

**STUDYING E-LEARNING ACTIVITIES IN A MOBILE PLATFORM
DEVELOPING A COURSE APPLICATION**

**A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
ATILIM UNIVERSITY**

**BY
AHMET YARKIN OZDEN**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
THE DEPARTMENT OF INFORMATION SYSTEMS ENGINEERING**

JAN 2017

Approval of the Graduate School of Natural and Applied Sciences, Atılım University.

Prof.Dr. İbrahim Akman
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

Assoc. Prof. Dr. Korhan Levent ERTÜRK
Head of Department

This is to certify that we have read the thesis "**Studying E-Learning Activities in a Mobile Platform: Developing a Course Application**" submitted by "**Ahmet Yarkın ÖZDEN**" and that in our opinion it is fully adequate, in scope and quality, as a thesis for degree of Master of Science.

Assoc. Prof. Dr. Korhan Levenet Ertürk
Supervisor

Examining Committee Members:

Assoc Prof. Dr. K. Levent ERTÜRK

Asst. Prof. Dr. Ö. Tolga PUSATLI

Asst. Prof. Dr. Yavuz İNAL

Date: January 23, 2017

I declare and guarantee that all data, knowledge and information in this document has been obtained, processed and presented in accordance with academic rules and ethical conduct. Based on these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Lastname: AHMET YARKIN ÖZDEN

Signature:

ABSTRACT

STUDYING E-LEARNING ACTIVITIES IN A MOBILE PLATFORM DEVELOPING A COURSE APPLICATION

Özden, Ahmet Yarkin

M.S., Information Systems Engineering

Supervisor: Assoc. Prof. Dr. Korhan Levent ERTÜRK

JAN 2017, 84 pages

Mobile-learning advancements provides varied options into traditional learning in Universities. Mobile applications that been used for game-like learning in Universities provides powerful e-learning tools for students. In some research shows that, some courses might require a interactive way of communication to make courses more efficiently and keep success rate at high in courses. To be able to consider these essentials those applications should be developed with considering the point of view of the students and the instructors. However, there is limited number of research focusing on development of mobile learning application for university undergraduate context.

In this thesis develop an Android mobile application by using Unity 3D software platform as a tool in order to discuss and study on e-learning activities in bachelor's and master's theses at the Atilim University, and to make recommendations for students who are currently studying or will be studied in course ISE 102 which is called Introduction to Management Information Systems.

The current study aims to answer questions about what non-functional requirements of m-learning environments might be and how evaluation will be accomplished while studying in m-learning environment for universities undergraduate courses. In addition to that, seeking an answer for viability of applications in universites undergraduate program. For further improvement and necessary data collection an application evaluation testing with purposeful

sampling made by ten participants. Additionally referred model introduction and phases that included in methodology were explained.

Research results show that, non-functional requirements for m-learning environments show great importance. Application's modifiability feature among in non-functional requirements might be resultant option for an application. Be able to adjust the contents for different course materials will provide circumstances that will be beneficial for implementing these application into universities undergraduate courses. In addition to that, scalability as a non-functional requirement can be considered as an essential improvement for an application. According to needs for students and instructors, the content can be scaled up or down. Due to evaluation of this application for this study is a relative subject, students perspective and point of view must be taken into consideration in order to measure the application level. Not only students, however also instructors of these courses perspective, feedbacks should be taken into consideration as a future work

Key words: e-Learning, m-Learning, game engine, Unity 3D, education, android, mobile application.

ÖZ

MOBİL PLATFORM ÜZERİNDE E-EĞİTİM AKTİVİTELERİNDE ÇALIŞMA

DERS UYGULAMASI GELİŞTİRME

Özden, Ahmet Yarkın

Yüksek Lisans, Bilişim Sistemleri Mühendisliği

Tez Yöneticisi: Doç. Dr. Korhan Levent ERTÜRK

Ocak 2017, 84 pages

Mobil eğitimin ilerlemesi üniversitelerin geleneksel öğrenimine çeşitli seçenekler sağlamaktadır. Üniversitelerde oyun tabanlı öğrenimlerde kullanılan mobil uygulamalar öğrencilere güçlü bir araç sağlamaktadır. Yapılan araştırmalara göre, bazı derslerdeki başarı oranının artması veya verimli bir şekilde gerçekleştirilmesi için bu derslerde etkin bir iletişim gerekmektedir. Bu koşullar göze alındığında, öğrencilerin ve eğitimcilerin görüşleri dikkate alınarak bu uygulamaların geliştirilmesi gerekmektedir.

Bu tezde Unity 3D adlı oyun motorunu kullanarak Atılım Üniversitesi lisans veya yüksek lisans programlarında e-eğitimi incelemek ve Atılım Üniversitesinde okuyan ve ISE 102 kodlu Yönetim Bilişim Sistemleri dersini alan veya alacak olan tüm öğrencilere bu oyunu önermek için bir android uygulaması geliştirmektedir.

Bu çalışmanın hedefi mobil öğrenme ortamları için fonksiyonel olmayan gereksinimin neler olabileceğidir. Ayrıca üniversitelerin lisans derslerinde mobil öğrenme ortamları için yapılan çalışmalarda değerlendirmelerin nasıl olması gerektiği sorusuna da yanıt aramaktadır. Buna ek olarak, bu uygulamanın üniversitelerin lisans dersleri için uygun olup olunmaması veya kullanılabilirliği hakkında cevaplar aranmıştır. Daha fazla gelişme ve gerekli veri toplamak için uygulama değerlendirme testi yapılmıştır. Bu test, amaçlı örneklemeyle birlikte on kişi üzerinde uygulanmıştır. Buna ek olarak, değinilen model ile ilgili bilgilendirme yapılmış ve içerdiği fazlar açıklanmıştır.

Arařtırmaların sonularına gre, mobil ğrenim iin gerekli olan fonksiyonel olmayan gereksinimler byk nem tařıtmaktadır. Uygulamanın fonksiyonel olmayan gereksinimler iindeki deėiřtirilebilirlik zelliėi uygulamanın ne ıkan zelliklerinden birtanesidir. Farklı ders materyalleri ieriklerini ayarlayabilmek, uygulamaların niversitelerin lisans derslerine avantajlı imkanlar saėlamasına olanak tanımaktadır. Buna ek olarak, llebilirlik bu uygulamanın sonucunda ne ıkan bařka bir fonksiyonel olmayan zelliklerden bir tanesidir. ğrencilerin ve eėitimcilerin gereksinimleri ve istekleri doėrultusunda, ierik llebilirliėi azaltılıp veya arttırılabilir. Bu uygulamanın deėerlendirilmesi greceli bir kavram olduėundan, ğrencilerin grřleri ve bakıř aıları uygulamanın llebilirliėi iin dikkate alınmalıdır. Sadece ğrencilerin deėil, ders eėitmenlerinin de grřleri, dřnceleri ve geri bildirimleri gelecek iřler iin dikkate alınılması gerekmektedir.

Anahtar Szckler: e-eėitim, m-eėitim, oyun motoru, Unity 3D, ğrenim, android, telefon uygulaması.

ACKNOWLEDGEMENT

I would first like to thank my thesis advisor Doc. Dr. Korhan Levent Ertürk, the head of the department Information System Engineering, at Atılım University. His door was always open whenever I ran into a trouble spot or had a question about my research or writing. He consistently allowed the development of this project to be my own work, however steered me in the right direction whenever he thought I needed it.

I am genuinely thankful to the Jury Members and for their valuable criticism and comments.

I wanted to thank all my colleuges, my friends for their support who kept me motivated all the time.

Last however not least, I wanted to thank my family for their belief, high patience and their love and support and everything that they have done for me.

CONTENTS

ABSTRACT	4
ÖZ	6
ACKNOWLEDGEMENT	8
CONTENTS	9
LIST OF TABLES	12
LIST OF FIGURES	13
CHAPTER 1	14
INTRODUCTION	14
CHAPTER 2	17
LITERATURE REVIEW	17
2.1. M-LEARNING AND E-LEARNING.....	17
2.1.1. <i>M-Learning Definition and Purpose</i>	17
2.1.2. <i>Why Mobile Learning?</i>	18
2.1.3. <i>Mobility of Technology</i>	19
2.1.4. <i>Mobility of learners</i>	19
2.1.5. <i>Mobility of learning</i>	20
2.1.6. <i>E-Learning Definition and Purpose</i>	21
2.1.7. <i>History</i>	21
2.2. GAME ENGINE.....	22
2.2.1. <i>What is Game Engine</i>	22
2.2.1.1. <i>Advantages in using a game engine</i>	23
2.2.1.2. <i>Disadvantages in using a game engine</i>	23
2.2.2. <i>Types of Game engine</i>	23
2.3. UNITY	24
2.3.1. <i>What is Unity</i>	24
2.3.2. <i>Unity History</i>	24
2.3.3. <i>M-learning by using a game</i>	27
2.4. RELATED STUDIES	28
CHAPTER 3	30
METHODOLOGY	30
3.1. ADDIE MODEL	30
3.2. RESEARCH QUESTIONS	32
3.3. ADDIE PHASES	32
<i>Analysis Phase</i>	32
<i>Design Phase</i>	32
<i>Development Phase</i>	33

<i>Implementation Phase</i>	33
<i>Evaluation Phase</i>	33
CHAPTER 4	35
M-LEARNING: DEVELOP A COURSE APPLICATION	35
4.1. ANALYSIS	35
4.2. DESIGN	35
4.3. DEVELOPMENT	36
4.3.1. <i>System Development</i>	36
General Structure of the System.....	36
Spin Control	37
Spin Control Calculation	37
Creating a Vektor from two points	38
Determine the Swiping	38
4.3.2. <i>Profile Management</i>	39
4.3.3. <i>Data Design</i>	40
4.3.3.1. Database	40
4.4. IMPLEMENTATION.....	42
4.4.1. <i>Supported Screen Resolution</i>	42
4.4.2. <i>User Interface Design</i>	42
4.4.2.1. Home Screen	42
4.4.2.1.1. Statistics	43
4.4.2.2. Spin Screen.....	44
4.4.2.3. Question Screen.....	45
4.5. EVALUATION	48
4.5.1. <i>TESTING</i>	49
4.5.1.1. Deployment to Android Devices	49
4.5.1.2. Deployment to Windows Devices	50
4.5.2. <i>Functional Requirements</i>	51
4.5.3. <i>Non Functional Requirements</i>	52
4.5.4. <i>Participant Results</i>	53
4.5.4.1. Mobile Usage	55
4.5.4.2. Desktop Usage.....	56
4.5.5. <i>DISCUSSIONS</i>	57
4.5.5.1. <i>What may be the necessary non-functional requirements for mobile learning environment in a course given in University undergraduate program? (RQ1)</i>	57
4.5.5.2. <i>What may be the user evaluations that developed for mobile learning environment in a course given in University undergraduate program? (RQ2)</i>	59
Student Perspective	59
4.5.5.3. <i>Can a mobile application be used for Universities undergraduate course content in the means of e-learning purposes? (RQ3)</i>	59
4.5.6. <i>Configuration</i>	60
4.5.7. <i>Determination of Faced Problems</i>	61
4.5.8. <i>Tools used in</i>	61

CHAPTER 5	62
CONCLUSION.....	62
5.1. ORIGINALITY	62
5.2. IMPACT	63
5.3. APPLICABILITY	63
5.4. USEFULNESS	63
5.5. LIMITATIONS OF THE STUDY	63
5.6. IN FUTURE USE.....	64
6. REFERENCES	65
7. APPENDIX A	71
7.1. TYPE OF GAME ENGINES	71
APPENDIX B.....	77
QUESTION.CSS	77
QUESTIONCONTAINER.CSS	77
QUESTIONLOADER.CSS	77
GAMESCRIPT.CSS	78
PROFILEMANAGER.CSS.....	78
SPINCONTROL.CSS.....	79
QUESTION.XML.....	79
APPENDIX C	80
FUNCTIONAL REQUIREMENTS TESTING RESULTS	80
NON FUNCTIONAL REQUIREMENTS TESTING RESULTS	81
APPENDIX D	82
PROGRAM EVALUATION TEST	82

LIST OF TABLES

<u>Table</u>	<u>Page</u>
Table 1 : Functional Requirements	52
Table 2 : Non-Functional Requirements	53
Table 3 : User Satisfaction Factors.....	54
Table 4 : Testing Results for overall application	54



LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
Figure1 : Ownership of Devices in 2016 [50].....	18
Figure2: ADDIE Model Phases.....	34
Figure3 : General Structure of the System	37
Figure4 : Spin Control Module	37
Figure5 : Profile Management Module	40
Figure6 : Questions Entities	40
Figure7 : Spin Control Entity	41
Figure8 : Profile Management Entity.....	41
Figure9 : Game ER Diagram.....	42
Figure10 : Homescreen	43
Figure11 : Statistics	44
Figure12 : Spin Screen	45
Figure14 : Wrong Answer.....	46
Figure13 : Question Screen	46
Figure15 : Correct Answer	47
Figure16 : Out Of Time.....	47
Figure 17: Unity Preferences.....	49
Figure18 : Screen Shot of Build Settings in Unity 3D.....	50
Figure19 : Unity 5 Remote Application Screenshot	51
Figure 20 : Mobile Usage.....	55
Figure 21 : Desktop Usage	57

CHAPTER 1

INTRODUCTION

Creating a game considered as an easy task at then beginning however later it will become more challenging. The game creation must include all the aspects of user-satisfaction to desired game objective. The balance between satisfaction and enjoyment is the hardest part for creating a game. Each part must be considered deeply and focused with lots of feedbacks and strategic decision making. In the game industry, there are lots of companies which are trying to publish games in different modern platforms for distrihowevering such as; Steam, GooglePlay, AppStore, HumbleBundle. It is pretty common that some games provided loads of revenue for companies to become top list tier games among all other games.

Games are built and developed mostly for entertainment. There are lots of types of games such as FPS(First Person Shooting), RTS (Real Time Strategy), RPG (Role Playing Games) or MOBA (Multiplayer Online Battle Arena) games. These all games are only for entertainment and some people playing these games in professional way whose are earning money by attempting tournaments with some sponsorships. On the contrary for pure enteratinment, in this thesis, the developed an application includes aspects of learning and education on IT subjects for an Atilim University with pop up questions and answers to encourage students to study and practice more their skills and self-improvement and its utilized in multi-platform.

Education is a huge market which can be given in a different ways. Besides collegues, universities or even elementary schools, there are lots of students who takes private tutoring. It is also sometimes refered as shadow education [1]. There are different views about private tutoring among authors. One of the author named Mark Brey[1] mentioned about how private tutoring affects students in negatively and cause inequality amongs students. He also mentioned for performance drops and pressure increasing on students which private tutoring cause. On the other hand, another author, Entrich highlight private tutoring which this method can have a neutralizing effect on disadvantaged family groups.

Digital Game-based learning is a new solution for everyone and it also fits on specific use-case for repetitive training. Some lessons need practicing and memorizing.

In early ages there was PDA(Personal Digital Assistants) however now its faded and replaced by tablets, smart phones, desktops, notebooks. When we consider this in a way of educational persepective, we can see that, many pupils using their digital devices for online education. Although immeasurable of tools and ways of e-learning with digital devices, it had been observed there is no such a gaming platfrom used for education. When the datas collected, we observed that, there are uncounted applications for educational purpose aim young kids whose age between around 5 to 10. Mostly education found in digital platform is consist on focusing language learning, speaking, communication, simple math problems (addition, subtraction, multiplication, division). For higher purpose of education, there is only few companies provide simulation games for mostly vehicle learning or medical care. There are no common approach to education with game in universities or colleges due to traditional learning. In this thesis, course mobile application is developed for information system engineering students by using popular gaming platform called Unity 3D.

Games help us developing non-cognitive skills, which are as fundamental as cognitive skills in explaining how we learn and if we succeed, according to the panelists. (MACKAY, 2013). There are lots of game tools for developing a games. Each game engine or tool is better than the another becuase their inner structure and purpose of development. With all in these options, Unity 3D game engine fits perfectly in the selection. First and the best reason for choosing Unity 3D, is the best game engine for android platforms. Games are developed and built by this engine shows highest performance among other game engines in android platforms. Second reason is Unity 3D is easy to use and learn, and can be accessed by everyone without paying unless profesional use. Some universities, Atilim University, includes courses about games and simulation, and they teach how to use Unity 3D. A little bit coding knowledge, Unity game engine is perfect for all kind of game creations. In addition that, Unity 3D is a multi-platform game engine which developed games can adjusted to any platform with one click.

While creating and developing this application, there are some additional helpful tools and ways are used. Firstly, the most important part of this application has an XML(Extensible Markup Language) database. All the related questions and answers are in XML. XML format is choosen because when the comparison between other databases are made, xml is undoubtedly fast and effective. All the questions and answers are loaded before game starts so there will be no unwanted delay while runningapplication. The design goals for XML is emphasize on simplicity and utility.

In this thesis, a mobile application developed for Information System Engineer students in Atilim University who takes course ISE 102 Introduction to Management Information Systems with using game engine called Unity 3D for Android platforms. Application is designed to implement a new kind of approach to higher end education and aim to help students through class and improve their knowledge about the course itself. Players who runs the application and starts a new quiz. Dragging their finger through spin circle to spin and a catagory, which is designed according to course book [61], is selected. After selection of catagory, students should answer a question related with that selected catagory. The contrihoweverions of this study are as follows:

- Designing a mobile application for university courses with in m-learning environment.
- Application can be adjusted to any kind of platform to play
- Due to ease of XML usage, the application can modified for any kind of course's verbal contents.
- Increase usage of mobile applications in education more often
- Application is designed on basic settings and can be developed for future use more effectively in case if it needed.

This thesis consists of five chapters. In Chapter 2, literature review is discussed about the key concepts such as e-learning, m-learning, game engines and Unity 3D. In Chapter 3, a metholodogy called ADDIE model is explained and their phases also explained to reflect this model into thesis. Then, in Chapter 4 design, analysis,development process,implementation of the application and their innerstructure with analysis explained in detail. In addition to that, UI and database shown in this chapter. Testing and implementation part tooks place in this chapter. Related and non- related functions are discussed. Finally derived conclusions and in future use are given in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1. M-Learning and E-Learning

2.1.1. M-Learning Definition and Purpose

Mobile Technologies are playing a vital role in education specially in academic lives. Devices which are used in learning such as smartphones, tablets, and e-book readers allows users to reach and access to information and enable interactivity between users. Using these devices also influence students and other users to keep and improve their learning preferences going on both within and outside. Mobile learning (M-Learning) simply described as delivery of learning, education or learning support on mobile phones, PDAs or tablets.

More students own Internet-capable devices now than ever. According to research and studies that been made by from Eden[49] reflects that a projected increase in connected devices could soon challenge even the most agile networks. Technology is embedded into students' lives, and students generally have positive inclinations toward technology and most students support institutional use of their data to advise them on academic progress in courses and programs.

Effective use of mobile technology is less about tools and more about students' digital literacy skills, including the ability to access, manage, and evaluate digital resources. Students might take plenty of pictures using their mobile phone cameras, however rarely do they use the device for meaningful learning experiences. So, even though students recognize mobile devices' value for academic work, they still look to institutions and instructors for opportunities and encouragement to use them that way. [40]

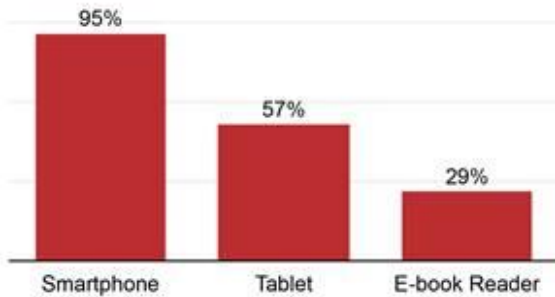


Figure 1. Device ownership

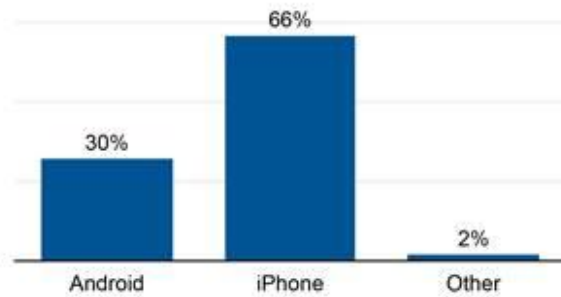


Figure 2. Smartphone ownership

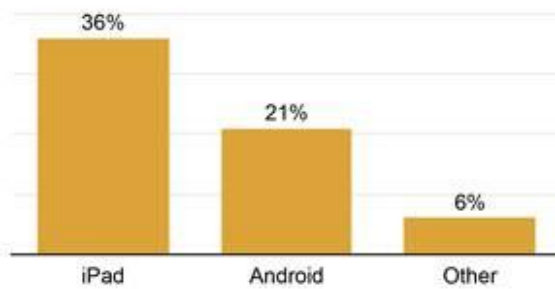


Figure 3. Tablet ownership

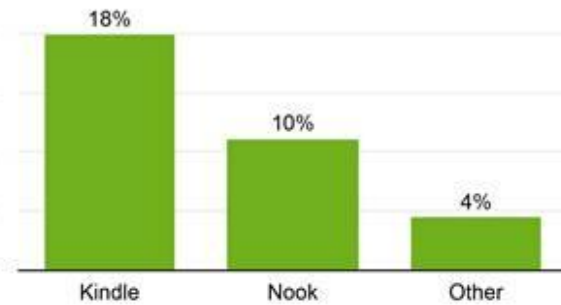


Figure 4. E-book reader ownership

Figure1 : Ownership of Devices in 2016 [50]

Main purpose of m-learning is to provide a baseline of mobile technology ownership and usage on which to build future research and educations. Main expectation is guiding potential initiatives to help students and instructors in adopting more effective learning and teaching practices across content areas. In addition to that m-learning address the implications for student training and skill development and for instructor support.

2.1.2. Why Mobile Learning?

According to different studies and research that been made by Jill [51] the main concept for why mobile learning is important has been listed below:

- Mobile learning helps learners to improve their literacy and numeracy skills and to recognise their existing abilities
- Mobile learning can be used to encourage both independent and collaborative learning experiences
- Mobile learning helps learners to identify areas where they need assistance and support

- Mobile learning helps to combat resistance to the use of ICT and can help bridge the gap between mobile phone literacy and ICT literacy
- Mobile learning helps to remove some of the formality from the learning experience and engages reluctant learners
- Mobile learning helps learners to remain more focused for longer periods
- Mobile learning helps to raise self-esteem
- Mobile learning helps to raise self-confidence

We can simplify the mobile learning in three stages. Mobility of Technology, Mobility of Learning and Mobility of Learner.

2.1.3. Mobility of Technology

The mobile technology referred to in this article is mainly more advanced cellular telephones. However there are other forms of technology such as “smart” phones, digital cameras, flash-discs, iPods and personal digital assistance devices (PDAs). Mobile devices used to deliver higher education content and instruction can also function as audioplayers, media-players and digital cameras. Advanced mobile devices are furnished with Wireless Application Protocol (WAP) and Wireless Fidelity (Wi-Fi) capacities so that a user can connect to the Internet by means of his or her [40]

These devices that mentioned above have the way of link to the Internet and content and instruction that can learns access and get information at anytime and anywhere. Most of the more advanced models can support portable, digital and wireless mode of teaching and learning. Mobile devices with advanced features can be more used and become fashionable than the standard desktop personal computers.

2.1.4. Mobility of learners

E-learning by users is mostly dependent on location and time (availability). If the computer is not linked to a wireless or internet connectivity which means that one must always work in one place and between a specific time interval. However with mobile learning, learning can occurs at any place and at any time. Ting[41] makes the following remarks about the advantages of mobile learning: “The overall advantages provided by the mobile learning are [that it is characterised by] more flexible, accessible and personalised learning activities. Such advantages keep the learners engaged in the ongoing learning

activities and enhance their productivity and effectiveness”. Furthermore, Guralnich [42] suggests that the designer would be better served if he/she considered the entire context in which learners will use particular m-learning programme.

Later on Uden[43] said that Mobile technologies offer new opportunities for students' educational activities in that they can be used across different locations and times”. Students using mobile technologies are not only remote from their instructors; they also fully control the access of information on their mobile devices. In this light, one of the main advantages of mobile learning is that it allows this generation of learners to enjoy a certain amount of freedom and independence.

2.1.5. Mobility of learning

Researchers and practitioners experiments for transmitting the full content of higher learning to students by means of mobile cellular devices. Advantages of mobile learning brings out that contents of education system can be easily accessed anywhere and anytime. [56] Walker points out that the advantages of mobile learning are not dependent solely upon the ability to use a portable and wireless communication device successfully. He argues that the kind of learning experienced by mobile owners is unique because it is received and processed within the context in which the learner is situated. The context is utterly individual – completely different from the rigid outlay of the traditional classroom or lecture room, and the computer laboratory.

Mobile learning devices have also enriched the theory and practice of e-learning. Contemporary consumers of higher education in developing countries almost always use mobile learning devices as adjuncts to e-learning in higher education. Sophisticated mobile devices are currently capable of delivering a comprehensive range of e-learning materials by means of web connection, infrared and bluetooth transmissions. For an example; Demonstrations of some of the learning materials developed are available on the m-learning project website at www.m-learning.org. These can be viewed on a PC or on mobile devices. Learners can access materials online via the mPortal/learning management system/intelligent tutor or use offline learning materials downloaded to the PDA/phones.

2.1.6. E-Learning Definition and Purpose

Today's world e-learning not only just known as a term however its used mostly in universities and other educational places in modern education system. It becomes highly popular in modern time and started to leave traditional ways behind. When education and teaching become essential, learning has needed to reform and improve itself through different ways and algorithms.

E-learning refers to 'educational learning'. [31] Before that it is called as Internet-Based Training then Web-Based Training. E-learning is a theory that using cognitive science principles using multi-media and its theory [32]. In more general term its under the term of "*Educational Technology*". It is a general term for theory and practice of educational approaches to learning or educational Technologies itself as an educational subject which may also called as ICT(Information Computer Technology).

The main approach of e-learning systems in our daily educational system is ease the way of learning and make it more faster and efficient. We can see many way of systems for implement and use the e-learning by using Computer Based Training(CBT), Computer-Based Instructions (CBI), Computer-Aided Instructions (CAI), Web-Based Training (WBI) and Technology Enchanced Learning (TEL)[33].

2.1.7. History

The concept of e- learning starts around 1950s. Writing slates, various of abaccus and blackboards used for a almost millenium in traditional education. Introduction books covered almost entire education system. Early 20th, duplicate machines were used to produce copies of runs (10-15) for classroom and home work purposes. First mass education step is creating a educational film with other mediated tools such as overhead projectors. Mostly used in WW1 and WW2 to measure and observe soldier intelligence and their recruiting step. Education of soldiers are took part in using films. Slide Projectors will replaced in 1950s

First computer terminal was established in mid 1960s for accessing the resources for a specific course in University of Illinois to record the lectures with media devices such as radio or television. First teaching via computer happened in Palo Alto University District to teach elementary school children spelling and arithmetic by Stanford University psychology professors Patrick Suppes and Richard C. Atkinson. First Computer was established in 1963

by Bernard Luskin in community college. Working with other corporations and universities the computer based learning developed and improved.

In 1971, a term “web learning” is heard by Ivan Illich who said that:“Up to now, what have we learned is learned from out of the school. Students also learned loads of things without teachers even despite of teachers. Colleges creating a job opportunity for lecturers and there are nothing beside this which students learn from them”[34]. He defended that students are most likely learn all the things they wanted to learn and come from self-desire and research ability. Teachers and tutors ability to teach are limited. The real learning come from the society itself.

In mid of 1980’s Computer Based Training(CBT) and Computer Based Learning (CBL) become available in content of courses and enable the interaction between student and computer drills.

Till 1900s heavy usage of web-based learning and online distance learning observed. Online communications and discussions had been made between teachers and students. In 1990 when the World Wide Web (www) comes, teachers started to embed their projects and teachings into multi-object oriented sites. On the contrary of CBT and CBL which both of their purposes are self-learning and improvement, web brings out simple instructions to students. Web affect on online learning brings more flexibility, efficiency and effectiveness to the students also teachers to implement their teachings into open world and share it with all students across world wide. In the research which is made in 2008 in U.S. Education Department shows that, 80% of the public schools and colleges offers distance online learning to students and 77% of them are participated in these courses via distance learning.

2.2. Game Engine

2.2.1. What is Game Engine

Game engine is a software platform which includes, rendering engine, 2D or 3D graphics, physics engine, audio engine and artificial intelligence, loading, animation, collision detection between objects to create and develop a game. [28].

Game engines are kind of middleware solution. It provides platform abstraction, models, sounds which enable to use it over and over again while creating or developing a game. These called are assets. Most confusion for game engines is thought as game engine is

a game itself. Game engine is considered as essential parts of a game however not the whole game itself.

Game engines are typically built for various types of games and it is adjusted to different platforms for game developers or users. [29].

2.2.1.1. Advantages in using a game engine

- Less development time required
- Less testing and debugging
- Many features directly available
- Better focus on the game design

2.2.1.2. Disadvantages in using a game engine:

- No control over the implementation of features
- Adding features not yet in the game engine might be cumbersome
- Dependent on other licensing scheme for release
- Other libraries/toolkits linked with the game engine (physics, AI...)

2.2.2. Types of Game engine

Game engines become more flexible and strong each day passed with their improvements and developments. [30]Game engines are designed and created with a specific game. Each game has it's own type. There are some game engines which widely known around world and become the best when comparing the engines with notable games. A list of game engines can be found in (**APPENDIX A**)

MMOG(Mass Multiplayer Online Games) Engines: Horde3D, Tourque3D, WorldForge

FPS (First Person Shooter) Game Engines: Aleph One, Cube 2, ForeLight Engine (H1Z1, EverQuest, PlanetSide 2), FrostBite (Battlefield Series), GoldSrc (heavily modified Quake Engine) which includes (Counter Strike, Half Life), Quake Engines (1-2-3), IW Engine

(Call of Duty Series), Source (Half-Life 2, Counter Strike Source, Left 4 Dead 2), Unreal Engine, Cry Engine (Crysis Series, FarCry Series)

RPG (Role Playing Game) Engines: Alamo (Star Wars Empire at War series), Aurora (Neverwinter Nights), Creation Engine (Elder Scroll V: Skyrim, Fallout 4), Infinity Engine (Baldur's Gate Series), Luminous Studio (Final Fantasy XV), Source 2(DoTA 2)

RTS (Real Time Strategy) : Essence Engine (Warhammer 40k)

Third Person Game Engines: Rockstar Advanced Game Engine (GTA V),

2.3. UNITY

2.3.1. What is Unity

Unity also called or known as Unity 3D is a development environment which is compatible for multi-platforms (IOS, Android, PlayStation, XBOX, Windows Phone, BlackBerry, MAC, Linux and Web). Unity becomes more and more popular for creating 2D and 3D games and applications.

2.3.2. Unity History

Unity Technologies was founded in 2004 by 3 young developers whose are David Helgason (Ex-CEO, currently Executive Vice President), [4] Nicholas Francis (CCO)and Joachim Ante (CTO) in Copenhagen, Denmark. Unity's maybe the best major factor of becoming one of the greatest development environment is support the independent developers. Creating the fundamentals of Unity Technologies the first mission was creating a 3D tool for web.

[4]The group decided to make a business plan and in order to do this they incorporated under the name of Over The Edge Entertaninment (OTEE). They used a modelling of Criterion which are relatively becomed actually popular and succesful in Playstation 2 middleware marketting. 2 years coding and hard work, Untiy engine was ready to launch and they decided to do it by making a commercial game called *Gooball*[4]. It is released in March 2005 by the company called Ambrosia Software. After release they started to break down the

game to find bugs errors to make it better and and they gain profit for it. In June 2005 they officially released the Unity 1.0.

After releasing version 1.0 they started to working to improve Unity as fast as possible. In version 1.0 Unity, building an application is only supported by Mac OS X. They were no current support for Microsoft Windows and web browsers. Although Adobe's Flash might were the one and only option for developers to publish the work on web, Unity brought the hardware-accelerated 3D graphics to the market. It has unquestionably high major impact on gaming industries. In addition to that, in version 1.1 Unity started to support C/C++ plug-ins to extend the development of gaming by hardware and software which are not dependent on Unity engine.

After 3 months later of releasing 1.1. they fixed, optimized and debugged the workarounds for older PCs. Main fixes were old Graphic Card bugs and driver issues. They released the fix patch after it and integrated in Unity 1.5.[7]

This version of Unity was the biggest step around Unity History. Major aim in version 2.0 was supporting and improving the Microsoft Windows support and web browser compatibility. To accomplish that, they added Microsoft DirectX which should be downloaded solely. [5]By adding Microsoft DirectX support, Windows Systems are become more faster which around 30 percent. In addition to this version, the other developments and add-ons were: web-streaming, real-time soft shadows, a terrain engine, networking, The Unity Asset Server and a new coded base GUI system. It is released on 2007 during Unite Developer Conference.

[5]This version of Unity is release for iPhone. Unity Team wanted to co-op with smart phone application rising and they decided to release and version which is used by iPhones. It is marketed as separated products and publish as two types of it in December 2008. Unity Basic and Unity Pro[18]. Between 2008 and 2009, Unity Team,now, known as Unity Technologies.

Unity Technologies still did not have the Windows support entirely and they figured out that, all customers using Unity Engine buying Mac OS X to use or develop applications by it. It is about Unity's current editor. In order to support this, they tear apart the current editor and re-wrote the editor and they successfully reach their objective. Unity 2.5 is

published during at the 2009 in Game Development Conference which is the first version of Unity with Windows support.

After the first biggest steps of Unity (Unity 2.0) next major activity and development happened in Unity 3.0. The features in Unity 3.0 are lightmapping, deferred rendering, Umbra Occlusion Culling, low level debugging and FMOD audio filters. While Unity 3.0 has reached more than 200.000 users, Unity became the top list around the game engines for educational purposes and the most used technology on mobile platforms.[19].

Unity Technologies included Flash deployment option and started on December 22, 2011. Nicholas Francis said that “Our vision has always been to let developers take their games to as many places as possible – and Flash deployment greatly furthers that. While we normally wait to ship our software until it’s rock solid, the Flash publishing option is just so awesome that we had to do a developers preview. I can’t wait to see where our new and existing users will now take Unity.”[20]. Unity 3.5 latest release was published on February 14,2012.[18]

Unity final release became available to its users on November 13,2012. Unity 4.0 is opened as pre-order to it’s users with included early access beta lists. New features were added in which are: Mechanim animation, Flash Deployment, Linux publishing preview and Shuriken particle system. Helgason stated that they had been waiting such a long time to publish this new release and stated also that they are sure-enough satisfied and happy about it’s arrival. [21]The newly added add-ons to Adobe Flash and Linux supports are the most vital improvements in Unity 4.0. Helgason also added his speech “These vital improvements, Unity become the most strongest, fastest evolving modern games development platform available.[21]”.

The next Unity 4.3 released on November 12, 2013.[23] While Unity developers using fake 2D (putting textures on plain flatform) they crated a out-of-the-box support for 2D game development. Until then the developers can use this version to authoring 2D games.

The latest Unity Version 5.0 inital release was on June 8, 2005. It was written in C, C++ and C#. The initial release supports the most multi-platforms(Windows, OS X, Ubuntu(experimental Deployment), Linux, Xbox360, Xbox One, Wii U, Nintendo 3DS line, PlayStation 3, PlayStation 4, PlayStation Vita, Windows Phone, iOS, Android, BlackBerry 10, Tizen, Unity Web Player, Windows Store, WebGL, Oculus Rift(coming soon), HTC

Vive, Gear VR, Android TV, Samsung Smart TV, tvOS, Adobe Flash, Google Native Client, Wii). Features available in Unity 5 brings the greatest power in gaming industry such as Physically-Based Standard Shader, Real-Time Global Illumination, HDR Reflection Probes, PhysX 3.3 support, Audio mixer, interactive 2D and 3D content, Unity Cloud, 64-bit support.

2.3.3. M-learning by using a game

Use of game engine to create e-learning is become the newest trend in our education systems. Not only it provides easy learning and understanding, it also provides the flexibility and efficiency. It also during research it increases the performance of students while performing tasks with using games and simulations[35]. In addition to this topic, traditional way of learning has an effect on students which may cause in lack of attention or less focusing.

Gaming environment motivates the players and rise the feeling of ambition and motivation to proceeding in game and complete it, increases the both performance and knowledge[36]. The research show that digital games are routinely listed as the most "important" and influential medium by those under 35[37].

To understand the impact of e-learning by using game-engine, simply we need to understand its importance and what can game engines provide. Provides a model of learning with digital gaming technologies; Shows how learning organizations are creating sustainable training programs that leverage gaming technologies; Explores what organizations are doing right now with gaming and simulation technologies to support learning; Develop guidelines and principles for using gaming technologies in e-Learning; Suggests implications for the future of instructional design.

When trying to choose the combination of game engine with learning the following questions should be answered:

- What models of game based learning are emerging?
- What are the driving factors behind game-based learning programs?
- What expertise is needed to create effective game-based learning materials?

Clearly when the game meets with learning, objects, terrains, dialogues, key concepts of the course or subject, visualization, interactive questions and answers or tasks, win or lose, achievement process and progress of the game will comes to front line.

In this thesis, we choose to create a m-learning application through the game-engine called Unity3D. Moreover in further chapters we discuss the details of how a Unity3D is established and used to create a e-learning mobile application.

2.4. Related Studies

Education is mostly given by colleges or universities where students must attend to in order to achieve related knowledge that what they are looking for. The next level in game design is a fully fledged 3D game engine which can publish to any platform using the same code base. Unity 3D is currently the popular option for game developers and can publish your game to all major platforms. The truth is, the majority of eLearning games will be built either within an authoring tool or using a more basic 2D HTML5 game engine. It's a step up from the basic interactions you can achieve inside an authoring tool, offering a huge leap in terms of creativity. Although the educational systems are improved and developed rather than the early ages, there are still only few places provide e-learning games that we are looking for.

As we all know, almost everyone now using smart phones for their all kind of works. Every need is designed as a application by smart phones and provide quick and effective solution. As in history in 1975 the game "*Wheel of Fortune*" started to shown on media in United States. In recently, we all know the game "*Trivia Crack*" that has been officially published in October 2013. In study and education, unfortunately, we cant see much variety of applications for this kind of approach. Design a mobile game for educational system shows different approaches through out the area you are speczializing. Unity 3D is a tool that mostly used for entertainment and varies games with different genre rather than educational purpose.

There are many examples of different and innovative ways in which computer gaming has been used to support learning and teaching in recent years, both with children and in Higher Education. For example, recent research with school children includes the use of bespoke science games (Magnussen, 2005), off the-shelf historical games (Squire & Barab, 2004), and multi-user gaming environments (Barab et al, 2005). Examples of recent research in Higher Education include the use of games to support the learning and practice of civil engineering concepts (Ebner & Holzinger, 2006), a competitive game to teach programming (Lawrence, 2004), and virtual reality games used with geography students (Virvou & Katsionis, 2006). The health sector has been using gaming visualisation techniques for several

years, for example through the use of virtual patients, and aircraft pilots often use aircraft simulations in the early stages of training (Kirriemuir, 2002).

There is also an varies of modules which are developed for National Education Ministry called “K12” programs. In this very modules there are one specific module designed for student information management system. NEM is using these modules for enhancing the educational system and improving the interaction between student, families and instructors for better feedback and information gathering. [69] Some of the modules of student information system management are: Personal Functional Systems Module, Messages Module, Behavior Module, Accountant Module, Measure and Evaluation Module, Guidance Module, Study Module, Diary and Class Attendance Module, Calendar Module, Clubs Module, Health Module and Service Module.

CHAPTER 3

METHODOLOGY

In this chapter, a methodology called “*ADDIE model*” has been explained and implemented on thesis. In this model each chapter represents the parts of the thesis and progression. These parts are consisted of five different parts and these are, Analysis, Design, Development, Implementation and Evaluation. All participants have knowledge about Management Information Systems and their usage of desktops according to user evaluation testing are frequently. [70][71][73] Early studies supporting the assumption argued that just five participants could reveal about 80% of all usability problems that exist in a product (Nielsen, 1993; Virzi, 1992). [72] However, according to Tullis and Albert (2008), twelve participants are enough to recruit in order to evaluate the system properly and to reveal usability problems. According to given assumptions, this user evaluation testing has performed with purposeful sampling with ten users. Except one participant, they frequently play mobile games. Rest of the part of this chapter includes information about ADDIE model and the phases definitions. How this model implemented on this thesis will take part in Chapter 4 in detail.

3.1. ADDIE MODEL

The abbreviation for ADDIE is referred to Analysis, Design, Develop, Implementation and Evaluation respectively. This model is considered as Instructional Systems Design (ISD). There are some theories educational technology which are currently included in this model such as: *behaviourism, constructivism, social learning and cognitivism*.

Behavioursim

Behaviorism is a learning theory that only focuses on objectively observable behaviors and discounts any independent activities of the mind. Behavior theorists define learning as nothing more than the acquisition of new behavior based on environmental conditions.

Constructivism

Constructivism as a paradigm or worldview posits that learning is an active, constructive process. The learner is an information constructor. People actively construct or create their own subjective representations of objective reality. New information is linked to prior knowledge, thus mental representations are subjective.

Cognitivism

Cognitive theory defines learning as "a semi-permanent change in mental processes or associations." Cognitivists do not require an outward exhibition of learning however focus more on the internal processes and connections that take place during learning.

The main assumption of cognitive psychology is that there are cognitive processes that take place and influence the way things are learned. Explanations for how cognitive processes work are known as information processing theories or models.

ADDIE model is used and designed mostly for instructional tool for education. Although it is used for learning and education, we should say that this model will not always follow the theories in educational technology.

The concept of ADDIE can be referred as a product development process in a systematic way. It aims mostly performance-based learning and it can also be represented as the traditional type model, waterfall model, with some sequential phases. ADDIE model can cover up entire instructional design method. In addition to that, design must be carefully planned built-in activities and return a cyclic feedback through process. Thus, all quality and timeline must be balanced. This model known as a starting point for developing learning objectives. It is assumed that intentional learning should comply with the following criteria: authenticity, innovation, inspiration and focus at students. It is assumed that intentional learning is complex, comprising eight basic elements involved in the learning environment, i.e. a student, peer, teacher, content, media, time, context and conditions. (Branch, 2009).

3.2. Research Questions

Main concern about this study was exploring the concept of how can an application and tools may implemented on mobile-learning environment and improving the concept of e-learning through self-education and self-improvement.

Participants were selected with convenience sampling and also had background knowledge about Information Technology. Due to their professions and previous backgrounds, participants had also knowledge about digital literacy and how to use mobile phones or any devices.

More specific research questions concerning these aspects can be elaborated as below:

1. What may be the necessary non-functional requirements for mobile learning environment in a course given in University undergraduate program?
2. What may be the user evaluations that developed for mobile learning environment in a course given in University undergraduate program ?
3. Can a mobile application be used for Universities undergraduate course content in the means of e-learning purposes?

3.3. ADDIE Phases

Each of the five phases of ADDIE model that we implemented on our thesis(see fig. 2) represents an important step, serving different purpose, providing a complete training development process.

Analysis Phase

As for the individual ADDIE stages, the first Analysis phase is a pre-planning phase, concerned with the instructional problem clarification, identification of the audience and its needs and identification of potential constraints, motivation and objectives. Simply, the questions who, what, where, when, why and by whom are answered.

Design Phase

In the second Design phase, the performance objectives are determined, instructional strategies devised, appropriate testing methods generated and calculations made. Shortly, the blueprint or course structure is created. In the design phase, the focus is on learning

objectives, content, subject matter analysis, exercise, lesson planning, assessment instruments used and media selection.

Development Phase

Third phase, development stage starts the production and testing of the methodology being used in the project. In this stage, designers make use of the data collected from the two previous stages, and use this information to create a program that will relay what needs to be taught to participants. If the two previous stages required planning and brainstorming, the Development stage is all about putting it into action.

Implementation Phase

The fourth phase of the model is Implementation Phase. The implementation stage reflects the continuous modification of the program to make sure maximum efficiency and positive results are obtained. The results of the design are represented in implementation phase.

Evaluation Phase

The last stage of the ADDIE method is Evaluation. This is the stage in which the project is being subjected to meticulous final testing regarding the what, how, why, when of the things that were accomplished (or not accomplished) of the entire project. There are two parts of testing found in evaluation phase. Those are “Software Testing“ and “User Interface Testing“

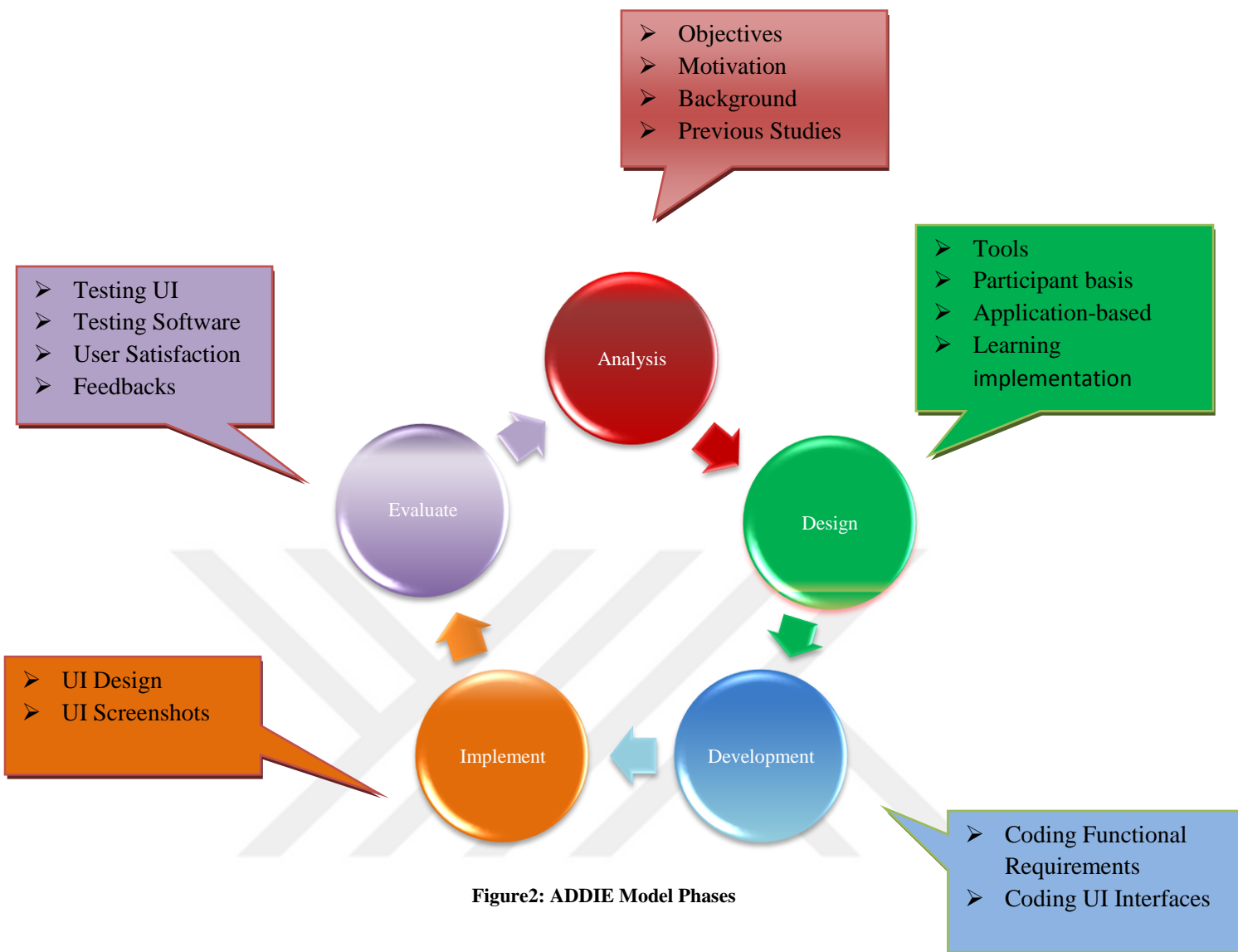


Figure2: ADDIE Model Phases

CHAPTER 4

M-Learning: Develop a Course Application

4.1. ANALYSIS

Before starting the development process, the desired application should enhance the process of learning. Up to today, there are lots of different examples for enhancing the learning with m-learning. There are uncountable applications that innumerable users are currently using through their lives. Pre-designing is the one of the most important phase among the other phases in ADDIE model. While applying this into our thesis, some questions should be answered as mentioned in (3.2.1. Analysis Phase). This application usage area is planned as Information System Engineering students in Universities. The students must self practice and self-educate themselves by using the developed application in order to achieve the enhancing learning progression for students. It will also used by non-IT students or other users however results will not be the same according to contents of the application.

Most of the users now learn new things by applications. For an example, there is an application which called “Dualingo” that teaches the person different languages in levels which are beginner to advanced. There are lots of applications which serves different purposes and our thesis had the idea from a game called “Trivia Crack”.

Expected objectives from this application usage is mainly enhancing the learning process and improve asynchronized e-learning. Details and further information will be explained later chapters.

4.2. DESIGN

In this part, firstly we introduce the application simply and explain why this application is chosen for educational system.

This chapter is talks about choosing the application genre. As we all know there are lots of type of application in means of genre which all of them provides different gaming experience. The genre for this application will be question and answer based application. The game includes questions in four different chapters. Each chapter has its own related questions.

Every player have to understand and fully recognize the contents of each chapter and answer the questions correctly. If they do wrong, it will starts all over again and this cycle repeats itself until player decided to exit application. There is a spin screen that decides the chapter. Then question is come in this section. Each question has one correct answer with other three answers. Following datas are includes Unity Versions and game resolutions for Android devices. This application is designed for only educational system and provides class-related information. By designing this application in android platform for education is simply trying to encourage students to enjoy their lessons or their projects or assignment and even also for rate of success in exams. The application content is created according to a course book and covers up all the sections in book. There are four main chapters and their subchapters. Moreover, the application is planned to adjustable for android smart phones. It can be also adjusted to Iphones. Teachers should plan the questions and how to use this application in to m-learning or even traditional learning.

4.3. DEVELOPMENT

4.3.1. System Development

General Structure of the System

Designed application system's running principle is shown in Figure 3. The user enters the start screen as the loaded immideatly. When the user clicks "*Play Howeverton*", they will redirected to spinning section where the user will drag and rotate the spin. After the spin completes, one catagory will be selected related with which section comes from Spin area. Lastly, user should select a question from the catagory its pre-defined by spinning. This is a user-demanded application that will redirected the screen to spinning screen when whole process is complete.

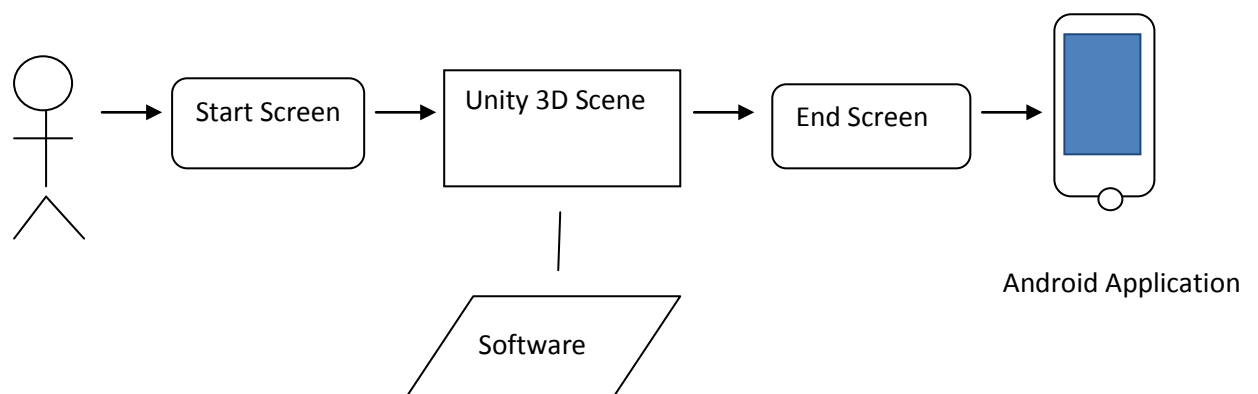


Figure3 : General Structure of the System

There are two main parts to be explained in this application, which are *Spinning Control* and *Profile Management*. They will be explained following sections in detail respectively.

Spin Control

Spinning control is the most one of the vital points in the application, where it decides the questions content. Spin Screen is the users where drag and rotate with one finger to be able to rotate the Spin. There are total four major category in the pre-defined course selected and each category is defined in each four parts of the spin circle. The overall Spinning process is shown in Figure 4.

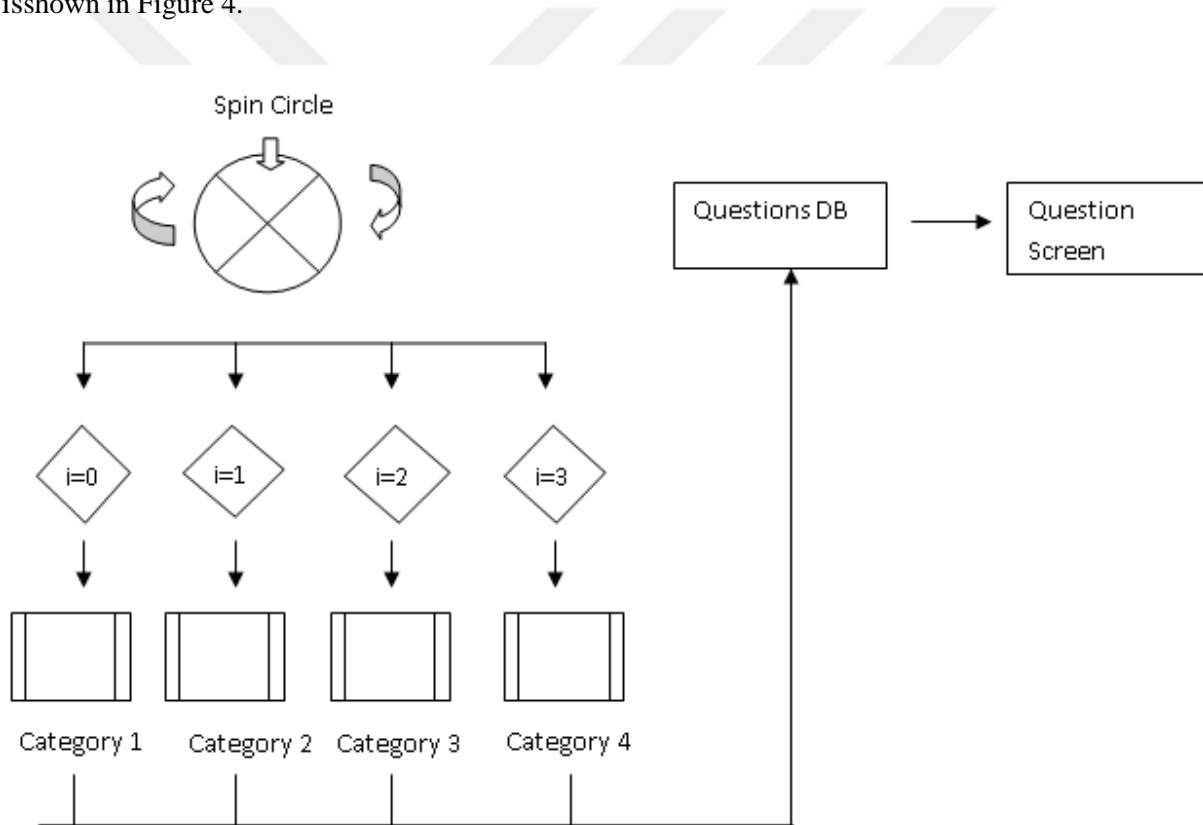


Figure4 : Spin Control Module

Spin Control Calculation

While designing the spinning we have to understand how we rotate the spin and how it will decide what is the result. It is decided by vektors and pressing and releasing. It is how we give an acceleration to a certain object. There is always one starting and one ending point and our constant will be a screen size.

Creating a Vektor from two points

This vektor is created to understand the exact position in the screen to determine the category selection in the end of the spinning process completes

F: First Press Position
R: Release Position
New Vector = $R.x - F.x, R.y - F.y$

Determine the Swiping

To be able to understand how user turns the screen, there should be an also an algorithm to determine the swiping. There should be at least four kinds of swiping in the screen can be done. These are: *Up*, *Down*, *Right* and *Left*. We created a new vector previously and we called it as “N”. User Touchs are also created a vector and we called this “T”. So the followings are the way of swiping calculations

Up Swipe

$N.y > 0$ and $N.x > -0.5$ and $N.x < 0.5$

Calc = $-1 * \text{calc}$ where calc is

If($T.x < \text{Screen Width}/2$)

Calc = 1

Else

Calc = -1

Down Swipe

$N.y < 0$ and $N.x > -0.5$ and $N.x < 0.5$

Calc = $-1 * \text{calc}$ where calc is

If($T.x < \text{Screen Width}/2$)

Calc = 1

Else

Calc = -1

Right Swipe

$N.x > 0$ and $N.y > -0.5$ and $N.y < 0.5$

Calc = $-1 * \text{calc}$ where calc is

If($T.x < \text{Screen Width}/2$)

Calc = 1

Else

Calc = -1

Left Swipe

$N.x < 0$ and $N.y > -0.5$ and $N.y < 0.5$

Calc = $-1 * \text{calc}$ where calc is

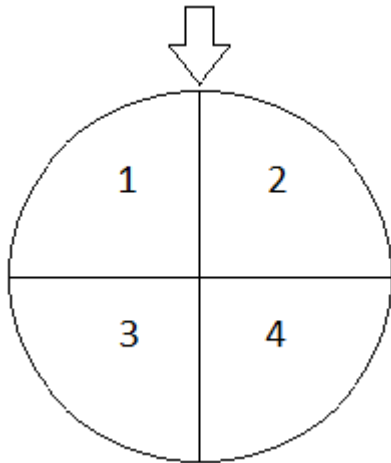
If($T.x < \text{Screen Width}/2$)

Calc = 1

Else

Calc = -1

In the above we explained how we calculated and locate the touch of the user and saved as a data. This section is all about using the collected datas and calculated the category selection when the spin is ended. This is a basic area selection where four categories are defined in each area of a circle. We divided the circle into four parts and each part represent a unique category. Lets called areas respectively: 1, 2, 3 and 4.



```
Variable : X % 360  
If (X<=90)  
Category = 2  
else if (X > 90 and X <=180)  
Category = 4  
else if (X > 180 and X <=270)  
Category = 3  
else if (X > 270 and X <=360)  
Category = 1
```

4.3.2. Profile Management

In this section is about the statistics that been hold and recorded both enter the application and exit the application of each individual user. Statistics are pretty important in games when users want to see their progress or their achievements through out game. It is a vital feedback from game to user which must be enabled and found in every game whatever the genre of the game is. When the user enters the game, the statistics of users games played increases. In profile management we have 3 answer options. User can answer the question either correct or wrong. Other and the last one is “Outof Time” where the user cant click the any answer during specified time interval. These 3 options are updated at the end of the quiz phase ended. The overall of the process is shown in Figure 5.

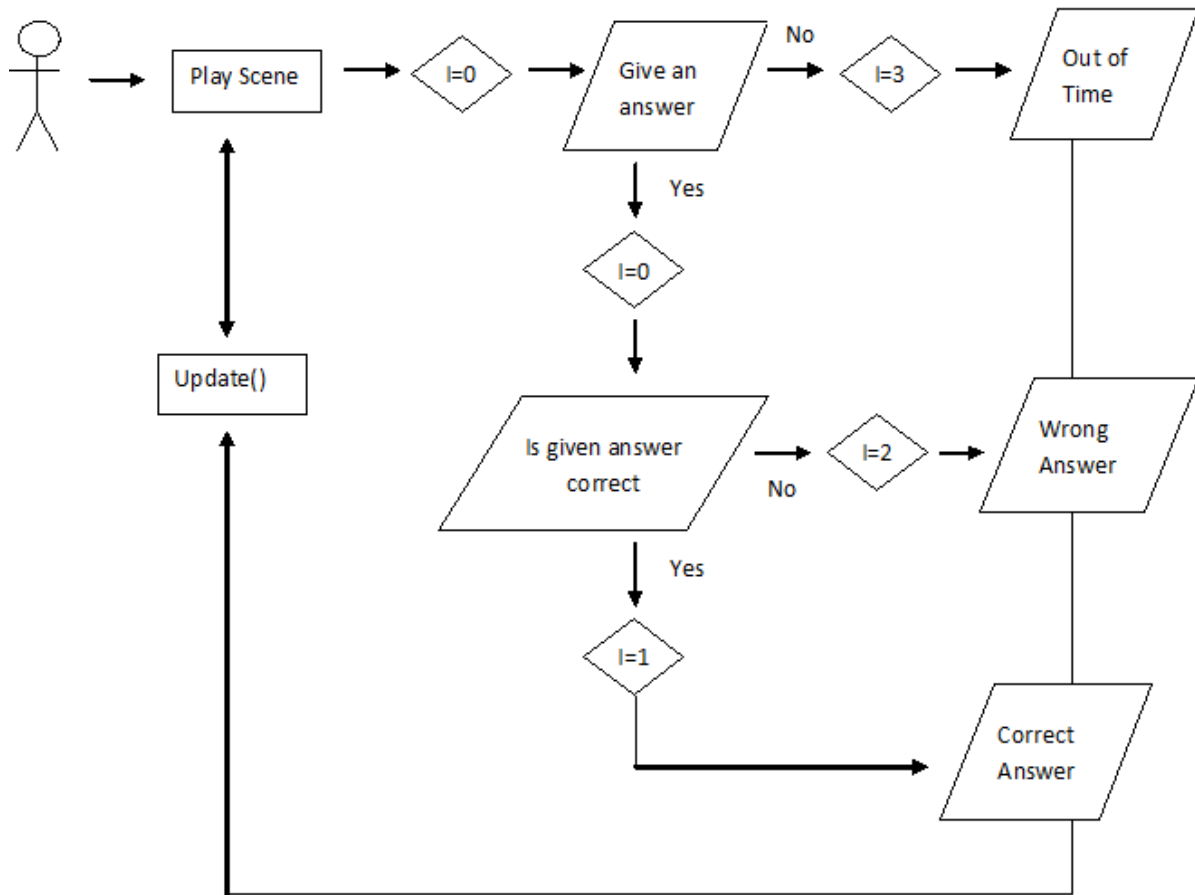


Figure5 : Profile Management Module

4.3.3. Data Design

4.3.3.1. Database

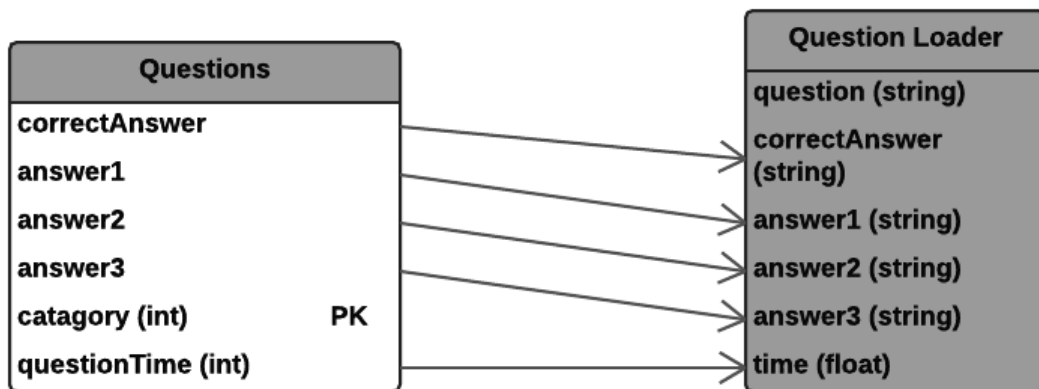


Figure6 : Questions Entities

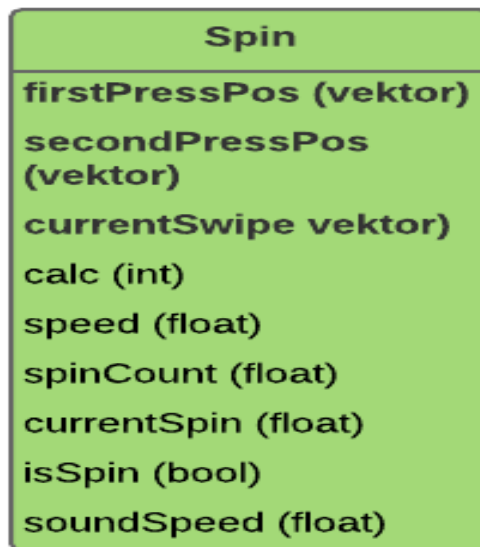


Figure7 : Spin Control Entity

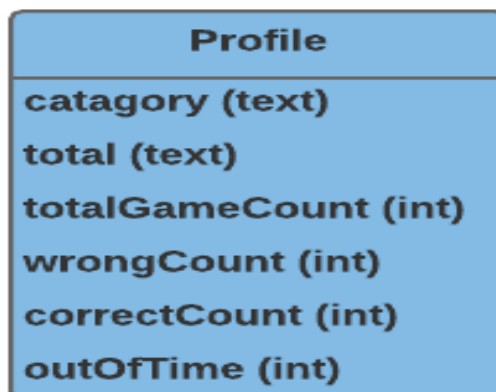


Figure8 : Profile Management Entity

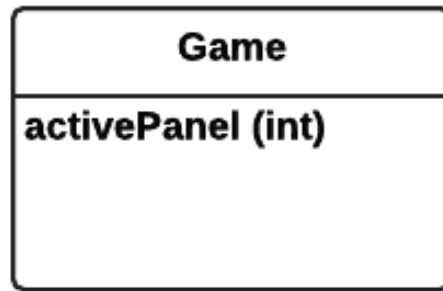


Figure9 : Game ER Diagram

4.4. IMPLEMENTATION

In the implementation, designed application may be used in ISE102 courses during a season and both lecturers and students may use this game to respectively for exams or study/practice. This application only built for ISE 102 lesson and expected more fun and joyful study without losing in books or notes which covers up all essential basic categories of the lesson.

4.4.1. Supported Screen Resolution

Game is meant to be played without any lags or delays. Also graphics are the another most important factor that game is satisfying enough. In Android devices the screen sizes are different. Applications that created for android mobile, it must have work under certain resolutions. Android screen configuration set to 480x320px resolution in olders android devices. Yet now, 75% of android devices have 800x480px screen and this application is designed for this mostly used resolution.

4.4.2. User Interface Design

This chapter is as important as other chapters. In this part we discussed the sections that application itself. That is why in here, we describe the parts of application user interfaces and it's details where user interacts through mobile smart-screen.

4.4.2.1. Home Screen

The application itself is simple enough to understand. It is a question and answer tool. Player will directed to homepage immediatly when they launched the application. Play

howeverton will be found in the middle of the screen. This screen is divided into two parts where bottom of the screen has three sub-howevertons which enable to swap between screens. These parts are: *Homescreen*, *Statistics* and *Credits*. These kind of applications are meant to be easy to understand and have to be user-friendly. All we have to do is put a single howeverton which directs us to game itself, nice background which also must suit for the game purpose and a nice background music.

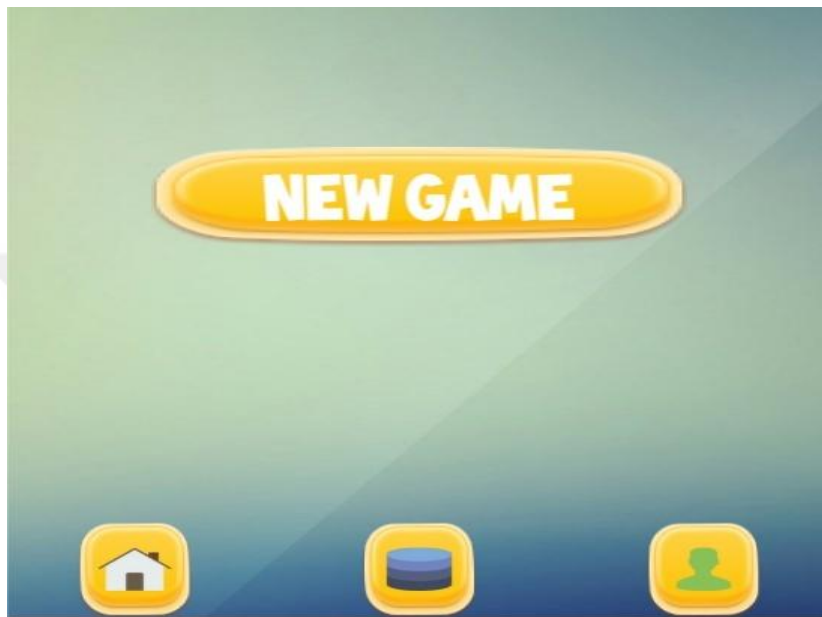


Figure10 : Homescreen

4.4.2.1.1. Statistics

While playing a game, there are always one main mission and an end. This is called a main scenario. Some games include side quests to enriched story line. Besides story line another important factor in games is player progression. Almost all games, we can see some achievements or reward systems or an statistical charts that shows how player progress through game and how good the player is. Even if this application is only meant for educational purpose, we could want to see how players perform in while answering the questions. Everyone wants to know when they make mistakes or when they make mistakes. So this part is holding information about each player wrong and correct answers both individually and category-based.

There is also a part that shows players unanswered questions because of out of time. For a student perspective, students know where they are the weakest and where they are the strongest while answering questions and can keep practicing and improving their weak parts.

For a lecturer perspective, they can examine and observe the students not only by exams however also their statistics in game, so they can help them giving better feedbacks.

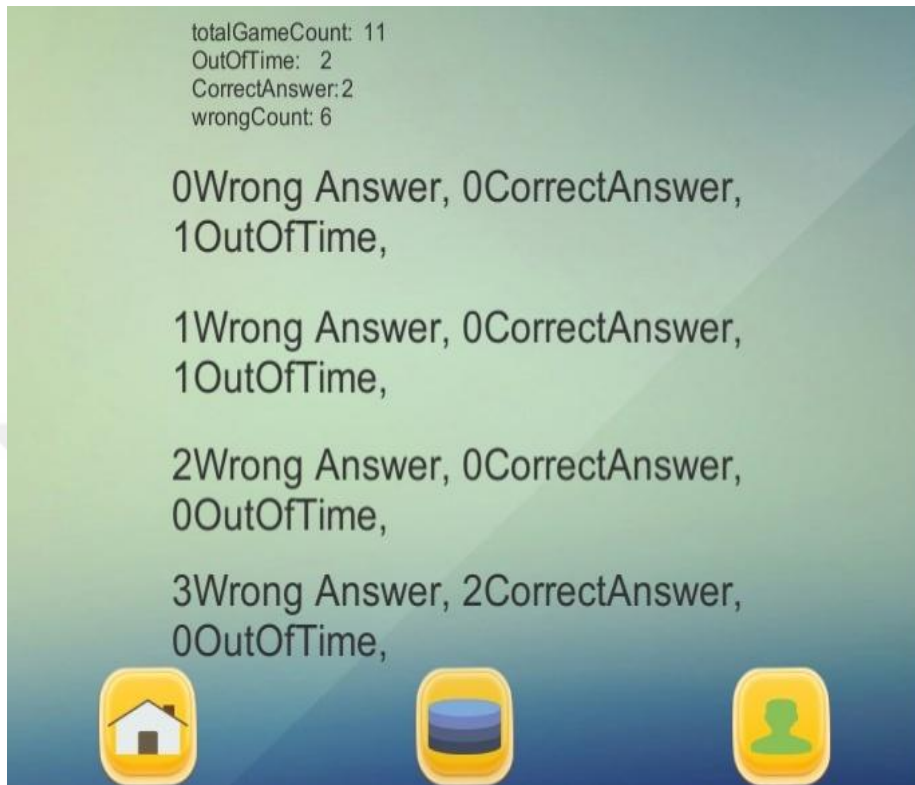


Figure11 : Statistics

4.4.2.2.Spin Screen

This screen is actually where the application is started. As we mentioned before, this application is designed for a specific University course which called ISE 102. We have a big spin circle which describes the categories (a.k.a: Chapters). Each chapter is separated with different colors. Category names are displayed top of the screen. User spins the circle by dragging their fingers. It can be rotated by both left and right directions. Category selection is defined by an arrow which is positioned very center-top of the circle. Spinning is a fixed function which can only be spun once per round. Once the spinning sequence begins, there will be no return back and the section from the end of spin is irreversible.



Figure12 : Spin Screen

4.4.2.3. Question Screen

Third and last part of the application is question and answer screen. The pre-defined questions are come to this screen in a result of which catagory was choosen. There is one text area that shows the question on top of the screen. When the screen loaded, the timer starts instantly. Four answers are stated below the question and game expects from user to choose correct answer to be move on. Players have three different choice in this section. One is giving the correct answer and continue through game. Second one is giving wrong answer will close that raund and return player to spinning screen again. Last choice is not giving an answer at all. This will also let you return to spinning screen. After each choice there is a text coming up middle of screen that states whether it is wrong or correct or out of time. Players can track the time by looking top of the screen where it stands above question.

The main reason of this application is: you should answer the questions only you know the answers. Trying to click random answers for questions will not improve yourself and also not help for your progression.

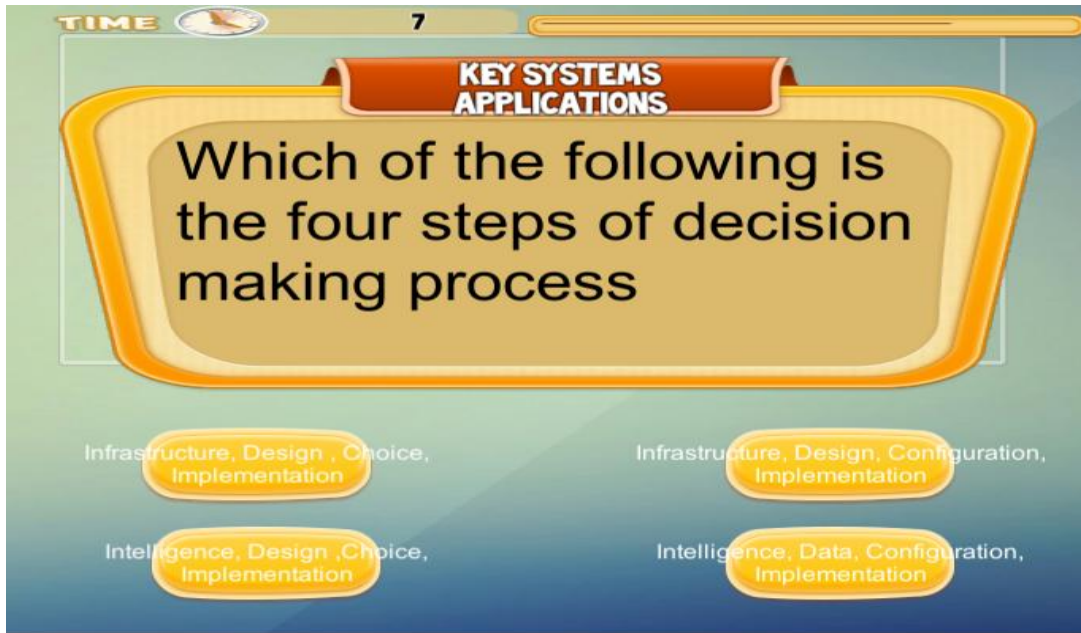


Figure13 : Question Screen



Figure14 : Wrong Answer

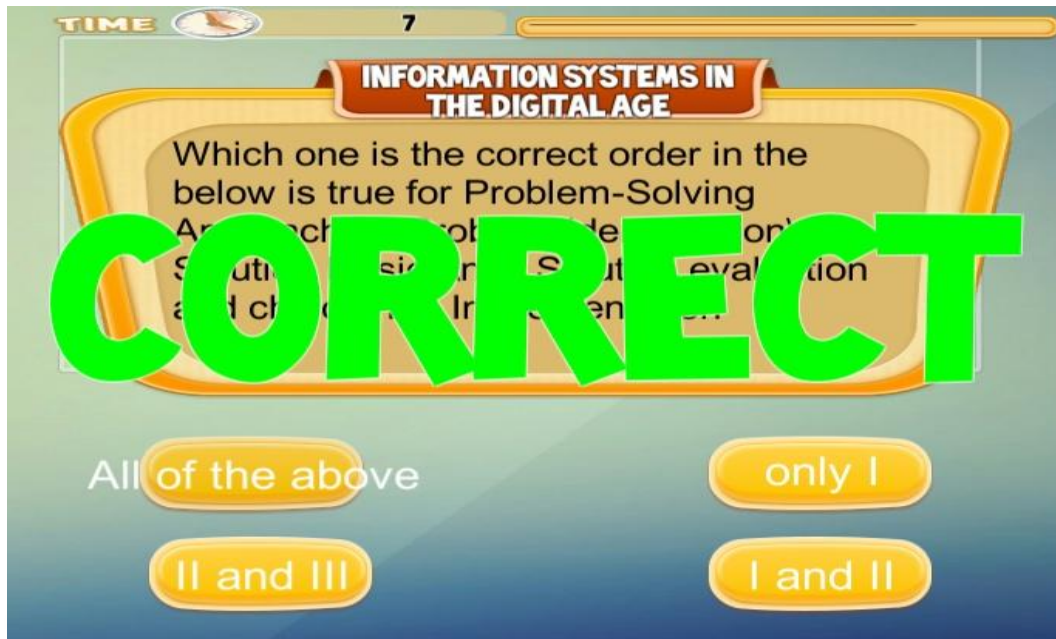


Figure15 : Correct Answer

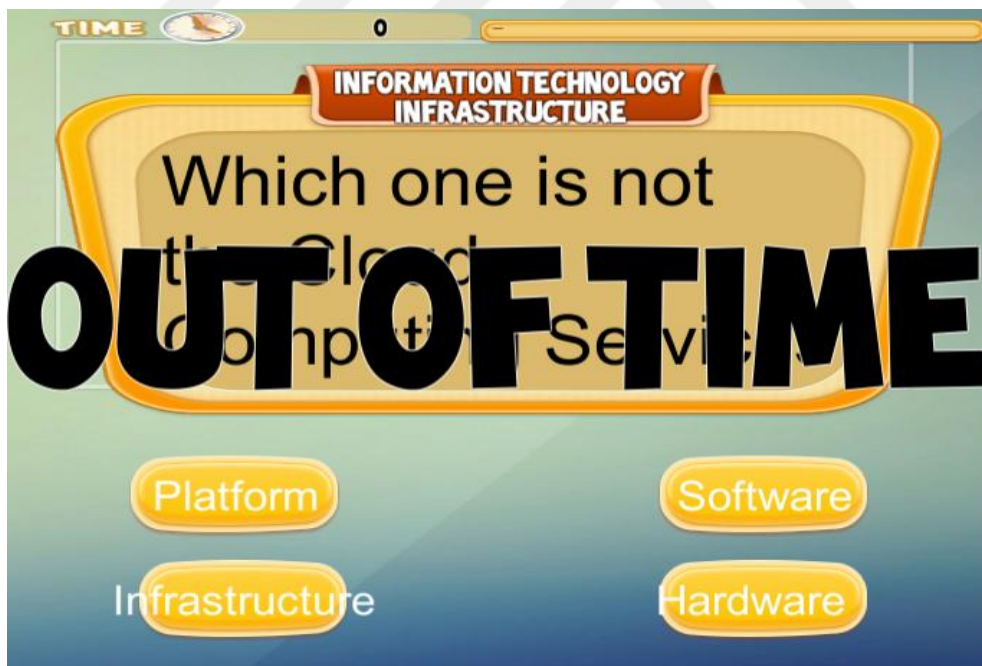


Figure16 : Out Of Time

4.5. EVALUATION

This part represents testing and evaluation part of the thesis and include four main parts. First section is about testing both functional and non-functional parts of the application. Second part is about evaluation of the application and third part is the application UI testing. Last part is the general summary of the testing results. The application is designed for the course ISE 102: Introduction to Management Information Systems in Atilim University. Question contents are hundred percent accurate and provided in the course book named: Essentials of Management Information System. It can cover up almost all sections in the book without causing any delays or peformance due to many questions. Game is compatible with any android devices with different screen resolutions however minimum required resolution is 686 x 503

Firstly a user evaluation testing is given to ten people who are gathered with convenience sampling and some others are volunteer participants. After they tried the application in android phone, complete user evaluation testing represented to be filled with their honest opinions. User evaluation testing can be found in (**APPENDIX D**). Participants have knowledge about information systems concepts at all and had studied before information system engineering. Overall studies and research shows that most of the users enjoyed the application and gave us positive feedback about performance quality and color, background selections. Sounds are failed, because in desktop sounds were clear enough to hear however in LG G3 smart phone, sounds were not coming quite well. In addition to this, questions and answers which are specially long ones, are hard to read in some resolutions. Besides, the time we put for answering questions were not enough so we changed the time value to ten to twenty due to some questions require more time to read it all. Application speed is running perfectly and clicks and other functions working without any delay or problem. There are some minor, fixable graphical user interfaces problem in question scene which can be improved in future versions.

This application isn't accessible through Google Play or any kind of stores. It is still an alpha version and there is still required some time to publish this version to the public. Yet, there are no bugs or errors occured or found during testing sessions. The application smoothly.

4.5.1. TESTING

4.5.1.1. Deployment to Android Devices

When unity project is build on android devices, Android SDK must be installed. Usually Google search can complete this task easily. Another way to download a SDK simply click in Unity Select >Edit > Preferences. In Prefences, click the tab “External tools” and download the SDK. Here you can see the section in red highlighted in Figure 17.

Next step is checking the latest drivers for targeting android devices. Some drivers may be out of dated so just download the lastest update from offical websites.

Last step before testing, you should enable your USB Debugging on your android devices. Tutorials for enabling can be found on internet.

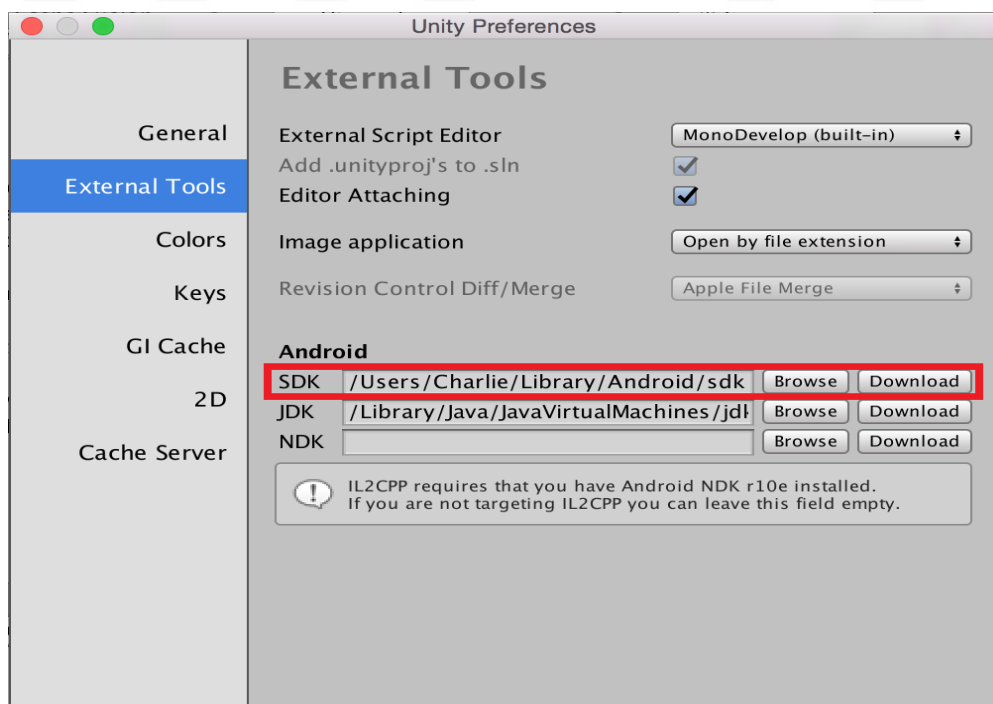


Figure 17: Unity Preferences

4.5.1.2. Deployment to Windows Devices

After all necessary steps completed, open your project on Unity and check build settings in File > Build Settings. Make sure that you choose Android tab and select “ Switch Platform “. To select a different platform simply highlight the desired platform and click “switch platform”.

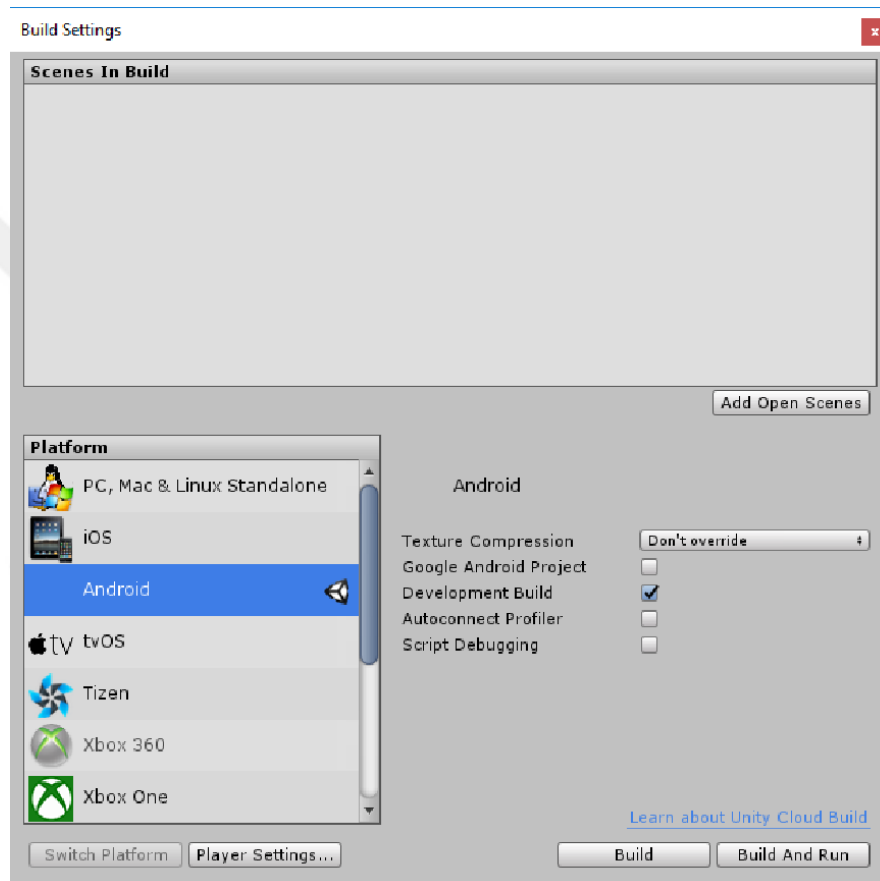


Figure18: Screen Shot of Build Settings in Unity 3D

To enable for testing last step is required to click Edit > Project Settings >Editor. In the editor screen, change devices option “none” to “Any android devices”. After doing that, plug your phone in your computer and open “Unity 5 Remote” application from your android device. Then, open your Unity 3D program and click “Play”. (Figure 18)



Figure19: Unity 5 Remote Application Screenshot

4.5.2. Functional Requirements

A functional requirement is, as the name implies, a functionality the system is required to have. In non-technical terms it is what the system is required to be able to do for it to work correctly.

ID	Name	Description
FR1	Start Game	User must be able to start a game
FR2	Spin	User must be able to turn the spin table
FR3	Select Answer	User must be able to click answer howevertorns

FR4	Timer	The application must let users know how much time left for end of the round.
FR5	Answer Notification	Application must show to the user a feedback according to their choices of answer wheter it is correct, wrong or outovertime.
FR6	Catagory Selection	Application should select the question from the right Catagory
FR7	Switching Panels	User must switch panels whenever they sees fit.
FR8	Statistics	Application must record the statistics each player correctly.

Table1 : Functional Requirements

Application has pre and post-tested to see wheter functions are working or not. Fortunetly we havent encountered any serious problems. Few modifications and changes can still be done due to needs. The application itself isn't ready for publishing and some cases couldnt be applied in game due to implementation and the building mechanism. Although there might some updates needed for improve the application, there are no such errors found during testing. Testing results can be found in (APPENDIX C).

4.5.3. Non Functional Requirements

In software system engineering, a software requirement that describes **not what** the software will do, however **how** the software will do it, for example, software performance requirements, software external interface requirements, design constraints, and software quality attrihowevers. Nonfunctional requirements are difficult to test; therefore, they are usually evaluated subjectively.”

ID	Name	Description
NFR1	understandability	Application must be easy to understand while playing
NFR2	operatability	Application should operate in without errors
NFR3	modifiability	Application must be able to be modified due to needs
NFR4	configurability	Application must be configured due to user needs
NFR5	simplicity	Application must be simple enough to being understand by users.
NFR6	User-friendliness	Application must be easy to use by users.
NFR7	Performance	Application must show high performance while running.
NFR8	Responsiveness	Application must repsonse the user in real time
NFR9	Security	Application must be secure enough to prevent any integrity breaches

Table2: Non-Functional Requirements

All testing results for both non functional and functional requirements can be found in **(APPENDIX C)**

4.5.4. Participant Results

ID	Factor	Importance
1	Graphics	Medium
2	Application Control	High
3	Application Speed	High

4	Application Content	High
5	Sound	High
6	Community	Medium-High

Table3: User Satisfaction Factors

User satisfaction is the vital concept for gaming industries. Every game genre has different approach and own satisfactory factors for users. They aim different objectives and different way of providing entertainment. For example, FPS games are prioritize the Graphics and Game Content with realistic physics. The more they build this theme on their games, more users will be satisfied during their gaming experience. When considering these effects, this application has been tested by ten participants whose have already completed Management of Information must course. Evaluation Test is created whose participants are gathered by convenience sampling. This program evaluation testing, there are some questions had been asked in order to measure user experience. The general responses from them indicates the user satisfaction that the application provides is shown in Table 3. They satisfied application speed however some android phones resolution is not expected to be optimized. Sounds also meant to be heard much more higher rather than testing on desktop. Application content is simple however required some knowledge to reflect the best performance. Application Control is easy to understand because dragging and clicking only functions, overall users satisfied with the control. Graphics is not meant to be higher due to educational approach yet every game or applications should have their unique background and must be compatible and serve the purpose of the application. There are no such complainings about graphics at all.

Test results are gathered by all and overall performance for application factors is shown in Table 4.

ID	Factor	Rate	Grade
1	Graphics	%100	PASS
2	Application Control	%100	PASS
3	Application Speed	%100	PASS
4	Application Content	%70	PASS
5	Sound	%40	FAILED
6	Enjoyment	%60	PASS

Table4: Testing Results for overall application

4.5.4.1. Mobile Usage

Assembling the data through evaluation testing, usage of digital devices is undoubtedly important. While the development of this application is delivered through mobile android devices, we wanted to examine the fact that in which areas participants use mobile phones. As a result of the evaluation testing, there are three major areas of mobile devices usage. Eight of ten people play application games through mobile devices. This is a positive feedback and answer that shows this kind of application is also viable through mobile devices that may be useful tool for both individual use and in a University environment. The common usage area for mobile devices were social medias such as; Facebook, Twitter, Instagram. Seven of the ten person indicates that, such websites as; Youtube, Dailymotion, Twitch.tv provides videos, audios, pictures and blog writings that entertain the user. Related graph of statistics can be seen in below. (Figure 20)

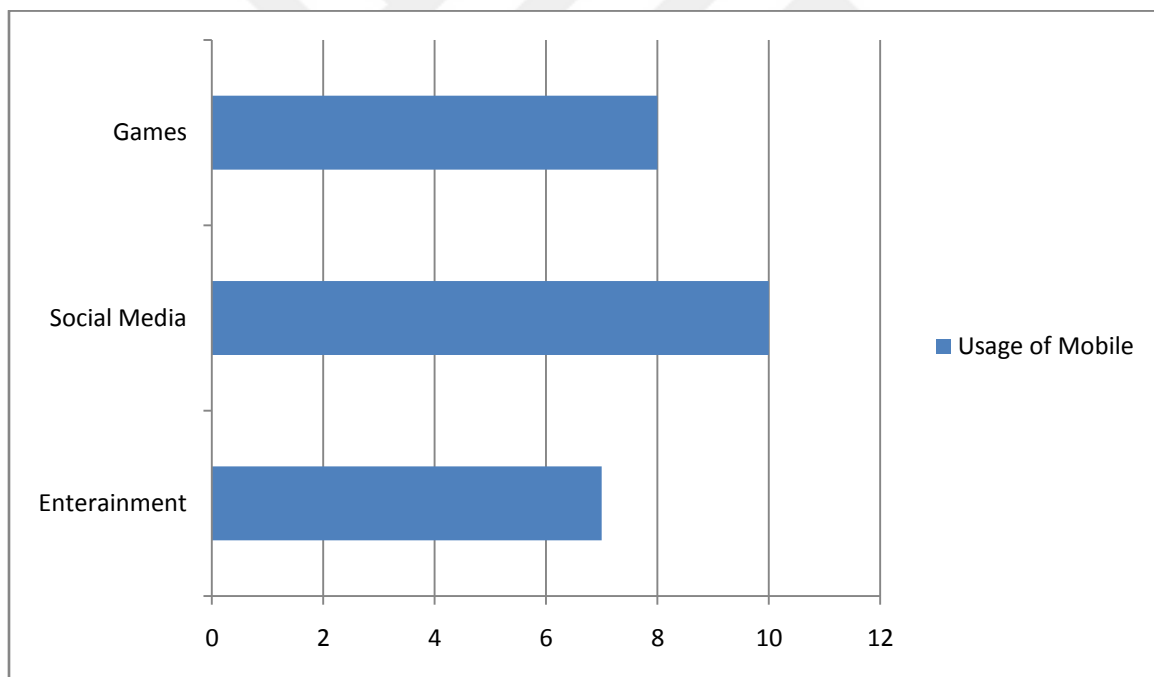


Figure 20: Mobile Usage

4.5.4.2. Desktop Usage

Before mobile devices become vital and important in user lives, desktops were the most used devices through users. After the increase usage of mobile devices, desktops are used for different reasons where also can accomplish any needs that any mobile devices can provide without portability and flexibility. As a critical factor where all participants had information technology background and they have a active on-going professional carrier, evaluation testing aims where the desktop usage is shifted according to participants. Four major area of usage for desktop gathered as a result from evaluation. First one is the highly used area of desktops in work. Based on professions, every user who has knowledge about information systems may also have knowledge about coding. These area it is called as developers. Developers are using desktops in order to achieve maximum performance and efficiency. To look up through a developer perspective, working environment is the most used area for desktops even for developing an android application. Second most used area for desktops are games. Today games are highly GPU(Graphical Processing Unit) dependent and most of the users whose are aimed in University students expected to have experience about gaming.

As a result, seven of then people were playing games through Desktops. Although mobile phones may be the best platform in order to surfing through social media, five of ten people still shows that desktop may be still used as social media sites. Also seven of ten people indicates entertainment sites can also viable for desktops. Related graph can be examined in below (Figure 21). To my perspective, Desktops are become a secondary tool where mobile phones cant do. Each devices has own specific good areas, for an example, desktops are the best platform in order to play a game to get an maximum enjoy and experience where mobile phones are best for gathering information, communication and surfing through websites whether is related with work or an entertainment.

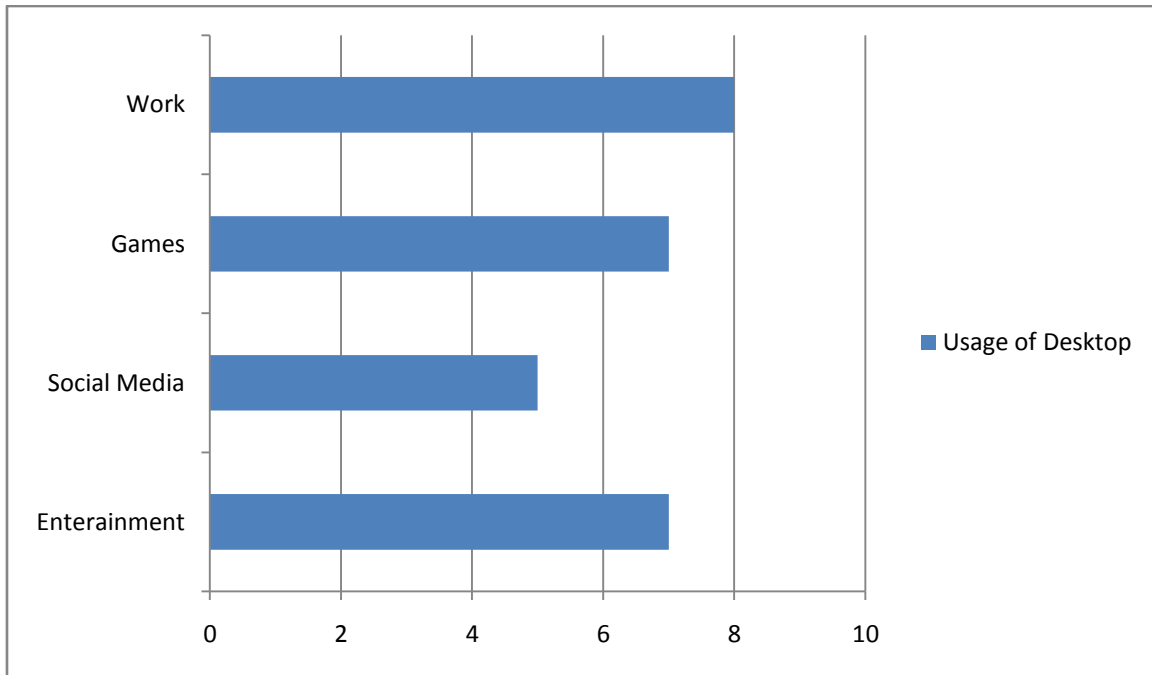


Figure 21: Desktop Usage

4.5.5. DISCUSSIONS

In this part, concluding remarks and their discussion with the prior studies are presented with parallel to the research questions. Following the discussions, overall significance of the study was summarized. Each research question was elaborated through participants statements without doing mobility testing and data collection. As an expert review the results are explained as follows

4.5.5.1. What may be the necessary non-functional requirements for mobile learning environment in a course given in University undergraduate program? (RQ1)

It is widely recognised that non functional requirements (NFRs) are crucial in software development and that different architectural choices can have different impact on the quality of the final system [74][75][76]. As mobile devices evolve and people discover new ways in which mobile devices functionalities can be applied to training, mobile e-Learning will likely become something increasingly different from conventional e-Learning. Mobile e-Learning will no longer be a miniaturised version of conventional e-Learning. Internet phones may be

applied to mentoring and they may be used to register students in courses and pay fees, as well as present training content through audio. Content development tools may appear that will provide the ability to publish content adaptively to a wide range of mobile devices. In addition, the student may well have control over reading or listening to the content using XML technologies.

Non-Functional Requirements(NFR) related to Mobile Learning Contents(MLC) can be “the MLC should fit the subject/topics and learning objectives of the course”.

The activity related to this statement is “Educational features” that verify that content and learning objectives are consistent with the national curricula requirements. Due to asynchronous way of learning the course materials must be selected and stored previously before the activity starts. When the course materials such as; books, pdf documents, .exe files must be installed and checked whether it is suitable with the content and curriculum of the course by instructors. There are also subclasses for the educational features which one of the features is “appropriateness of learning objectives”. Due to study is taking place in universities, there should not necessarily be a need to look up on to ages. These subparts are essential for utilizing the assets of learning by neglecting the early stages of development.

Another result of the study is to demonstrate innovative mobile contents for addressing training in IT and education sectors and to evaluate the requirements, especially non-functional requirements, of e-learning modules for mobile applications and services. [74]Using an application in e-learning environment might suit mobile delivery media and to methodologies for adapting Multimedia Educational Software to m-Learning environments. In addition to that there are other distinct properties for non-functional requirements such as; functionality, reliability, ease of use, economy, safety, flexibility, repairability, adaptability, understandability, documentation, enhanceability. These are also known as Quality Factors. These factors are based on external views or observations through methodologies by researching samples and data. Based on external views of an graduated IT engineer participants, using an application or any mobile approach for courses in universities to support m-learning environment, the results were positive and there are no boundaries or limitations in the perspective of users.

4.5.5.2. What may be the user evaluations that developed for mobile learning environment in a course given in University undergraduate program? (RQ2)

In order to measure mobile learning environment usability in universities for undergraduate program, student perspectives and their point of views and previous knowledges about game-like learning environment should be known or evaluated. In addition to that instructor behaviours and approaches to these environment also should be evaluated as same importance as students for future work.

Student Perspective

As a student perspective, technology and digital literacy is important. Most of students in universities using mobile devices or another digital devices for various of reasons. For educational purposes, students should be able to use these devices for education. Gender and age is irrelevant due to this evaluation taking place in university environment. Students should have enough knowledge to use mobile devices and applications effectively and should also have some fundamental knowledge about courses given on m-learning environment. In addition to that, student must familiar with different genre of games in order to ease acceptance for game-like learning environments. Satisfactory is another criteria for user evaluation. Each individual could have different expectations and purposes from applications. Due to gamer perspectives each application will be evaluated through certain aspects such as graphics, control, audio, physics and some non functional requirements. Each measurements might show different results according to students, so while evaluation testing is done, these parts might take into consideration while implementing these solutions into universities. matched and instructors should adjust or develop themselves in order to guide and implement these solutions into university undergraduate courses.

4.5.5.3. Can a mobile application be used for Universities undergraduate course content in the means of e-learning purposes? (RQ3)

Most of universities have e-learning and m-learning supporting platforms where being used since 1990. Even now, there is more powerful infrastructures and platforms exist. In order to use mobile applications for universities undergraduate programs, university should have necessary infrastructure to support these environment suchs as wireless connections, computer labs. In Higher Education, however in the field of civil engineering, Ebner and Holzinger (2006) evaluated a game for teaching theoretical concepts to Masters-level

students. This study uses a pre-test/post-test method to compare learning between a group of students who attended lectures and played the game voluntarily and those who just attended lectures. There was no significant difference in learning between the two groups. However, there are issues of bias with this methodology due to the voluntary nature of participation.

Computer game-based learning studies have also been undertaken in the area of adult and continuing education. Gander (2000) evaluated the use of a computer-based adventure training game for teaching information systems concepts to adult learners. Thirty students took part in the evaluation and were split into three groups, each playing for different lengths of time (30–90 minutes) and undertaking a pre- and post-test as a way of measuring learning. The results of the tests show that, learning was certainly happening in the groups that used the games for 60 minutes or more. Since the experiment did not use a control group, it is impossible to determine whether this would be the most effective way to teach this subject

According to these studies without discussing the effectiveness of the approach, it could be said that, mobile applications can be used for universities for undergraduate course contents. [79][80] To maximize efficiency according to Selwyn (2011) Stansbury (2013), teaching should be learner-centered instruction and members of instructors could be new. Better if new instructors have some experience in video games and interest areas about using video games for teaching. These applications can be applied in to small courses where syllabus is designed by instructors. Students should be undergraduate students without gender distribution. Application should be easy to use and include specific characteristics of the course. Preferred to be able to illustrate examples or experience something new.

4.5.6. Configuration

This application is designed for android devices and also can be played on any devices such as laptops, desktops, tablets with an free-scaled resolution. These are the following settings for an optimal performance:

Audio

- Level: -74.8 Db
- Clipping: 0.0%

- DSP load: 0.5%
- Stream Load: 0.5%

Graphics

- FPS: 1002,9 (0.6ms) in CPU
- CPU: main 0.9ms
- Render thread: 0.5ms
- Batches: 15
- Screen: 686 x 503 (minimum required) 3,9 MB

4.5.7. Determination of Faced Problems

There is not so much problems faced during designing phase of this Project however there is only one and only problem is security. This application is only designed for education and for an only one lesson for now and the security protocols didnt applied in the game. While designing this application there will be additional security options will be found in Atilim University website and the Game administration is belongs to teachers responsibility. Multiplayer options also can be challenging while creating such an application, because an external interface for serverintegration must be written and without proper time and technical requirements, this option couldnt be done.

4.5.8. Tools used in

- Unity 3D 5.4.2 (64 bit) : Greatly popular and mostly used game engine. Free Version used for students.
- Microsoft Visual Studio 2015: It is programming tool that is used to implement codes on the game.
- Adobe PhotoShop: Used for cut and re-design the shapes that is used in game.
- Android SDK: It is a must add-on for developing and testing an android game in Unity
- LG G3 D855 Smart Phone: Used for testing and debugging Unity 3D Android Game
- XML: A markup language that is used to hold all variables in database.

CHAPTER 5

CONCLUSION

E-learning keep spreading and become more used through in educational areas. With the growing technologies, mobile applications will be used everywhere for any purpose in near future. Combining with those two concepts might be the educational system can be replaced for current system. Course application that developed is holding all concepts and verbal information which belongs to defined course. The application can be used as a tool that help students prepare themselves to midterm exams or finals. Students can run this application in computer laboratories till it will be available in Google Play. It can also help anyone who wants to study the defined course. The best part of the system is can be adjusted to any course's verbal sections in university. This application can be updated and improved in order to provide more fun and different varies of concepts to improve educational studies in further time. When the application is asked whether if it becomes a replacement for courses, there is no certain or proved answer to be given. These approaches are designed and developed in order to help educational system and giving an opportunity to test their usefulness. According to research and previous examples, there are various type of applications and initiations in m-learning. As it seen before, both negative and positive effects can be given which is differ from student perspective and point of view. These kind of apporaches should be tested through universities in instructor's observation and keep recording results and should be analysed continuously to say these kind of applications are viable or not. Due to lack of mobility testing this course application only provide verbal contents and aims self improvement. Although there is still need to be done in order to conclude this approach as a success, the research and evaluation testing shows the facts where its is also compared with other similar research and studies, this kind of applications might help students in courses during their education in universities. It might be acceptable for e-learning purpose as long as students digital literacy and instructors experience is matched.

5.1. Originality

There are many educational games around the World however for a specific course content education throughout with a game is the first application designed for a Atilim

University. General population for education games are for kids. Only some simulation games are meant for higher purposes for real-life schemes. For an Atilim University this is the first game designed for ISE 102 course.

5.2. Impact

The developed application and testing shows us that, this application's inner structure can be also used for any kind of lessons which include verbal sections. It may be the easiest and fun way to learn a content just with click and dragging.

5.3. Applicability

This Project is designed for Atilim University IT students however can be applied any IT students in any University or any person who has some knowledge in Information Technology. Best area of applying this application is where that most students can play this application with the nowadays technology in home, outside or classroom.

5.4. Usefulness

When application examined through out user perspective, and according to user evaluation testing has been made the application might be considered as user friendly. Could be added some instructions if it needed however as we can see through testings and trials, game itself is easy to understand. Moreover, any people who wants to learn some IT knowledge even if they had no background before, can learn lots of essential concepts and information through playing this application.

5.5. Limitations of the Study

There are some boundaries and limitations for this study. Due to lack of time and no necessary conditions available, user evaluation testing could be more data structured. Questions are related with application itself however there should have been task based questions in the evaluation in order to keep record or collect data analysis for perspectives and point of views for students accurately. Besides, there were not enough opportunity and circumstances for testing this application to current students who are taking courses on universities. Testing with students in universities also could have enabled the fact that, the application and its usefulness could be also analyzed with learning outcomes. In addition to that, not only students however, instructors feedbacks could have been important to test the

application feasibility. Instructors feedbacks will be taken into consideration into future work for more accurate results and approaches.

5.6. In Future Use

In future use, this application can be played in mutliplayer and users test their knowledge against other people. There will be a different version of in options which users can play this application for fun in “Normal Mode” or a levelling system and more serious way of testing skills is “Competitive Mode”. There will be also an login screen which users can login via Facebook or Google accounts. Graphical User Interfaces will be fixed and adjusted.



6. REFERENCES

- [1]Bray, Mark (2011). The Challenge of Shadow Education: Private Tutoring and Its Implications for Policy Makers in European Union. NESSE and the European Commission. <<http://www.nesse.fr/nesse/activities/reports/activities/reports/the-challenge-of-shadow-education-1>>
- [2]Unity - Engine Features<<https://unity3d.com/unity/engine-features>>
- [3]How Unity3D Became a Game-Development Beast
<http://insights.dice.com/2013/06/03/how-unity3d-become-a-game-development-beast/>
- [4] Ed Fear, 2009. <<http://www.develop-online.net/analysis/united-they-stand/0116643>>
- [5] Unite 2007 Developer Conference “Unite 2007 -Keynote”Event. San Francisco Film Centre, San Francisco, CA. October 10th, 2007. Keynote Presentation.
<<https://unity3d.com/unite/archive/2007>>
- [6]Unity Technologies. "Fast Facts." Unity -Fast Facts. N.p., n.d. Web. 21 Dec. 2013.
<<http://unity3d.com/company/public-relations>>
- [7] Joachim Ante, 2006. <http://forum.unity3d.com/threads/2864-Unity-1-5-1-unleashed>
- [8]“Shea, T. (2014). Gamification: using gaming technology for achieving goals. New York: Rosen Pub.
- [9]“Gamification is Everywhere — However What Is It?”, [online], Consulted 08.02.2013, <http://tomhumbarger.wordpress.com/2011/10/18/gamification-is-everywhere-however-what-is-it/>
- [10] Adams, E. 2010. Fundamentals of Game Design, Second edition, p. 32-33, New Riders
- [11] Dansie, J. (n.d.). Game Development in Unity [Scholarly project]. Retrieved July & aug., 2016, from <https://theses.fi/bitstream/handle/10024/68068/Dansie_Jason.pdf?sequence=1>
- [12] Tatu, L. (2013). EDUCATIONAL MOBILE GAME, TURKU UNIVERSITY OF APPLIED SCIENCES, from<http://theses32-kk.lib.helsinki.fi/bitstream/handle/10024/55158/Laine_Tatu.pdf?sequence=1>
- [13] Busch, C., Claßnitz, S., Selmanagić, A., & Steinicke, M. (n.d.). Developing and Testing a Mobile Learning Games Framework [Digital image]. Retrieved September 21, 2016, from <www.ejel.org/issue/download.html?idArticle=414>

- [14]Nielsen, J. M.,& Olseng, J. (n.d.). *[Game-based Learning] The Knowledge Challenge Game* [Scholarly project]. Retrieved July 11, 2016, from <<https://daim.idi.ntnu.no/masteroppgaver/013/13236/masteroppgave.pdf>>
- [15] Chung, L. (n.d.). Non-Functional Requirements [PPT]. Texas.
- [16] A. B. Cremers, Sascha Alda, Non-functional Requirements [Online]. Available: http://www.iai.uni-bonn.de/slides/10_Interactive%20Systems.pdf
- [17] Exploring the SDK. (2013). [Online]. Available: <<http://developer.android.com/sdk/exploring.html>>
- [18]Unity Technologies. "Press Releases." Unity - Press Releases. N.p., n.d. Web. 18 Jan. 2014. <<http://unity3d.com/company/public-relations/press-releases>>
- [19] Jon Brodtkin, . N.p. Web. 4 Dec 2014. <<http://slashdot.org/topic/cloud/how-unity3d-become-a-game-development-beast/>>
- [20]Unity Technologies. "Unity Technologies Begins Unity 3.5 Open Beta With Flash Player Deployment." Marketwire.Web. 29 Dec. 2013. <<http://www.marketwired.com/press-release/unity-technologies-begins-unity-35-open-beta-with-flash-player-deployment-1601525.htm>>
- [21] Unity Technologies. "Releasing Unity 4.3." Unity Technologies Blog. N.p., n.d. Web. 18 Feb. 2014. <<http://blogs.unity3d.com/2013/11/12/releasing-unity-4-3/>>
- [22]Unity Technologies. "The Next Generation of the Unity Game Engine Unveiled." Marketwire. N.p., n.d. Web. 10 Feb. 2014.<<http://www.marketwired.com/press-release/the-next-generation-of-the-unity-game-engine-unveiled-1670512.htm>>
- [23] Android SDK. (2013). [Online]. Available: <http://developer.android.com/sdk/index.html>
- [24] Android SDK Manager. (2013). [Online]. Available: <<http://developer.android.com/tools/help/sdk-manager.html>>
- [25] Paschali, M. E., Ampatzoglou, A., Chatzigeorgiou3, A., & Stamelos, I. Non-functional requirements that influence gaming experience: A user evaluation testing on gamers satisfaction factors [Scholarly project]. Retrieved Dec. & jan., 2016, from <<http://users.uom.gr/~achat/papers/mindtrek14.pdf>>
- [26] H. Desurvire, M. Caplan and J.A. Toth, "Using Heuristics to Evaluate the Playability of Games", Special Interest Group on Human Factors in Computing Systems, ACM, Austria , pp. 1509 – 1512, 2004.

- [27] H. Ham and Y. Lee, "An Empirical Study for Quantitative Evaluation of Game Satisfaction", 2006 International Conference on Hybrid Information Technology, ACM, pp. 724-729, November 2006.
- [28] Eberly, D. H. (2007). 3D game engine design: a practical approach to real-time computer graphics. Boca Raton, FL: CRC Press.
- [29] Harrison, Lynn T. Introduction to 3D Game Engine Design Using DirectX 9 and C#. Berkeley, CA: Apress, 2003. Web.
- [30] Magnusson, Lars V. Game Mechanics Engine. Thesis. Østfold University College, January 3, 2011. Print
- [31] "Clark, R. C., & Mayer, R. E. (2003). E-Learning and the science of instruction: proven guidelines for consumers and designers of multimedia learning.
- [32] "Mayer, R. E. (2014). The Cambridge handbook of multimedia learning. Cambridge: Cambridge Univ. Press.
- [33] "Januszewski, A., & Molenda, M. (2008). Educational technology: a definition with commentary. New York, NY: Lawrence Erlbaum Associates.>
- [34] Illich, Ivan. Deschooling Society. New York: Harper & Row, 1971. Print, from <http://thenewobserver.co.uk/wp-content/uploads/2012/06/deschooling_society.pdf>
- [35] Javier Torrente et al.. "Integration and Deployment of Educational Games in E-learning Environments: The Learning Object Model Meets Educational Gaming". Journal of Educational Technology & Society 12.4 (2009): 359–371. Web...
- [36] Stephanidis, Constantine. Universal Access in Human-computer Interaction: 6th International Conference, UAHCI 2011, Held as Part of HCI International 2011, Orlando, FL, USA, July 9-14, 2011, Proceedings. Berlin: Springer, 2011. BookMetrix. Web. 19 Apr. 2016.
- [37] Squire, Kurt D. "Game Based Learning." Rice University. E-Learning Consortium, Feb. 2005. Web. 5 Apr. 2006. <http://cohesion.rice.edu/Conferences/Hewlett/emplibrary/Game-Based_Learning.pdf>.
- [38] Lam, J., Yau, J., Cheung, S.K.S.: A review of mobile learning in the mobile age. In: Tsang, P., Cheung, S.K.S., Lee, V.S.K., Huang, R. (eds.) ICHL 2010. LNCS, vol. 6248, pp. 306–315. Springer, Heidelberg (2010).

- [39] Dahlstrom and Bichsel, ECAR Study of Undergraduate Students, 2014, 17; and Dahlstrom, Walker, and Dziuban, ECAR Study of Undergraduate Students, 2013, 22.
- [40] Trinder, J. (2005). Mobile Technologies and Systems. In A. & Kuklska-Hulme (Ed.), Mobile learning: A handbook for educators and trainers, USA: Taylor & Francis.
- [41] Ting, Y. R. (2005). Mobile Learning: Current Trend and future Challenges. Proceedings of the Fifth International Conference on Advanced Learning Technologies, Los Alamitos, CA: IEEE Computer Society Press.
- [42] Guralnich, D. (2008). The Importance of the Learner's Enviromental Context in the Design of M-Learning Product. International Journal of Interactive Mobile Technologies, 2 (1), 36-39.
- [43] Uden, L. (2007). Activity Theory for Designing Mobile Learning. Journal of Mobile Learning and Organisation, 1 (1), 81-102.
- [44] Walker, K. (2007). Introduction: Mapping the Landscape of Mobile Learning. In M. Sharples (Ed.), Big Issue in Mobile Learning: a Report of a New Workshop by the Kaleidoscope Network of Excellence Mobile Learning Initiative (pp. 5-6), UK: Learning Science and Research Institution: University of Nottingham.
- [45] Android WorkFlow Testing. (2013). [Online]. Available: <<http://developer.android.com/tools/testing/index.html>>
- [46] Android UI Testing. (2013). [Online]. Available: <http://developer.android.com/tools/testing/testing_ui.html>
- [47] L. S. Wang, T. J. Li, T. Sun, Z. Y. Liu, X. D. Sun, "The Database Design Based on Native XML Database Technology", Applied Mechanics and Materials, Vols. 241-244, pp. 2561-2564, 2013
- [48] Laudon, K. C.,& Laudon, J. P. (2007). Essentials of business information systems(9th ed.). Upper Saddle River, NJ: Pearson/Prentice Hall.
- [49] Dahlstrom, E. (2015). ECAR national study of undergraduate students and information technology, 2011. Boulder, CO: EDUCAUSE Center for Applied Research.
- [50] Seilhamer, R.,& Bauer, S. (2015, June 22). Students' Mobile Learning Practices in Higher Education: A Multi-Year Study. Retrieved from

<http://er.educause.edu/articles/2015/6/students-mobile-learning-practices-in-higher-education-a-multiyear-study>

[51] Attewell, J. (2005). Mobile technologies and learning: a technology update and m-learning project summary. London: Learning and Skills Development Agency.

[52] Home | 4A Games. Retrieved January 25, 2017, from <http://www.4a-games.com/index.html><http://www.moddb.com/engines/alamo>

[53] Build engine. (1969, December 01). Retrieved January 25, 2017, from <http://www.moddb.com/engines/build><http://www.c4engine.com/>

[54]Bethsheda. Retrieved from <https://bethesda.net/en/news><https://www.cryengine.com/>

[55] Essence Engine. (1966, January 01). Retrieved from <http://www.moddb.com/engines/essence-engine>

[56] ForgeLight™ engine. Retrieved from <https://www.cryengine.com/community/viewtopic.php?f=126&t=106982>

[57] Fox Engine. Retrieved January 25, 2017, from http://metalgear.wikia.com/wiki/Fox_Engine

[57] Goldsource. Retrieved January 25, 2017, from <https://developer.valvesoftware.com/wiki/Goldsource>

[58] HeroEngine. (n.d.). Retrieved January 25, 2017, from <http://www.heroengine.com/heroengine>

[59] Quake Engine. (1969, August 01). Retrieved January 25, 2017, from <http://www.moddb.com/engines/quake-engine>

[60] Karin, Lead Editor (Photo: Kevin Loh). (n.d.). "Every day, I am humbled to be part of this amazing team of creative, passionate, hilarious, respectful, supportive, inspiring people." Retrieved January 25, 2017, from <http://www.bioware.com/en/about/>

[61] Studio. Retrieved January 25, 2017, from <http://www.infinityward.com/studio>

[62] Game Engine: JADE. Retrieved January 25, 2017, from <http://www.mobygames.com/game-group/game-engine-jade>

[63] All Games. Retrieved January 25, 2017, from <http://na.square-enix.com/us/games>

[64] Real Virtuality. Retrieved January 25, 2017, from <http://artaniminteractive.com/real-virtuality/>

[65] Rockstar Games. Retrieved January 25, 2017, from <https://www.rockstargames.com/>

[66] Main Page. Retrieved January 25, 2017, from https://developer.valvesoftware.com/wiki/Main_Page

- [67] If you love something, Retrieved January 25, 2017, from <https://www.unrealengine.com/what-is-unreal-engine-4>
- [68] Havok. Retrieved January 25, 2017, from <https://www.havok.com/>
- [69] K12. Retrieved January 26, 2017, from <<http://www.k12net.com/k12net/>>
- [70] Nielsen, J. (1993). Usability engineering. Boston: AP Professional.
- [71] Nielsen, J. (2000, March). Why you only need to test with 5 users: Alertbox. Retrieved April 15, 2003 from <http://www.useit.com/alertbox/20000319.html>.
- [72] Tullis, T., & Albert, B. (2008). Measuring the user experience: collecting, analyzing, and presenting usability metrics. Amsterdam: Elsevier/Morgan Kaufmann.
- [73] Nielsen, J. (1994). Estimating the Number of Subjects Needed for a Thinking Aloud Test. *International Journal of Human-Computer Studies*, 41(3), 385-397.
- [74] Devanbu, P., Brachman, R., Selfridge, P. & Ballard, B. (1991). LaSSIE: A KnowledgeBased Software Information System, *Communications of the ACM*, 34 (5), 34-49.
- [75] Arango, G. & Prieto-Diaz, R. (1991). *Domain Analysis and Software System Modelling*, California: IEEE CS Press.
- [76] Avellis, G. (2000). *Annotating Multimedia Educational Software with Non Functional Requirements – An Approach to Evaluate Educational Multimedia*, UCL Internal Report.
- [77] Sommerville, I. (2006). *Software Engineering*, 8th Edition. International Computer Science.
- [78] Handal, B, Ritter, R and Marcovitz, (2014). *Implementing Large Scale Mobile Learning School Programs*
- [79] Stansbury, J. A., & Munro, G. D. (2013). *Gaming in the Classroom An Innovative Way to Teach Factorial Designs*. *Teaching of Psychology*
- [80] Selwyn, N. (2011). Editorial: In praise of pessimism—the need for negativity in educational technology. *British Journal of Educational Technology*, 42(5), 713- 718.

7. APPENDIX A

7.1. Type of Game Engines

Name	Cross - platform	Target Platform	Notable Games
4A Engine	Yes	Microsoft Windows, OS X, GNU/Linux, PlayStation 3, PlayStation 4, Xbox 360, Xbox One	Metro 2033 Metro Last Night,
Alamo	Yes	Windows, OS X, Xbox 360	Star Wars: Empire at War Star Wars: Empire at War: Forces of Corruption Universe at War: Earth Assault
Build engine	Yes	Windows, Linux, OS X, DOS	Duke Nukem 3D Shadow Warrior Blood Redneck Rampage
C4 Engine	Yes	PlayStation 4, PlayStation 3, Microsoft Windows, Mac OS X, Linux, iOS	World of Subways City Bus Simulator 2010 Quest of Persia: Lotfali Wingball Bounce The Visible Dark World Hunter Project Reality 2
Creation Engine	Yes	Windows, PlayStation 3, Xbox 360, Xbox One, PlayStation 4	The Elder Scrolls V: Skyrim Fallout 4
CryEngine	Yes	Microsoft Windows, OS	Farcry Series

Series		X, Linux, PlayStation 3, PlayStation 4, Wii U, Xbox 360, Xbox One, iOS, Android	Crisis Series Lichdom: Battlemage Sniper: Ghost Warrior 2 Homefront: The Revolution Ryse: Son of Rome, Sniper: Ghost Warrior 3
Essence Engine	No	Windows	Company of Heroes Company of Heroes: Opposing Fronts Company of Heroes: Tales of Valor Company of Heroes Online Warhammer 40,000 Dawn of War II, Warhammer 40,000: Dawn of War II – Chaos Rising Warhammer 40,000: Dawn of War II – Retribution Company of Heroes 2
Forgelight Engine	No	Windows	Free Realms PlanetSide 2 Landmark, EverQuest Next H1Z1: Just Survive H1Z1: King of the Kill
Fox Engine	Yes	Microsoft Windows, PlayStation 3, PlayStation 4, Xbox 360, Xbox One	Pro Evolution Soccer 2014 Metal Gear Solid V: Ground Zeroes Silent Hills P.T. Pro Evolution Soccer 2015 Metal Gear Solid V: The Phantom Pain Pro Evolution Soccer 2016

GoldSrc	Yes	Windows, OS X, Linux, PlayStation 2, Xbox, Dreamcast	Half-Life Team Fortress Classic Half-Life: Opposing Force CounterStrike Ricochet Deathmatch Classic Half-Life: Blue Shift Half-Life: Decay Day of Defeat Counter-Strike: ConditionZero Counter-Strike Neo Counter-Strike Online
HeroEngine	No	Windows	Star Wars: The Old Republic
Quake Engine Series	Yes	Windows, Linux, OS X	Quake Quake II Quake III Arena Doom 3 Doom 3: BFG Edition Quake 4 Rage Wolfenstein: The New Order Wolfenstein: The Old Blood The Evil Within
Infinity Engine	Yes	Microsoft Windows, Mac OS, Mac OS X, AmigaOS 4	Baldur's Gate Planescape: Torment Icewind Dale Baldur's Gate II: Shadows of Amn Icewind Dale II
IW engine	Yes	Microsoft Windows, OS X, PlayStation 4, PlayStation 3, Xbox One, Xbox 360, Wii	Call of Duty Series

		U, Wii	
Jade	Yes	Cross-platform	Beyond Good & Evil Prince of Persia: The Sands of Time Prince of Persia: Warrior Within Prince of Persia: The Two Thrones Peter Jackson's King Kong: The Official Game of the Movie Rayman Raving Rabbids TMNT Rayman Raving Rabbids 2 Naruto: Rise of a Ninja Naruto: The Broken Bond James Cameron's Avatar: The Game Prince of Persia: The Forgotten Sands (Wii)
Luminous Studio	Yes	PlayStation 4, Xbox One, Microsoft Windows	Final Fantasy XV
Odyssey Engine	Yes	Windows, OS X	Star Wars: Knights of the Old Republic Star Wars: Knights of the Old Republic II: The Sith Lords

OGRE	Yes	Linux, Windows (all major versions), OS X, NaCl, WinRT, Windows Phone 8, iOS and Android	Torchlight
Real Virtuality	Yes	Microsoft Windows, Xbox	ARMA 2 ARMA 3 DayZ

REDengine	Yes	Microsoft Windows, OS X, Linux, Xbox 360, Xbox One, PlayStation 4	The Witcher 2: Assassins of Kings The Witcher 3: Wild Hunt
Riot Engine	Yes	Windows, PlayStation 2	Drakan: Order of the Flame Drakan: The Ancients Gates The Lord of the Rings: The Fellowship of the Ring The Suffering The Suffering: Ties That Bind
Rockstar Advanced Game Engine (RAGE)	Yes	Microsoft Windows, PlayStation 3, PlayStation 4, Wii, Xbox 360, Xbox One	Tennis Grand Theft Auto IV Grand Theft Auto: Episodes from Liberty City (The Lost and Damned, The Ballad of Gay Tony) Max Payne 3 Grand Theft Auto V
Source	Yes	Windows, OS X, Linux, PlayStation 3, Xbox, Xbox 360, Android	Half-Life 2 Counter-Strike: Source Left 4 Dead Counter-Strike: Global Offensive

			Vampire: The Masquerade – Bloodlines
Source 2	Yes	Windows, OS X, Linux	Dota 2
Unity	Yes	Windows, OS X, Xbox 360, Xbox One, Wii U, New 3DS, PlayStation 3, PlayStation 4, PlayStation Vita, Windows Phone, iOS, Android, BlackBerry 10, Tizen, Unity Web Player, Windows Store, WebGL, Oculus Rift, Gear VR, Android TV, Samsung Smart TV	GooBall Dead Frontier Battlestar Galactica Online Temple Run 7 Days to Die Deus Ex: The Fall Unturned

Unreal Engine	Yes	Cross-platform	Deus Ex Deus Ex: The Conspiracy Tactical Ops: Assault on Terror
Vengeance Engine	No	Windows	Tribes: Vengeance SWAT 4
Vision	Yes	Microsoft Windows, Xbox 360, PlayStation 3, Wii, Wii U, iOS, Android, PlayStation Vita, IE6 and up, Firefox 2.0 and up, Google Chrome, Opera 9	Arcania: Gothic 4 Stronghold 3 Orcs Must Die! Bus Simulator 2012 Orcs Must Die! 2 Stronghold Crusader 2
X-Ray Engine	No	Windows	S.T.A.L.K.E.R.: Shadow of Chernobyl S.T.A.L.K.E.R.: Clear Sky S.T.A.L.K.E.R.: Call of Pripjat

APPENDIX B

Question.css

```
publicclassQuestion{  
    [XmlElement( "Question" )]  
    publicstring question;  
}
```

QuestionContainer.css

```
.  
. .  
.  
[XmlRoot( "QuestionCollection" )]  
publicclassQuestionContainer{  
    [XmlArray( "Questions" )]  
    [XmlElement("Question")]  
    publicList<Question> questions=newList<Question>();  
.  
. .  
.
```

QuestionLoader.css

```
using UnityEngine;  
usingSystem.Collections;  
usingSystem.Collections.Generic;  
usingUnityEngine.UI;  
  
publicclassQuestionLoader : MonoBehaviour  
{  
    [System.Serializable]  
    publicclassQuestionAttb  
    {  
        publicstring question;  
        publicstring correctAnswer;  
        publicstring answer1,answer2,answer3;  
        publicfloat time;  
    }  
}
```

```
.  
.
```

GameScript.css

```
.
```

```
.
```

```
public int activePanel;
```

```
    private static GameScript instance;
```

```
public static GameScript Instance
```

```
{
```

```
get
```

```
{
```

```
if( instance != null )
```

```
{
```

```
return instance;
```

```
}
```

```
else
```

```
{
```

```
    instance = GameObject.FindObjectOfType<GameScript>();
```

```
return instance;
```

```
}
```

```
}
```

```
}
```

```
// Use this for initialization
```

```
void Start()
```

```
.
```

```
.
```

```
.
```

ProfileManager.css

```
.
```

```
.
```

```
.
```

```
public void populateProfile(){
```

```
    foreach (Text t in category) {
```

```
        t.text = "";
```

```
    }
```

```
total.text = "";
```

```
for (int i = 0; i < 4; i++) {
```

```

for(int j=0;j<3;j++){
    if (j == 0) {
        statistic [i, j] = PlayerPrefs.GetInt ("WrongAnswer" + i, 0);
    }elseif (j == 1) {

```

.
.
.

SpinControl.css

```

using UnityEngine;
using System.Collections;
using UnityEngine.UI;

```

```

[RequireComponent( typeof( RectTransform ) )]
public class SpinControl : MonoBehaviour
{
    public AudioClip arrowAudio;
    //inside class
    Vector2 firstPressPos;
    Vector2 secondPressPos;
    Vector2 currentSwipe;
    public int calc=-1;
    public float speed=5.0f;
    public float spinCount=0.0f,currentSpin=0.0f;
    bool isSpin=false;
    float soundSpeed = 0.0f;
    // Update is called once per frame
    void Update()

```

.
.
.

Question.xml

```

?xmlversion="1.0"encoding="UTF-8"?>
<QuestionCollection>
<Questions>
<Question>
<Question>Which one represent the correct dimensions of Information Systems?</Question>
<CorrectAnswer>Organizations, Technology, People</CorrectAnswer>
<Answer1>Organizations, Telecommunication, People</Answer1>

```

APPENDIX C

Functional Requirements Testing Results

ID	Name	Description	Grade
FR1	Start Game	User must be able to start a game	PASS
FR2	Spin	User must be able to turn the spin table	PASS
FR3	Select Answer	User must be able to click answer howevertorns	PASS
FR4	Timer	The application must let users know how much time left for end of the round.	PASS
FR5	Answer Notification	Application must show to the user a feedback according to their choices of answer wheter it is correct, wrong or outof time.	PASS
FR6	Catagory Selection	Application should select the question from the right Catagory	PASS
FR7	Switching Panels	User must switch panels whenever they sees fit.	PASS
FR8	Statistics	Application must record the statistics each player correctly.	PASS

Non Functional Requirements Testing Results

ID	Name	Description	Grade
NFR1	understandibility	Application must be easy to understand while playing	PASS
NFR2	operatability	Application should operate in without errors	PASS
NFR3	modifiability	Application must be able to be modified due to needs	PASS
NFR4	configurability	Application must be configured due to user needs	PASS
NFR5	simplicity	Application must be simple enough to being understand by users.	PASS
NFR6	User-friendliness	Application must be easy to use	PASS
NFR7	Performance	Application must show high performance while running.	PASS
NFR8	Responsiveness	Application must repsonse the user in real time	PASS
NFR9	Security	Application must be secure enough to prevent any integrity breaches	FAIL

APPENDIX D

PROGRAM EVALUATION TEST

How often do you use a desktop computer and why?

1 2 3 4 5

never frequently

How often do you use a mobile device and why?

1 2 3 4 5

never frequently

How often do you play mobile games?

1 2 3 4 5

never frequently

Application

Question #1: How would you rate the application overall?

1 2 3 4 5

Poor Very Good

Question #2: How would you rate the visual quality of the animation?

1 2 3 4 5

poor quality excellent quality

Perceived Quality: The following will allow you to rate the visual quality of the animation

strongly disagree disagree neutral agree strongly agree

The color used in the animation is consistent and effective...

The sounds in game are heard without delay or any problems

The Application running on very good speed without any delays or performance issues

Application is simple enough to understand

Additional Comments