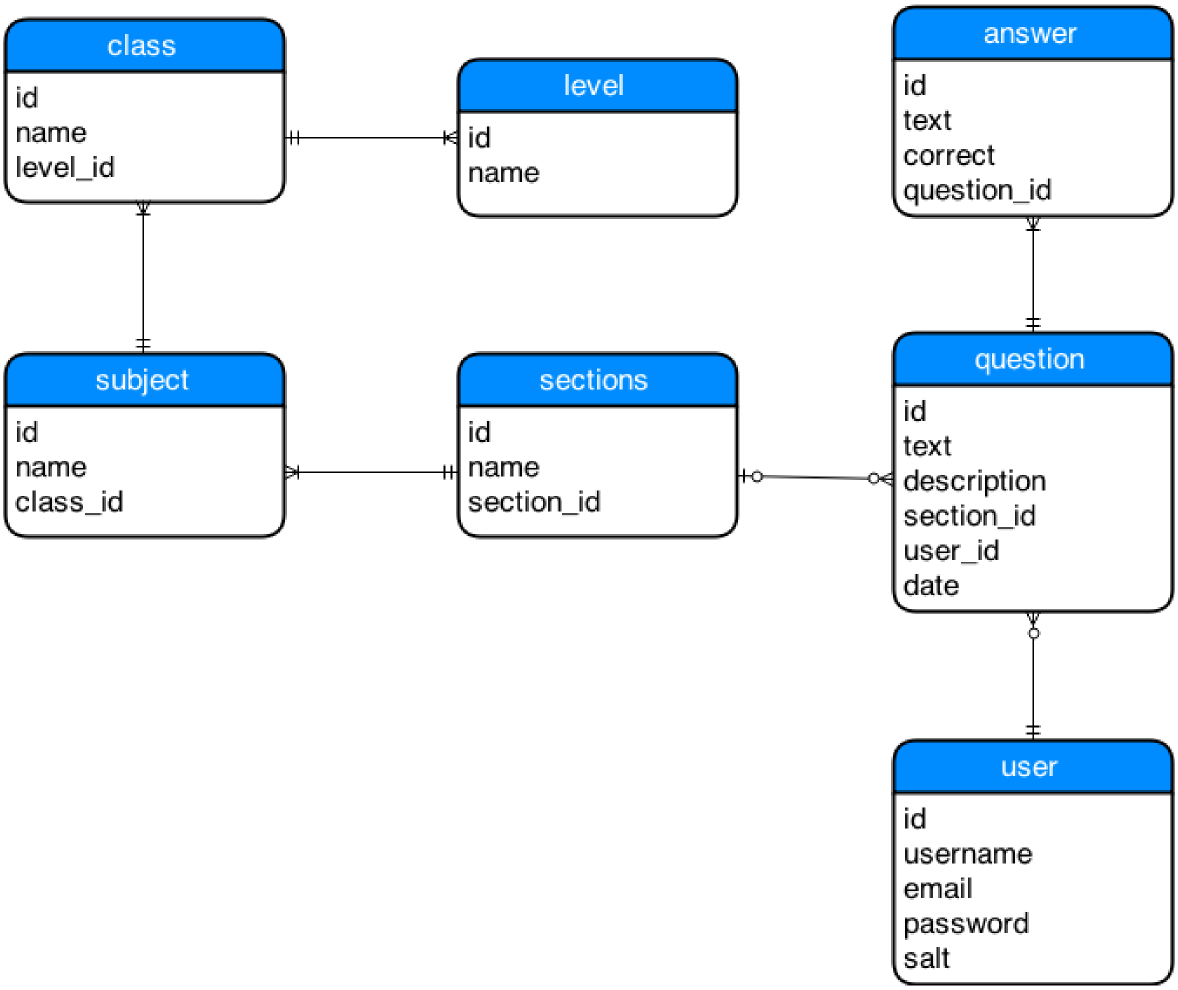


Figure 16: Entity Relationship Diagram

6.2.3 PHP Functions

The PHP functions' main mission is to communicate with the database. In addition it also manages the login sessions.

6.2.3.1 Database Communication

The client sends and requests data from the server. To respond to these requests and give the client what it demands, I have created a PHP file named *feed.php* on the server.

There are two commonly used methods to make the communication between a client and server, the GET and the POST methods. They both send a request over HTTP but have some differences.

The query is sent from the URL with name and value pairs in the GET method. This method is less secure because the data is sent over URL and they are stored in the browser history. It also has data length restrictions, and allows up to 1024 characters only.

In the POST method, which is the method I used, the query string is not sent in the URL but in the HTTP message. POST requests don't have restrictions on data length. I will here describe how the requests are handled on the server. The section about the client will present the client part of this communication.

The *feed.php* file receives a POST request from the client. It contains 10 different functions. Based on a parameter given from the client, one of these functions is called. All the functions execute a MySQL query to the database, and forwards the results it gets to the client as a JSON object.

6.2.3.2 The functions

`getAll()`

This function is created for the mobile client to let it save all the data locally in the device. It returns all the data related with the questions.

`getLevel()`

This function returns names and ids of all the levels.

`getClass()`

Returns the classes of a given level.

`getSubject()`

Returns the subjects of a given class.

`getSection()`

Returns the sections of a given subject

`getQuestionIds()`

This function returns the primary keys of the questions of a given section.

`getQuestion()`

Given the question id, this function returns the questions text, explanation text and answer alternatives of that question.

`answer()`

This function is called when the user selects an answer, and is used to check if the user has made a correct answer.

`insert()`

This is used to insert new categories to the system.

`insertQuestion()`

When the user submits the question form, this function inserts the new question into the database.

6.2.3.3 Security issues

SQL injections are a threat for web applications. If this security issue is not handled well, an attacker can use this vulnerability to damage the system. An attacker can try to execute his/her own SQL statement by inserting it to the data sent to the server.

To avoid this, I have used the PHP function *`mysql_real_escape_string().`* This function escapes special characters in a string and secures the SQL query. All the PHP functions escapes the data received from the client before it executes the query to the database.

6.2.3.4 Login System

Many different login scripts in PHP and MySQL are available on internet. I did not have any reason to create my own login script for StudTest, hence I did follow a tutorial from wikihow.com to create it. The login system consists of following functions and scripts:

`login()`

Check the email and password against the database and returns true if there is a match.

`checkbrute()`

This function is created to avoid brute force attacks. These kind of attacks are when attackers try to login with thousands of different passwords on a user. This function registers login attempts, and blocks the user after five failed attempts.

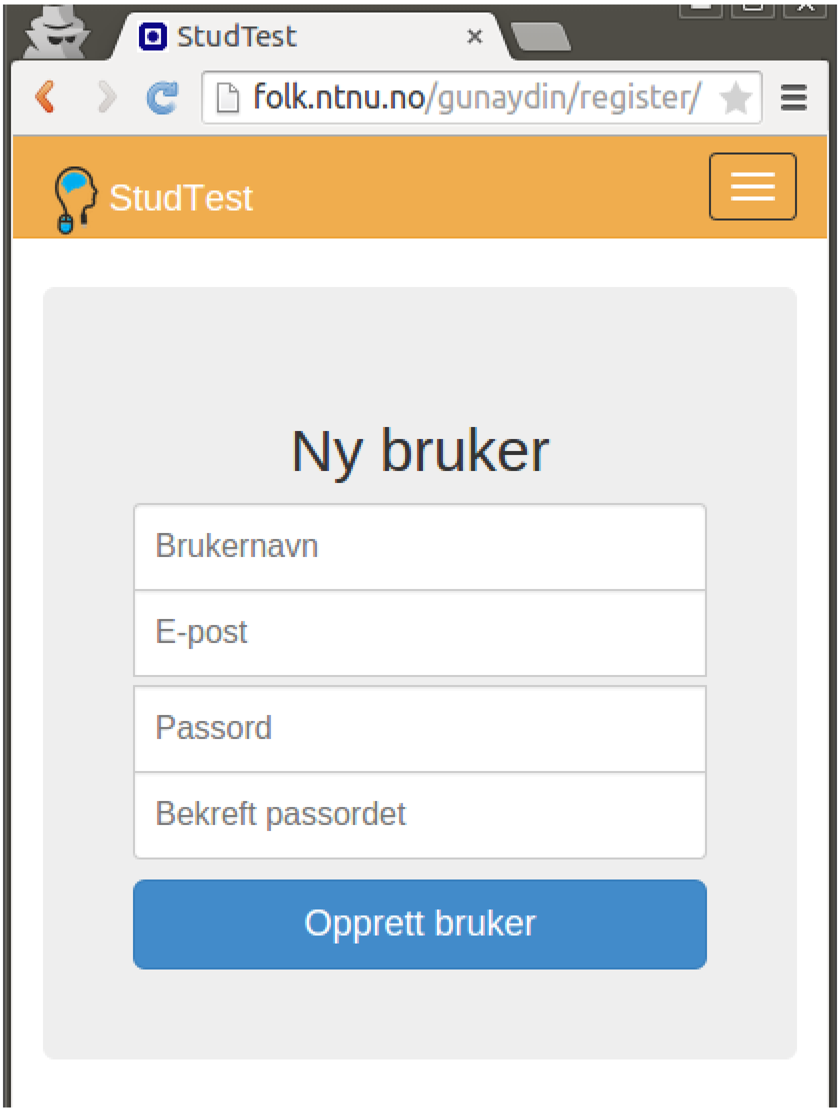
`loginCheck()`

This function checks whether the user is logged in or not and returns true if the user is logged in.

`logout functions`

A group of functions that deletes the session and redirects the user to another page.

Other parts of the login system consist of registration page and login page. The registration page validates entered username, email and password. It checks whether the user or the email is already used or not, and if the entered passwords match with each other. With help of some JavaScript functions, the passwords are hashed before they are processed to the database.


StudTest
folk.ntnu.no/gunaydin/register/
StudTest

Ny bruker

Brukernavn

E-post

Passord

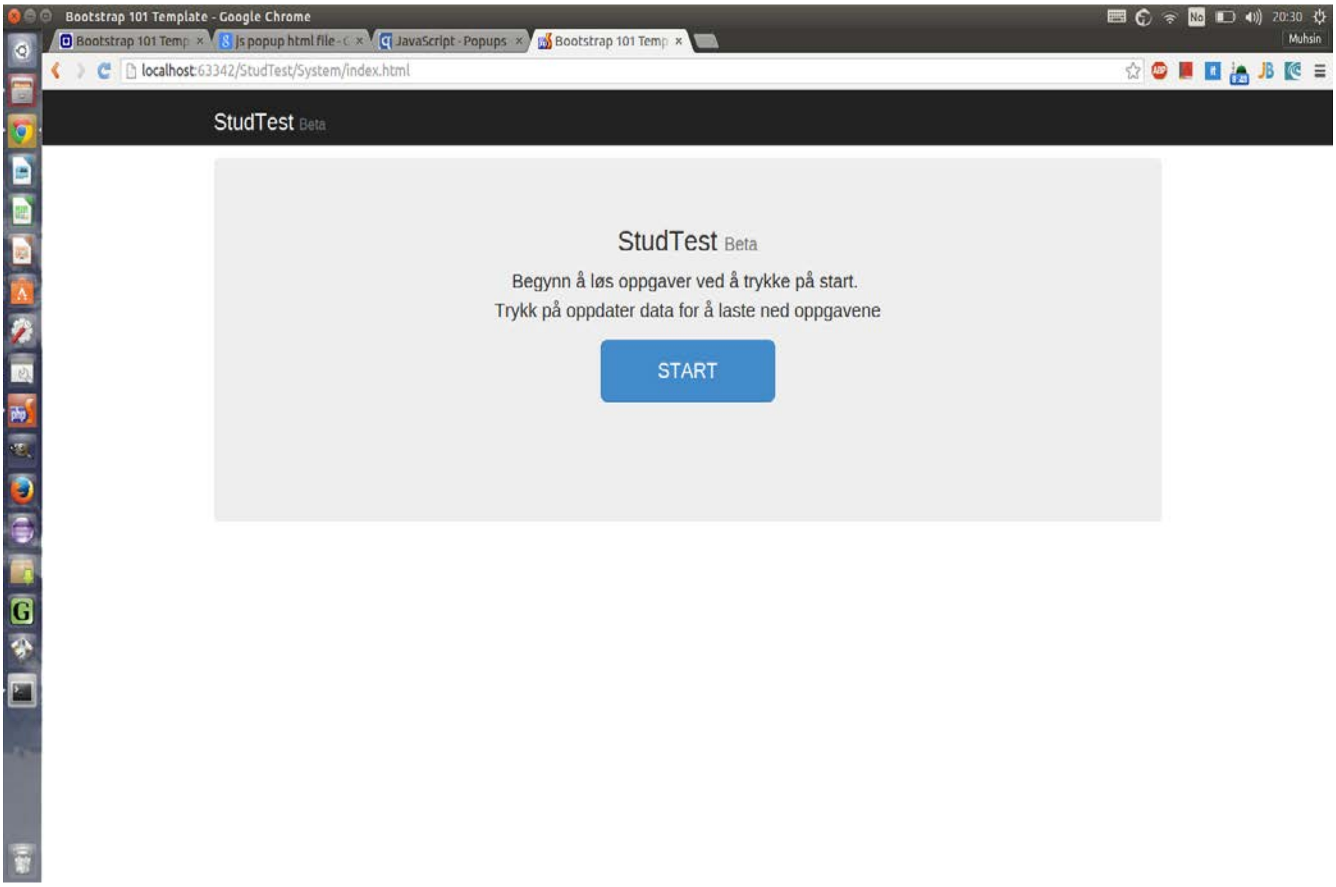
Bekreft passordet

Opprett bruker

Figure 17: Create New User

6.2.4 Web Client

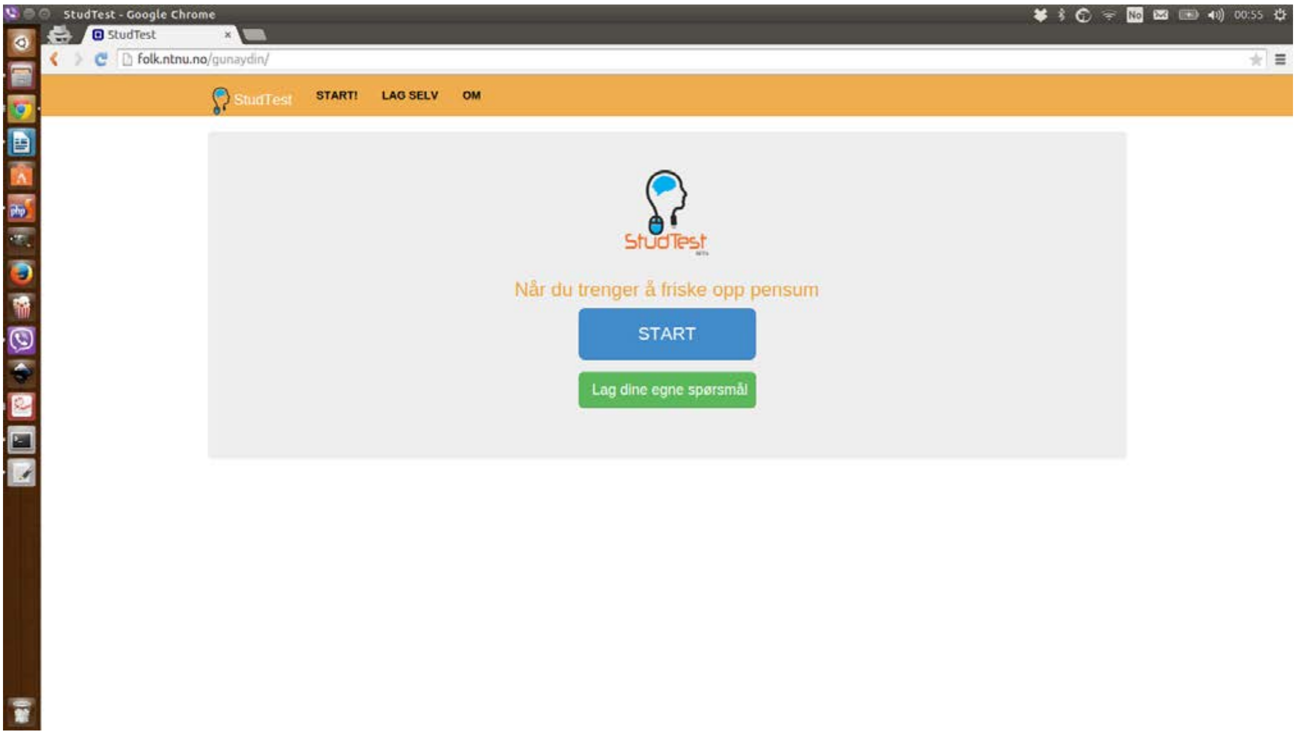
The client's layout is built with the Bootstrap framework. I started the process by modifying the *starter template* available on the Bootstrap official page. By testing different combinations of colors, Bootstrap elements and layouts I tried to create a simple and user friendly design. I also got opinions from other people and changed some parts based their feedbacks. Figure 19 shows the final design of the application, the previous screenshot is from the early design phase.



StudTest Beta

Begynn å løs oppgaver ved å trykke på start.
Trykk på oppdater data for å laste ned oppgavene

Figure 18: Early Design



Når du trenger å friske opp pensum

Figure 19: Final Design

The system consists of two main parts; the main page where users can solve questions and the admin page where users can create questions.

6.2.4.1 Main Page

There are two buttons on the main page, one of them starts the test section and the other directs the user to the admin page. When the start button is pressed, the different categories will show up and the user can navigate to the subject he/she wants.

The HTML elements are dynamically created and removed during the whole process. This is done by the JavaScript functions, which we will take a look at below (the helper functions are not described).

`start()`

> The function runs when the page is opened and it appends the HTML elements to the main page.

`getLevels()`

> This function is called when the start button is pressed. It cleans the main window and appends new HTML elements before it runs the queryDB() function.

`queryDB()`

> This function makes a request to the server to get the categories. It is a general function, and based on the state of the application it asks either for the levels, classes, subjects or sections. When the server successfully responds, it appends a button for each category.
>
> For example when a user press the *start* button in the main page, this function asks for the levels from the server, and appends them as buttons (*Ungdomskole, VGS* and *Univ./Høyskole*). When one of these levels are selected, the getLevels() function then asks for the *classes.* The communication with the server is done with the AJAX function, described in the section 6.2.4.3.

`getQuestion()`

> When the user selects the section, then this function is called. It gets the questions from the database and sets up the HTML elements so that the user is able to read the question text and select an answer.

`answerQuestion()`

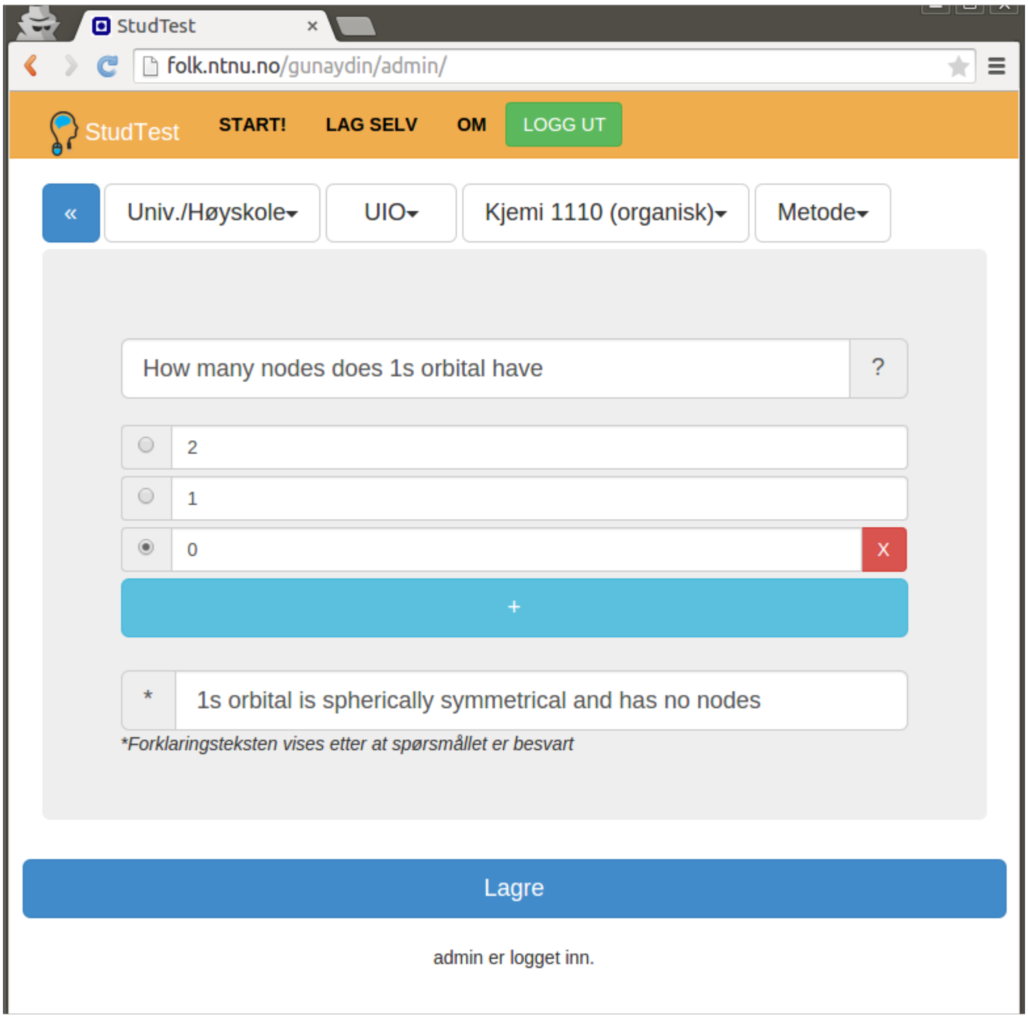
> This is the function that is called when the user answers a question. It checks in the database whether the answer is correct not. Based on that, it sets right colors to the alternatives.

`calculateResult()`

> This function runs when the quiz is finished. It calculates and shows the results.

6.2.4.2 Admin Page

The admin page is created to add questions. The question form appears when the user selects a topic. To create a new question, the user has to write a question text and at least two answer alternatives. It can be added up to 5 alternatives with the '+' button and only one of them can be the correct answer. The correct answer is assigned from the radio buttons beside the answers. It is also possible to write an explanation to the questions.



How many nodes does 1s orbital have

○ 2

○ 1

● 0

1s orbital is spherically symmetrical and has no nodes

*Forklaringsteksten vises etter at spørsmålet er besvart

admin er logget inn.

Figure 20: Admin Page

The JavaScript functions in the admin page make HTTP requests to the server as well. It uses a customized version of the *queryDB* function. In addition it has a *validator* function that validates the question form and adds it to the database, if it is correctly filled. Otherwise it gives a feedback to the user about what is missing or wrong.

6.2.4.3 AJAX function

AJAX is a jQuery function which is used to perform asynchronous HTTP requests. I have used this function to communicate with the PHP functions in server.

```
$.ajax({
  url: 'http://folk.ntnu.no/gunaydin/feed.php',
  type: 'POST',
  dataType: 'JSON',
  data: {action: current, ...},
  timeout: 5000,
  success: successFunction,
  error: errorFunction
});
```

The snippet above is the AJAX function I used. The URL specifies the location of the server. The type of the HTTP request is set to POST and the data type expected from the server is JSON. Parameters added inside the data brackets, contains the information sent to the server. It is the *action* parameter that decides which of the PHP functions to run. If the request successfully returns within the timeout time the succesFunction handles the returned data. Otherwise the errorFunction is called.

6.2.5 Mobile Client

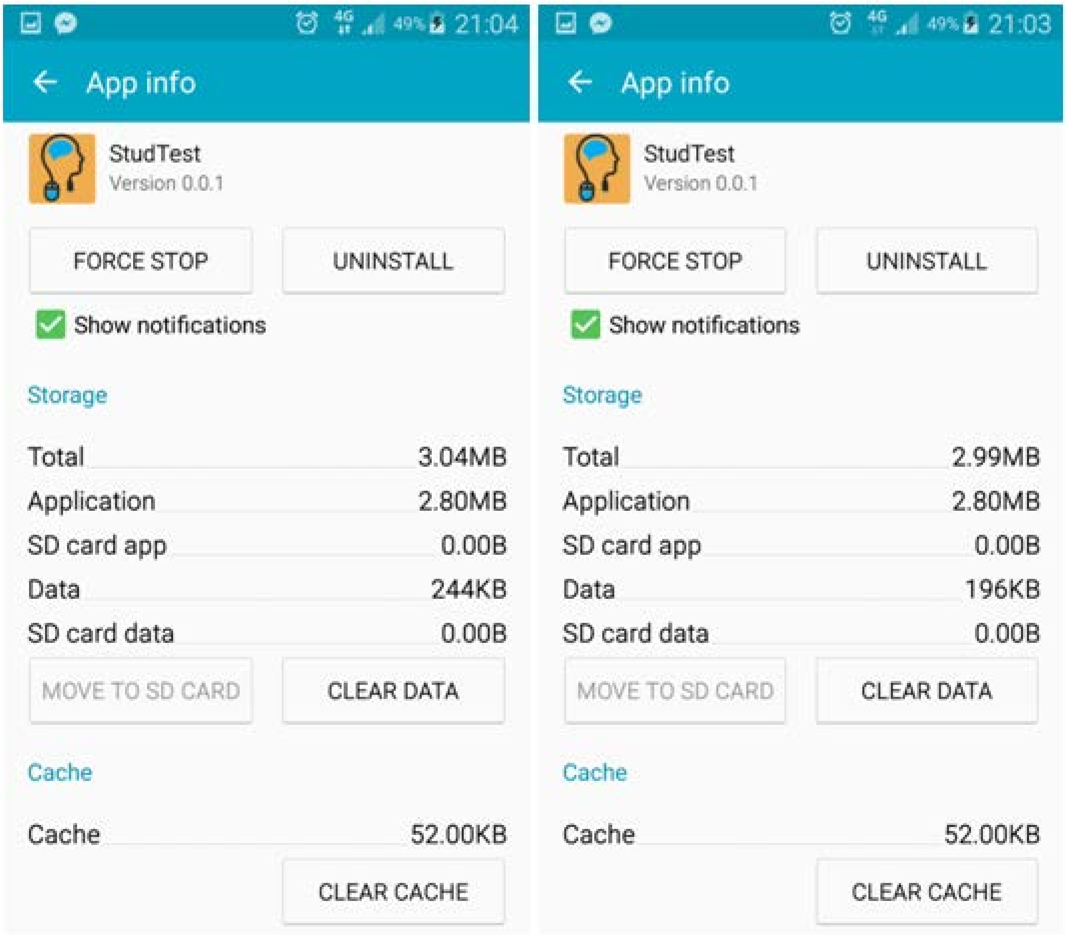
Bootstrap simplified my task to implement the mobile client. The interface was responsive and I could use the HTML and CSS code from the web client. I only replaced some buttons in the main window. There is no difference in design between the mobile client and the web client. Both versions give the same user experience, the main difference is in implementation.

In the first run when the users press the *START* button, they will be informed to download data from the server. Data can also be downloaded by pressing the *OPPDATER DATA* button in the main window.

Like the web client, the communication with the server is happening with the AJAX function. When the user wants to download or update the question database, the JavaScript function loadDatabase() is called. This function makes a HTTP request to the server, and gets the whole database as a JSON object. The data is then saved to the device as a *WebSQL* database with the same structure as the *MySQL* database.

The JavaScript functions in the web client are also used in the mobile client. The difference in the mobile version is that the system makes queries to the local database instead of making requests to the server. This functionality enables offline usage for the mobile client. The admin page is not included in the mobile client, to add questions the web client has to be used. There is a button on the main window and in menu that directs the user to the web client.

The application used 2.99 megabytes of memory before the questions were downloaded from the server. After downloading the question database (70 questions) the used space became 3.04 megabytes. The screenshots show the difference in memory usage to be 48 kilobytes.



StudTest
Version 0.0.1

☑ Show notifications

Storage

Total	3.04MB
Application	2.80MB
SD card app	0.00B
Data	244KB
SD card data	0.00B

Cache

Cache	52.00KB

StudTest
Version 0.0.1

☑ Show notifications

Storage

Total	2.99MB
Application	2.80MB
SD card app	0.00B
Data	196KB
SD card data	0.00B

Cache

Cache	52.00KB

Figure 21: Android App Info

PART IV

Results and Evaluation

7.Chapter

Results

This chapter will present the results from the user test. I will first go through the questionnaire and present the feedbacks about the different aspects of the system. The next section will be about discussions made with users where more detailed comments about the system are presented. The last section contains test results of the Android application.

7.1 Questionnaire

The questionnaire is built by different statement/question sections. In the first section there are questions about the user and device properties. The users' age, gender and computer skill level is asked. These questions will answer me if there are relations between a user's personality and the user experience. Technical questions about the device are also asked in order to know the variety of used devices, and to evaluate the multi-platform support.

The second part of the questionnaire contains statements related with the usability, usefulness and functionality of the system. Respondents are given a scale of 1 to 5, where the answers are based on their degree of agreement or disagreement to the statements.

1- Strongly disagree
2- Disagree
3- Neither agree nor disagree
4- Agree
5- Strongly agree

In the last part of the questionnaire, users' are asked if any errors occurred during the testing and if they have any comments. The questionnaire was answered by totally 16 people. Results are expressed in percentage.

7.1.1 Usability

The questions about the usability are taken from the System Usability Scale. Results from this part are not very relevant with my research questions, but it will help me to understand if the users had difficulties using the system. This may have negative impacts on the users' rating to the other features.

	5	4	3	2	1
I think that I would like to use this system frequently			9,00%	36,40%	54,50%
I found the system unnecessarily complex	63,60%	27,30%	9,00%		
I thought the system was easy to use				27,30%	72,70%
I think that I would need the support of a technical person to be able to use this system	81,80%	18,20%			
I found the various functions in this system were well integrated				36,40%	63,60%
I thought there was too much inconsistency in this system	63,60%	36,40%			
I needed to learn a lot of things before I could get going with this system	81,80%	18,20%			
I would imagine that most people would learn to use this system very quickly				16,60%	83,30%
I felt very confident using the system				27,30%	72,70%
I liked the look-and-feel of the system			9,00%	54,50%	36,40%

Table 4: Questionnaire Results 1

7.1.2 Performance

The participants were asked a question about the performance of the system. This statement is will help me to understand the system performance in different devices.

	5	4	3	2	1
I thought the system was slow	54,50%	27,30%	18,20%		

Table 5: Questionnaire Results 2

7.1.3 Screen Size

To measure the effectiveness of the responsive design, I added two questions related with the screen size of used device. The results give an overview of whether the system is responsive to different screen sizes.

	5	4	3	2	1
I think the display on my device was too small for the application	45,50%	36,40%	18,20%		
I think the display on my device was too big for the application	36,40%	45,50%	18,00%		

Table 6: Questionnaire Results 3

7.1.4 Knowledge improvement and motivation

The most important factor of the application is its usefulness. Some statements in the questionnaire were about whether the system is instructive or and in which context they would use the system, only before exams or regardless of the exams.

	5	4	3	2	1
I learned something by solving questions				45,40%	54,50%
I would use this system to prepare for tests/exams				18,20%	81,80%
I would use this system regardless of exams/tests	27,30%	18,20%	45,50%	9,10%	
I think that solving curriculum related multiple-choice questions. will be useful for students in their studies			9,10%	45,50%	45,50%

Table 7: Questionnaire Results 4

Some of the statements present users motivation for using the application, either by adding or solving questions. Currently, limited motivating factors are available. The result from these statements will answer if additional components are needed to increase motivation.

	5	4	3	2	1
I wanted to retry the questions to get higher score				9,10%	90,90%
I would add questions to StudTest. if I think they will be useful for students				54,50%	45,50%
I would add more questions to StudTest. if it have had a reward system (e.g ranking. score)			45,50%	27,30%	27,30%

Table 8: Questionnaire Results 5

7.1.5 Errors and faults

The testers used personal computers, tablets and smartphones to try the system. Device variety was important to have in order to measure the applications adaptability. The list of different devices used under the testing is as follows:

- Windows PC (Samsung and Acer)
- Macbook Air
- iPhone 5 and 6
- Android Phones (Samsung, HTC and Sony)

The usage of different devices did not change the system's behavior. None of the testers did experience any errors during the test.

7.2 Discussions and comments

This section will present the comments written in the questionnaire and feedbacks given in the oral discussion.

7.2.1 Feedback

One of the users commented the admin panel; he mentioned that he was uncertain if the system successfully created the subject he added, because no feedback was given. And meant that the system should display an information message, and inform the users that the category was successfully added.

7.2.2 Navigation between questions

After answering a question, a user has to navigate manually to the next question. This was a little bit confusing for two of the testers. Their opinion was to highlight or reveal a “next question” button after answering a question.

7.2.3 Categorization

Several users did misunderstand the categorization of the questions. When they tried to add questions, it was an uncertainty about the section the questions should belong into. Sections are basically the different topics in a subject, i.e. Algebra, Geometry or Probability in mathematics.

One of the users named the section as "My test", two other users asked me about what they were supposed to write there. Another user mentioned that he was confused about the same issue, but came out of the situation at the end.

7.2.4 Rating and comment

One of the test users, who shared his opinions about the system, gave some ideas of extra functionality. He said that the users should be able to give points to the questions, and eventually also write comments to them.

7.3 Android Mobile Application Test

The android application was tested with different android devices. The goal for the tests was to look for the local storage support and the performance of the application. Smartphones with the Android operating system does have different hardware, and thus it might be difference in the performance. The most important is that the application is running with an acceptable speed even with older devices.

I did test the system with three different devices with following specifications:

Samsung Galaxy S4

Android Version: 4.4.2

Display size: 5 inches

HTC One M7

Android Version 5.0.2

Display size: 4.7 inches

HTC Desire

Android Version 2.3

Display size: 3.7 inches

The application did work properly without any errors in all the devices. HTC Desire was the oldest and smallest device and had poorer performance, but still the performance was in an admissible level. The smaller display did not have any negative effect in the user experience.

There were no remarkable differences in user experience between HTC One and Samsung Galaxy S4. Both did run the application very smoothly without any inconvenience. All the devices used between 10 and 20 seconds to setup the database after downloading it from the server.

8.Chapter

Evaluation

This chapter will evaluate and discuss the results presented in the previous chapter, and will refer to the calculated values. The evaluation will be based on the feedbacks gained through the questionnaire and the discussions with the testers.

8.1 Usability

To measure the quality of the usability, I will look at the feedbacks from the users. When we look to the rating of the statements about usability in the questionnaire, we can clearly see that the responses are mostly positive. Minor drawbacks that some users did touch upon during the discussions did not have big effects on their overall rating. To summarize we can say that the users did not have any difficulties using the system. Thus, we can conclude that the usability does not have a negative impact on the users' experience.

Nine percent of the respondents did neither agree nor disagree in the statement "I found the system unnecessarily complex". This small degree of complexity is caused by the issues mentioned in the discussion section. The lack of feedback in the admin panel and the less-effective navigation method between questions can be improved by making minor changes in the interface. Such as:

- Show users a success message when they add a new category.
- Reveal a button that goes to next question when users' selects an answer.

Some users were confused about categorization of the questions. This confusion is primarily caused by the users' unfamiliarity to the concept of the system, but to minimize this misunderstanding the system should describe the meaning of each category. The admin panel should be more informative to the users.

8.2 Performance

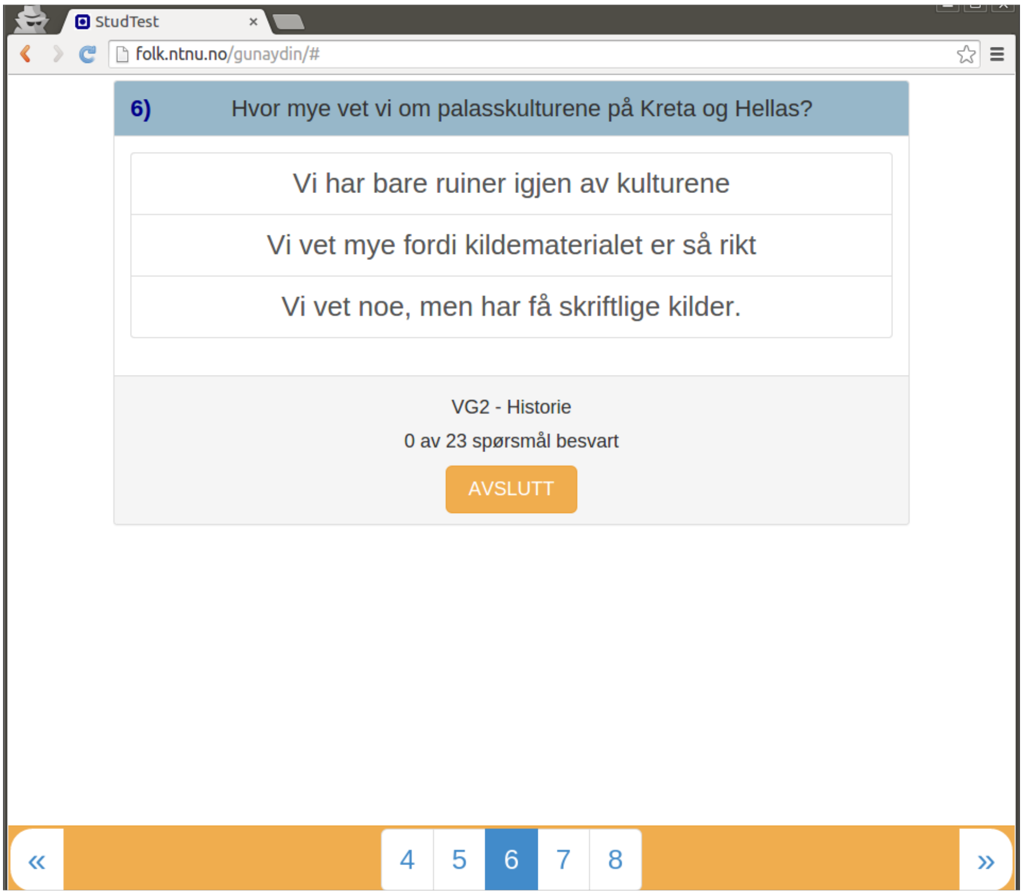
The results from the questionnaire show us that the system is working with acceptable speed. 54,5 percent of the users strongly disagreed and 27,3 percent disagreed in the statement “I thought the system was slow”, while 18,2 percent neither agreed nor disagreed to the same statement. Although no one agreed on this statement, we can see that some users might be happier with better performance.

The performance experience may differ because of the device used or the expectation the user has. It is possible to create better algorithms and improve the implementation to increase the performance, but this is not necessary because overall results shows that users are satisfied and no commented were made about any performance issues. The results from the Android application test also shows that the system is running with acceptable performance even with older smartphones.

8.3 Screen Size

The ratings given to the two statements about display size, shows that the system has god responsiveness. The interface did fit the different displays properly without creating difficulties to the users. Besides the questionnaire feedbacks, I also tested the responsiveness by resizing the browser while it was running the system.

The Bootstrap framework did its work as it should, and reacted successfully to the different window sizes. The screenshots below shows an example of the reaction.



StudTest

folk.ntnu.no/gunaydin/#

6) Hvor mye vet vi om palasskulturene på Kreta og Hellas?

Vi har bare ruiner igjen av kulturene

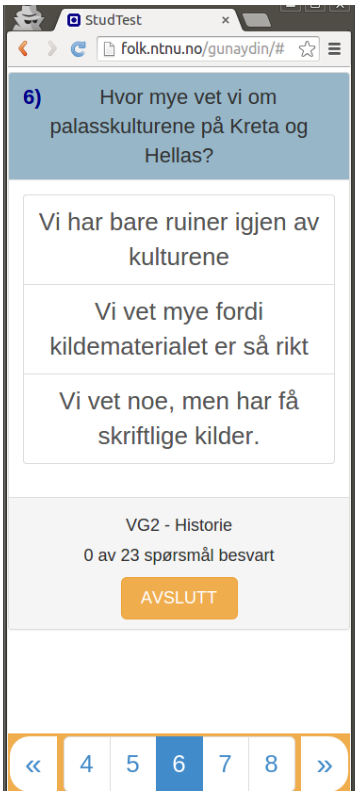
Vi vet mye fordi kildematerialet er så rikt

Vi vet noe, men har få skriftlige kilder.

VG2 - Historie

0 av 23 spørsmål besvart

Figure 22: Screen Resizing 1



StudTest

folk.ntnu.no/gunaydin/#

6) Hvor mye vet vi om palasskulturene på Kreta og Hellas?

Vi har bare ruiner igjen av kulturene

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Vi vet noe, men har få skriftlige kilder.

VG2 - Historie

0 av 23 spørsmål besvart

Figure 23: Screen Resizing 2

8.4 Knowledge improvement and motivation

When we look at the questionnaire responses, we can see that many users agreed on the fact that this system was useful. All the users meant that they learned something by solving questions, and 90 percent of the users meant that the system will help students with their studies. The results are promising, and give positive indications of that the system is successful.

Among the testers did 90,9 percent strongly agree to the statement “I would use this system to prepare for exams”, and the remaining 9,1 percent did agree. Not many users wanted to use the system regardless of exams. This clarifies that motivation of the users relies on their need for preparation. This result was expected, as the system was developed for exam preparation. Together with that, it will only be an advantage for the system, to add factors that motivate users to use it regardless of exams.

In order to increase the motivation a reward system can be built. We can see from the feedbacks that all the test users wanted to retry the questions to get higher score. Similar to that, the users can gain points and get higher scores by solving questions. Even more exciting will it be with achievements, for example give harder questions or new functionalities to users with higher score. The reward system can also be used to increase competition, by ranking the users based on their points.

On the other side, the system needs users to add questions, and the contributors will increase with some motivation. The test results indicate that many users are willing to add questions to the system to be helpful to others. About 55 percents meant that a reward system would increase their willingness. This could be done by giving users points for each contribution, and give higher rankings to the users that add more questions.

Another method to increase motivation and participation is to add social media support. Enabling users to share their rankings and scores in different platforms, might add more competition and ensure more users get familiar with the system.

8.5 Reliability

Enabling users to add questions to the system brings a new challenge, which is measurement of data quality. Users might add wrong or bad questions to the system, such questions will decrease reliability of the system. To deal with this issue, some extra functions need to be implemented. One of the solutions is to create a feedback system where users will be able to report, comment or rate the questions. With this method is it possible to distinguish between good, weak and incorrect questions. Data validation was not included as a part of this thesis, but it is mentioned because of its importance.

8.6 Android Application

The test results of the Android version were positive. The application was able to perform all its functions without any problems in different devices. StudTest is now ready to run in the Android platform, and can be published in Google Play. The technologies and the frameworks I have chosen to use for the implementation did not cause any disappointments. Based on this result and the technical details previously described, we can indicate that StudTest will be compatible in the iOS platform as well.

8.7 Summary

The overall result showed that despite some minor shortages, the StudTest system worked as planned. It is useful, user friendly, available in multiple-platforms and a supportive tool for the students. The test process revealed new ideas that have the possibility to strengthen the overall quality of the system. Together with these improvements the system will be a candidate for a system accepted by many users.

PART V

Summary

9.Chapter

Conclusion

In this thesis, I have presented the idea, implementation, test and evaluation of the multi-platform quiz application; StudTest. I presented the project idea and went through theoretical and technical topics related with the system. Similar projects and applications were summarized and compared with StudTest. I have developed a test version of the system, which has been tested and evaluated. Based on gained feedbacks, I tried to measure the usefulness of the system and find motivating factors.

The main goal for this project was to take the first steps towards a system that aims to help the students in their school works. A system that provides an alternative and more exciting method for exam preparation is something students would appreciate. I have gained feedbacks and ideas about the system through the questionnaire and discussions made with test users. In addition to that, many people shared their personal opinions about the idea. The overall results showed me that this idea has the potential of being a successful system, accepted and used by many users. StudTest also have a potential to be a content rich system, because it enables user contribution.

The technical solution I have chosen, gave me the possibility to develop a system supported by many different platforms, such as personal computers, smart phones and tablets. The applied solution also made it possible to create a mobile version, which enables offline usage of the application. These factors increased the availability of the system and opened its doors to maximum amount of users.

10. Chapter
Further Work

The scope of this project was to create a testable system, it therefore needs to be improved before considering it as a finished product. I feel that the results gained in this thesis are enough to give opinions about the usefulness, technical solutions and limitations of the system. Nevertheless, a further work with a broader participation of test users and implementation of additional functions will be necessary to make a final evaluation of the product.

10.1 Additional functions

Based on the feedbacks, discussions and evaluations, we can summarize a list of functions that should be included in StudTest.

10.1.1 Question Editing

The current implementation does not allow users to edit the questions they added. When users login to the admin page, it should list all previously created questions to be edited or deleted. Enabling modification of bad or incorrect questions will increase content quality.

10.1.2 Quiz History

When a user finishes a test, the system should save the results and create a result history. This will help the students to keep track of their progress. This will also add more competition by enabling users to compare results with each other.

10.1.3 Reward system and competition

As discussed in the evaluation part, to increase the motivation of the users a reward system should be implemented, both for solving and adding questions. Users should get higher points when they make progress, this will also bring competition. Gaining higher scores should be a credit and lead to new possibilities.

10.1.4 Rating, report and comments

The content should be validated and quality measured. As mentioned previously, this can be done by enabling user given comments and rating to the questions. The users should also be able to report incorrect questions to the administrators. Some school subjects may change the curriculum, and the earlier added question might be non-important. Be able to report such questions will increase the quality of the content.

10.1.5 Search Function

To make it easier for the users to find subjects, the system should have a search function. This will increase the usability and reduce complexity.

10.1.6 Questions with Images

To be able to create more interactive and different types of questions, it should be possible to add images to the questions. Images of figures, tables or curriculum related graphics/pictures might be some examples. However, this function has a drawback for the mobile version, as it is increasing the database size. A practical solution should be researched.

10.2 Improvement in the interface

Although the users were mostly satisfied with the interface, it had some small weaknesses that should be improved. The upgrade should be strengthened with a broader user test.

10.3 iOS and Windows Phone Application

The mobile version of the system is technically ready to be deployed to the iOS platform. This should be done, in order to make a more detailed evaluation of the multiplatform support. With some changes in the local storage method (see section 1.6.3) it is also possible to create a Windows Phone version, and let their consumers be able to use the system as well.

10.4 Evaluating the implementation

In this project the main focus of the evaluation was the usage of the system. A detailed technical review should be done by skilled users. The implementation, used technologies and the code should be evaluated, and improved. Quality attributes such as modifiability, security, maintainability, testability and more should be considered when making this evaluation.

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Appendices

Appendix A

Questionnaire

This appendix contains the questionnaire used in the user test.

StudTest User Feedback Form

StudTest Questionnaire

About You

1. **Age**
   Alder

2. **Gender**
   Kjønn
   Mark only one oval.

   ○ Male
   ○ Female

3. **My computer skill level is**
   Mark only one oval.

   ○ Novice
   ○ Beginner
   ○ Intermediate
   ○ Professional
   ○ Expert

Your Device

4. **What type of device did you use, while testing StudTest**
   Hvilken type enhet brukte du, mens du testet StudTest
   Mark only one oval.

   ○ Laptop/PC
   ○ Tablet
   ○ Smartphone
   ○ Other:

5. **Brand and model (e.g. iPhone 5s, Samsung s4)**
   Merke og model (f.eks. iPhone 5s, Samsung s4)

   ....

6. **Which operating system did you use?**
   Hvilket operativsystem brukte du?

   ....

7. **Which web browser did you use?**
   Hvilken nettleser brukte du?

   ....

Questions

For the following questions, please chose a number between 1-5 based on how much you agree or disagree.

Vennligst velg et tall mellom 1 og 5, ut i fra hvor enig eller uenig du er i utsagnene.

1- Strongly disagree / Sterkt uenig
2- Disagree / uenig
3- Neither agree nor disagree / Verken enig eller uenig
4- Agree / Enig
5- Strongly agree / Sterkt enig

Usability

8. **I think that I would like to use this system frequently**
   Jeg kunne tenke meg å bruke dette systemet ofte
   Mark only one oval.

   ○ 1
   ○ 2
   ○ 3
   ○ 4
   ○ 5

9. **I found the system unnecessarily complex**
   Jeg synes systemet var unødvendig komplisert
   Mark only one oval.

   ○ 1
   ○ 2
   ○ 3
   ○ 4
   ○ 5

10. **I thought the system was easy to use**

Jeg synes systemet var lett å bruke
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

11. **I think that I would need the support of a technical person to be able to use this system**

Jeg tror jeg vil måtte trenge hjelp fra en person med teknisk kunnskap for å kunne bruke dette systemet
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

12. **I found the various functions in this system were well integrated**

Jeg syntes at de forskjellige delene av systemet hang godt sammen
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

13. **I thought there was too much inconsistency in this system**

Jeg syntes det var for mye inkonsistens i systemet. (Det virket “ulogisk”)
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

14. **I needed to learn a lot of things before I could get going with this system**

Jeg trenger å lære meg mye før jeg kan komme i gang med å bruke dette systemet på egen hånd

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

15. **I would imagine that most people would learn to use this system very quickly**

Jeg vil anta at folk flest kan lære seg dette systemet veldig raskt

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

16. **I felt very confident using the system**

Jeg følte meg sikker da jeg brukte systemet

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

17. **I liked the look-and-feel of the system**

Jeg likte systemets utseende

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

18. **I thought the system was slow**

Jeg syntes systemet var treg

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

19. **It was fun to use the application**

Det var artig å bruke systemet

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

20. **I think that the subjects/topics and the questions are well categorized**

Jeg tenker at fagene/emnene og oppgavene er godt kategorisert

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

21. **I think the display on my device was too small for the application**

Jeg syntes at skjermen på enheten min var for LITEN for dette systemet

Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

22. **I think the display on my device was too big for the application**
Jeg syntes at skjermen på enheten min var for STOR for dette systemet
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

Adding Questions

ANSWER THIS PART ONLY IF YOU HAVE ADDED QUESTIONS

SVAR PÅ DENNE DELEN KUN HVIS DU HAR LAGT TIL OPPGAVER

23. **I think that I did improve my knowledge in the subject(s) by adding question(s)**
Jeg tenker at jeg økte mine kunnskaper i de emenene jeg lagde oppgaver til
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

24. **I think that solving curriculum related multiple-choice questions, will be useful for students in their studies**
Jeg tenker at å løse pensum-relaterte flervalgsoppgaver vil hjelpe studentene med deres utdanning
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

25. **I would add questions to StudTest, if I think they will be useful for students**
Hvis studentene vil ha nytte for det, vil jeg legge til oppgaver på StudTest
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

26. **I would add more questions to StudTest, if it have had a reward system (e.g ranking, score)**

Jeg ville lagt til flere spørsmål til StudTest, hvis den hadde hatt et belønningssystem (f.eks. rangering, poeng)
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

Solving Questions

ANSWER THIS PART ONLY IF YOU HAVE SOLVED QUESTIONS

SVAR PÅ DENNE DELEN KUN HVIS DU HAR LØST OPPGAVER

27. **I learned something by solving questions**

Jeg lærte noe av å løse oppgaver
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

28. **I wanted to retry the questions to get higher score**

Jeg ønsket å gjenta oppgavene for å få høyere poengsum
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

29. **I found the questions relevant with the school curriculum**

Jeg syntes at oppgavene var relevat med skole pensum
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

30. **I would use this system to prepare for tests/exams**
Jeg ville brukt dette systemet for å forberede meg til prøver/eksamen
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

31. **I would use this system regardless of exams/tests**
Jeg ville brukt dette systemet uavhengig av prøver/eksamener
Mark only one oval.

○ 1
○ 2
○ 3
○ 4
○ 5

Comments

32. **Did the system work properly on your device?**
Fungerte systemet feilfritt på enheten din?
Mark only one oval.

○ Yes
○ No

33. **If no, please describe the problem that occured**
Hvis nei, vennligst forklar problemet som oppsto

....
....
....
....
....

34. **Please share your thoughts about StudTest (Optional)**
Vennligst del dine tanker om StudTest (Valgfritt)

....
....
....
....
....