Social Networks in Education:  
A Facebook-Based Educational Platform  

by  

Samira Åsberg  

LIU-IDA/LITH-EX-A—13/033 — SE.  

2013-05-29
Social Networks in Education: A Facebook-Based Educational Platform

by

Samira Åsberg

LIU-IDA/LITH-EX-A—13/033 — SE.

2013-05-29

Supervisor: Peter Bunus
Examiner: Kristian Sandahl
Acknowledgement

I would like to show my most sincere gratitude to my examiner Professor Kristian Sandahl for sharing his time and information to improve my work and knowledge and for providing me the possibility to complete this thesis. I would also like to acknowledge Professor Sandahl for creating and supporting the master program, Software Engineering and Management, which is what brought me to Linköping and Sweden in the first place.

I would like to express the deepest appreciation to my supervisor Dr. Peter Bunus, for introducing me the topic and guiding me through all the phases of this thesis work. Peter supported me a lot to think like a researcher and conclude my information and thoughts in a structured way. Dr. Bunus also inspired me a lot as a student, which helped grow my confidence and become a better team player and also made me realize where I wanted to go with my career in the IT world long term. For these valuable insights and lessons, I would like to say my most heartfelt thanks.

I am also very grateful to my husband, Mikael Åsberg, for helping and answering all my questions regarding both technical and non-technical issues and for all his support for all difficult times I had.

Finally, I would like to thank all my teachers, administrative staff, and all my family and friends who were beside me and supported me to achieve my goals.
Abstract

Social networking sites are among the most popular daily activities of students these days. Students are mostly using social networking sites for communication and sharing of their experiences. Facebook is an example of a social networking site, which supports additional features such as creating a profile page, creating group pages and supports possibility of implementing different integrated application with Facebook. These features improve the Facebook experience, allowing users to form groups, where they can introduce ideas and concepts, which can be shared and discussed in a structured style.

For this thesis we have created a new learning management system by implementing an online educational platform within a Facebook context. This work introduces a new, complementary style of education, where students can improve their knowledge and sociality outside the university in an innovative way. The platform takes advantage of gamification, which introduces game-like elements to concepts such as education and learning management systems, to make them more fun and rewarding.

The goal of this thesis is to extend the educational border to an interesting online environment where students can learn, communicate, and examine their knowledge globally in different courses within our application platform in Facebook.
Dedicated to my grandmother and my parents for their unconditional support and love.
# Table of Contents

1  Introduction .................................................................................................................. 1

1.1  Background .................................................................................................................. 1

1.1.1  eSocial Classroom ................................................................................................. 2

1.2  Outline of Work .......................................................................................................... 5

2  Problem Definition........................................................................................................ 6

2.1  Goal .............................................................................................................................. 6

2.2  Scope ............................................................................................................................ 6

2.3  Objective ...................................................................................................................... 6

3  Literature Review.......................................................................................................... 7

3.1  Background and Related Work .................................................................................. 7

3.2  Academic and SNSs boundary integration case studies ............................................. 8

3.2.1  Educational Use of social networking in higher education .................................. 8

3.2.2  Using Facebook within a Geriatric pharmacotherapy course .............................. 9

3.2.3  Conclusion of literature review ............................................................................ 10

4  Software Requirements Specification ......................................................................... 11

4.1  Product Perspective and Functions .......................................................................... 11

4.2  User Characteristics .................................................................................................. 11

4.3  Functional Requirements ......................................................................................... 11

4.4  Non-Functional Requirements ................................................................................. 12

5  Analysis and Design ..................................................................................................... 13

5.1  Design - Overview of Application Architecture ...................................................... 13

5.1.1  Use Case Diagrams ............................................................................................... 13

5.1.2  Activity Diagrams ................................................................................................. 16

5.1.3  Sequence Diagrams ............................................................................................... 19

6  Screen Shots ................................................................................................................ 22

7  Designing for Usability ................................................................................................ 29

7.1  PACT .......................................................................................................................... 29

7.1.1  People ...................................................................................................................... 29

7.1.2  Context and Activities .......................................................................................... 32

7.1.3  Technologies .......................................................................................................... 32
8 Technologies Used........................................................................................................... 33
  8.1 Facebook.................................................................................................................. 33
  8.2 Social (Facebook) Graph API.................................................................................. 33
  8.3 Facebook PHP SDK .............................................................................................. 35
  8.4 XHTML ................................................................................................................... 35
  8.5 Java ......................................................................................................................... 36
  8.6 JavaScript ............................................................................................................... 36
  8.7 Servlets ................................................................................................................... 36
  8.8 XML ......................................................................................................................... 37
  8.9 XML Schema.......................................................................................................... 37
  8.10 XPath ...................................................................................................................... 37
  8.11 AJAX ..................................................................................................................... 37
  8.12 MySQL .................................................................................................................. 38
9 Implementation ............................................................................................................ 39
  9.1 Java Backend ......................................................................................................... 39
    9.1.1 Design Pattern .................................................................................................. 39
    9.1.2 Design Principle .............................................................................................. 39
    9.1.3 Application initialization and lifetime .............................................................. 40
    9.1.4 Request/Response Handling – The Controller .............................................. 40
    9.1.5 Business Logic and Persistence – The Model and Database ......................... 40
    9.1.6 The View ......................................................................................................... 41
  9.2 PHP Backend ......................................................................................................... 41
  9.3 Frontend .................................................................................................................. 41
10 Testing ....................................................................................................................... 42
  10.1 Testing ................................................................................................................... 42
    10.1.1 Black Box Testing ......................................................................................... 42
    10.1.2 White Box Testing ....................................................................................... 42
11 Result .......................................................................................................................... 43
  11.1 Expected Result .................................................................................................... 43
  11.2 Actual Result ........................................................................................................ 43
12 Conclusion and Future Work ....................................................................................... 44
  12.1 Conclusion ............................................................................................................ 44
  12.2 Future Work ......................................................................................................... 44
References: .................................................................................................................... 45
1 Introduction

1.1 Background
Studying and analyzing of individual user behavior in online environments has been an interesting topic for researchers since the development of the internet [3]. Different researches and statistics show that, both the number of social networking sites (SNSs) and social networking users are increasing. Table 1.1 shows statistics regarding activities of users in an online environment.

<table>
<thead>
<tr>
<th>Online Activities</th>
<th>Online Teens (12-17)</th>
<th>Gen Y (18-32)</th>
<th>Gen X (35-44)</th>
<th>Younger Boomers (45-54)</th>
<th>Older Boomers (55-63)</th>
<th>Silent Generation (64-72)</th>
<th>G.I Generation (73+)</th>
<th>All Online Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play games online</td>
<td>78</td>
<td>50</td>
<td>38</td>
<td>26</td>
<td>28</td>
<td>25</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>Watch videos online</td>
<td>57</td>
<td>72</td>
<td>57</td>
<td>49</td>
<td>30</td>
<td>24</td>
<td>14</td>
<td>52</td>
</tr>
<tr>
<td>Get info about a job</td>
<td>30</td>
<td>64</td>
<td>55</td>
<td>43</td>
<td>36</td>
<td>11</td>
<td>10</td>
<td>47</td>
</tr>
<tr>
<td>Send instant messages</td>
<td>68</td>
<td>59</td>
<td>38</td>
<td>28</td>
<td>23</td>
<td>25</td>
<td>18</td>
<td>38</td>
</tr>
<tr>
<td>Use social networking sites</td>
<td>65</td>
<td>67</td>
<td>36</td>
<td>20</td>
<td>9</td>
<td>11</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>Download music</td>
<td>59</td>
<td>58</td>
<td>46</td>
<td>22</td>
<td>21</td>
<td>16</td>
<td>5</td>
<td>37</td>
</tr>
<tr>
<td>Create SNS profile</td>
<td>55</td>
<td>60</td>
<td>29</td>
<td>16</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Read blogs</td>
<td>49</td>
<td>43</td>
<td>34</td>
<td>27</td>
<td>25</td>
<td>23</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>Create a blog</td>
<td>28</td>
<td>20</td>
<td>10</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Visit a virtual world</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 1.1: Diversity of online activities between different age groups according to Jones and Fox 2009 [1].

Based on the information from table 1.1, we can observe different level of user’s interaction with online activities based on their age category. The statistics show that users with ages between 18 -32 years are the most engaged ones. Users of this category, of whom many are students, are spending great amount of time playing online games, watching videos, creating profiles in online sites, using different SNSs, and also creating and reading different blogs.

Now the question is what are these SNSs? And how can these technologies be used as an educational framework to build an attractive environment, where students can communicate and connect with each other to share their knowledge?

SNSs can be defined as web based services where users can create public or semi-public profiles to build set of connections with other users within the system [5]. SNSs provide different tools and possibilities to connect users based on their specific aim and policies. For instance, LinkedIn is a business-oriented SNS, which is mainly used for professional networking. Twitter is an online social networking and micro blogging service, which gives possibilities to its users to send and read text-based posts of up to 140 characters and Facebook is a SNS which helps people to communicate more efficiently with their friends, family and coworkers.
Facebook is one of the most popular SNSs, which was built by students of Harvard university in 2004, for the students of Harvard university. Later, it was used by students from other universities and became the most popular SNSs of the world [6]. The number of Facebook users is increasing rapidly. In March 2012 Facebook had more than 937 million subscribed users [7]. Several studies show that more than 85% of college students use Facebook as one of their SNSs [4]. This close interaction of students with Facebook proves how this networking site is important in student’s social life, which supports different level of academic and social integration in its context, which can be used as a basis on educational framework [4].

This SNS increase both teacher–student and student–student interactions in the online environment, which help students to support each other regarding class assignments, examinations, and also group project work [4]. Building a teacher–student relationship in online environment lets students to glimpse teacher profile information, which may improve the interaction and classroom climate, which has a direct effect on student’s motivation and learning ability [8].

The following list shows different levels of course integration with Facebook [4]:

- **Profile page**: It is a possibility where the instructors can create a profile for themselves. This profile page can be used as a tool where teacher–students can communicate via Facebook email, IM, and through wall posts.

- **Creating a group page for a class**: Instructors can even create a separate page for the course. This alternative lets students to find their classmate on Facebook and have a communication both with each other and their course leader. With help of this course page both students and instructors can post information, pictures, and videos related to the course and have an online discussion. Additionally, the instructors can notify all the students who registered themselves to this group about different events.

- **Replacing/Duplicating web course functions on Facebook**: Facebook lets users connect their personal, academic and/ or business web pages to Facebook, thereby any discussion on those pages into Facebook.

- **Integration of Facebook application**: This advanced alternative lets instructors create a Facebook application. Students, after registering to these applications, can take advantage of its educational utilities to educate and examine themselves.

1.1.1 **eSocial Classroom**

Web 2.0 and SNSs technologies can be used in innovative ways to create platforms for additional course materials. As shown in figure 1.1, combing of popular online technologies, SNSs, and mobile applications as additional educational resources can provide an interactive environment with extraordinary accessibility. With the help of these technologies we can form the eSocial classroom where students can communicate and share their knowledge and receive feedback and comments.
from their teacher in the social networking classroom. Additionally, the teacher can provide educational audio/video material, which can be downloaded by students. And, last but not least, is the course blog, which provides an environment where students can discuss their ideas and issues outside the university and classroom [2].

Figure 1.1 illustrates both the traditional and eSocial classroom. The right side of figure shows the traditional style of education, which has several limitations. For instance, it just consists of a course web page where course instructors can upload lecture slides, so students need to check the home page regularly to get the updated information, materials and events. This style of education also suffers from accessibility, which is limited to computers and do not provide an interactive environment where students can have discussion with each other.

To overcome these limitations we propose the eSocial classroom, whose architecture can be explored in the left side of the above figure. In this style of education, course materials, interaction and communication is extended to SNSs, online technologies and course blogs, which has a broader accessibility letting students access and update their information via computers, smart phones, and tablets. This increase in accessibility provides for better interaction and communication among students and teachers outside university.
Providing interactive lecture slides, sound files, video files, test quizzes in SNSs and course blogs are just part of the *eSocial* classroom which can be extended to a great level. Therefore, in this project we have created a Facebook application, to investigate and research how it could be used to educate and examine students.

In this investigation we limited our studies to educate and examine students by designing test quizzes in our Facebook application. To do this we integrated both *gamification* and *Learning Management System* concepts to improve the effectiveness of our educational platform as additional course material.

*Gamification* is using game design technique and game thinking to engage people, encourage action and improve their learning [29]. It is an aspect that many organizations are considering as an ingredient for building brand advocacy. These days many companies are creating their own specific game to not only train their employees but also keep their customer still interested in their business. Tech-industry research firm Gartner estimates that by 2014, more than 70% of large companies will use these techniques for at least one of their business processes [12]. Additionally, several studies by Traci Sitzmann, show that users who were trained in interactive environment have higher skills than users who learned in less interactive environment.

The other important concept which has been introduced in our application is *Learning Management Systems* (LMSs). LMSs are set of online functionalities, which let both instructors and learners to interact and share materials in an online environment. LMSs functionalities are grouped in three categories: 1) instruction, 2) assessment, and 3) communication [9][10].

The *instruction* category consists of course materials, which are provided to students by lecture notes or podcasts, and randomized multiple choices questions with correct answers.

The *assessment* category educates students by examining them with online quizzes and finally *communication* define as set of instructors–students and students–students interactions in an online environment, which builds educational discussion where students can improve their knowledge.

To develop all these LMS functionalities we designed several sets of multiple choices questions with answers, where students can examine and educate themselves. In addition to cover the communication side of LMSs we designed a related *group page* within Facebook to help users to have interaction. Regarding the *gamification* aspect, we designed the application in such a way to increase the user score for every correct answer. We also add a timeframe for question generation, which motivates students to check the application regularly for new questions. Additionally, the profile section of the application shows the user’s percentile compared to other participants, which can be considered as additional motivation for better results.
1.2 Outline of Work

Chapter 2 discusses the problem definition. Chapter 3 contains the literature review. Chapter 4 clarifies the requirements and specifications of the project. Chapter 5 details analysis and design and includes both design overview of the application architecture of the application, interaction and database modules. Chapter 6 collects screenshots of the application. Chapter 7 discusses usability design of the application in detail. In this chapter the effect of PACT analysis and its benefits on the interface design of the application are revealed. PACT analysis is combination four elements of People, Activities, Context and technologies that support designers to have a closer connection to their users, which improves the quality of the application design. Chapter 8 defines the different technologies used in the application development. Chapter 9 is about implementation and both the Facebook integration and application implementation are explained separately, in detail. Chapter 10 discusses testing. Chapter 11 and 12 concludes the result and presents the future work.
2 Problem Definition

2.1 Goal
Using social networks and playing online games are popular activities among college students [1] [4]. Observing their daily interaction with social networks, sharing information, communicating and possibility of creating online pages, adding different applications and uploading videos and photos inspired us to create an educational platform within a social network for students. The goal of this project is to make the learning experience more engaging, to encourage collaborative work and knowledge sharing among students, to provide an interactive platform for the educators to reach students, deliver lecture material in totally new way [2] and constantly evaluating their learning progress and ease their learn ability.

2.2 Scope
The project, at present, is confined to Facebook, but can be extended to other services. In this project any user with a valid Facebook account can use the application, which generate online questions and build competence and competition in an interactive social environment. Additionally in order to support the application and encourage collaborative work, we designed the group page for the application, where students can share their information and experience within this educational platform.

2.3 Objective
The key intention of this project is to make the application for educating students in the most popular social network, namely Facebook.

We believe this popular social network platform helps us to improve the interaction of students with different courses. Also the gamification side of this application attracts student’s attention to play and learn important concepts of course materials in an innovative style.

This application also improves the interaction of students among each other and teacher in an online environment, which helps the examiner to evaluate and follow student’s progress more precisely outside the classroom.

Finally every student will receive immediate result and evaluation of their knowledge compared to his or her classmates from the application automatically.
3 Literature Review

3.1 Background and Related Work

Even though SNSs have been around for a few years, there is no consensus among researchers in the academic world if these can be utilized to provide educational value. Some researchers are concerned regarding integrity questions and/or view them as a source of distraction, whereas others find great educational potential [32]. In [35], Summers and Svincki discuss the important role the physical classroom plays in building a sense of belonging to a group among students, which encourages cooperation and communication, both of which are beneficial for the educational performance. However, when students are taking traditional e-learning courses (i.e., courses which have online activities), team building and exchange among students is harder to achieve [34]. By structuring e-learning courses around social networking platforms, Hungs in [36] argues that much of these problems are alleviated, since communication and being part of a group are core concepts of SNSs. Additionally, Hung writes that it is not only courses that are given exclusively online that can benefit from SNSs but also traditional classroom courses can be successfully complemented to stimulate exchange and cooperation among students.

In [33], Bangert surveyed 1173 students who participated in fully online courses and found that these students believed that the presence of a classroom community directs and improves the quality of education, and that there was often less of that in online courses.

In addition to creation of a classroom society in online education, Estus in [37] claims that SNSs can be used as a platform, which could improve the communication among participants and become the source of encouragement and motivation among students to contribute and share their experiences and knowledge with each other. Estus also added in her research that using the online services and technologies is part of current generation student lifestyle, which helped her research, which was about using Facebook within a geriatric pharmacotherapy course be accepted and followed by students as a natural process, rather than an additional course activity. In [38] Rivero collected few interesting quotes from a group of CEOs regarding their experiences about integration of social media with education. For example Khanna, CEO of Chalkpad technologies, said “Social media tools can play a big role in the classroom as it opens the door to collaborate easily like never before, but there still has to be some level of control on the content.”[38]. Controlling of the content, privacy and relationship among users is one of the common concerns among researchers within SNSs [35] [37] [38]. Who can participate in the educational Networking Sites and what they post is the fear which forced most of the researchers to provide strict accessibility to their educational platform within SNSs[35][37]. But it is not the only reason for disagreeing with integration of academic word and SNSs. As mentioned earlier, some researchers believe this integration is a source of distraction rather than bringing educational benefits. Forste et.al in [39] conducts a detailed investigation regarding academic and social outcomes of using electronic media among university students. In this research they asked first year students to utilize time diary data to find out how using the social medias like SNSs, cellular phones and online activities affects their face-to-face relationships and also their final grades. The finding shows that, those students who are using these technologies are having better social life. They are able to meet new people in an online word and involve them in their daily life outside the SNSs. These students also have the ability of handling multitasking activities and can do more than one task at a time, which have a negative effect on their final grades. For instant two- third of students use electronic media in the classroom and/or when they are studying or working on their homework. Additionally, using SNSs as a supplementary place for
providing course material and distribution of news and information may invoke confusion and extra effort for students to find the updated data, which invoke extra time investigation [37]. In [40] Cains, points out several issues regarding the view of universities about participation of their students in SNSs. There were several examples which show that numerous universities acted strongly against students who posted unprofessional content. These universities which are concerned about their reputation control and monitor their student’s profiles and in some cases they banned student profiles completely. Some Academic administrators and researchers did not agree that the relationship between students and the faculty should be extended onto SNSs, as they viewed those to be inappropriate for professional communication.

After discussing several opinions regarding extension of academic boundary to SNSs, an obvious question would arise. “Why can’t social media become a bigger boon for education than we’ve ever seen?” [38]. We believe giving answers to questions like this, need detailed study of available case studies and analyze the related result.

3.2 Academic and SNSs boundary integration case studies

In this section we explore two case studies of using SNSs within an academic boundary. The first case study focuses on educational use of social networking technology in higher education in two universities of Taiwan in 2009. In this case study, students were able to share information regarding their personal interests and related course information in the SNS for knowledge sharing. The second research, which was more focused in educational discussion, used Facebook within a geriatric pharmacotherapy course in a pharmacy collage in 2010.

3.2.1 Educational Use of social networking in higher education

Hung in [36] used Ning as a social framework for its educational research. Ning (www.ning.com) is a web based platform, which lets its users to create their social network around specific idea or interest. Users in Ning can post comments, share pictures, videos and create forums and blogs for discussion [41]. In this research, 67 students participated in connection with four face-to-face courses, where 54% of them were male and 46% were female. The age distribution of participants in this research is shown in graph 3.1.

Graph 3.1: Distribution of participant age in Hung research.

The distribution of above categorized age with respect to familiarity and comfortably of using computers and technologies as a supplementary tool for learning, shows that 97% of participants have been using computers in their everyday life, and 76% of total participants were aware about
SNSs and have an account in at least one of the social networking sites. Additionally, almost one quarter of the participants with no prior experience in SNSs were above 35 years old.

In this research, participants could interact within an SNS as a supplementary environment to communicate with each other and share different materials like photos and videos, which contain information both related to their personal interests and academic related topics. At the end of the course, the participants were provided a survey, which included questions regarding the participant’s view of using an SNS as a support to academic work.

According to the survey result we can see most of the students strongly agree/ agree that integration of an SNS platform with an academic framework would improve the collaboration and knowledge sharing among students, which could break the traditional cooperation limitation, which was mostly possible within course time at university. It also demonstrates how this platform increases the possibility of creativeness by showing and sharing the personal interest within an SNS. Additionally students reflect how the general teaching style, engagement, and connection of students in the course was supporting in their learning. These questions, which were utilized by Rovai’s research [42], focus exclusively on class community, something that can be affected by external factors like online activity.

However, we cannot conclude from these data, how using the SNS changed this general feeling and engagement in the course, since there is no data which could distinguish the result from those who participated in SNS with respect to those who did not.

Nevertheless, the positive achievement of this integration (integration of SNS with academia) was not free of challenges. Technical problems, privacy and integrity concerns, phishing and spam attacks, overloaded sharing information and discussion were some of the challenges students were concerned about.

### 3.2.2 Using Facebook within a Geriatric pharmacotherapy course

Course time limitations and the necessity of discussing different topics in detail were two of the issues, which Estut mentioned in her research [37]. To overcome this limitation and use the benefit of SNSs within the academic world, she decided to create a group page where students could follow discussions more in detail at any time. To do this, every week she assigned three bloggers who were responsible to post a related and interesting topic or question regarding healthy aging on the Facebook group. Students, by joining to this group, could participate actively in discussion and also motivate their reasoning or providing new dimensions of view by posting related links, text and videos.

Results showed that almost 90% of students thought the Facebook activities supplemented the course curriculum and the class discussion effectively. Students also believed that utilizing Facebook was an innovative style of discussion, which improved their ability to learn new topics and cooperate and engage with their classmate more deeply.

Additionally, students mentioned writing comments and giving feedback in text was more structured and easier to follow than oral discussion in the class. However, students complained about that it was easy to miss interesting discussions occurring when they were not online since the Facebook notification system limited. Some students, particularly those belonging to older age groups, with limited previous experience of using SNSs also voiced complaints that is was more difficult for them to use the system. Additionally, students mentioned that since the Facebook page was just a
supplement to the course page, they now had two places they needed to visit instead of just one to keep themselves updated.

3.2.3 Conclusion of literature review
After studying several research papers exploring the idea of using social networks such as Facebook as an educational instrument, it is clear there are several risks that need to be taken into consideration. These risks include that social networks might serve as a distraction, integrity and privacy concerns, some people are reluctant to start using these services etcetera. However, when those risks are compared against the possible benefits, which include increased social interaction, enhanced group and community forming, feedback and comment opportunities, it seems clear that an approach that attempt to mitigate the above mentioned risks while harnessing the possible benefits is a worthwhile undertaking. No change or introduction of a new element is ever going to be completely risk free, and as long as one tries to identify and understand possible risks and weigh them against benefits, that should be enough to allow oneself to introduce changes which are perceived to yield a net total positive surplus.
4 Software Requirements Specification

4.1 Product Perspective and Functions
The goal of this project is to develop an application, which connects a student’s educational life to their social life, and also to improve the interaction and communication of students–students and student–teachers within an online environment.

The proposed interactive learning platform aims to provide the following functionalities:

- The application will be integrated with Facebook and connected to student’s Facebook profile. Students should give permission to the application to access their public information.
- The Facebook application also connects to a database to store the student’s information.
- The database is constantly updated.
- The *gamification* part of the application, aims to provide an interesting educational environment, which motivates students to interact with the application.
- The learning management system part of the application examines and educates students from different aspects.

4.2 User Characteristics
This project aims to improve and extend the students educational life to the student’s social life. Thus, the ultimate target user would be a student with a Facebook account.

4.3 Functional Requirements

- **Connection between the Facebook Application and Facebook Profile:**
  Students add and permit the application to be connected to their Facebook profile to use their public information.

- **Input:**
  The application sends user-id, user name, sex, student program, and how the student have answered all question sets and frequent questions they have taken. The information which is related to question statistics will be updated constantly as the student uses the application.

- **Action selection:**
  In this project, a student can execute different actions like selecting their educational program, specific course, question sets, frequent questions, viewing their application profile.

- **Process of question generation:**
  This project has both timed and non-timed questions. The non-timed questions are grouped in the form of sets, and a result will appear at the end of each set, whereas timed based questions are generated at specific times and given only one at a time. As soon as time-based question has been answered, the result will be immediately displayed.

- **Percentile calculation:**
Application follows student progress and will update his/her percentile. The percentile is ranking, divided by course, which ranks the student’s accumulated score against the other participants.

- **Statistics updating:**
  The application will calculate the statistics for every question set. These statistics show how the student understood the questions and concepts with respect to their selected answer. With help of these statistics, the course leader can analyze strengths and weaknesses of students in each area.

- **Score generation for Question sets:**
  As a quality requirement of the application, scores for question sets should only be updated when a student takes the question set for the first time. Later, a student can rehearse a previously taken question sets, but his or her scores will not increase.

- **Adding the educational program:**
  In this project, the educational program of students is an interesting piece of data, since it is interesting to see if there are trends to be found among students who share the same educational program. Based on the requirements, a student should insert this information as the first step of using the application.

- **Output:**
  The application provides different output according to user demands. Displaying the user name, user-id, user profile picture, percentile, and course score in the application profile. The set of questions answers, student selected answers and statistics for every question will be given as an output after competition of every question set.

### 4.4 Non-Functional Requirements

- **Generating of question every 30 minutes:**
  In the frequent question part of the application, questions should be generated every 30 minutes. According to this requirement, if a student tries to execute the frequent question before 30 minutes have passed since the student previously answered a frequent question, a counter should display the remaining time. Respectively, if the time of requesting a frequent question is equal or greater than 30 minutes, a new frequent question should be displayed.
5 Analysis and Design

5.1 Design - Overview of Application Architecture

In this chapter we will show the design of the application, both in detail and in an overall view, with the help of UML diagrams. User interaction, system functionalities, and detailed request handling are included in this visualization, alongside use case-, activity- and sequence diagrams.

5.1.1 Use Case Diagrams

A use case diagram is a behavioral diagram, which identifies the functionality of the system. These diagrams are created from a use-case analysis to articulate the high-level requirements of a system.

Use case diagrams identify the actors and use cases of the system. These diagrams describe system functionalities or series of actions in the system. In these diagrams, an actor is a person or organization, which interacts with the system, whereas use case diagrams describe the relation of the actors with each other and the system.

In use case diagrams we can show the system boundary, which is a rectangle box placed around the use case diagram to specify the scope of the project. Additionally, in order to support the diagrams and explore use case functionalities, textual-use case descriptions are essential.

The following figures are the application use case diagrams used in the project:

![Use Case Diagram](image)

**Figure 5.1: eSocial Classroom system use case Diagram**

Fig 5.1 illustrates the eSocial Classroom system. As shown in above figure, the application should interact with both user and database. The interaction part is a set of actions which user must execute in order to use the benefit of the application services. Additionally, the Facebook application needs to communicate with a database in order to access and update user (student) information.
Figure 5.2: Use-case diagram of user and Facebook application instructions

Fig 5.2 illustrates the detailed interaction between the user and the application. Users with a valid Facebook profile need to register with the application in order to make a connection between the application and his or her personal profile. After registering with the application, a new user must as a first step select his or her educational program before any other interaction is available. After registering to the application and inserting their educational background, students are able to execute different functionalities of the application according to their needs an unlimited number of several times.

The Facebook application is currently available for three different courses, which are all available inside the application to any user. Therefore, students need to select their specific course in order to examine their knowledge with both Question Sets and Frequent Questions. The Question Sets contain sets of related questions where students can see only one question at a time. For starting a new question, answering the previous question is mandatory. After answering the final question in a set, a result table will be presented to the user. The result table consists of two columns that show the correct answers of the questions along with the selected answer by the student. The table also displays distribution of selected answers among different options in the form of percentage for each question.

The Frequent Question is a time-based question, where every question will be generated every 30 minutes. If the student selects the Frequent Question within a time which is less than 30 minutes, the display shows the remaining waiting time before the feature is available again. However, a user selects Frequent Question when the time since they last selected the aforementioned feature is equal
to or greater than 30 minutes, the application will present the next frequent question available for taking.

The profile section of the application displays user information such as user ID, User profile picture and also user percentile for the currently selected course. The percentile ranks a given score in a set of scores, showing how many percent of the scores in the whole set are less than the ranked score.
5.1.2 Activity Diagrams

Activity diagrams are dynamic diagrams which are demonstrating the business and operational workflows of a system. Activity diagrams articulate the workflow of the system step by step from the initial state to the final state.

The following figures illustrate the activity diagrams used in the project:

![Activity Diagram]

**Figure 5.4: eSocial Classroom Activity Diagram**

Fig 5.4 illustrates the activity diagram of the eSocial Classroom. As was mentioned earlier, first students should initiate interaction with the application by executing it from their Facebook profile. Then, in order to provide the proper service to users, the application should connect to the database. This connection between the application and the database involves set of requests and responses to add or deny the student request to the application.
Figure 5.5: Activity diagram of student and Facebook application interaction

Fig 5.5 illustrates the student interaction with the application from the point of view of an activity diagram. The above figure shows precisely the set of steps which the user executes from registering till execution of different functionalities of the application.
Fig 5.6 illustrates the activity diagram of communication between the application and the database. When students add the application to their profile, the application connects to the database and searches for student registration. If student does not exist in the database, the application will add it to one of its tables. Then according to user activity the related information will be added or updated in the database and will be returned to the application.

Figure 5.6: Activity diagram of Facebook application and database communication
5.1.3 Sequence Diagrams

Sequence diagrams, which are also known as timing diagrams, show the interactions between different classes and objects of the system with respect to their sequential order. Every class or object in the sequence diagrams has a vertical line which illustrates its lifetime. The horizontal line represents the interaction of objects and processes with respect to the order of their occurrence. In sequential diagrams the collaborations between objects starts near the top of the diagram and ends at the bottom.

Fig 5.7 illustrates the interaction of student with the application with respect to their sequential order. At the beginning when the student connects for the first time to the application and approves it, they will receive acknowledgment from the application. This acknowledgment either confirms that the user is added to the application, or due to some technical error(s) user need to reregister to the application.

A user, who successfully registered to the application, needs to select his or her educational program in order before they can do anything else. When a student changes which course is currently the active course, the system automatically responds by displaying his or her total score for that course in the score section of the user interface. If the user forgets to select which specific course they should work with, an alert window will notify the user with a proper message should they try to perform any course-bound actions.

Currently, students can execute three different course bound actions, namely Selecting Question Sets, Frequent Questions, and Profile. The proper response from the application provides the related services to the student.

Fig 5.8 illustrates the sequential diagram of communication between the application and database. When back-end system is launched, the application must connect to the database. If the connection was successful, the database will acknowledge this to the application. If it was not, the system cannot function. When a registered user initiates interaction with the application, the application needs to check if the user ID has associated educational program information and the application performs this check by asking the database. The database will compare the given user ID to its list of known user IDs and answer Boolean true or false depending on if the user is known or not. If the user is known, they will be presented with main application page. However, if the user is unknown, they will be presented with a screen where they must select their educational program before they can continue.

Information in the database is constantly added and updated based on the activities of current users and the addition of new users.

All communication between the application and the database happens in response to an incoming request (apart for some initialization work). If no requests are coming in, i.e., if no one is using the application, the connection lies dormant. If it is dormant for a very long time, the connection is automatically closed, but it will be resumed if new requests start coming in. The connection is also closed if the application shuts down.
Figure 5.7: Sequential diagram of student and Facebook application interaction
Figure 5.8: Collaboration of Facebook Application with database in sequential order
Figure 6.1: Registration request for adding the application to user Facebook account.

Figure 6.2: Educational program selection before using the application.
Figure 6.3: Confirmation message after selecting the educational program.

Welcome To
E-Social Classroom

Figure 6.4: Main eSocial application interface.
Welcome To
E-Social Classroom

Figure 6.5: List of courses available in eSocial application.

6.6: Printing the alert message to inform about missing prerequisite step.
Figure 6.7: Selecting the desire question set.

Figure 6.8: Question sample from question set.
Figure 6.9: Question set result.

<table>
<thead>
<tr>
<th>Question Set Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer: Preventing pattern application</td>
</tr>
<tr>
<td>Your answer: Template Method</td>
</tr>
<tr>
<td>Correct answer: Memento</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question Set Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer: Pattern to support UNDO</td>
</tr>
<tr>
<td>Your answer: Memento</td>
</tr>
<tr>
<td>Correct answer: Memento</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question Set Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer: Factory pattern</td>
</tr>
<tr>
<td>Your answer: Both option A and B</td>
</tr>
<tr>
<td>Correct answer: Both option A and B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question Set Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer: Class Explosion Avoidance</td>
</tr>
<tr>
<td>Your answer: Adapter</td>
</tr>
<tr>
<td>Correct answer: Decorator</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question Set Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct answer: Change in Transportation Class</td>
</tr>
<tr>
<td>Your answer: Strategy</td>
</tr>
<tr>
<td>Correct answer: Strategy</td>
</tr>
</tbody>
</table>

Figure 6.10: Question sample from frequent question.

Interpreter pattern

If you would like to give another name to the Interpreter pattern what name would you like to choose from the possibilities enumerated below?

- (A) Translator
- (B) Slew executor
- (C) Many many interpretations
- (D) Little language

Submit answer
Figure 6.11: Selecting the wrong answer in frequent question and receiving immediate result.

Figure 6.12: Selecting the correct answer in frequent question and immediate score updating.
Figure 6.13: Frequent question cool down page.

Figure 6.14: Profile page of eSocial application.
7 Designing for Usability

7.1 PACT

PACT consists of four elements: People, Activities, Contexts, and Technologies [30]. With help of these concepts we can study how people undertake activities in context using technologies. In this chapter we present a variety of each element and their interaction in eSocial application design to make an interactive and interesting user interface.

In PACT analysis, the people analysis focuses on the users of application by having the designer investigate and study of users from physical and physiological perspective. The activity analysis concentrates how repeatedly users interact with the application. The context analysis considers physical environment and it also analyzes social and organizational context. The technology analysis includes the input and output of system in both terms of software and hardware. It also investigates how user communicates with different technologies of system. Fig. 7.1 illustrates the relationships of PACT analysis elements.

![Figure 7.1: PACT analysis elements and their relationship [31]](image)

7.1.1 People

People are different from one another. These differences are important points which should be considered by designers to have a better design from the user’s perspective. Therefore, different characteristics of physical and psychological differences of users are important factors, which should be taken in to account when designers perform people analysis.

In this analysis, the designers and users need to have a close collaboration to build an understandable design, which can match with user characteristics and background. In order to have an understandable design, the designer should consider using mental models. Thus, designers should ask users to interact with the system and give feedback about their experience. Designers use this information to redesign the system until users feel the system has an easy to use interface and they can capture the complete and correct conception of the system. Fig. 7.2 illustrates creating a mental model.
Our target users for this application are students, and in order to ensure the interface follows the usability concept of PACT analysis, we asked five trial users to try a prototype implementation of the user interface and give feedback. In addition to user comments, we also employed a design methodology known as card sorting. When employing card sorting, one will assign each user interface element, for example an input button or an output field, to a unique card. When the whole interface has been modeled in terms of discrete cards, the whole “deck” is given to users who fully understand the concept of the application and let them lay out these cards as they see fit, to create what they feel is the best end user experience.

The card sorting revealed that the users thought it was difficult to change from one course to another, since that option was not always accessible, but part of the initial front page of the application. Based on this criticism, we created a drop-down list from which the active course could be changed and we made it available in all states of the application. Furthermore, the trial users did not like the use of links as activators for different functionalities such as question sets, frequent question, and profile, since they gave the impression of navigating away to a different site. The placement of the aforementioned activators was also a concern. We addressed these concerns by changing the activators in buttons and making them part of the application frame, which would also house the course selector and score display.

Based on the free-text comments we introduced colors to denote correct and wrong answers (green for correct, red for wrong) when answering questions, instead of using words alone. Finally, we made the application state clearly exactly how long the user has to wait to be able to respond to a new frequent question, instead of simply informing that one was not yet available.

After introducing the changes described above, our trial users and ourselves felt that the application was easier to use and that the whole experience was improved. Fig 7.3 illustrates the main eSocial Classroom interface.
The eSocial Classroom application user interface is free-flowing in the sense that a user can switch between courses, take question sets, frequent question, or check their ranking in the profile as they see fit. There is, however, some order imposed by the application, which requires users first having selected the course they are interested in, and only thereafter can they perform any other actions. In PACT, it is desirable to give end users easy to understand feedback when he or she is trying to perform some action without having completed all prerequisite steps. In some cases it is not possible or desirable to prevent step skipping technically, as it can lead to a cumbersome user interface. In our application this applies to the dialog shown in figure 7.4, which is displayed if the user is trying to perform some course-connected activity without first having selected a course.

![Figure 7.3: eSocial Classroom interface](image)

![Figure 7.4: Alert window for user notification](image)
7.1.2 Context and Activities
Context and activities are two correlated parameters, so we analyze both of them together. Context can be seen from different viewpoints. Depending on the scenario or activity, sometimes it is good to see the context as a surrounding environment around the activity and other times maybe it is useful to see the context as the feature which glues different activities together. In this project our context is Facebook, which is a social networking site where our activities are taking place.

In this application we have three scenarios regarding our application activities. The first scenario is related to connection of the application to the user Facebook profile, where users download and add the application to their profile. The second scenario is related to set of activities, which the application expects a user to follow before using the application service. So users need to select their educational program from a provided list. The final scenario is a set of activities which a user follows as an actual application service where users select the specific course to examine their knowledge with sets of timed and non-timed based questions. Additionally, users are able to check their progress percentile among other users in the profile section of the application.

7.1.3 Technologies
For technologies, in this project the logged in user in to the Facebook, can use both mouse and keyboard as an input device to use the application. Users who are logged in with their mobile and/or other touch screen devices can also interact with the application. The output is a table which consists of correct answers, user selected answer and set of percentages which shows distribution of selected answers among different options by participants.
8 Technologies Used

8.1 Facebook
Facebook is a social networking site which launched in February 2004 in Harvard University. Soon this social network became popular and spread to other states of America and the whole world.

This active social network currently has more than 845 million users and is available over 70 different languages.

Facebook provides several features which support its users with different services. Messaging, chat, questions, Time Lines, news feed,” like” pages, groups, and networking are just some of these features.

This site with help of its innovative features captured many users and also researchers attention to study and evaluate how Facebook affected its users social life. Latest studies show that users spent more than 7 hours per month in Facebook which increased by 10% compared to last year and placed Facebook in the top ten most visited websites [16]. Based on the rapid growth of Facebook users and their activities, researches expect the effects and importance of Facebook to increase in the future to a great extent.

8.2 Social (Facebook) Graph API
Facebook Graph API follows the concept of Social Graph API. In the Social Graph API every data is presented as an object or a node, and if these data are related to each other, the social graph API will link them together. Based on the above explanation, we can describe the Social Graph API as a “Global mapping of everybody and how they are related” [17].

The concept of the Facebook Graph API was introduced by Facebook in 2007 and it is the core structures of Facebook. In Facebook, every photo, video, and every friend in user friend list are objects with a unique ID. These objects will be connected to each other if Graph API can find a relationship between them. Friend relationships, photo tags and shared content are some of these relationship samples [18].
Figure 8.1 illustrate an example of the Facebook Graph API. According to this figure and the Graph API concept, all the eight users are linked to one of the Facebook pages, which in this example is called *TDDB84 Facebook page*. Each user can find public information regarding others users who registered themselves in this page, which means TDDB84 is a point which connects all these users together.

Now let’s think *user E* would like to become friends of *user F*. These two users after execution of few necessary steps become each other friends and Graph API would connect these two users with additional link which in this scenario is called *friendship link*.

The concept of linking the data is not just limited to the fan pages and direct friends, but also having mutual friends, participating in public events and other similar activities will let the Facebook Graph API to link users to different stories and other users.

The other advantage of Social Graph API in virtual web pages is to help users to find their other friends and contacts from other accounts.
As shown in Figure 8.2, it’s possible to find other users public connections which had been created in other web pages with Social Graph API. This concept helps users who are using different online environments or SNSs find each other. For instance, according to the above figure user a, b, and e are friends in Google+. When user a register to Facebook with his or her Gmail account, this social graph API would suggest user e and b as a friend to user a within Facebook, in case if they opened account in this SNS. In other words, users can find their contacts easily as a suggested friend by new web services [19].

8.3 Facebook PHP SDK
Facebook PHP SDK (Software Development Kit) Provides set of server side functionality services like Graph API, FQL and also a now deprecated REST API. It is the feature which lets users to integrate Facebook features into their site or making full-fledged Facebook application. It also simplifies the process of authentication and authorization.

The Facebook PHP SDK combined with JavaScript SDK provides seamless session management in both client and server sides of an application.

In order to use the advantage of these SDKs, developer needs to have application id and application secret number which can be obtained from Developer App site [18].

8.4 XHTML
XHTML stands for eXtensible HyperText Markup Language and is defined as an XML language. It sought to replace HTML (before HTML5 was introduced) as the de-facto language for writing markup for the web (markup being the essential user interface elements that make up a web page). The problem with the HTML standard prior to version 5 was that even though it at a first glance looked very similar to XML, with the same type tree structure constructed using elements, it was not in fact an XML language. Rather, it was based on the much less strict standard of SGML, Standard Generalized Markup Language. XML has very firm rules of how elements, attributes, and its other
language constructs should be placed, SGML is much less strict. Since HTML was so permissive it lead to HTML code not being conciseley constructed, which lead to ambiguities in interpreting it. This ambiguity caused major headaches for web developers as different browsers rendered the same piece of HTML code differently, which meant several versions of the same page had to be written. XHTML sought to alleviate these problems by enforcing a much stricter standard where there was no wiggle-room. While cross-browser issues still do exists especially for complex pages, it is obvious that the communities increased adoption of stricter standards have improved this a lot the past five to ten years [20].

8.5 Java
Java is a general-purpose programming language that originally came out in 1995, and it has been evolved ever since. It has a syntax which is very similar to C++, but is not quite as low-level as C++ and don’t have the more complex C++ constructs like templates (later versions have a simpler alternative called generics). Java also comes with a more extensive library than what can be found in the C++ standard library. Java is available for a large number of platforms, including Windows, the different Mac flavors, GNU/Linux and Unix systems, and also for many platforms for devices that are smaller than a full-blown desktop computer. Java code is not compiled into a native representation, instead it is compiled into Java byte code and hence requires a Java virtual machine to be installed on the target machine which does that actual runtime interpretation of the code. For this project, Java version 6 was used. Java version 7 had not yet been released when the project was started and version 7 is still considered quite bleeding-edge, whereas version 6 is considered modern but at the same time also mature with good support [21].

8.6 JavaScript
JavaScript is a client-side scripting language that appeared the same year as Java, 1995, but despite appearing in the same year and having similar names, the two languages do not actually share a common origin and they have very different semantics. For a rich web experience there needs to be something on the client side which can react dynamically, all the logic cannot be on the server end and that is where JavaScript comes in. All major browsers for all major platforms support it and a whole host of sites could not function without it [22].

8.7 Servlets
Servlets is a Java technology for making web applications. It is a server-side technology and at its deepest, most simple core provides a request-response architecture where one has a web application that is presented with incoming HTTP requests and allows appropriate HTTP responses to be created and sent back. This allows server-side business logic to be written in Java seamlessly as the core messaging mechanism is Java code too. The standard Java development kits do not come with an implementation of the Servlet API, instead such implementations are bundled with a Java application server, which acts as a web server monitoring different ports for traffic. For this project, the open-source Java web application server Apache Tomcat version 7 was used. Apache Tomcat is a modern web application server that sees a lot of development and version 7 supports version 3 of the Servlet API, the latest version at the time of writing [23].
8.8 XML
XML stands for Extensible Markup Language and can be seen as a grammar for constructing text documents that are readable by both humans and computers. The XML grammar gives the user a toolbox of constructs such as elements, attributes, and cardinality which allows the user to create a representation of their data, and the representation is actually a tree. XML first appeared back in 1996, but it took several years before it saw widespread adoption. Today it is very popular and used by a host of applications to represent data and there are lots of tools and libraries available for processing XML data. Many programming languages even have built-in support for XML. The appeal behind it has a lot to do that it is so easy to query and XML document for data and to perform validation of its contents in a platform-independent way [24].

8.9 XML Schema
XML Schema is an XML-related technology used to create rulesets for how XML documents should be structured for some serialized data. The XML language itself can only say if a given text is a well-formed XML-document, i.e., it should have a certain header, a root element, all tags should be closed in the order they were opened, attributes quoted and so on. However, just because some text is a well-formed XML document, it does not mean it is useful for an application. An application could be expecting a serialization of a question sheet in XML form while the input could be a pastry recipe in XML form. This is where technologies like XML Schema come in. It allows one to create a very detailed rule-set of exactly how an XML document should look like to be regarded to be a representation of some data item. The XML Schema language is also expressed in XML. In our example above, the application which reads question sheets in XML form, could first check the input that if it is a well-formed XML document. If it is, it could validate it against an XML Schema. If it passes validation, it will know for sure that the input is valid and is ready to be queried. Before XML saw widespread adoption, it was common for programs to store or exchange data in some home-brewed format. Writing a complete validator for such ad-hoc formats was a tedious process indeed and the solution would constantly have to be updated as the format of the data was updated. With XML and the corresponding XML Schema, one gets these things for very little effort [25].

8.10 XPath
XPath is a language built solely for querying XML data. It allows the user to construct queries similar to those of SQL select statements, which will query the XML data for items that fulfill some condition. An example of such a query could be “find all elements name which has the attribute age between 19 and 26”. There is more than one query language for XML, but XPath is considered to be the simplest one and other XML query languages, such as XQuery, build on top of it. For most applications, performing queries like the one in the example above, XPath is sufficient [26].

8.11 AJAX
Ajax stands for Asynchronous JavaScript and XML and is a technology used for dynamically updating parts of a web page without requiring user input. Ajax enabled the creation of web sites with a more intuitive and less clumsy experience by transparently updating parts of a page without a full-page reload in response to events on the client side [27].
8.12 MySQL

MySQL is a rational database management system (RDBMS) based on Structured Query Language (SQL) [14]. A rational database stores data in the form of tables, and users are able to retrieve data by specifying specific rows or columns in one or more tables and several constructs are available to filter the results from these queries. There are many reasons for accepting the rational database as a data model, since they are relatively easy to understand and work with, have a separation of logical and physical data, provide easy management and handling of data without knowing intimate result computation details etcetera [15].

MySQL supports all platforms virtually and provides application programming interfaces for C, C++, Eiffel, Java, Perl, PHP, Python, Ruby, and Tcl [14].

MySQL is popular with web application and several high-traffic web sites including Facebook, Wikipedia, Google and YouTube.
9 Implementation

The implementation of this application can be categorized into a frontend and a backend. At the frontend side we have a combination of XHTML/CSS and JavaScript. This is code that is interpreted at the client side, at the end-user’s computer. The backend consists of two parts: a smaller part written in PHP and a much larger part written in Java. The core business logic of the application along with storing of application data is done by the Java backend.

9.1 Java Backend

In technical terms the Java backend is a servlet, which is deployed in an Apache Tomcat application server. When writing server-side logic, there are many languages and toolsets on offer. We selected to use servlets because of several reasons. One big reason is that we wanted a server-side system where we could easily control the state and life-time of the application and its data. Since there can be many simultaneous users, each of which should have their own state, keeping track of all this individual states in a dependable and easy-to-use-way was a big requirement when we selected the server-side framework. We also wanted to have clearly defined entry and exits of the server-side application, in order to do initialization and clean-up work, respectively, in a reliable way and also to avoid doing repeated initialization work. These things are all provided by Java Servlets. Additionally, Java is a compiled and strongly-typed language, as opposed to being interpreted loosely-typed, which moves the detection of many kinds of programming errors to the development stage instead of during the runtime stage. Java also has very good database support built into its standard library, which helps us fulfill another key requirement which involves remembering application state since the application was first deployed. Finally, Java was a familiar language with very mature tools and good platform and community support, speeding up development time considerably, which is always very valuable as most projects have tight time constraints.

9.1.1 Design Pattern

The Java backend implementation follows the model-view-controller design pattern. In this pattern the model is the heart of the application, containing all business logic and related data. The model is used by the controller, which will request different computations from the model as user input requests come in. The model will compute some result based on those requests and give it back to the controller, which simply passes it on to the view to be displayed. The view reflects the state of the model and it does not contain any business logic, it only concerns itself with how data should be displayed. By applying the model-view-controller design pattern to the application, we guarantee flexibility and reusability of the application components.

9.1.2 Design Principle

Throughout the implementation of the Java backend we also followed the design principle that says never program to an implementation, always program to an interface. In practice this means that all classes that are to be used by other classes always have a corresponding interface and all communication between classes is done through those interfaces, not concrete types. By following this principle we can rewrite or even replace key implementations of the application without affecting other parts, minimizing effort.
9.1.3 Application initialization and lifetime
A key part from the servlet framework itself, which is used by the application, is the interface `javax.servlet.ServletContextListener`. A class, `ApplicationListener`, implements this interface, which only has two methods, namely `contextInitialized` and `contextDestroyed`. The method `contextInitialized` is run when the application is started by the application server. In this method, we trigger all initialization code once and for all. The model, which is a singleton (i.e., only one can exist at any given time) is created during this step. For performance reasons, the model will populate internal, in-memory data structures with all information available in the database. The database keeps track of which courses, there are, which students have registered with the application, all the questions and questions sets and, last but not least, the historicity regarding how students have answered questions. Since many queries are read-only, i.e. they do not change any data, big performance gains are won by having synchronized views of database information already loaded. The other method provided by the interface, is `contextDestroyed`. This is called when the application server is shut down or the application stopped. In this method we do clean-up work and close all open connections in an orderly manner.

9.1.4 Request/Response Handling – The Controller
The second key part of the servlet framework used is the class `javax.servlet.http.HttpServlet`, which we have extended in a class named `RequestHandler`. The `HttpServlet` class provides, among other things, a method named `doGet`, which we have overridden in the `RequestHandler` class. This is a very important method which is called by the application server as it receives HTTP GET Requests from connected clients (the client in this case would be a user using the Facebook application and the client side software would generate these requests and send to server based on user input). The method takes two arguments, the first one encapsulates the request data itself and the second encapsulates the response that one wants to send as a reply to the request (a so called out parameter). There is also a `doPost` method which is called if the application receives an HTTP POST Request, but since our client side use GET requests exclusively, any POST requests are simply ignored. Since all incoming requests come to the `RequestHandler` class, it acts as the controller in our MVC-scheme. The `RequestHandler` will perform sanity checking on all incoming requests and if the request passes all checks, it will call the appropriate method on the Model to compute some data. The result return by the model will be sent to proper view which will create HTML dynamically to be displayed. In other words, all the logic for tying together different requests with their corresponding model computation and view presentation is handled by the `RequestHandler` class. If an incoming request should not pass sanity checking (maybe an unknown user ID, or an unknown course, or some other data in the request does not make sense), an error message will be returned and later displayed by the client.

9.1.5 Business Logic and Persistence – The Model and Database
The model class encapsulates all the server-side business logic of the application. It is the only class that has access to the database (a MySQL database), which is used for persistence. A lot of the logic is actually described in the SQL queries that have been tailored to compute results based on information stored in the database. The database has basic tables storing student programs, a user list, courses, all questions and questions together with detailed statistics keeping track of how students have answered these questions. By storing each individual answer (Was it right or wrong?), many different kinds of different statistics can be computed. As mentioned in section 7.1.3, the model keeps an in-memory representation of all database data to speed up queries. Data is written to the database as soon as possible, and all writes are transaction based, which means they either are completed in full or do not occur at all, we means we guarantee database integrity in case of an
unexpected shutdown. As is customary in MVC, the Model doesn’t know about the controller or the view, it only provides a public interface to its data, which the controller uses. The Model class uses several smaller helper classes which encapsulate concepts such as questions, question sets, and ongoing question set sessions. Many of these helper classes are just known by the Model itself. The Model does not know anything about Facebook, or servlets, or that it is, in fact, a web application, it only concerns itself with computations of business data and the storing of that data. By isolating the model from its context and technological choices as much as possible, we make it easier to replace it, to move it to another type of application, and to test it.

9.1.6 The View
The view is the simplest of the three parts that constitute our MVC-scheme. It is a set of interfaces and classes, where each interface/class knows how to display on particular type of data. All display is in the form of XHTML/CSS, which is sent to the client to be rendered by the user’s browser. The knowledge of tying together different kinds of data with different view lies in the controller, which will invoke the proper view based on the request once the model has computed the data to be visualized. There are several different kinds of view classes accepting different kind of data (request-dependent), but they all work essentially the same in that they will dynamically generate XHTML/CSS code tailored for the data which should be displayed.

9.2 PHP Backend
While Java web application makes up the lion’s share of the backend implementation, there is also a small, but crucial, part of the backend written in PHP. This part of the backend is the first that is executed when a user start to interact with the application and its purpose is simply to re-direct the user to the proper page. First, it will check if the user is registered with the application. If not, it will use the Facebook PHP SDK to display a standard Facebook application dialog where the user can choose to accept the application or not. If the user chooses not to, the user cannot proceed to any other part of the application. If a user has accepted the application, the PHP backend will then check if he or she has a university program associated with them. If not, the user is guided to a special dialog where he or she can register her university program. If both above steps have been successfully completed, the PHP backend will redirect the user to main application page where he or she can take questions, view statistics and use the other functionality provided the application.

9.3 Frontend
The frontend of the application (here frontend means code that is executed or interpreted at the client side) is written XHTML/CSS (for visual appearance) and JavaScript (for logic and dynamic behavior). All XHTML/CSS code lives inside a so called iframe[20] on the Facebook page. Iframes where originally invented by Microsoft back in 1997 during the development of Internet Explorer, but is a standard tag since HTML version 4. In simple terms, iframes are used for embedding pages inside other pages and it is the standard Facebook way of hosting an application inside their page. Some the XHTML/CSS code is hard-coded on the pages the application visits (these are the pages the PHP backend, which is described above, directs the user to) and some parts are dynamically generated on the server. The JavaScript is used for sending AJAX requests to the server in response to different user input actions and update the user interface dynamically as responses come back.
10 Testing

10.1 Testing
Testing of software is a continuous process during and after development of the software. Testing helps developer to discover and remove errors before software delivery to customer.

The main goal of testing is to remove as many as possible errors, but it is very difficult to have a bug-free software, especially in a large project.

In this chapter, we present different testing methods such as black box-, unit-, and integration-testing, which were applied in this project to guarantee the correctness, security, and quality of the application. All tests that were formally written (i.e., unit and integration tests) were all written for the Java backend since that by far makes up the largest part of the code base and also because we were familiar with the Java testing frameworks and those frameworks had good support in the development environment we used (Eclipse). Time constraints did not allow us to have a complete test coverage, but we made sure to test all critical and complicated parts of the Java backend.

10.1.1 Black Box Testing
Black Box testing is an approach which tests the requirements and specifications of the project. In black box testing the expected result and actual result compare against each other. The result of this comparison provide both validation and verification information to tester.

In this project, our application was continuously tested as an end-user would test it, by using the application through Facebook. In an on-going way different paths the user could take through the user interface were tested, looking for misbehavior both on screen, faults immediately visible to an end-user, and also more subtle, internal faults that a user might not even be able to notice. The latter type of faults was searched for by monitoring logs made by the web application and checking its internal state and the state of its database.

10.1.2 White Box Testing

10.1.2.1 Unit Testing
Unit testing is the method which tests the smallest testable component of the source code. Unit testing mostly is written by developer than tester to ensure them the code meets the requirement and behave as it expected and can be written manually or as part of build automation.

In this project we applied several unit testing to ensure every component and also particularly those doing some calculation using primitive (and therefore easy to synthesize) input data. No attempt was made to get full test coverage on a unit level because of time and resource constraints but also because it’s hard to simulate many parts of the application.

10.1.2.2 Integration Testing
Integration-testing exercises communication between modules in order to try and verify that they communicate with each other as was intended. We deployed integration testing to ensure that messages or events pass through the different modules of the system as desired.
11 Result

11.1 Expected Result
In this project we used different technologies and *gamification* to create an innovative application, which provides additional resources of educational material for students in one of the most popular SNSs where knowledge, engagement and sociality of students can improve to a great extent.

Since Facebook plays an important role in the social life of many humans, especially students, we were expecting several students regardless of their gender and age to have regular interaction with the application. We were expecting this interaction to motivate our students to engage course material to improve their knowledge and final exam result compared to other students who were not using the application.

11.2 Actual Result
The actual result of this project proved that students accept and used Facebook as an additional education platform. According to the statistics collected by the application and daily monitoring of database information, we observe that more than half of the course students registered to the application within a week after launching it. Most of the participants were male (88%), which is higher than their total percentage in the course itself.

To study how the interaction of students with the application improved their knowledge and final exam result, we collected data from the application database, which contained information regarding the student’s name, program, number of answered question sets, and the total score of students who registered and used the application. The course examiner used the collected data to compare it with the final exam result. We wanted to see if students who had interacted with the application had a higher exam average compared to students who did not use the application. We also wanted to examine how high application score correlated with final exam score. The comparison results were disappointing; the average exam score of students who had interacted with the application did not show any improvement over students has not. Furthermore, there seemed to be no correlation between having good application score (i.e., being in the top percentile) and having a good final exam score.

Additionally, the “fan page” of the application, which was created as a platform for knowledge sharing and social activities between students was not popular, and we suspect this was due to the fact that the fan page and the application were completely separate entities. We believe that by integrating the fan page with the application and by providing different types of challenges that promote team work and not just quizzes, would improve the benefit of the application.
12 Conclusion and Future Work

12.1 Conclusion
In this project we have proposed and implemented an educational application which has gamification and learning management system features within an SNS context. This application which contains test quizzes was a supplementary course material which could examine and educate students in an innovative way within Facebook. Additionally, Facebook as a main platform could improve the connection and communication among students and course instructor outside university.

Based on the outcome of this project our actual result partially met our expected result. The actual idea of using Facebook as an educational platform was successful in student life since more than half of students registered and used the application during the first week after launching the application, but we could not find any special improvement in our users final examination result. We believe providing detailed and additional course material, which involve more engagement of group work for achieving result with sketching UML diagrams within this platform may improve the learning ability and result improvement of students. Additionally, the globalization of this application where students from different universities can be an additional motivation for group work and knowledge sharing.

12.2 Future Work
We would like to propose two different future works. First we would like to see improvement of the platform to look more interactive with additional gamification features to motivate students to improve the interaction and engagement. Secondly, we would like to see additional type of questions and tutorial material which involve more group work and interaction of students within Facebook with additional future research in this area.
References:


Social Network in Education: A Facebook-Based Educational Platform

Author(s): Samira Asberg

Abstract

Social networking sites are among the most popular daily activities of students these days. Students are mostly using social networking sites for communication and sharing of their experiences. Facebook is an example of a social networking site, which supports additional features such as creating a profile page, creating group pages and supports possibility of implementing different integrated application with Facebook. These features improve the Facebook experience, allowing users to form groups, where they can introduce ideas and concepts, which can be shared and discussed in a structured style.

For this thesis we have created a new learning management system by implementing an online educational platform within a Facebook context. This work introduces a new, complementary style of education, where students can improve their knowledge and sociality outside the university in an innovative way. The platform takes advantage of gamification, which introduces game-like elements to concepts such as education and learning management systems, to make them more fun and rewarding. The goal of this thesis is to extend the educational border to an interesting online environment where students can learn, communicate, and examine their knowledge globally in different courses within our application platform in Facebook.

Keyword:
Social Network in Education; Social Networking Sites, Facebook; Gamification; Learning Management System; Online Activities; eSocial Classroom; Social Graph API;
Upphovsrätt

Detta dokument hålls tillgängligt på Internet – eller dess framtida ersättare – från publiceringsdatum under förutsättning att inga extraordinära omständigheter uppstår.

Tillgång till dokumentet innebär tillstånd för var och en att läsa, ladda ner, skriva ut enstaka kopior för enskilt bruk och att använda det oändrat för icke-kommersiell forskning och för undervisning. Överföring av upphovsrätten vid en senare tidpunkt kan inte upphäva detta tillstånd. All annan användning av dokumentet kräver upphovsmannens medgivande. För att garantera äktheten, säkerheten och tillgängligheten finns lösningar av teknisk och administrativ art.

Upphovsmannens ideella rätt innefattar rätt att bli nämnt som upphovsman i den omfattning som god sed kräver vid användning av dokumentet på ovan beskrivna sätt samt skydd mot att dokumentet ändras eller presenteras i sådan form eller i sådan sammanhanget som är krävande för upphovsmannens litterära eller konstnärliga anseende eller egenart.

För ytterligare information om Linköping University Electronic Press se förlagets hemsida http://www.ep.liu.se.

Copyright

The publishers will keep this document online on the Internet – or its possible replacement – from the date of publication barring exceptional circumstances.

The online availability of the document implies permanent permission for anyone to read, to download, or to print out single copies for his/her own use and to use it unchanged for non-commercial research and educational purpose. Subsequent transfers of copyright cannot revoke this permission. All other uses of the document are conditional upon the consent of the copyright owner. The publisher has taken technical and administrative measures to assure authenticity, security and accessibility.

According to intellectual property law the author has the right to be mentioned when his/her work is accessed as described above and to be protected against infringement.

For additional information about the Linköping University Electronic Press and its procedures for publication and for assurance of document integrity, please refer to its www home page: http://www.ep.liu.se.

© Samira Asberg