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Umbrella: Web-based Health Education Quiz Game for School Kids

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Title	Umbrella: Web-based Health Education Quiz Game for School Kids
Number of Pages	59 pages + 2 Figures/Tables + 2 Abbreviations/Glossaries
Date	18 May 2016
Degree	Master of Science
Degree Programme	Information Technology
Specialisation option	Mobile Programming
Instructor	Jaana Holvikivi, Principal lecturer

The purpose of this thesis was to create a web-based quiz game prototype called Umbrella. Umbrella was an innovation project aimed to develop a gamified e-learning tool which helps to improve school pupils' motivation towards learning about their health and wellbeing. It was conducted in collaboration with students from the fields of public nursing, oral hygiene and information technology of Metropolia University of Applied Sciences and in international co-operation with the Tokushima University, School of Oral Health and Welfare, Faculty of Dentistry. Thus, the name of the prototype, Umbrella was taken from a Japanese traditional umbrella which is a type of paper umbrella as to strengthen the academic relationship between the two universities.

The study was conducted by a qualitative method. The data was collected with theme interview methods several times at the Helsinki yhteislyseo in 2014 and 2015. The themes of the interview were based on the school Health Promotion Study events arranged by the National Institute for Health and Welfare. Thirty-three young people were interviewed in 2014. All interviews were recorded. The collected data was transcribed and anonymized and then the data was analysed with inductive content analysis method.

The prototype was first introduced as a learning tool in November 2015 and is fully functional at the time of writing the thesis. The quiz questions were prepared both in Finnish and English, however the Finnish questions were used in this particular thesis.

The thesis concludes that a preventive educational intervention program supported with Information technology (IT) provides excellent means to improve the awareness levels, the life-style and overall health practice of school pupils. A few ways to further develop Umbrella in future would be considering using complex game engines to support multi-player mode, including an image quiz option and internationalization.

Keywords	Quiz, Students, Health, Wellbeing, Game, Umbrella, Education

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Abbreviations/Glossaries

HTML	Hyper Text Markup Language
CSS	Cascading Style Sheet
PHP	Hypertext Preprocessor
AJAX	Asynchronous JavaScript and XML
SQL	Structured Query Language SQL, is a group of special words used exclusively for interacting with databases.
JSON	Java Script Object Notation
IT	Information Technology
API	Application Programming Interface
DOM	Document Object Model
XML	EXtensible Markup Language
DB	Database
IEEE	Institute of Electrical and Electronics Engineers
URL	Uniform Resource Locator
RDBMS	Relational Database Management System
JQuery	A JavaScript library and a client side programming language.

Use Case	A collection of possible scenarios related to a particular goal
Sequence Diagram	Flow of objects within a system in a visual manner and in time sequence
Innovation	Converting an idea into a useful product.
E-learning	A process of learning supported by Information technology.
phpMyAdmin	A web interface built on PHP to interact with MySQL database.
MySQL	A relational database system MySQL is the world's most popular open source database application and is commonly used with PHP.
Prototype	Sample or model of a product
Gamification	A concept of creating a game-like learning environment.
Bootstrap	An open source framework used for building websites and web applications.
Sublime Text 3	A cross-platform compatible text and source code editor.
Database	A structured collection of records or data stored in a computer system

1   Introduction

This master's thesis describes the process of building a web-based quiz game application called Umbrella.

1.1   Background

In the 21st century, technology is part of everything that we do. During the last three decades, technology has grown rapidly, and its inevitable impact on our lives is undeniable. IT has changed the way we look at things, the way we do things and even how we play games. The field of education is no exception. High tech software and hardware have changed the old methods of teaching and learning. From abacus to e-learning software, technology has found their way in the educational process, through computers, laptops and many other equipment. [1.]

Because of the development of internet technology and portable devices, people are able to access more types of media and highly-functioning web applications without time limitation and place restriction. In this context, e-learning is more and more an efficient way for learning because one of the main purposes of e-learning is to give learners opportunities to learn anytime and anywhere.

Researchers and educators have been working for years to improve the e-Learning effectiveness, having changed the e-Learning paradigm substantially, from teaching to learning. E-learning is a growing part of our society and the value of game-based learning has increased continuously. [2.]

Umbrella was a multidisciplinary project conducted in collaboration with students from the fields of public nursing, oral hygiene and information technology of Metropolia University of Applied Sciences and in international co-operation with the Tokushima University, School of Oral Health and Welfare, Faculty of Dentistry.

It was an innovation project aimed to create a gamified e-learning tool which will enhance school pupils' motivation towards learning about their health and wellbeing. It is a quiz game application with multiple choice questions related to health and well-being of young people. It is used on tablet or desktop devices on a web-site.

In order to ensure that school children are well aware of their health and wellbeing, it should be taken into account that a well-planned preventive educational intervention program supported with Information technology (IT) provides excellent means to improve the awareness levels, the life-style and overall health practice of school pupils and their families. With this consensus, the Umbrella team decided to create a web-based quiz prototype.

The project was offered to interested students with presumably adequate experience in the field. The innovation project was started in 2014 with an estimated duration of two years.

The name of the prototype, Umbrella was adopted from a Japanese traditional umbrella which is type of paper umbrella. Tokushima University and Metropolia University of Applied Sciences have international academic exchange agreements and bilateral study visits. This enables students from the two universities to gain a more effective understanding of their respective academic and cultural traditions.

Thus, the term Umbrella was used as to strengthen the two universities' academic relationship. According to the plan drawn by the representatives of the two universities, in the long run, Umbrella, the quiz prototype will be adopted in Japanese elementary schools as well. Figure 1 on the next page shows what a Japanese traditional umbrella looks like.

Figure 1 Traditional Japanese umbrella

The reason why this kind of study was interesting for the writer is that the writer was a system administrator in the past with a little web development experience, and later has developed a huge passion to become a full stack web developer.

In this paper a quiz game, Umbrella is explained in detail. This tool allows learners to compete with their friends in the quiz. Furthermore, to increase playfulness, the questions are divided to four major types or categories with ten questions randomly allocated to each selected category at a time. The tool stores the players' results by time and date played into a database. Furthermore, the tool analyses the learners' record from the database and allows them to view and share their previous results on social media.

1.2   Gamification Concept

Gamification aims to harness gaming into bringing more meaning in everyday work life by blending dull work routines with immersion of games. By providing the workforce with more engaging working environment, the main idea of gamification is to increase the productivity otherwise unattained with traditional incentives, such as monetary gain or raising in the ranks. This does not mean totally converting workspaces into game stations and full of magic mushrooms, like in Super Mario Bros-game, but changing boring and repetitive tasks into more engaging and interesting via one's personal gratification for the employee or their team.

Gamification does not only focus on the productive side of business, but also searches value from the customer herself. Activating the customer through a gamified question-naire, innovative web-based game or gamified trial version of a computer program, the relationship with the customer can be enhanced and her connection with the product deepened. [3.]

The concept of gamification is to create a game-like learning environment. This concept has been widely used as a learning tool, due to its highly successful nature in making users come back for repeated use, as well as effectiveness in actual learning. [4.] The concept utilizes human eagerness for stimulation in instances such as instant gratifica-tion and giving the user a feeling of progress immediately in contrast to waiting for a test.

1.3 Research Questions

This thesis in general aimed to answer the following two questions:

1. How to raise school children's motivation towards learning about their health and well-being by implementing game technology into modern teaching environment?

2. What kind of game can be engaging and inviting while still being educational?

The major goals of this project are firstly, to create a game, which also can be considered as a learning tool that offers an additional learning method. The game is not intended to be a singular method, but to be used as a supplementary learning tool.

The second aim is to make the game entertaining enough to make the user return for repetition while still being educational. Moreover, the game should be inviting as well as easy to use.

2 Organizations Involved in Umbrella Project

This chapter gives general information about the organizations involved in the development of Umbrella.

2.1 Helsinki Metropolia University of Applied Sciences

Metropolia University is Finland's largest university of applied sciences. Students from different campuses of this university have played the greatest role for the success of the project. Having come together from three different departments of the university, the students finalized the two-year project successfully. These three departments where the participants came from are IT, oral hygiene and public nursing departments.

The main role of the nursing students was preparing educational health quizzes by taking the maturity level of the children into consideration. The oral hygiene students on the other hand were responsible for dealing with all teeth and hygiene related questions. Moreover, they tested the game prototypes with pupils and collected feedback on the game design.

2.2 Helsinki yhteislyseo

Helsinki yhteislyseo is an elementary school located in Kontula, eastern side of Helsinki where the testing events took place several times in connection with oral health fair events. Students of different ages and grades took part in the testing events. Detail of the events' outcome are presented in the Findings section of this paper.

2.3 Tokushima University

Tokushima University is a Japanese university on the Shikoku island. In addition to working in a multidisciplinary team spirit within the university, the Metropolia University of Applied Sciences students worked with their counterparts from the School of Oral Health and Welfare Faculty of Dentistry Tokushima University.

For the wide-range collaboration with this university, several online and in person meetings took place as a workshop and experience sharing. In fact, the Tokushima University first developed an oral health testing application on computers, which gave inspiration for this project. It was implemented by a software company, and tested with younger children in primary schools.

3   Method and Material

This chapter discusses the research approach, methods and data collection applied in the present study.

Although there are many applications that focus on general quizzes, there is not any in the target elementary schools that focuses on learning or improving knowledge in health and well-being area only. Almost all other apps are either predominantly fun-oriented or trying to provide knowledge from a variety of fields.

Umbrella mainly emphasizes gaining health knowledge while having fun. So when the students are having fun playing the quiz, they are gaining health related knowledge which helps in gaining good grades and having better understanding of the subject matter.

3.1   Research Approach

In qualitative research, there are three main data collection methods: observation, theme interview and different text analysis. The data collection method depends on the phenomenon subject to research and its characteristics, accuracy and authenticity of the information required. Figure 2 illustrates a process diagram for qualitative research. It shows the research process of an individual qualitative research. This process diagram can also be used in action research, which uses qualitative research methods for understanding the phenomenon. [5.]
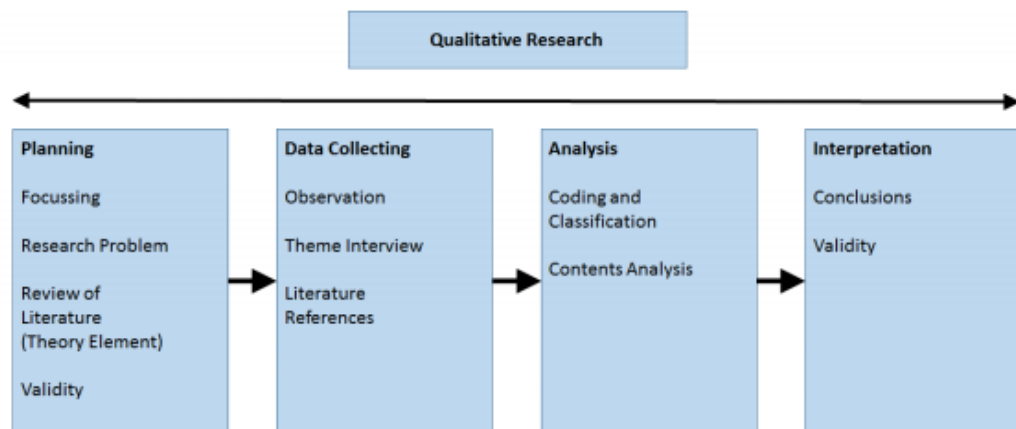
Figure 2 Process diagram for qualitative research reprinted from [4].

As it was described in the background section of this paper, this project was an innovation project executed in collaboration with public health and oral hygiene students. Since these students are going to be mentioned several times and also have done their final thesis on parts of this innovation project as well, they will be referred at as 'thesis partners' from this on.

The main data sources of this study were thus the thesis partners. Data used were mainly questions prepared by the thesis partners. However, a functional study in collaboration with supervisors and thesis partners as well as the feedbacks and suggestions from the pupils and their teachers have greatly helped to improve the quiz game application from the original version which missed several important features to the well advanced newest version. Feedbacks from the pupils, the teachers, the thesis partners and supervisors was collected and analyzed for further development.

As part of the study, several groups of nursing and oral hygiene students have done their thesis on Umbrella during year 2014 and 2015. They have all contributed their part to enhance the application, especially by collecting and analysing data, analysing feedbacks and monitoring the pilots.

The study was conducted by a qualitative method. The data was collected with theme interview methods several times at the Helsinki Yhteislyseo in 2014 and 2015. The themes of the interview were based on the school Health Promotion Study events arranged by the National Institute for Health and Welfare. Thirty-three young people were interviewed in 2014. All interviews were recorded. The collected data was transcribed and anonymized and then the data was analysed with inductive content analysis method. [6] [7].

3.2   Research Process

The development of the application started from bottom up approach. The writer focused on the users, the technology and the actual learning situation, rather than investigating the more general problem of teaching. Initially the IT team was told to come up with any potential game concept that would help the students learn about general concepts of health related problems but later the basic ideas relating to content, gameplay and structure of the application came from the nature of the school need, letting the students learn about health related matters through quizzing.

For this project, the intention was to utilize the concept of gamification. Gamification is the use of game thinking and mechanics in order to engage users in something that is not necessarily a game. [4] By using game-like ideas and processes one can easily encourage users to engage in the material.

The intention was to use the human intuitive eagerness of improvement and encourage a feeling of "trying one more time". The idea is that by visibly seeing how to improve as well as seeing an instant gratification of said improvement, the user will be stimulated to try to do better and thus learn more about the fields within the game.

The approach to this project was to find a type of game that would both be easily intuitive, as well as offer any complexity that would be required. The game would have to have a simplicity that would allow for the highest number of users capable, as the users would be a diverse group of students. The game would have to have a simple input, as well as easy to read output.

The game would have to be welcoming to users as well as not imply an excessive amount of learning, as that would easily make users weary of the game contents. An inviting start as well as an engaging gameplay would increase the amount of time a user would spend on the game.

3.3   How Students Learn

In a game, a user (or player) would learn the mechanics of the game by repeating actions, both after trying intuitive movements as well as explained actions. Repetition is thus very important, both for the game flow, as well as learning. However, to have excess amounts of repetition would easily make the game boring to a user and cause user retention to drop. The solution would be to have enough optional repetition while still offering a higher level of complexity to other users.

In a game that attempts to teach, it is also important to allow for easy access to subjects that may interest the user. This means that when the user encounters something he or she finds interesting, they may as easily and quickly as possible find more information.

As the game is intended to be a supplement to teaching and meant for elementary school pupils, the project would not require more complex game engines or prerequisite programs for this project.

4   Development of Prototype

In this section, the development of the quiz game is described.

The fundamental idea behind the project was to make a tool that would offer new aspects of learning. The team aimed to create a tool that fits into modern age, but still stays true to the ground level concepts of studying. The target group is school pupils in the 6th-9th grade. The audiences are expected to connect to the internet and to use tablet, desktop computer or laptop to use the application.

During development, some guidelines for the applications gameplay were made.

- The tool would be capable of being used alongside any other form of educational tools.
- It would easily be opened and have a single quiz round within moments, while still allowing for the repetition.
- Playing a round in a game would not be limited in time. Users would take time as long as they want to think over and answer quiz.
- In the game, users would at any time be able to view their result progress.
- Users would be able to be given description for a question they couldn't answer correctly.
- Users would be able to share their quiz results with their friends or families.
- Users would be able login to their respective account and be able to logout from.
- Users would be encouraged to do better by being rewarded with stars and motivating texts according to their scores.
- The tool would allow several difficulty levels as the awareness and mental maturity of the students vary.
- Users would be able to exit from the quiz in between without completing a round.
- Users would be able to play the content they want to learn more about.

The user group of the prototype is elementary school of 6th- 9th grade students. As the users are junior class students, the language should also be easily understandable. A difficulty understanding the language would drop user retention and eagerness by reducing the enjoyment, as the user would face a barrier that is not necessary to the gameplay.

5 Introduction of Used Technologies

A set of different web languages were used to code the Umbrella application. In this chapter all used web languages and technologies are introduced.

5.1 JQuery

Umbrella is built up on jQuery blocks. JQuery is defined as "a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers." (jQuery official website)

The fact that jQuery has become the most popular JavaScript library in web development, easy to learn and open source and provided for free has helped the writer to have preferred it over other JavaScript libraries for a client side programming of the quiz application. It has been used to add many functionalities into Umbrella web pages and to manipulate the DOM (Document Object Model) elements.

To implement jQuery into a web development, the only thing is to get the jQuery referenced in our HTML file. There are two effective ways to refer jQuery in a web application development.

One way is to use popular websites that host their own copy of jQuery JavaScript file within the HTML of a webpage. For instance, using library hosted by Google, jQuery can easily be loaded using the following line of code within the <head> section of the HTML.

```
<script    type="text/javascript"
src="//ajax.googleapis.com/aj
ax/libs/jquery/1.9.1/jquery.m
in.js"> </script>
```

Downloading the jQuery library file to a local computer and including the downloaded file into the main project folder is the other alternative, then referring the file directory in the head section of HTML of a webpage.

Once the jQuery library is loaded by using either of the above two options, a webpage can call any jQuery function supported by the library. Some of the common uses of jQuery are modifying text, processing form data and performing animations. JQuery mainly works with Ajax or scripting languages such as PHP to access data from a database server. Thus in the early versions of Umbrella, jQuery and Ajax were used together to access the Metropolia University database.

The latest version of Umbrella uses PHP to retrieve data from the database instead of JSON and Ajax. The database and related topics are discussed in detail later.

Besides JQuery being free and easy to use, the other main reason that helped jQuery to become very popular is the fact that it is cross-browser compatible. Instead of having to write custom functions for each popular web browsers, a single jQuery function can for example be used without a need for customization into Chrome, Internet Explorer, Safari, and Firefox.

5.2   HTML, CSS and Bootstrap

HTML (Hypertext Mark-up Language) is the standard mark-up used to create web pages. HTML elements form the building blocks of all websites. Figure 4 shows an example of HTML.

```
<!DOCTYPE html>  <!--  This  tells  the  browser  what
version     of     HTML    you    are    using    -->
<html> <!—All of the HTML codes go inside HTML tag --!>
<head>  <!--  Head  section  of  HTML  holds  information
about    files    and    title    the    webpage--!>
</head>
<body> <!—All the contents seen on a webpage go in the
body                  section                   --!>
</body>
</html>
```

CSS is a style sheet language used for describing the look and formatting of a document written in a mark-up language. CSS 3 was used in this project.

Bootstrap is an open source framework used for building websites and web applications. Bootstrap 3 was used along with CSS3 to design the UI (User Interface) in this project.

5.3   PHP

PHP is an acronym for "Hypertext Pre-processor". It is a server side scripting language. PHP is the language that you use to make the server generate dynamic output—output that is potentially different each time a browser requests a page. [8].

PHP was used as a server side script in the latest version of this project. It is used to connect to the MySQL database to transfer data from and to it.

5.4   Sublime Text 3

Sublime is a cross-platform compatible text and source code editor. Almost every aspect of Sublime Text can be extended or customized very easily. Some advantages of Sublime Text are its modifiable behaviour, adding macros and snippets, extend menus, opening project folders and adding files to it, auto completion and much more. Using the editor's API, one can even create whole new features to build complex plugins. Figure 5 on the next page shows Umbrella project opened with Sublime Text.
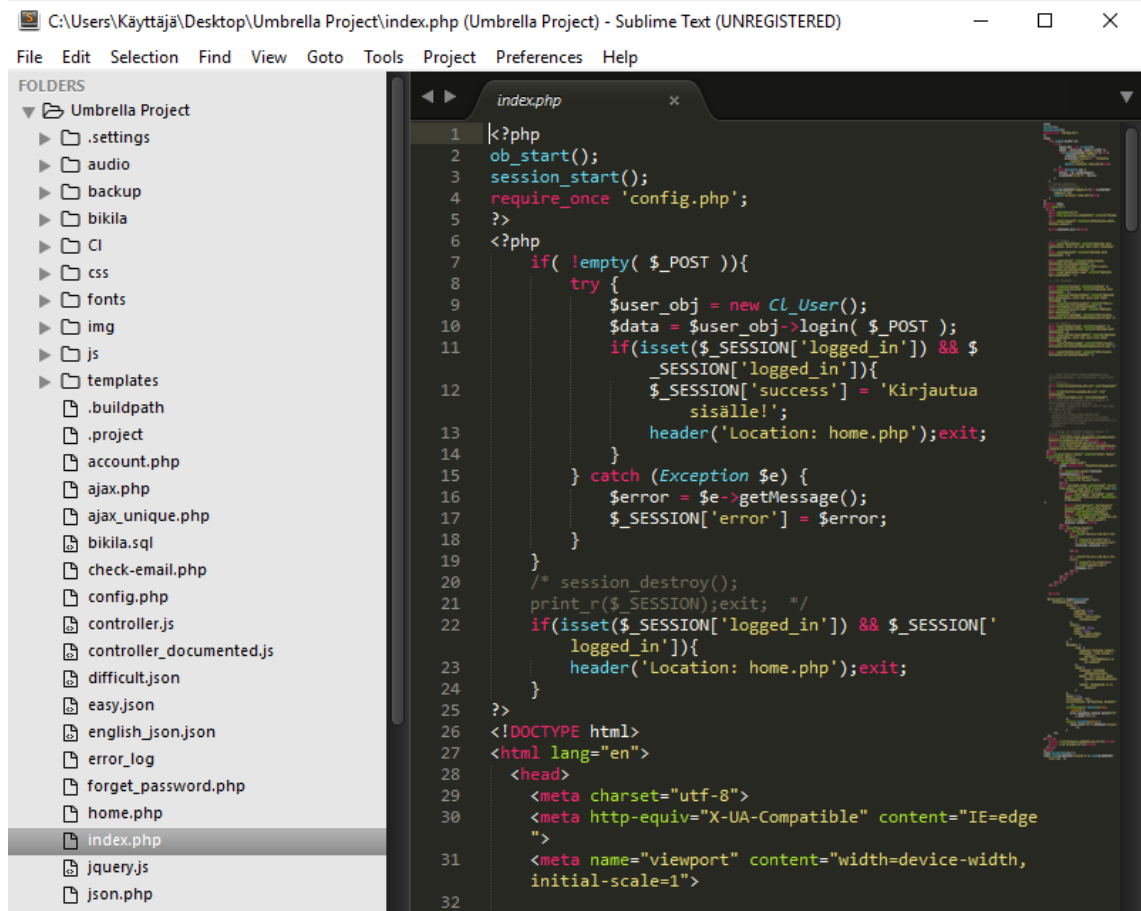
Figure 3 Umbrella in Sublime Text 3

In Figure 5 above, the Umbrella project structure is shown. The sidebar provides an overview of the active project. On the sidebar, project folder, sub folders and project's files are shown. On the right hand side, the current opened file is viewed and it can also be edited.

5.5   AJAX and JSON

Ajax is the concept of refreshing a part of an HTML document without reloading the entire page.

Ajax is not an acronym; it does not stand for anything. Many think it stands for Asynchronous JavaScript and XML, but it does not; it's just a word. Ajax can be synchronous, and it does not have to be XML. It can be XML, JSON, or even HTML. It's all about passing data to and from the server. [9].

As hinted above, JSON is an open standard JavaScript or AJAX data format that uses human readable text to transmit data objects. The earlier versions of Umbrella used a JSON data format stored on a server with an external JSON file type.

5.6   PhpMyAdmin

PhpMyAdmin is a free, open source and cross platform which helps to connect to MySQL with a valid username and password combination. It provides an interface to a MySQL server and accessed through a web server.

The latest version of Umbrella relies on this platform to design its database. The platform is given access to by the Metropolia University of Applied Science's server administrators. Figure 6 shows phpMyAdmin main interface.

Figure 4 phpMyAdmin main interface

As it can be seen in Figure 6, the database with all its tables structure, the host server and the user's name are seen.

5.7   MySQL and SQL

MySQL is the world's most popular open source database application (according to MySQL's Web site, www.mysql.com) and is commonly used with PHP. The MySQL software comes with the database server (which stores the actual data), different client applications (for interacting with the database server), and several utilities.

SQL, short for Structured Query Language, is a group of special words used exclusively for interacting with databases. SQL is surprisingly easy to learn and use, and yet, amazingly powerful. [10.]

SQL queries are used for many activities. For instance, to create a database, to create tables, to insert records to a table, to delete records, to modify table, to drop a table and etc.

6 Features

Under this section the features of Umbrella quiz game are introduced in detail. The major features of Umbrella are:

- ➢ The login, logout,
- ➢ Changing password,
- ➢ Recovering a lost/forgotten password,
- ➢ Selecting a category,
- ➢ Selecting a level
- ➢ Multiple choices for a question,
- ➢ Score counting and rewards,
- ➢ Viewing a description for a question on answering a wrong answer,
- ➢ Exiting the quiz at any time and playing as many as possible,
- ➢ Being able to view score history by time and date played,
- ➢ Being able to share the results on Facebook, Twitter and Google+.

Figure 7 on the next page illustrates all functional features of the Umbrella quiz game and shows the privilege of the players and the administration.
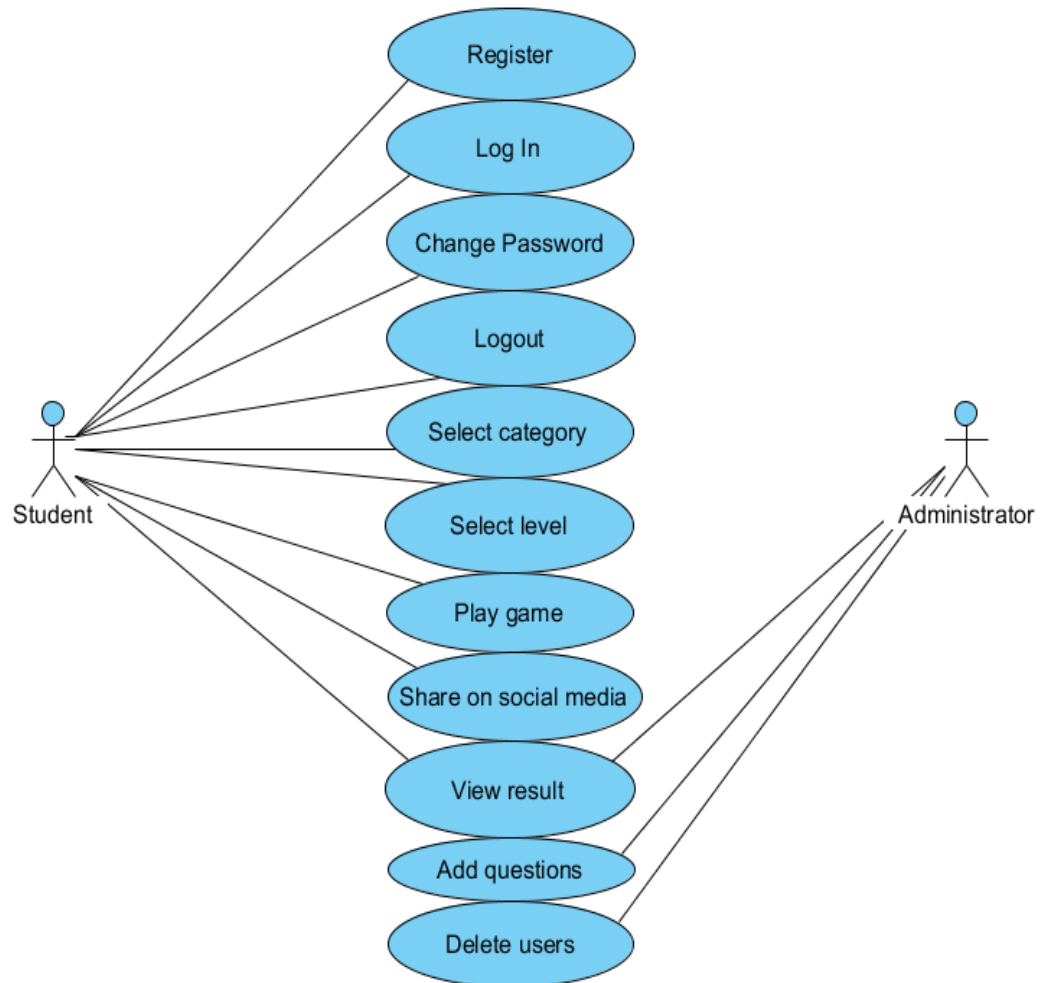
Figure 5 Umbrella in usecase

As shown in Figure 7, a user has the privileges to register, login, change password, logout, select a category and a level, go through the quiz questions, share results on social media, view results. The administrator can view the user's result, add questions to the database and delete users when needed.

6.1 Registration

A user of the app has to first be registered into the database before he/she is able to use it. However, as the application is intended for school kids and there was no necessity for a complex registration form, a student is only expected to have a valid email and password during registration.

The users have to fill in a valid email address. That will help in case they later forget their password and need to get a new one. If a password is forgotten, the user would be sent a new password to the email address. Thus, the prototype filters if the entered email has been in a correct email format. If a desired email is not in a correct format, an error message will be fired on attempt to send the filled form to the database.

The registration page also controls if the entered email is already in use or not. If the email has already been in use, the "email already exists" message will be displayed. However, when the filled data is all correct and it is successfully saved to the database, the system informs the user that the registration has been successful and will automatically navigate to the Login page in order to let the new registered user login to the app and start playing the quiz.

All these registration scenarios are going to be illustrated in the next consecutive figures.

Figure 6 Failed registration due to incorrect email format

Figure 8 shows the filled in email is not complete. It misses an email format. The server replies with an error message that hints to enter a valid email.

Figure 9 shows the registration second scenario with an existing email in the database.
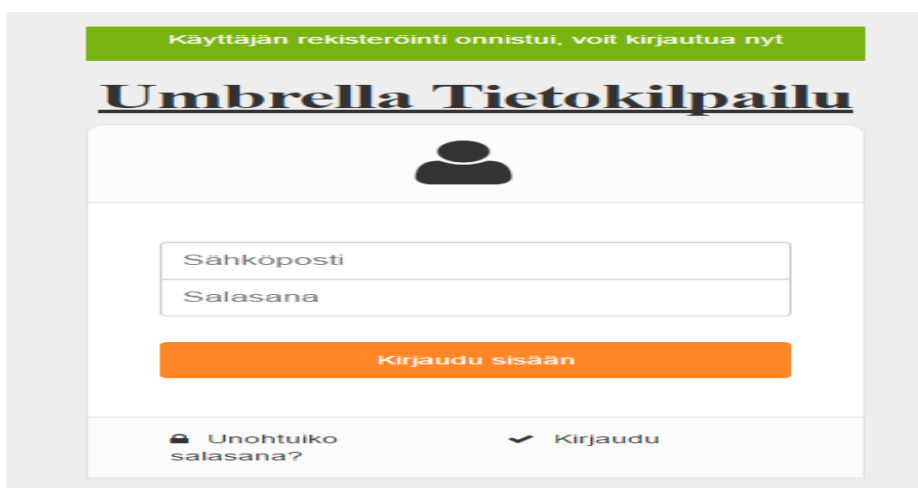
Figure 7 Failed registration due to an existing email address

In Figure 9 the entered email is already in use. The user has either to use a different email address or to login with this email if it belongs to him/her. In case the user forgets his/her password, recovering password is possible. Figure 10, shows a successful user registration.

Figure 8 Successful registration

Figure 10 shows how a successful registration is done. Once the registration is successfully done, the system will automatically direct the user to the login page. Here in Figure 10 the green backgrounded text shows the registration process was successful.

Figure 11 shows the sequence diagram for a new user registration procedure.

Registration Sequence Diagram
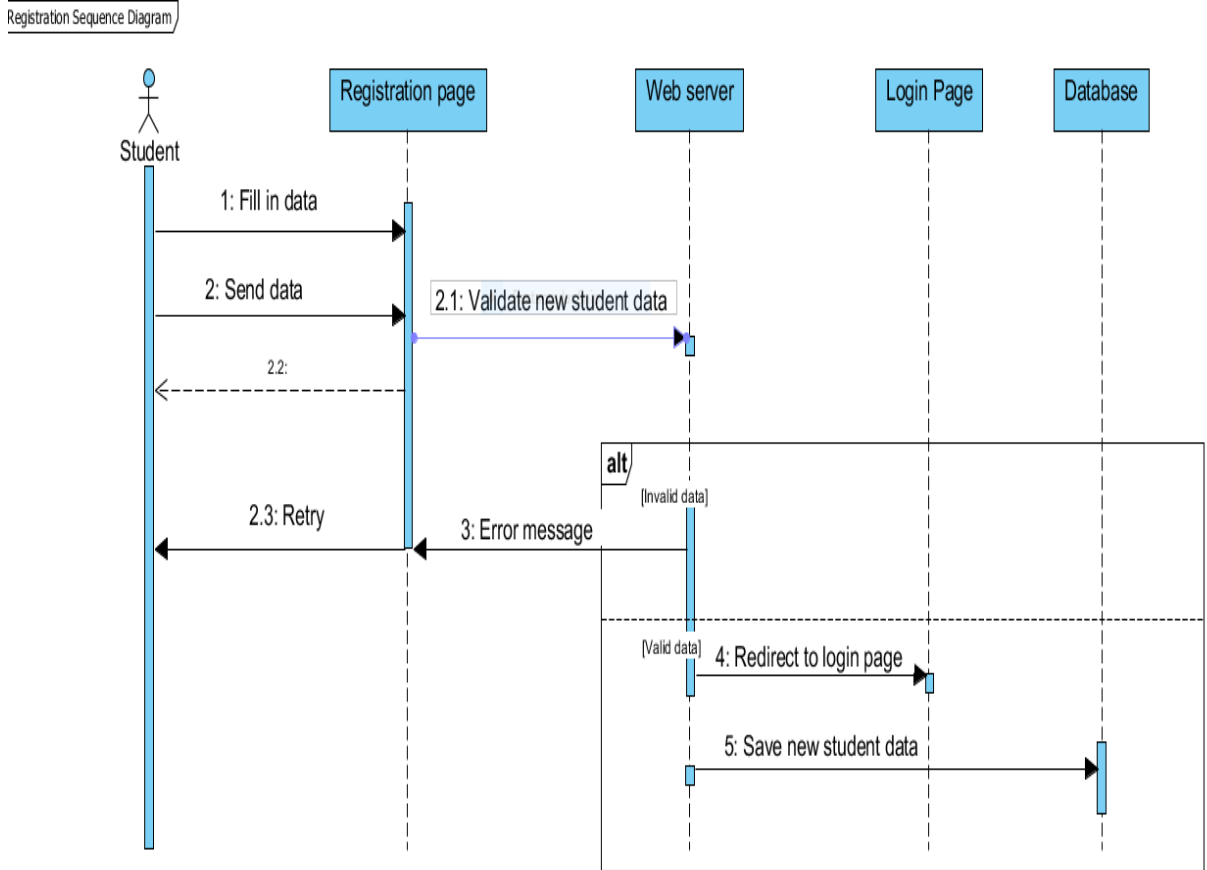
Figure 9 Registration procedure in sequence diagram

A user fills in his/her name, email and password in their respective place. If the entered email is incorrect due to a wrong email format or it already exists in the database, error message "please enter a valid email" or "Email already exists" will be shown to the user respectively as shown in Figure 8 and 9. However if the entered data is all correct, the user will be shown a success message and redirected to login page.

6.2   Logging in

After the registration procedure is successfully done and the user is saved into the database then a user specified e-mail address and password can be used for logging in. Umbrella checks from the database that a valid e-mail address and password are found in the database. The log-in thus succeeds when a compatible e-mail address and password are found in the database. Because of this the users should remember their email and password in order to be able to log in to the system and play the game.

The login page will handle the submission of the login form to validate the user. That is accomplished within this block of code shown in Figure 12, which checks for a form submission:

```php
if( !empty( $_POST )){
try {
$user_obj = new CI_User();
$data = $user_obj->login( $_POST );
if(isset($_SESSION['logged_in']) && $_SESSION['logged_in']){
$_SESSION['success'] = 'Kirjautua sisälle!';
header('Location: home.php');exit;
                                      }}
 catch (Exception $e) {
$error = $e->getMessage();
$_SESSION['error'] = $error;
            }}
if(isset($_SESSION['logged_in']) && $_SESSION['logged_in']){
header("Location: home.php");exit;
}
```

The above PHP code performs minimal validation of the email and password fields. Any errors that occur are added to a PHP array named $error. If no errors detected, a database query selects the user's id, name and date created from the database. These three pieces of information are then stored in a session and the home page is opened for the user to start playing the quiz. Figure 13 on the next page shows a failed login attempt.
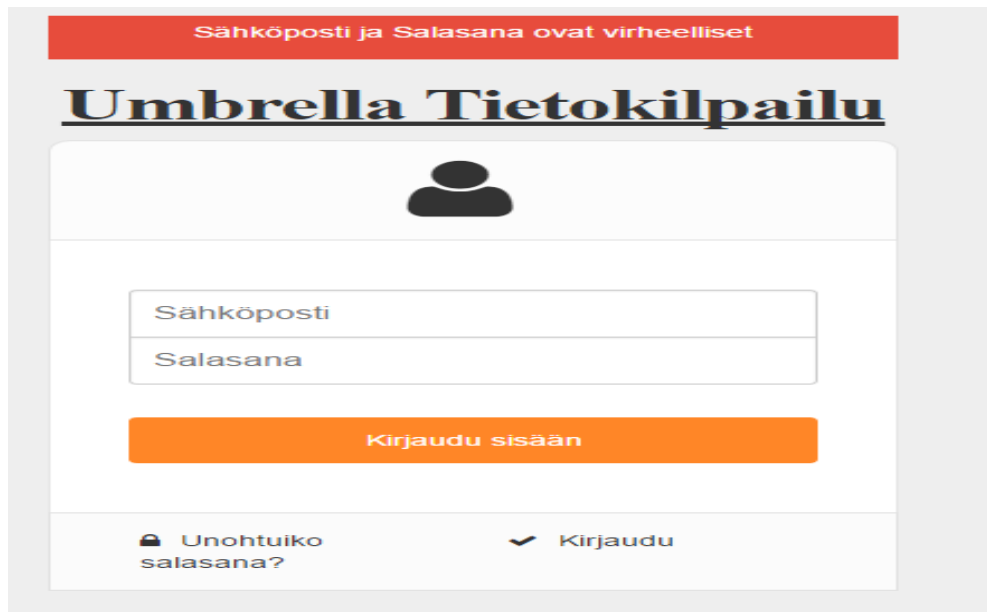
Figure 10 Failed Login Attempt

As shown in Figure 13 above, Umbrella checks from the database if e-mail address and password provided in the text inputs exist. The log-in thus succeeds when a compatible e-mail address and password are found in the database. In the situation illustrated in Figure 13, the user didn't provide compatible email address and password.

Figure 14 shows a detail illustration of log in process using sequence diagram.
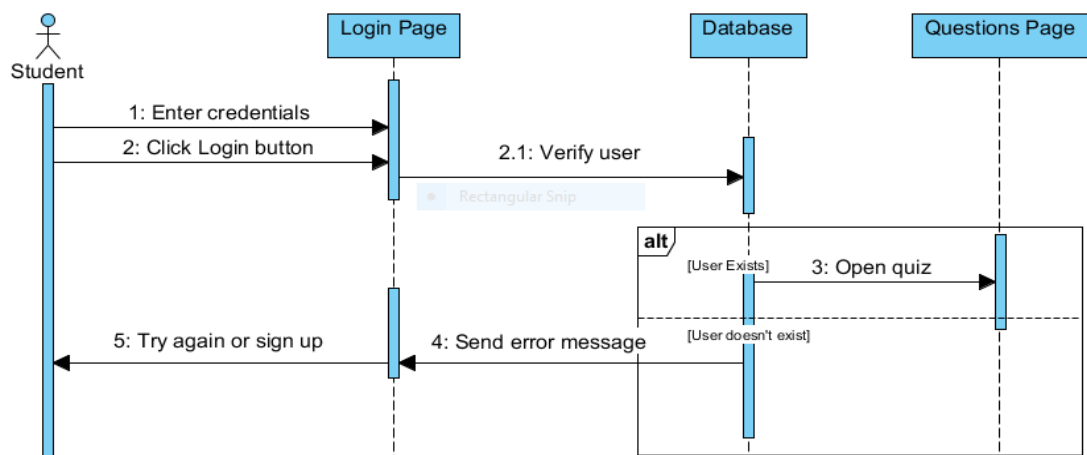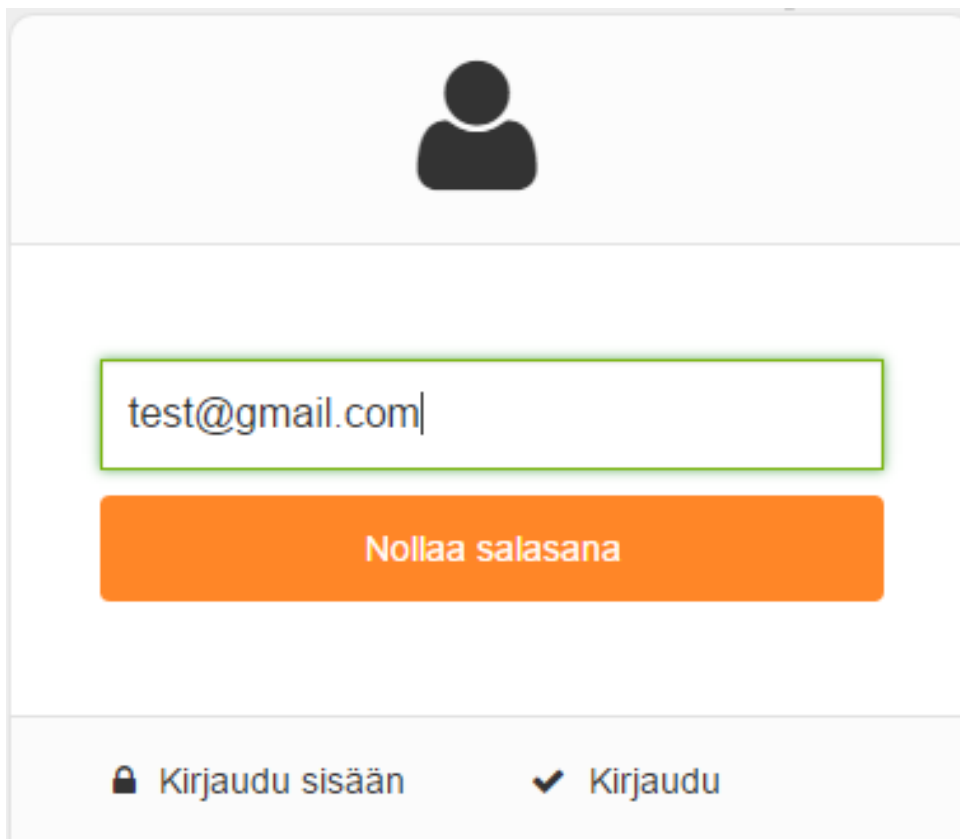
Figure 11 Login procedure in sequence diagram

A user enters his/her email address and password in the form on login page, then the login page forwards the request to the server. If the entered email address and password are incorrect, an error message sent back from the server will be shown to the user. However, if the entered credentials are correct, the user will directly be redirected to the home page.

6.3   Recovering Forgotten Password

As it was hinted in the registration section, a user with a valid registered email will get a new generated password in his/her email if a password is forgotten. This generated password can later be changed once the user is logged in to the system with this new generated password and an existing email address. Figure 15 shows a procedure to recover forgotten password.

Figure 12 Recovering forgotten password

Figure 16 below shows a sequence diagram illustrating the password recovery process. In order to more elaborate what is seen in Figure 15 about the forgotten password recovery, sequence diagram below is used.
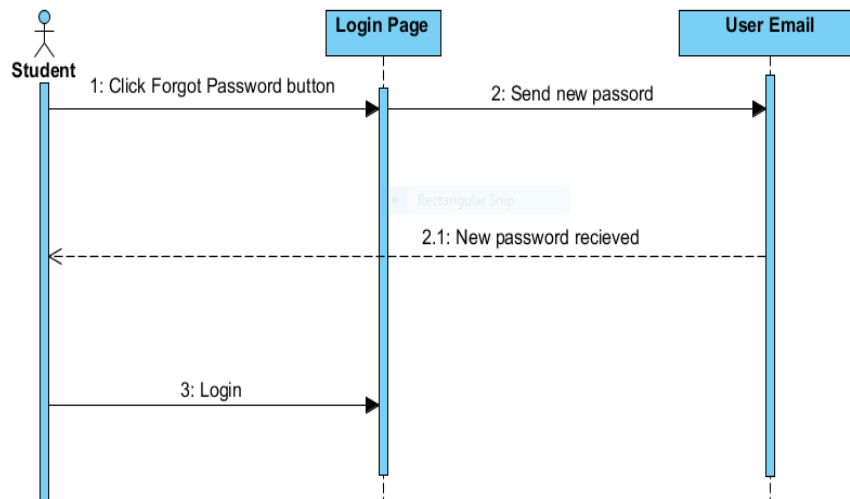
Figure 13 Procedure for recovering forgotten password in sequence diagram

A user hits the 'Forgot password' button on the login page, then the user will be asked to fill in his/her email. A temporary password will be sent to the provided email if the email was already registered. Up on receiving a new password, the user can login and change the password to a memorable password that is easily remembered.

6.4 Changing Password

It is always recommended to use a strong password with a valid email. Umbrella enables the users to change their password at any time for any reason The new password will then be automatically synchronized with the existing email in the background in the database and used for next time login activity. Figure 17 on the next page shows how to change the password.

Nimi	Test
Sähköposti	test@gmail.com

Nykyinen Salasana	
Uusi Salasana	
Vahvista Salasana	
	Vaihda Salasana

Figure 14 Screenshot of how to change password

Furthermore, the detail procedure of changing password is illustrated in sequence diagram below in Figure 18.
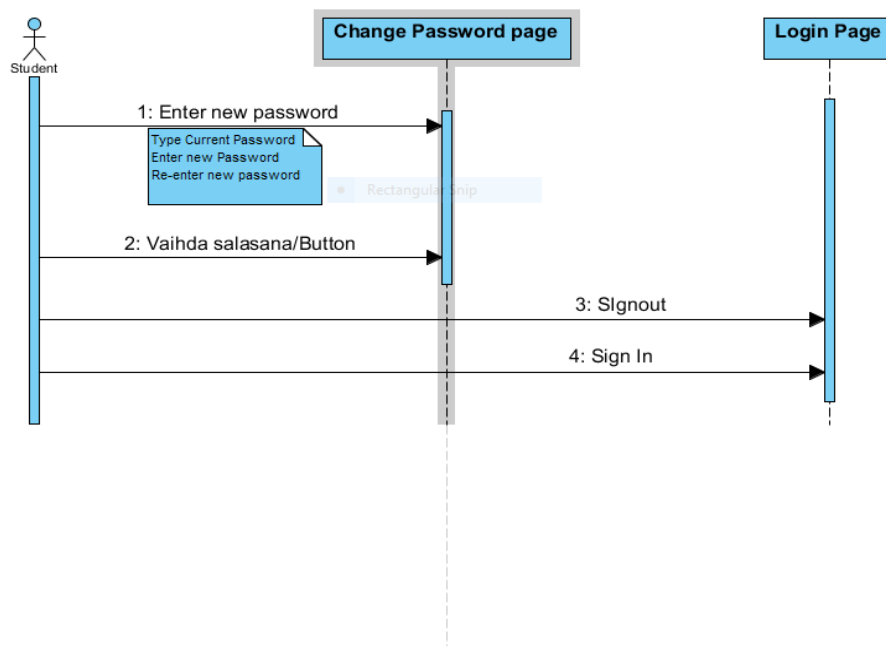
Figure 15 Changing password in sequence diagram

In the setting, the user hits on change password button. The user will be asked to enter the current password to check whether the account belongs to him/her and the desired new password. If the entered current password is correct, it will automatically be replaced by the new one. The user has to logout and then login again for the new password to have an effect.

6.5   Selecting Quiz Category and Level

One of the very important features of Umbrella is the fact that a user is able to select a category and level that he/she get more interested in or the field and level that he/she wants to master.

The categories that were chosen to be represented in this quiz were gathered from the groups of healthcare students that were in charge to ensure that the information that would be given in the quiz would be factual and educational.

The main categories would be general health as well as dental care. Below that there also subcategories that would allow for the user to choose for their own difficulty level, allowing users to tailor the quiz more towards their own capabilities.

A user cannot navigate to the questions page without selecting a category and a level. There are four categories under where the quiz questions have been categorized. The categories are:

➢ Liikunta/Exercise: this category contains all quiz questions related to physical exercises.

➢ Hyvinvointi/Well-being: this category contains questions on sleep, sexual health and so forth.

➢ Ruoka & Juoma/Food and Drink: this category contains questions related to food and drink.

➢ Hampaat & Suu/Teeth and Mouth: this category contains questions related to teeth and mouth care.

Figure 17 on the next page shows the categories available in the game.

Figure 16 Screenshot of Umbrella homepage, selecting a category.

As shown in Figure 19, a user can select from the four available categories to start the quiz. On attempt to get to the questions page without selecting a category, the user will be shown a message to select a category.

Umbrella also enables the users to choose a level from the three difficulty levels available. The user should select a level depending on his/her awareness and knowledge on the selected category.

These levels are:

1) Easy

   This level is meant for students who have little knowledge about the selected field. This level is believed to be the easiest level to get started the quiz game with.

2) Medium

   As the name suggests, medium level is an intermediate level which is not as easy as the easy level and the students who have managed to score high score in this level are believed to have a good understanding about the field.

3) Difficult

   This level contains more sophisticated questions. The students who manage to score a high score in this level are believed to have strong understanding about the field.

Below Figure 20 shows the available three difficulty levels.

Figure 17 Selecting a level

As shown in Figure 20, there are three available levels to select one at a time. These levels are easy(helppo), medium(medium) and difficult(vaikea) levels. There is no restriction in selecting any of the levels, one has not necessarily need to complete easy level to navigate to medium or difficult level.

Figure 21 shows the quiz category and level presented in a sequence diagram. The sequence diagram gives detail of the procedure.
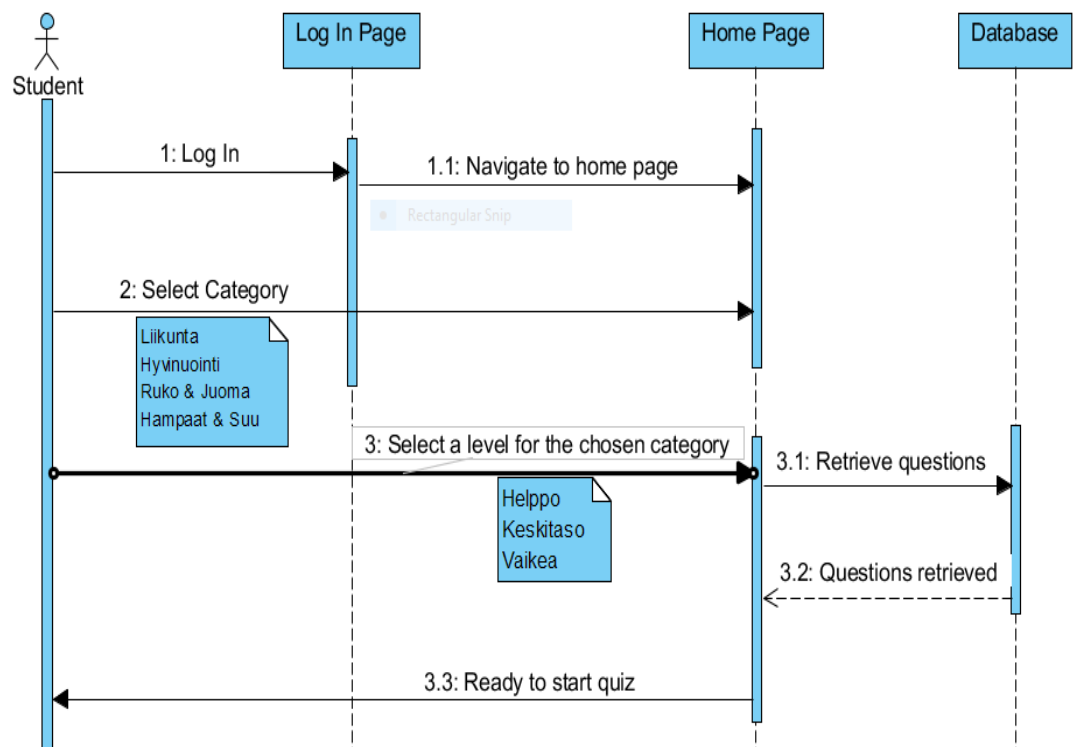
Figure 18 A procedure to select a category and a level

As shown in Figure 21, a successfully logged in user selects a category and a level before he/she is redirected to the questions page. Once a category and a level are selected the user is ready to start the quiz.

6.6   Logging out

When a user has done all she/he intended to do, he/she can end the session and log out. Figure 22 below shows a screenshot of log out feature.

Figure 19 Screenshot of logout feature

By clicking on his/her account setting, a user can either change password or log out of the application. The button spotted in the figure above, written in Finnish as 'Kirjaudu Ulos' lets the user logout simply. Figure 23 on the next page shows a sequence diagram of how to log out.
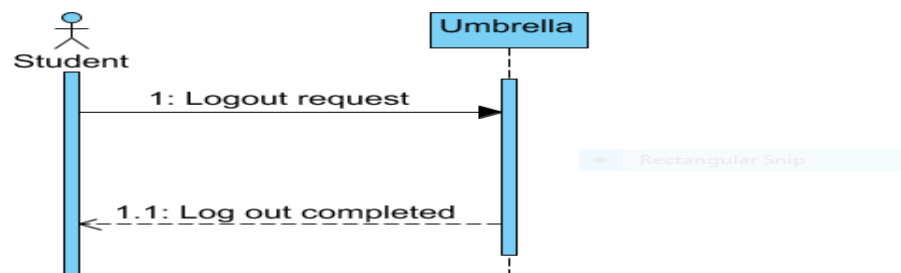
Figure 20 Logout procedure in sequence diagram

The user hit on the log out button which references the logout.php file. The server destroys current session, clears the cache and return the user to the login page.

6.7   Questions and Gameplay

The gameplay would have to be simple enough so that students who are not very familiar with games would be able to play as well. The questions should have to be simple enough to be understood easily. As the quiz was meant for Finnish schools, the language used was Finnish for the current version of the application.

The total number of about 200 questions were divided into four categories. After having passed the quizzes within the highest difficulty possible in the game, the player will receive the awards.

Depending on the scores that the player has reached within the game, the player reaches one of 3 endings. The "Excellent job!" ending, in which the player will be rewarded with three stars, demonstrating that the player did every quiz near perfectly. The "Well done!" ending, where the player has done most things right, but can still do a little better. The "You can do better!" ending where the player is encouraged to do better, because it's true they can do so! The idea behind the endings is to never discourage the player from trying the game again, as some are bound to try to just jump to the end of the game to see what happens then, and some might not be very knowledgeable in the areas of the quiz focus.

When a compatible email and password is met on attempt to log-in to the system, the user will directly be taken to the home page. The home page is where a user selects a category and level at a time before being able to play around with quiz game. Unless a category is selected, a user can not start the quiz. An error message which warns to select a category will pop up on attempt to progress to the quiz without selecting a category. Once a category and a level have been selected, a set of random questions associated to the selected category and level will be displayed.

The user then will keep on playing until the questions in the current array are finished unless she/he quits in between. A score will start counting up automatically on answering a correct answer. The user will be presented with different stars as an award for his/her performance. Depending on his/her performance, the user will be given from one star to three stars.

Figure 24 illustrates how a successfully logged-in user plays the Umbrella quiz game.

Figure 21 Gameplay screenshot

In the situation illustrated in Figure 24, the current player has answered 4 questions out of the total ten questions played at once. Accordingly, the player has scored 40 points, which means he answered all questions correctly. On answering a correct answer, the player will be applauded with audio which goes in background and an avatar cheering up with encouraging gestures.

Below Figure 25 shows how an associated description appears on choosing a wrong answer.
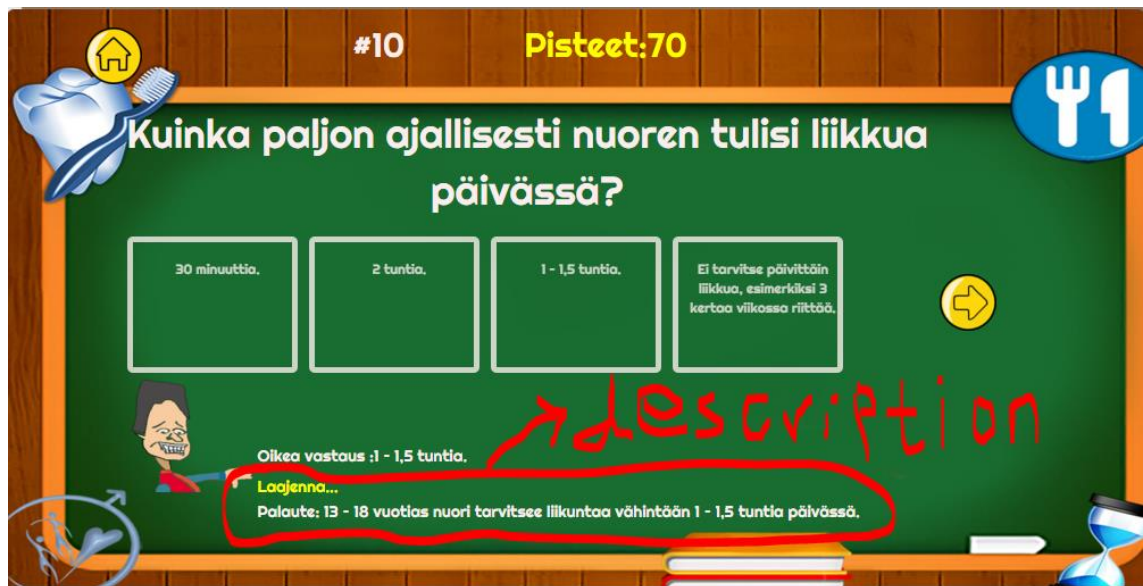
Figure 22 Description shown on choosing a wrong answer

Figure 25 shows the current number of random question on top of the page along with current score of current player. A random avatar is seen on either getting a correct or wrong answer.

Another very important aspect of Umbrella is the description that is displayed underneath the answer options if the student has not chosen the correct answer. Users can view the descriptions to know the correct answers for next time, circled in red.

Figure 23 Final page

Figure 26 shows a final page of Umbrella. On the final page, the payer knows how many right answers he/she has answered and will be rated accordingly. In this figure it is clearly be seen that the player completed the game, which means he/she answered ten questions and scored 70 points that earned him/her two stars as an award. The players are encouraged to do better always. Thus, an encouraging text is always displayed along with the earned stars. On this same page the user is able to share his/her result on Facebook, Twitter or Google+. Figure 27 shows a view on the result page.

Figure 24 View result page

Figure 27 shows records of a logged in user listed in order of time and day played. A player can always come back any time and view his/her performance played some time ago and share on social media. Figure 28 shows how a shared result link would be displayed when it is clicked.

Figure 25 View result

Figure 28 is a continuation of Figure 27. A player clicks on view result link and gets here, where he/she can see all the questions along with the answers he/she answered. The right answers are written in green and wrong answers are in red. From this page the user is able to share the results on social media supported in this application and can go back to the home page too. The above mentioned gameplay components are depicted in Figure 29 in use case diagram.
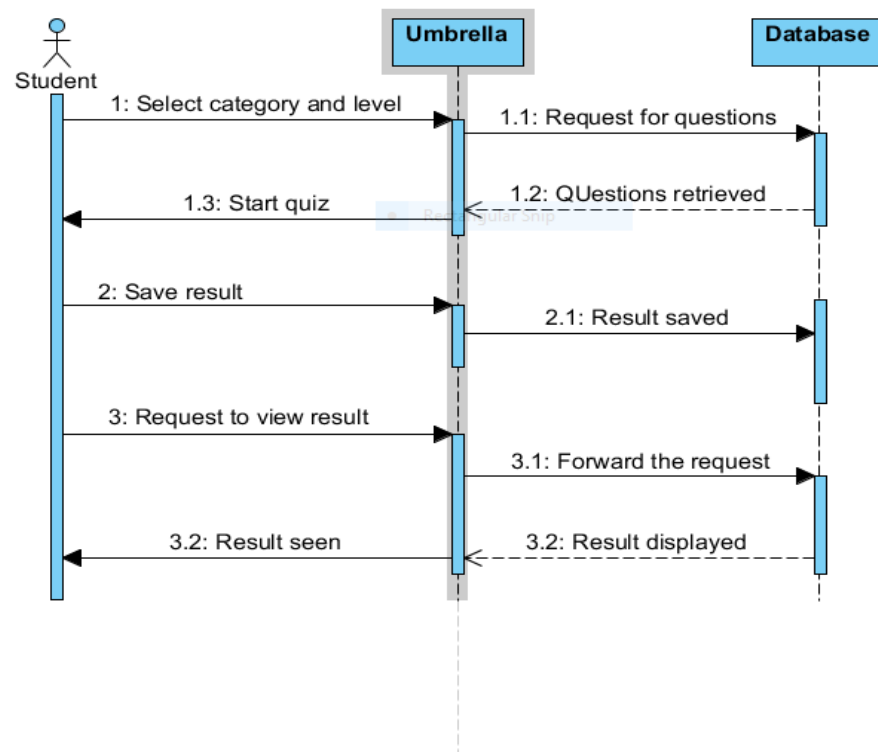
Figure 26 The gameplay in sequence diagram

A player selects a category and level of his/her interest, then he/she will be redirected to the questions page and the server will display the questions associated to the selected category and level. The user starts playing the quiz and the results will be stored to the database linked to his/her account. The user can share his/her result immediately after finishing a game round or anytime later at his/her convenience.

6.8   Scoring System and Awards

During development the questions were tested with volunteering students in the proper age group. The results were somewhat controversial as some found the questions difficult and some found the same questions easy. As questions have a perceived difficulty based on the viewpoint of the user, and as the users are a diverse group, the difficulty is something that will vary from user to user. Allowing for a large set of questions and allowing the user to pick from certain categories and levels themselves will solve this particular issue somewhat.

The gameplay consists of users receiving four different possible answers to a question. The user would choose one of the choices by clicking the choice, followed by a response telling them if it was correct or wrong. Pressing upon the choice the user will receive both visual and audio feedback.

Getting a correct answer will make the user receive 10 points and losing the answer will keep the user at the current point. As there is a set of ten questions to go through to earn an award at a time, the user has to make till end to see how much he/she has earned and how many stars he/she has been given as an award. That makes a total possible point one hundred (100) for a user in a game round.

The user will get a corresponding star/s depending on his/her performance. Accordingly, if the user scores a point less than 50 he/she will get a single star as an award even if he/she scores zero. That is meant not to discourage the user and to help them try more and more again. If he/she gets a total score of between 50 and 70 he/she will earn a two-star badge. And, finally, if he/she scores more than 70 out of hundred, he/she will earn the maximum star which is a three-star badge.

6.9   Sharing on Social Media

The Facebook button lets users add a personalized message to the links before sharing on their timeline, in groups, or to friends' Messenger. The quiz content appears on Facebook with a title, description, and image thumbnail. Figure 30 shows the procedure to share results on social media, mainly Facebook, Twitter and Google+.
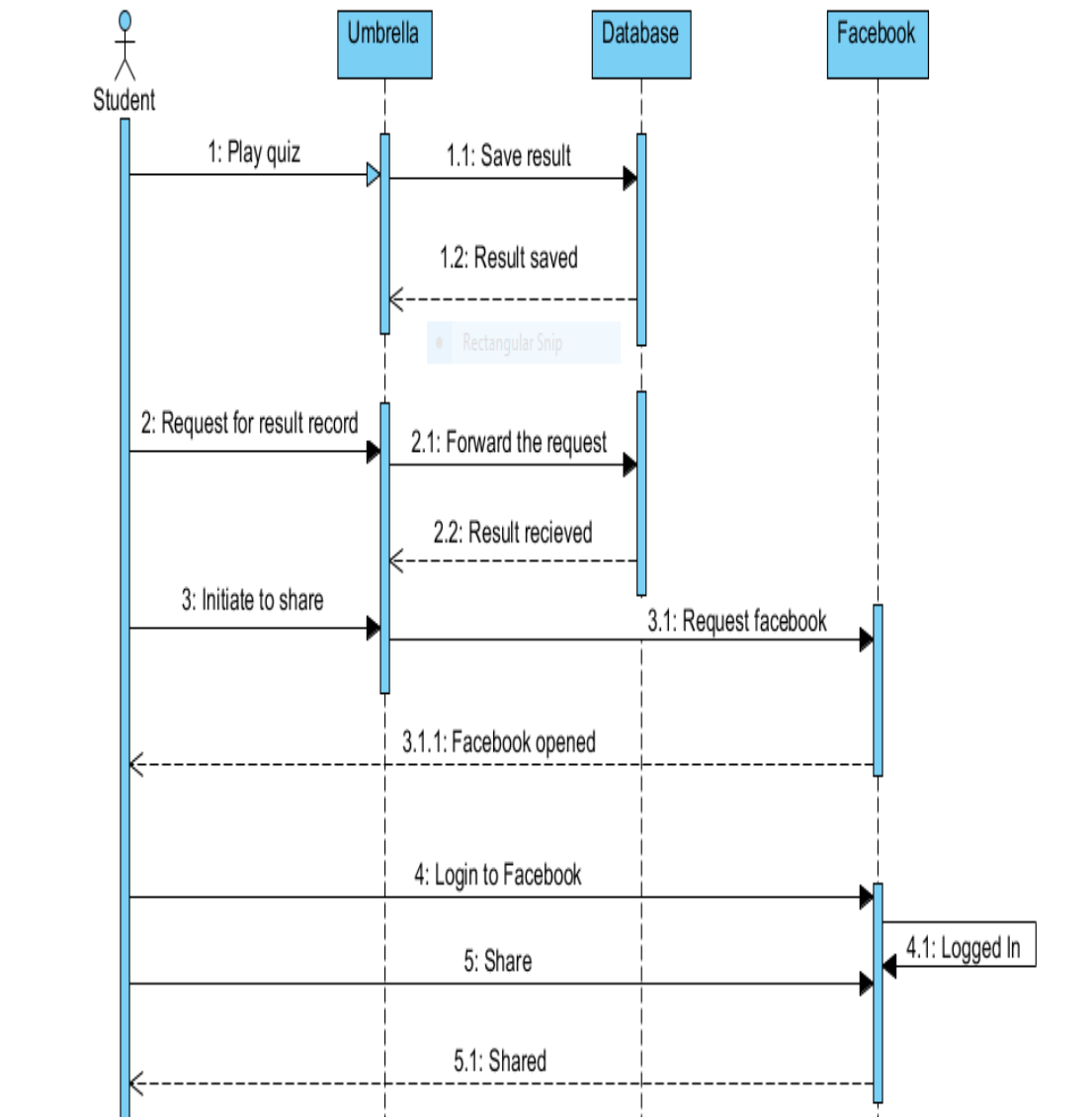
Figure 27 Sequence diagram of sharing Umbrella to social media

There are two ways a user can share his/her results to social media using the application. These are either on the final page of the quiz or on the results page. These two ways are well described in the Questions and Gameplay section using screenshots taken from the actual app.

A user with a valid Twitter credentials can share his/her results on Twitter as well. The same sequence diagram used above for Facebook works both for Twitter and Google+ as well, however used API (Application Programming Interface) to access each platform obviously differs.

7   Earlier Versions of Umbrella

In this chapter, the old two versions of Umbrella are presented. The development of Umbrella was started in 2014 and since then, several versions have come in. However, everything described in this paper, except what is discussed under this very section is all about the latest version of Umbrella.

7.1   First Version

The first version of Umbrella was the original prototype. It was a working prototype which lasted for some months until it was designed to a new look user interface with some good features. Figure 31 shows the first version home screen.

Figure 28 Umbrella first version home page

As it can be seen in Figure 31, a player inserts his/her name/nickname and selects an avatar of his/her favourite. By clicking 'let's Go' button, the player can navigate to the next page, but if the user's name was already in the database, an error message that indicates the existence of the name would be popped up. Below Figure 32 shows questions page of the first version.

Figure 29 First version question page

There would be a time counter to limit a player to answer a question in a certain period of time. All questions stored in the database would have to be played at once for a player to see how many points he/she scored. This was a reason for considering a third and latest version which is described in the entire paper. On this page, the logged in person's name and the questions are displayed for the player. The timer starts counting down immediately. Figure 33 shows the result page of the first version of Umbrella.

Figure 30 First version the result page

On this page, the results along with an associated message will be displayed. Here it is possible either to navigate to the next level or to logout.

7.2   Second Version

This time, the old user interface has completely designed to a brand new one and programming languages and data storage methods have slightly been changed as well. The fact that an external. json file was used in the second version to store the data amounts to their differences. Below Figure 34 shows the home page of Umbrella's second version.

Figure 31 Home page of Umbrella second version

A player selects a level of his/her interest by clicking on one of the buttons and navigates to the questions page. Figure 35 shows questions page of the second version.

Figure 32 Questions page of Umbrella second version

This page is basically similar to the questions page of the first version, however the way they are displayed and the avatar added make it a better version. As is shown in Figure 35, clicking on one of the answer options means the score starts counting in the header if the player gets the right answer and on the other hand remains the same if her/his answer is wrong. By clicking continue button until the entire questions end from the external JSON file stored on the remote server, the final result page is displayed. Figure 36 shows the final page of the second version.

Figure 33 Final page of Umbrella second version

The score, grade and message are displayed to the user depending on the user's performance. It is possible either to replay or navigate to home page to select another level from this page.

8   Designing of Umbrella Database

A database is a structured collection of records or data stored in a computer system and organized in such a way that it can be searched quickly and information can be retrieved rapidly. [8.]

Database is used in the application to store data such as questions, user emails and passwords, results, levels and categories. Old versions of Umbrella used non-relational database. They depended on an external file saved on the main server to retrieve or save data.

8.1   Using External JSON File in Old Versions of Umbrella

JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal data-interchange language. [11.]

A JSON data file was initially used in the earlier versions of Umbrella to store the quiz questions and answers. This file was stored in a server and pulled in with a combination of user events and Ajax calls.

8.2   Using MySQL with phpMyAdmin

In the early days of the Web, many sites used "flat" text files to store data such as usernames and passwords. This approach could cause problems if the file was not correctly locked against corruption from multiple simultaneous accesses. Also, a flat file can get only so big before it becomes unwieldy to manage—not to mention the difficulty of trying to merge files and perform complex searches in any kind of reasonable time.

That is where relational databases with structured querying become essential. MySQL, being free to use and installed on vast numbers of Internet web servers, rises superbly to the occasion. It is a robust and exceptionally fast database management system that uses English-like commands. [8.]

The main terms of database are:
Database
    The overall container for a collection of MySQL data.
Table
    A sub container within a database that stores the actual data.
Row
    A single record within a table, which may contain several fields.
Column
    The name of a field within a row. [8].

MySQL is a relational database management system(DBMS). A MySQL database contains table/s, each of which contains rows. Within the rows there are various columns that contain the actual data.

For instance, to create a database called 'umbrella' in MySQL database, the following simple command is applied.
<div align="center">CREATE DATABASE umbrella;</div>

A selection of common MySQL commands most often used are listed in Table 1. The commands are, however, not dealt with more detail here.

Table 1 Common MySQL commands.

Command	Parameter(s)	Meaning
ALTER	*database, table*	Alter *database* or *table*
BACKUP	*table*	Back up *table*
\c		Cancel input
CREATE	*database, table*	Create *database* or *table*
DELETE	Expression with *table* and *row*	Delete *row* from *table*
DESCRIBE	*table*	Describe the *table*'s columns
DROP	*database, table*	Delete *database* or *table*
EXIT (Ctrl-C)		Exit
GRANT	*user* details	Change *user* privileges
HELP (\h, \?)	*item*	Display help on *item*
INSERT	Expression with *data*	Insert *data*
LOCK	*table*(s)	Lock *table*(s)
QUIT (\q)		Same as EXIT
RENAME	*table*	Rename *table*
SHOW	Too many *items* to list	List *item*'s details
SOURCE	*filename*	Execute commands from *filename*
STATUS (\s)		Display current status
TRUNCATE	*table*	Empty *table*
UNLOCK	*table*(s)	Unlock *table*(s)
UPDATE	Expression with *data*	Update an existing record
USE	*database*	Use *database*

[8.]

Using JSON file format to manage data could not eventually answer some important questions created during development. Using a relational database like MySQL is found to be a better alternative to answer the questions that came into play. Some advantages of a relational database over a local JSON file are:

- Potency to query data in a database.

- Capability to search for data from a database relatively rapidly.

- Easily relate information from two different tables together using primary keys and indexes.

- Generating well-structured reports from a database.

- Stored data has a built-in structure to it.

- Information of a given type is always saved only once; manual investigation is unnecessary for duplication.

- Highly safe and fault-tolerant.

- Databases can manage very large and complicated data sets.

- Multiple users can use databases at the same time without corrupting the data.

- Databases extend well and modified easily.

The only thing needed to be able to communicate with MySQL database is to place the following few lines of code in the PHP code.

```
DEFINE ('DB_USER', 'username');
DEFINE ('DB_PASSWORD', 'password');
DEFINE ('DB_HOST', 'localhost');
DEFINE ('DB_NAME', 'databaseName');
```

As described in the previous chapters the Umbrella database was designed using phpMyAdmin designing web interface.

There are four tables in the database design.
- ➢ Questions Table
- ➢ Scores Table
- ➢ Users Table
- ➢ Categories Table

All parameters of the tables are introduced in more detail in the next sub sections. Figure 37 shows the tables relationship.
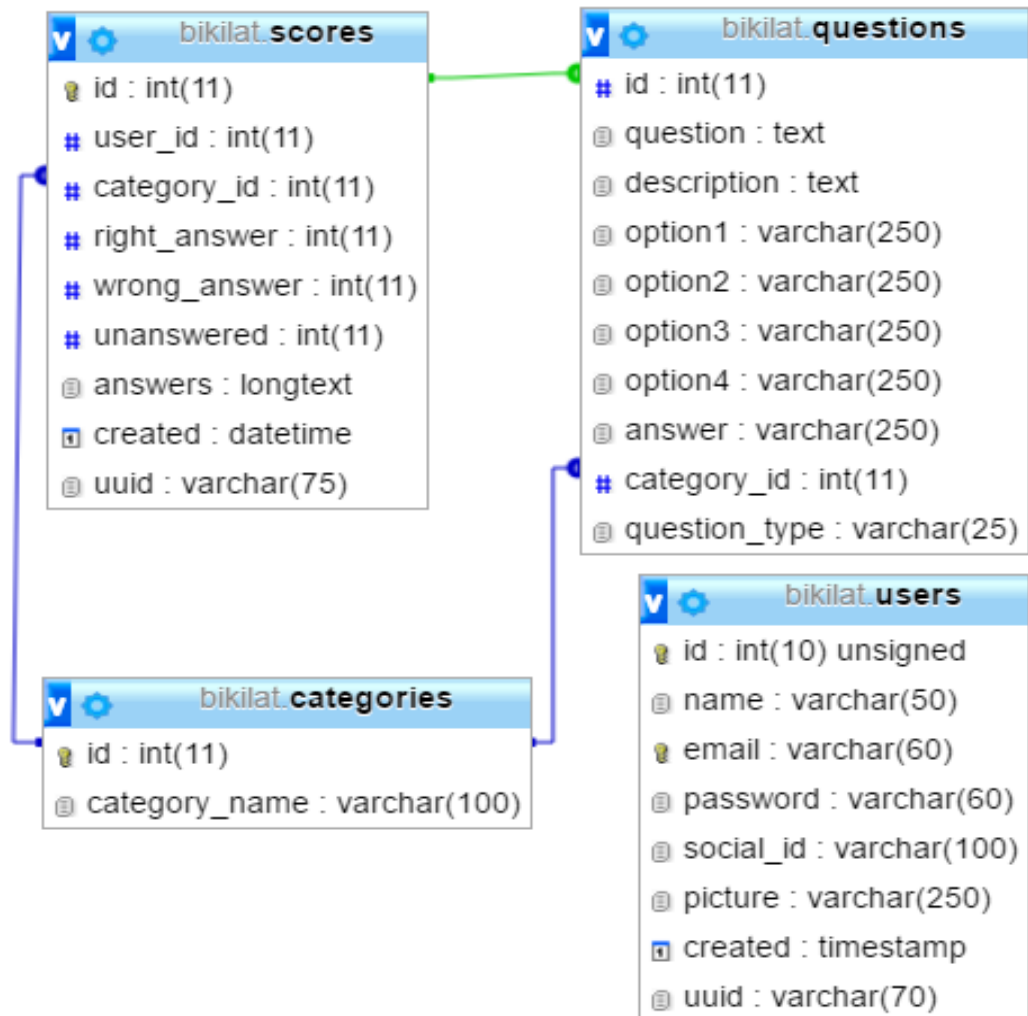
Figure 34 Tables relationship

Above Figure 37 shows the inter relationship between the four tables. MySQL is called a relational database because the data elements are divided into related tables. Primary key and foreign key values are used to set a relationship between tables. A primary key uniquely identifies each record in a table. A foreign key is putting one table's primary key in another table.

8.2.1   Questions Table

The questions table is the main table of Umbrella. It is where the quiz questions are stored in. The following SQL query creates the 'questions' table in the database.

```
CREATE TABLE `questions` (
    `id` int(11) NOT NULL,
    `question` text,
    `description` text,
    `option1` varchar(250) NOT NULL,
    `option2` varchar(250) NOT NULL,
    `option3` varchar(250) NOT NULL,
    `option4` varchar(250) NOT NULL,
    `answer` varchar(250) NOT NULL,
    `category_id` int(11) NOT NULL,
    `question_type` varchar(25) NOT NULL
);
```

Below Table 2 shows the table structure for question table.

Data stored in this table are id used as a primary key, question which holds list of questions, description holds detail information about the question, option1-4 are answer options, answer is a place holder for the right answer, category_id identifies a category of a particular question and helps to create a relationship with categories table, and question_type holds level category of a particular question.

Table 2 Table structure for table 'questions'

Column	Type	Null	Default
id	int(11)	No	
question	text	No	
description	text	No	
option1	varchar(250)	No	
option2	varchar(250)	No	
option3	varchar(250)	No	
option4	varchar(250)	No	
answer	varchar(250)	No	
category_id	int(11)	No	
question_type	varchar(25)	No	

Indexes

No index defined!

As hinted above, questions table has ten fields, each set to a certain data type that defines the field. These types are listed under 'Type' column in Table 2 above, namely int which stands for integer data types, text for plain text data and varchar for mixed variables and characters data types.

The scores table is where the score history of a student or a user is saved in with time and date played. The following SQL statement creates table 'scores'.

8.2.2 Scores Table

```
CREATE TABLE `scores` (
   `id` int(11) NOT NULL auto_increment,
   `user_id` int(11) NOT NULL,
   `category_id` int(11) NOT NULL,
   `right_answer` int(11) NOT NULL default '0',
   `wrong_answer` int(11) NOT NULL default '0',
   `unanswered` int(11) NOT NULL default '0',
   `answers` longtext character set latin1,
   `created` datetime NOT NULL,
   `uuid` varchar(75) NOT NULL,
   PRIMARY KEY (`id`),
   KEY `user_id` (`user_id`,`category_id`)
);
```

As it is easily understood from questions table, in above pieces of SQL statements, columns or data fields are defined with their respective data types. It is not necessary to list them all as it is understandable with common sense.

Below Table 3 shows the scores table structure after it was created using above SQL statement.

Table 3 Table structure for table 'scores'

Column	Type	Null	Default
id	int(11)	No	
user_id	int(11)	No	
category_id	int(11)	No	
right_answer	int(11)	No	0
wrong_answer	int(11)	No	0
unanswered	int(11)	No	0
answers	longtext	Yes	*NULL*
created	datetime	No	
uuid	varchar(75)	No	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null
PRIMARY	BTREE	Yes	No	id	867	A	No
user_id	BTREE	No	No	user_id	21	A	No
				category_id	48	A	No

Scores table consists of necessary information about a user scores with date and time played included. User id is indexed as a primary key and category id is used as a foreign key which is a primary key in categories table.

8.2.3 Users Table

The users table contains necessary information about a user. The following SQL statement then creates the 'users' table in our database.

```
CREATE TABLE `users` (
    `id` int(10) unsigned NOT NULL auto_increment,
    `name` varchar(50) NOT NULL,
    `email` varchar(60) NOT NULL,
    `password` varchar(60) NOT NULL,
    `social_id` varchar(100) NOT NULL,
    `picture` varchar(250) NOT NULL,
    `created` timestamp NOT NULL default CURRENT_TIMESTAMP,
    `uuid` varchar(70) NOT NULL,
    PRIMARY KEY  (`id`),
    UNIQUE KEY `email` (`email`),
    KEY `login` (`password`)
) SET FOREIGN_KEY_CHECKS=1;
```

The users table is defined using SQL statement above. Below Table 4 shows the structure of the table 'users' after it is created in the database.

Table 4 Table structure for table 'users'

Column	Type	Null	Default
id	int(10)	No	
name	varchar(50)	No	
email	varchar(60)	No	
password	varchar(60)	No	
social_id	varchar(100)	No	
picture	varchar(250)	No	
created	timestamp	No	CURRENT_TIMESTAMP
uuid	varchar(70)	No	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null
PRIMARY	BTREE	Yes	No	id	12	A	No
email	BTREE	Yes	No	email	12	A	No
login	BTREE	No	No	password	12	A	No

The users table consists of all necessary data about the user of which the picture field was not implemented. This field was intended to upload the user's profile picture. The user Id field is a primary key and email and password cannot be a null value.

8.2.4   Categories Table

The categories table contains the four question categories that were introduced in the chapter two of this paper. The following SQL statement creates the categories table in the database.

```
CREATE TABLE `categories` (
  `id` int(11) NOT NULL,
  `category_name` varchar(100) NOT NULL,
  PRIMARY KEY(`id`)
);
```

As it is seen in an SQL statement above, the categories table holds only two important fields, id (primary key) and category_name which holds names of the four available categories in the game. Table 5 shows the categories table structure created using the SQL statement.

Table 5 Table structure for table 'categories'

Column	Type	Null	Default
id	int(11)	No	
category_name	varchar(100)	No	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null
PRIMARY	BTREE	Yes	No	id	4	A	No

The categories table consists of two fields, category id and category name whereas the category id is a primary key. This table handles the main four categories discussed in the previous chapters.

9   Findings

This chapter reflects on the issues and challenges confronted during the project and how well they were managed. In addition, some of the developmental choices that have been made since start of the project will be argued.

As this study was dependent on development, there are two aspects of findings, technical findings and teaching and learning findings.

During the early phase of development, the idea of the application was made clear to the IT team by supervisor Jaana Holvikivi. All selected to develop the application were interested in the initial concept. However, it took quite a long time to draw the first simple prototype as the team was not well organised at the beginning. As a consequence, there were doubts about how much time would the project take to accomplish. After most of the students left the team, the author was eventually assigned as a team leader. In the end, it was only the author who took the project all the way to the implementation phase.

Umbrella is now a fully functioning prototype. Since 2014, the game was being developed and it has been tested three times in Helsinki yhteislyseo since then before it was finally published.

During the first test in 2014, the Umbrella team (the public nursing, oral hygiene students and the author) were coaching and monitoring the students' health knowledge in a health event held in Helsinki yhteislyseo. More over the nursing and oral hygiene students were focused on collecting feedback from the students, introducing the game play and pilot testing the quiz game. The game is expected to be implemented in different schools in Finland and Japan in the future.

The team had a new health event in 24.4.2015 in the Helsingin yhteislyseo. The author along with the oral hygiene students guided the gameplay. The oral hygiene students exceptionally observed and filled perception forms about the players. From the forms, it was deduced that most students (6th graders) liked the game and those who did not told that the questions were too difficult. [7].

The quiz game was officially introduced as a learning tool for young students in autumn 2015. As a learning tool, it has some important features that have helped the pupils to learn from playing with it. The registration and log in process are very simple, which is excellent as the tool is meant to be easily accessible. The usability is simple, with clear markings and easily intuitive actions. The feedbacks to the students are clear and concise. The utility of this teaching tool alongside other teaching methods has good potential to help students further their health and wellbeing knowledge.

It was learnt through time that using MySQL database with phpMyAdmin is an easier way to play around with the data. Thus the first two versions of the game were finally replaced as they used a local JSON file for data storage.

The students can play the quiz again and again until they complete all the categories and levels with the highest possible points. This is very important as it helps the students improve their knowledge about their health, directly amounting to the set goals of this study.

10 Discussion and Future Development

The goal set for the study was successfully met. Umbrella is a fully working prototype and was introduced as a supplementary learning tool in November 2015. The students of Helsinki yhteislyseo proposed a new name for the project in May, 2016 at a time when this study was all set to be published. Even though it was not used in this paper, the team has lately decided to change the name of the project to 'Tietoa Tulevaisuuteen – terveyspeli nuorille' in Finnish or 'Knowledge to Future – health game to school children' in English.

In fact, there is still room to make the prototype more engaging by adding some advanced features and functionalities. Thus, the following features and functionalities can be added or improved in the future.

> ➢ Supporting multiplayer

> The multiplayer functionality can be the main expansion of Umbrella in the future. In order to make a multiplayer quiz game, where one can play against classmates or friends over the internet, a number of technical challenges would have to be addressed and the gameplay needs to be re-designed.

> Despite the fact that this feature would highly improve the player experience and would influence positively the students' learning process, it requires a considerable amount of time and effort to get it done. However, this feature should be one of the main features to be added in the future. With the single player mode, one can play whenever for as long as one would wish non-stop. That is quite interesting, however the multiplayer mode is definitely the most fun way to learn to add up on Umbrella.

> ➢ Developing a native mobile version

> The current version of Umbrella is designed for tablet and desktop devices. However, getting a step up and designing a native mobile app would make it even more wanted and useful.

> ➢ Making the user interface more attractive and dynamic by adding fancy stuffs and animations.

- ➢ Adding voice to the questions and answers for someone who does not like to go through and read text.

- ➢ Using game engines and adding a moving avatar that guides the players on what to do and how to play.

- ➢ Implementing in as many schools as possible and internationalization

Adopting this game in as many schools in Finland and Japan as possible would make it far-reaching.

The quiz can also be used for some other purposes. For instance, in higher education institutions to collect feedbacks about a certain matter, or to evaluate the maturity level of the students on a specific matter, especially when the features above and more are added.

For any individual or group who may continue working further on Umbrella, it is highly recommended to consider the above suggested future developments in order to make it even a more useful tool than it currently is.

11 Summary

Umbrella is a multi-disciplinary quiz game application designed to help students learn about their health and wellbeing in an easy and fun way. The utility of this teaching tool alongside other teaching methods has good potential to help students further their health and wellbeing knowledge.

The major goal of this study was to create a quiz game meant to both offer a chance to supplement students who need extra teaching, as well as students who wish to master the field better.

The main data is set of questions prepared by nursing and oral Hygiene students of Metropolia University of Applied Sciences. The school pupils of the Helsinki yhteislyseo were in a key role during testing. The game was tested by these pupils in collaboration with their teachers during several school health care events. Feedbacks collected from the pupils during the test events, the nursing and oral hygiene students and the supervisors has helped a lot to add and improve the game features.

The prototype is fully functional and was first introduced as a learning tool in November 2015. The quiz questions were prepared both in Finnish and English, however the Finnish questions were used in this particular thesis.

The client side of the application was designed with the latest dynamic web technologies such as JQuery, AJAX, Bootstrap, CSS 3 and HTML while the server side programming language was PHP.

The database was designed in MySQL accessed on Metropolia's official phpMyAdmin page. It seemed that using MySQL database with phpMyAdmin is an easier and lighter way to manage a database compared with doing the same with JSON data format. MySQL was used to design the database and PHP helped to access the database at the final version of Umbrella.

One way to further develop Umbrella in future would be using game engines to support multi-player mode and all suggested features. In addition, image quiz questions for the game content could be added into it as an alternative to text questions in the future. Moreover, it is recommended to create an English version soon, so that the plan to implement this prototype in Japanese elementary schools would be realised.

Reference

1. M. Isuru T. C. Perera , Kulari Lokuge , Hiranya Mudunkotuwa, Nevindaree Premarathne and Madura Kularathna. QuizFun: Mobile based quiz game for learning. [online]. Sri Lanka: Informatics Institute of Technology; 2009. Accessed 09 May 2016.
2. Kuan-Cheng Lin, Ting-Kuan Wu, Yu-Bin Wang. Developing a Web-based and Competition-based Quiz Game Environment to Improve Student Motivation. Taichung 402, Taiwan: JOURNAL OF NETWORKS; 2011.

3. Afifa Amriani, Alham F. Aji , Andika Y. Utomo, Kasiyah M. Junus. An Empirical Study of Gamification Impact on E-Learning Environment. Depok, Indonesia: IEEE Xplore: [online]. Accessed: 17 April 2016.
4. Nummelin Tomi. Gamification an overview of mechanics and application. [online]. Lahti: Lahti University of Applied Sciences; Spring 2015.
Accessed 06 May 2016.
5. Kananen, J. Design Research as Thesis Research (Applied Action Research). Tampere: Juvenes Print - Suomen Yliopistopaino Oy; 2013.
6. Elina Kinnunen ja Malla Hyytiäinen. No risk, no fun. Helsinki: Metropolia University; 2015.
7. Sisko Hilska, Tiina Holck, Jutta Kahelin. How secondary pupils experience the importance of nutrition, physical exercise and sleep on health: Metropolia University; 2015.
8. Robin Nixon. Learning PHP, MySQL, JavaScript, and CSS, Second Edition. 1005 Gravenstein Highway North, Sebastopol, CA 95472: O'Reilly Media, Inc.; 2012.

9. Tim Wright. Learning JavaScript: a hands-on guide to the fundamentals of modern JavaScript. Edwards Brothers in Ann Arbor, Michigan: Pearson Education, Inc.; 2013.
10. Larry Ullman. PHP and MySQL for Dynamic Web Sites, Fourth Edition. Berkeley, CA 94710: Peachpit Press; 2012.
11. JSON. Introducing JSON. [online]. URL: www.json.org. Accessed 09 May 2016.