Chemistry Mobile Game-Based Tutorial

by

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CERTIFICATION OF APPROVAL

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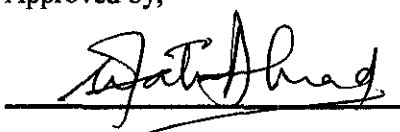

(Assoc. Prof Dr. Wan Fatimah Wan Ahmad)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NABIL FIKRI B ABDUL RAHMAN

ABSTRACT

During the past decades, the world had been rapidly advancing especially in the terms of interactive multimedia. The advancements had affected humans throughout the world, despite of ages and races and especially had affected teenagers, ranging from the age of 16 to 24 years old. They had been introduced with lots of new interactive multimedia's technologies, such as online gaming and three dimensional screens. However, the advancement did not go well in the education field. Teachers are still applying the conventional ways of teaching, which produces boredom to the students. This is also applied in chemistry, one of the important subjects in today's world. Hence, the conventional way of teaching chemistry in high-school is boring and not interesting enough to develop student's interest. Furthermore, there are thousands of nomenclature, formulas and derivation need to be memorized by the students in progressing their way through the subject. For this reason, the researcher had come out with a concept in introducing a chemistry mobile game-based tutorial, which is intended in solving the problems. The objectives of the application are to research on the suitable types of game in providing educational storyline and effectively becoming a catalyst for student's interest in the subject of chemistry; to develop a prototype of Android™ based game which is based on the syllabus of chemistry and also to evaluate on the usability of the developed game. The genre of the game will be adventure plus role playing type of game. The game will be developed by following the iteration and incremental software development model. Three type of learning theory will be used as a guideline for the game, which are cognitivism, constructivism and behaviorism. Various tools such as Adobe Photoshop and Android™ development kit for Eclipse are used. It is hoped that the game will bring benefits especially for the students to appreciate chemistry better, not to learn for the sake of examination but to understand the real concept ultimately.

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CHAPTER 1

INTRODUCTION

1.1 Background

Interactive multimedia had extensively being absorbed into our daily life. It plays a significant role in molding new forms of communication, advertisement, entertainment and education. One of these forms, such as using games in the intention of educating students has not been developed widely.

Today's young adults between the age of 16 to 24 years old have grown up in a networked environment in which they get used to interact with technology and engaging enthusiastically in playing computer games. For this new generation, conventional face to face learning seems less favored than studying in an immersive digital gaming world. The changes of student's preferred learning style stimulates researchers to explore and think on how to make educational computer games in improving student's learning.

It is known that tailor-made and well-designed computer games had offer several benefits over conventional, lecture based teaching. It is said that educational computer games can raise learners' motivation, enable learners to interact with the interactive learning environment and also help in improving their problem solving skill. Yet, it does not guarantee that the use of computer games in educating students can bring those stated benefits, unless the educational content of the games, the pedagogy and the assessment method are carefully considered to integrate with the games. (Cheng (2009))

The proposed project, which is to develop chemistry mobile game-based tutorial will be focusing on the crafted syllabus which are developed for teaching high school students. The syllabus which contains basic yet important subdivision of the chemistry subject is essential for the student to understand it. This is to equip them with basic knowledge of chemistry before they are being introduced to higher level of chemistry which will be

taught in the higher-level learning institution. Failing to do so will result in loss of interest in the subject of chemistry, hence experiencing difficulties in learning chemistry. Therefore, in order to equip students with the knowledge of chemistry, the learning environment of the subject itself need to be interactive and exciting enough in order to motivate students and increase their interest on the subject of chemistry.

These characteristic, which are to provide entertaining and interactive style of environment, are easily fulfilled and satisfied by implementing mobile games-based tutorial throughout the learning period. This is due to the fact that games which are educational and guiding will draw the student's attention in learning the subject implemented in the game. It will also provide effective practice opportunity and motivation for learning on certain subjects. Games will also make education process into an enjoyable and pleasant process. It will also enable students to be more active in class. (Tuysuz, 2009)

Hence, as stated earlier, the proposed project is to develop chemistry mobile game-based tutorial for high-school students. After the game had been developed, several testing process will be executed in order to determine it acceptance by the public, especially the high-school students.

1.2 Problem Statement

The project was proposed and will be developed based on the problem statements below. The statements are:-

1) The conventional way of teaching chemistry in high-school might be boring and not interesting enough to develop student's interest in the subject of chemistry.

This is true due to the fact that the conventional way of teaching chemistry in high-school is solely based on one way interaction, which is from the teachers to the students. Sometimes, teachers just read the materials from the text books in educating students throughout the course. This kind of environment will inhibit student's potential and discourage them in learning effectively. Hence, interesting and interactive environment

of learning for students to participate is required in bringing student's interest for the subject of chemistry.

2) There are thousands of nomenclature, formulas and derivation need to be memorized by the students in progressing their way through the subject of chemistry.

There are over 118 elements allocated in the periodic table and are being categorized into metal, non-metal, halogen and other categories. These elements then can be combined with each others to produce another type of compound. Metals such as Sodium and non-metals such as Oxygen can be combined and will produce Sodium Oxide. The combination of the elements will produce thousands to millions of compound, even though the syllabus of high-school subject of chemistry is only cater for the first 20 elements in the periodic table (from Hydrogen to Calcium), yet it does produce a great number of possible combination. Hence, in order to cater this problem, a game-based solution will be developed in providing the opportunity for students to memorize and become familiar with elements composition, nomenclature, atomic number and so on.

1.3 Objectives and Scope of Studies

The objectives for the proposed project are:-

1) To research on the suitable types of game to be developed which suitable for high-school students in providing educational storyline and become a catalyst for student's interest in the subject of chemistry.
2) To develop a prototype of Android™ based game which is based on syllabus of chemistry for high-school students by the end of the given timeline.
3) To evaluate on the usability of the developed prototype by conducting a User Experience Test (UX) towards the target audience.

The scope of studies will basically to be developed around the syllabus of the subject of chemistry which centers on high-school students. Furthermore, the scope will be

focusing on developing game which center around calculation-based chemistry subject, such as:-

- Formula and Chemical Equation
- Periodic Table of Elements
- Electrochemistry
- Acids, Bases and Salts
- Thermochemistry
- Rate of Reactions

CHAPTER 2

LITERATURE REVIEW

2.1 Conventional Problem and Solution

Chemistry is the science of matter and the changes it undergoes during chemical reactions. Chemistry are being grouped into lots of subcategories such as inorganic chemistry (the study of inorganic matter), organic chemistry (the study of organic also know as carbon-based matter), biochemistry (the study of materials found in biological organisms), physical chemistry (study of chemical processes using physical concepts such as thermodynamics and quantum mechanics) and analytical chemistry (the study of chemical composition and structure). Hence, due to these large subcategories of chemistry, teaching chemistry in high-school will not be an easy task. Teachers need to equip themselves with deep understanding and vast knowledge with regards to the subject of chemistry in order to provide smooth transitions of knowledge from the teachers to the students. However, by applying the conventional method of teaching, student will become boring and might lose interest in learning chemistry.

2.1.1 Learning Theory

According to Orey (2008), learning theory is interpreted as an enduring change in behavior, or in the capacity to behave in a given fashion which results from practice or other forms of experience where it is observed in a timely manner. He also states the five questions to distinguish learning theories, which are:-

1. How does learning occur?
2. Which factor influence learning?
3. What is the role of memory?
4. How does transfer occur?

5. What types of learning are best explained by the theory?

Therefore, he explained the three major learning paradigms, which are behaviorism, cognitivism and constructivism.

Behaviorism is based on the observable changes in behavior. It focuses on a new behavioral pattern being repeated until it becomes automatic to the learner. The learner is characterized as being reactive to conditions in the learning environments.

Cognitivism is based on the thought process behind the behavior. It focuses on how information is received, organized, stored and retrieved by the mind and the learner is characterized as being very active in the learning process.

Constructivism is based on the premise that the learner constructs their own perspective of the world, through their own experiences and schema. The goal of instruction to let the learner be able to elaborate and interpret information.

Hung (2001) had summarize the learning theory as shown in Table 2.1.

Table 2.1: Summary of theories of learning

Behaviorism	**Stimulus and Response** 1. Students remember and responds 2. Teachers present and provide for practice and feedback
Cognitivism	**Information transmission and processing** 1. Students remember strategies, rules and patterns 2. Teachers plan for cognitive learning strategies
Constructivism	**Personal discovery of knowledge** 1. Discover relationships between concepts 2. Teachers provide instructional context for active and self regulated students
Social Constructivism	**Learning is a social construction, mediated by different perspective** 1. Through authentic projects, students discuss and dicover meanings 2. Teachers provide for facilitation and scaffolds among the students

He also had come out with key concepts of dominant learning theories as shown in Table 2.2.

Table 2.2: Key concepts of dominant learning theories

	Behaviorist	Cognitivist	Constructivist	Social constructivist
Learning	Stimulus and response	Transmitting and processing of knowledge and strategies	Personal discovery and experimentations	Mediation of different perspective through languages
Type of learning	Memorizing and responding	Memorizing and application of rules	Problem solving in realistic and investigative situations	Collaborative learning and problem solving
Instructional strategies	Present for practice and feedback	Plan for cognitive learning strategies	Provide for active and self-regulated learner	Provide for scaffolds in the learning process
Key concepts	Reinforcement	Reproduction and elaboration	Personal discovery generally from first principle	Discovering different perspectives and shared meanings

In order to make the learning environment becomes more effective, Norman (1993) had lists seven requirements for an effective learning environment, which are:-

1. Providing a high intensity of interaction and feedback from the student
2. Create specific goals and procedures
3. Being motivational
4. Provide continual feeling of challenge which is not so difficult (create frustration) or too easy (create boredom)
5. Provide a sense of involvement with the task given
6. Provide the appropriate tools for the task
7. Avoid distraction and disruption which will destroy the student's experience

2.2 Games as teaching tools

The requirements provided by Norman are easily fulfilled and being satisfied better by games compares to other learning medium. Tuysuz (2009) stated some of the advantages of computer based game are:-

1. As the games are built in entertaining format, it will amuse the users and give them pleasure by including conflicts, competitions, challenges and confrontations. By providing rules, it will help the player to understand the structure of the game. By providing aims, missions or objectives, it will motivate the users. Interaction will always make the users active. Games will help learning as they contain scores and feedbacks.
2. User's spatial abilities and cognitive development will increase after playing with simulations and games.
3. Users will also develop expert behaviors such as pattern recognition, problem-solving, qualitative thinking, and principle decision making as their individual expertise with game increases.
4. User's motivation, skill and ability to explore, experiment and collaboration will also increased by playing computer games.

Hence, by referring to the advantages, it is appropriate to use games as teaching tools. Games are appropriate be used in education since they are being educational and guiding, therefore they will draw the educator's attention. Games will also present effective practice opportunity and supply motivation for learning on certain subjects. The support of games in education will also turns education into an enjoyable and pleasant process. It will also enable students to take active roles in the teaching of the subject.

Tuysuz (2009) also state the result which he obtained from a study conducted towards 95 students with regards to the research on game's effectiveness towards educating students. He stated that learning supported with computer-based games increased permanency in learning, increased the student's interest with regard to the course, enabled the student to understand better, made the course become joyful and entertaining, enabled the students to focus on the course, prevented them from being bored and made the course visual. However, he also stated the disadvantages of implementing computer-based games in educational purposes. The disadvantages are

that it sometime spoiled the order of the course, it decreases teacher-student interaction, made the course noisier and the student will not be able to learn the course profoundly.

2.3 Proposed Learning Flow

Basically, a game itself will not cater for the intended outcomes. It needs to be built in a well-designed manner in order to release the full capability of games in helping educating students. Paras and Bizzocchi (2005) proposed a learning flow for educational games as in Figure 2.1. From Figure 2.1, games will foster play, which will produce a state of flow. The state of flow then will increase the user's motivation and significantly supports the learning process.

Figure 2.1: Proposed learning flow

2.4 Elements in Effective Games

Dondlinger (2007) states the elements which are required in order to create an effective video game. The elements are:-

1. Edutainment vs. Educational Games

   Edutainment games are the ones which follow skill and drill format in which players will either practice repetitive skills or rehearse memorial facts. In contrast, educational games require strategizing, hypothesis testing and problem solving. Characteristics of these kind of games will includes a system of rewards and goals which motivate players, learning content which is relevant to the plot and interactive cues that prompt learning and provide feedback.
2. Motivation

   Motivation in games might come from the game's narrative context, goals and rewards within the game or from intrinsic to the act of playing. Motivation to play is a significant characteristic of educational games and both intrinsic and extrinsic rewards had been considered in building an effective game design.
3. Narrative Context

Narrative context basically brings the definition regarding the storyline which being developed throughout the games. Narrative context does motivate learning, however for an educational game to be effective, the learning content must align with the narrative plotline.

4. Goals and Rules

   Goals and rules are equally important with the other element in bring up player's motivation through the game. There are currently three type of goals which are short-term, medium-term and long-term.

5. Interactivity and Multisensory Cues

   Interactivity and multisensory cues are equally as important as the other element. Interactivity between the player and the game, either it is providing too much freedom (become boring) or imposes too much control (become passive) will determine the game's effectiveness. Multisensory cues will help learners in understanding complex phenomena.

Nor Azan et al. (2009) also state the components which are necessary to be included in the game. The components are:-

1) Game story's background
2) Rules
3) Immersive
4) Enjoyment
5) Feedback
6) Multimedia technology
7) Challenge and competition
8) Reward/award

2.5 Genres of Game

According to Nor Azan et al. (2009) too, researches had been conducted in order to determine the most popular genre of games played by the students. In the research, questionnaires had been given to 582 form four students from local secondary schools in Selangor. The researchers had list up to 11 genres of games to be chosen by the students,

which are tactical shooters, role playing, racing, car combat, sport games, adventure games, fighting games, combat Sims, puzzle games, rhythm games and other. The result of the questionnaire is as Table 2.3.

Table 2.3: Percentage of the students playing different types of digital/electronic games

Types of digital/electronic games	Percentage (%)
Tactical shooters	42.4
Role playing	18.6
Racing	67.2
Car combat	26.6
Sports game	50.8
Adventure games	62.1
Fighting games	55.9
Combat Sims	19.8
Puzzle games	42.4
Rhythm games	21.5
Other	4

According to mobygames.com, the genre of racing is a type of game which involves in using a motorized vehicle and the objective of the game is to move faster than the opponents in order to reach a specific goal or beat a specific time. Examples of motorized vehicle are cars, superbike, powerboat and also spacecraft.

Adventure type of games denote any game on the world where the emphasis is based on experiencing a story as seen by one or multi user-controlled character, hence manipulating the characters and the environment they live in.

Role playing type of game (RPG) denotes any games where the character development is the main driving gameplay mechanic. Usually, one or more character are created and shaped by the user, which then will embark on a series of encounters which will increase the character's wealth, inventory or combat statistics.

2.6 Benefits of Applying Games in Teaching

According to Dondlinger (2007), by applying interactive video-game in teaching, a lot of benefits shall be gained, especially for the students. The learning outcomes are:-

1) 21st Century Skill

   Specific skills such as attention, spatial-concentration, problem-solving, decision-making, collaborative work, creativity and ICT (Information, Computer and Technology) will be able to be developed by the students in practicing educational video games.

2) Deduction and Hypothesis Testing

   Educational video games promote deep learning, hypothesis testing, strategizing and appropriating contents as a tool to play, hence this kind of approach are conducive to deductive reasoning and hypothesis testing to be develop by the students.

3) Complex Concepts and Abstract Thinking

   Study shows that technology applications including video games will promote mastery of complex concepts.

4) Visual and Spatial Processing

   There are studies which show that adolescents with medium to long-term experience playing video games show greater visual capacity, motor activity and spatial ability, which are reflexes and responses.

2.7 Examples of Chemistry Games

There had been several developments in game-based teaching for chemistry subject which available either through the internet or being develops as materials in lectures. Howe et al. (2005) had come with a set of games which can be prepared and played during class time in order to develop active interaction between students and teachers and create an entertaining environment of education, especially in the subject of chemistry. Even though it is not a computer game-based learning, yet it promote the usage of games during lectures in order to increase student understands with regard to chemistry. Lang and Bradley (2009) had produced a journal regarding the teaching of chemistry in an online-game platform. The simulation online-game, known as Second Life, is one of the popular simulation online-game throughout the internet. The journal stated on how teaching of chemistry had been done in the game. Models of molecules had been placed in a virtual museum where gamers can access in order to gain

information regarding the molecules as shown in Figure 2.2. Apart from that, there is also chemistry games developed to a card-based type of game. One of them is called Elementeo as being shown in Figure 2.3.

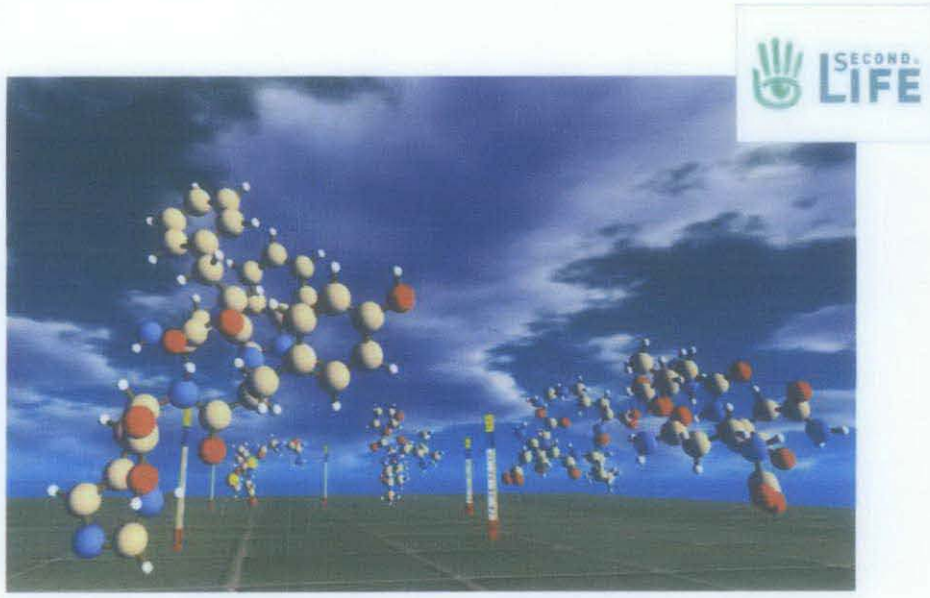

Figure 2.2: The Amino World in Second Life™ (Source: http://secondlife.com)

Figure 2.3: Lists of cards available in Elementeo™ (Source: http://www.elementeo.com)

2.8 Approaches on Courseware Testing

Another objective of the project is to conduct research on the effectiveness of the developed game and also the usability of the game. According to Syazwan Nordin et al. (2011), the effectiveness and the usability of the developed courseware can be determined by conducting tests as Figure 2.4. According to Figure 2.4, in order to determine the effectiveness of the developed courseware, a group of students will be divided into two. One of them will be called as the control group and another one as the experimental group. Initially, both of the group will be having a pre-test to determine the average score of the students. Then, the control group will be undergoing the conventional style of teaching while the experimental group will be learning using the developed courseware. Post-test then will be given to the students in order to measure the effectiveness of the courseware. Usability testing is also conducted for the students in the experimental group which then will determine the four important element of usability, which are effectiveness, efficiency, utility and learn ability.

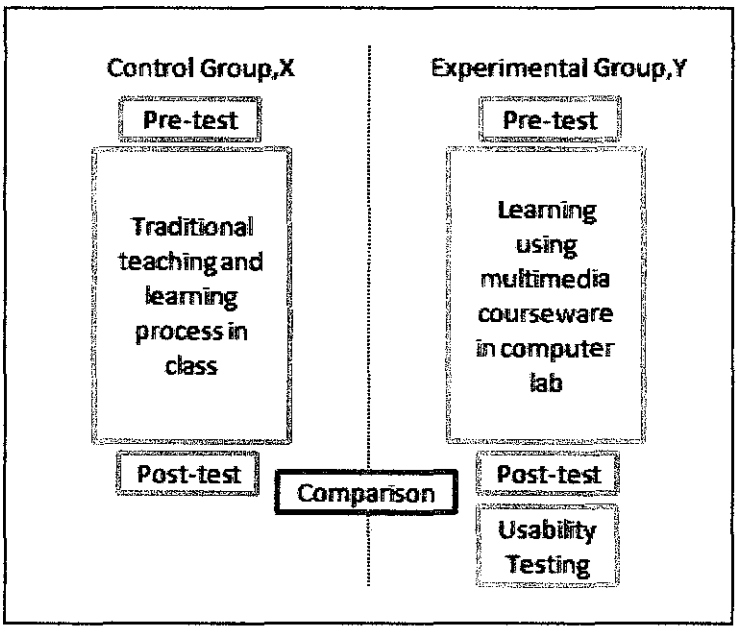

Figure 2.4: Courseware Effectiveness and Usability Testing Framework

2.8.1 Usability

Bevan (2001) and Hollowgrass (2008) defines usability from ISO 9241 which states that usability is the extent to which the product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. The definition explains on how to identify information which is necessary to be taken into account when evaluating usability in terms of measures of user performance and satisfaction. It also explains on how measures of user performances and satisfaction can be used to measure how the components of the work system affect the quality of the whole work system in use.

Bevan (2001) had come out with a quality model which defines metrics for usability and quality in use as per Figure 2.5.

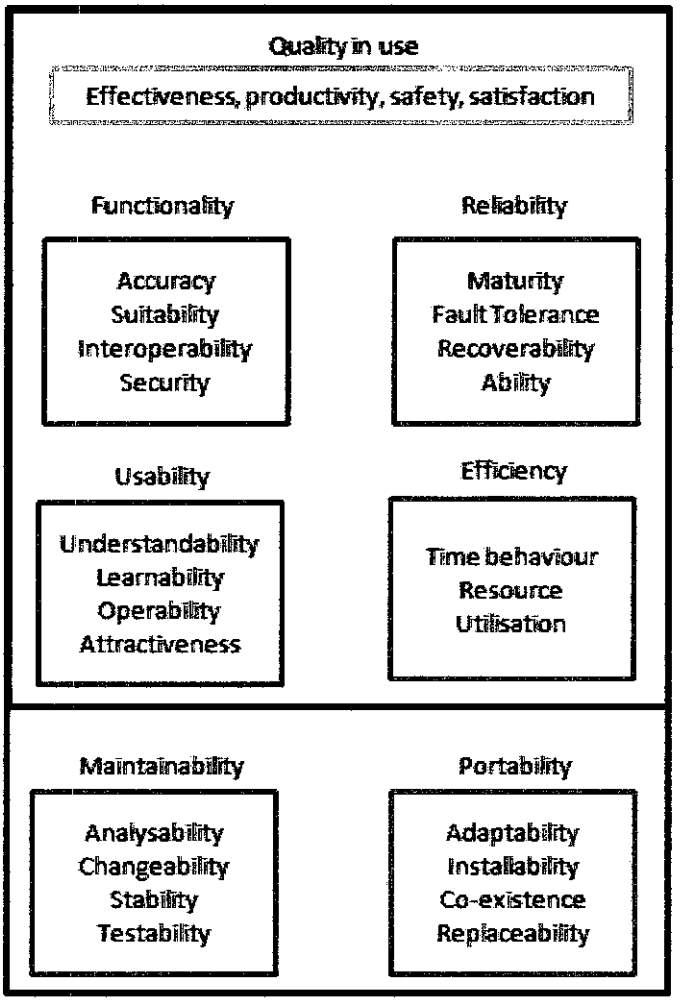

Figure 2.5: Quality Model

Hollowgrass (2008) who manifests usability in the terms of User Centered Design (UCD) had come out with six phases of UCD which takes the elements of usability. The six phases are:-

1. User research, which will determine the users which will be using the application
2. User modeling, which determines the user's need, ability and perception
3. Requirements definition, which define on how the product can meet the user's need
4. Delivery method definition, which define on how the product will deliver its services
5. UI design, which define on how the product will appear and work for the user
6. Development support, which define the feedbacks gathered and ways to improve the application in the future

She also mentions four other ways in order to improve usability, which are:-

- Heuristic evaluation: The evaluators will examine the interface and judge its compliances with recognized usability principles.
- User testing: Small multiple tests will be run with the users to discover interface elements that should be kept, changed or removed.
- Paper prototypes: Involves creating rough drawings of an interface (on paper) to use as models of a design.
- Competitive analysis: Testing interface design with similar features for similar goals.

Suziah et al. (2009) had come out with a list of usability features that can determine the usability of the system. The lists are:-

- Either the presentation is clear
- Either the system is user friendly
- Either the system is easy to use
- Either it is easy to navigate around the system
- Either it is easy to determine the user location in the system

CHAPTER 3

METHODOLOGY

3.1 Achieving Objectives

The purpose of this research is to determine the best type of games to be developed in helping the teaching of the chemistry subject in Malaysia's high-school. Another purpose of the research then is to determine either the game developed is meeting the standards in the terms of usability with regards to the game interface.

The first research, which is to determine the best type of game to be developed, will be implemented by conducting researches on the previous literature regarding the best type of game to be developed in the context of mobile game-based tutorial. Studies will also be conducted in determining the important criteria that a certain games need to have in order for it to be effective for learning and education purposes. Studies on impacts of games towards students shall also be carried out in order to determine the benefits and consequences, hence preparing the countermeasure for the proposed advantages and disadvantages. The studies mentioned, which will be studied regarding student's opinion will be done in a survey type of studies, which is by giving the students questionnaires, and the questionnaires results will be analyzed by the researcher. Studies on the best development process in developing the game will also be conducted in order to determine the best way to develop the game, such as the design phase, the execution phase or the testing phase, need to be thoroughly studied so that the developed game will be produced of the utmost quality.

The second research, which is to determine the usability of the game developed with regards to its interface will be conducted by performing a User Experience Test (UX) towards a group of randomly selected students which have understanding on the basic knowledge of chemistry. Around 5 to 7 respondents will be selected for the UX. The UX

will be conducted to the respondents' one-by-one. Each respondent will be given the game to try, without any instruction in a given time limit. After the time is up, the respondent will be given a set of questionnaire in determining either the game is meeting the usability's standard or not.

3.2 Proposed Software Development Model

The proposed software development model is iterative and incremental model. The basic idea of iterative model is to develop a system through repeated cycles (the iterative part) and in smaller portions at a time (incremental), which allow the developers to take advantage of what was learned during the development of earlier part of the system or application. During iterations, design modifications will be made and new functional capabilities are added. Figure 3.1 depicts the iteration and incremental software development model.

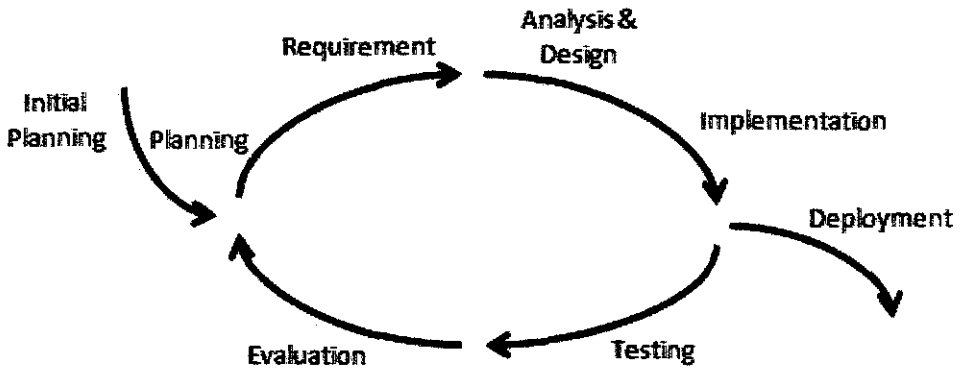

Figure 3.1: Iteration and Incremental Software Development Model

1. Initial planning

   Main activities:-

   a) Find literature review regarding the topic – References from previous researches are collected and analyze in order to obtain valuable information with regard to the developed application. This is useful as to gain beneficial information such as to decide the appropriate genre for the game and also to provide evidence to support the developed application.

b) Assess on literature review finding – Results from the analysis of the literature review will be inserted into the report and will be use as a guideline for the developed application. The result will be used as a stepping stone for the researcher to embark on his research with regard to the developed application.

2. Planning

   Main activities:-

   a) Perform research on which type of game to develop – Research are being done against the results obtained from the analysis of the literature review being collected at the initial planning. The genre is decided by referring to the type of games which present the largest amount of preferred games which were chosen by a group of students by a survey conducted in a research.

   b) Decide on which platform required to develop the game – Decision on which platform to be used for the developed game will be decided based on the marketability and acceptance of current trends. For this developed game, the researcher will be choosing the platform of mobile operating system, known as the Android™ Operating System (Android™ OS).

3. Requirement

   Main Activities:-

   a) Get the software needed in order to develop the game – As getting out of the planning stages, the requirement stage will start by prepare all the needed software and tools which will be used in the game. Required tools and software which are needed in order to develop the game are Android™ development kit for Eclipse and Adobe Photoshop.

4. Analysis & Design

   Main Activities:-

   a) Brainstorm on concept and storyline – Concepts and storyline is important in game development. It will be the one which decide the user's attraction to the game, either it is attractive enough or not. For the concepts and storyline, the researcher is intending in implementing 'Fantasy' type of storyboards in order to catch the user's attention.

b) Decide on which subtopic of chemistry to be focus on the game – The subtopic which will be delivered into the game is one of the main criteria for the game development. This will be the one which decide the learning element which will be embedded into the game.

5. Implementation

   Main Activities:-

   a) Start developing the project – The most important part of the project where the researcher will be utilizing every resource which he has in order to come out with the prototype as stated in the objectives.

6. Testing

   Main Activities:-

   a) Conduct testing on the developed game – One of the important phases in the development of the game which will generate results that determine the usability of the developed game.

7. Evaluation

   Main Activities:-

   a) Get user's feedbacks regarding the developed game – Feedback's are acquired from the usability testing conducted during the testing phase. The feedbacks then will be analyzed in order to determine the effectiveness of the developed game and stored for the future improvement of the game.

Figure 3.2 depicts the proposed Gantt chart that will be used as a guide during the development of the project.

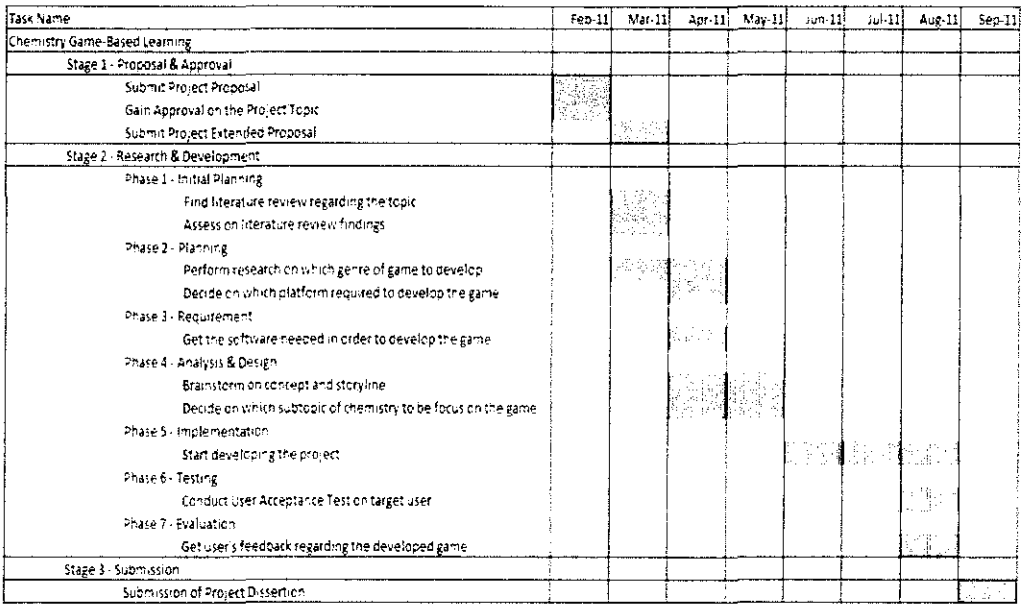

Figure 3.2: Proposed Gantt chart for the project

3.3 Testing Method

Usability testing has been conducted regarding to this project in order to determine either the developed project had met the three important element of usability. The three important elements are:-

- Learnability, either it is easy for users to accomplish basic tasks the first time they encounter the design or the architecture of the project
- Efficiency, either it is easy for users to apply back the knowledge once they have learn regarding the design or the architecture of the project
- Satisfaction, either the design of the interface is pleasant to the user's eye

The usability testing has been conducted to a group of 6 people, with various backgrounds. Each of the participants had been given around 15 to 20 minutes of time in order for them to explore the system by themselves. No orders or directions were given to the participant in order to obtain the absolute results of the usability of the system.

15 to 20 minutes later, after the participants felt satisfied with the exploration of the system, each participants were given a set of questionnaire related to the three elements

of usability. Results obtained from the questionnaire were gathered and analyzed in order to determine the usability of the system.

CHAPTER 4

RESULTS AND DISCUSSIONS

After extensive research with regards to the mobile game-based tutorial, the researcher had come out with ideas and concepts on how the game will be developed, its requirement and explanation on how it will achieve its objectives.

4.1 The ID Model

The developer had produced an ID model such as Figure 4.1. The ID model basically explains the elements needed which will be implemented in the game. It is divided into four categories, which are:-

- Source
- Learning theory
- Learning approach
- Content

4.1.1 Source of ID Model

Source describes the material which will be gathered by the developed in order to develop the games. Important materials such as sounds, images and attractive wording are necessary in order to grab user's attention to the games, hence exponentially increasing the user's exposure towards the learning part of the game.

4.1.2 The Learning Theory

Learning theory describes the three major theories which are expected to explain the user's characteristic of learning by using the game-based application. Cognitivism is in relation with information transmission and processing, which related to constructing strategies and patterns. The game will be built in adventure plus role-playing type of

games, and there will be scenes where the user will be facing challenges while doing quests or fighting the enemies. This type of event will need the user to construct precise plan or strategy in order to combat successfully throughout the game, hence, providing cognitivism type of learning.

Constructivism is related with personal discovery of knowledge, which explains on the self-discovery of relations between concepts. The game is intended to be developed in a manner of a world surrounded by chemical knowledge and application. For example, the developer is intending to embed the knowledge of chemistry which the user had or will be learning during their form four into the game. This will make the user become familiar with the game and can easily relate themselves with the game as they venture through it. One of the examples is; user is familiar with the chemical reaction between acid and alkali, which will result into salt and water. In the game, there will be enemies with the property of alkali, and in order to combat them efficiently, the user need to apply acidic type of skill, which will turn the enemies in dust in a short matter of time.

Behaviorism is related with stimulus and responds which will develop user in responding quickly and efficiently. In order to implement this kind of learning theory, the developer in intending in applying pop-quizzes of simple chemical type of question which the user need to answer in a given time. If the user successfully answers it, rewards will be given, and if the user failed, penalty will be given and might result in a more difficulty of quest or battle with the enemies. Thus, by this kind of quizzes, the user is expected to be able to react and think quickly and be applying this kind of characteristics in their daily life.

4.1.3 The Learning Approach

Learning approach and contents is describing on the methods which will be implemented in the game in order to achieve the learning theory, which are cognitivism, constructivism and behaviorism.

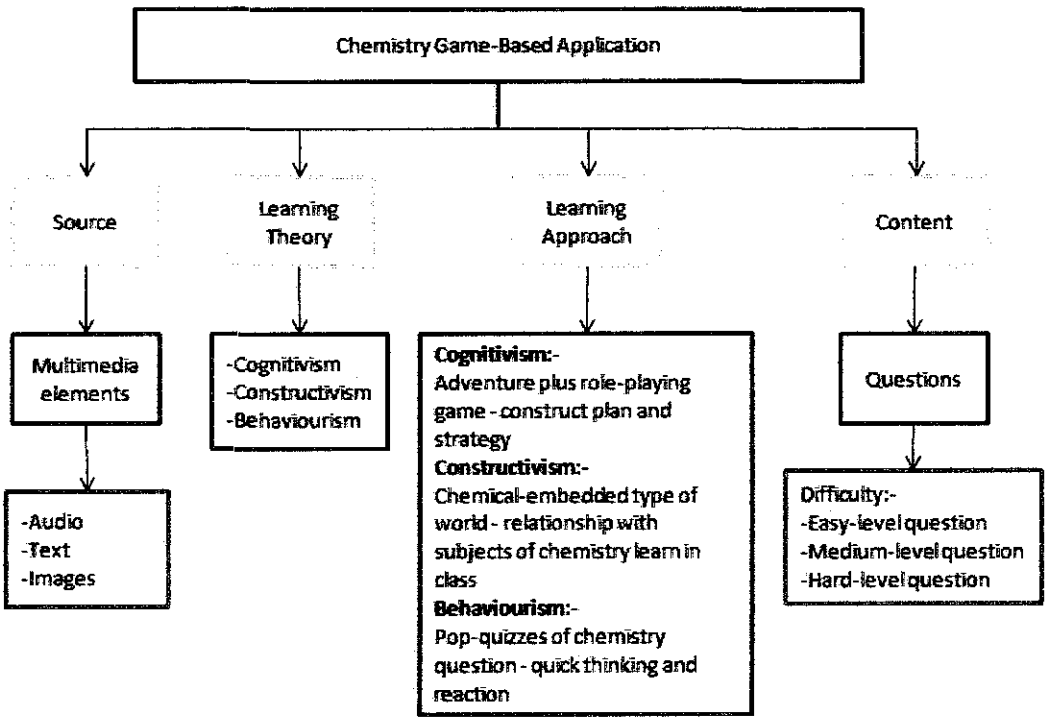

Figure 4.1: ID Model of the game-based application

4.2 The Gameflow

The developer had also come out with the general gameflow for the chemistry game-based learning application as shown in Figure 4.2. The game will basically start from the menu and ends when the user enters the exit state. The normal arrow describe that it is a one way process from the previous state to the next state, which the double arrow describe a two ways process, where the user can always go back and forth from the previous state to the next state. Example for one way process is exiting the game. It will trigger when the user enter the exit state and the game will be shutting down. User is not able to re-enter the game apart from starting the application again. Example for two ways process is saving the game during gameplay. While playing, user will be able to save their journey into the database, and when done, user can directly continue back the game.

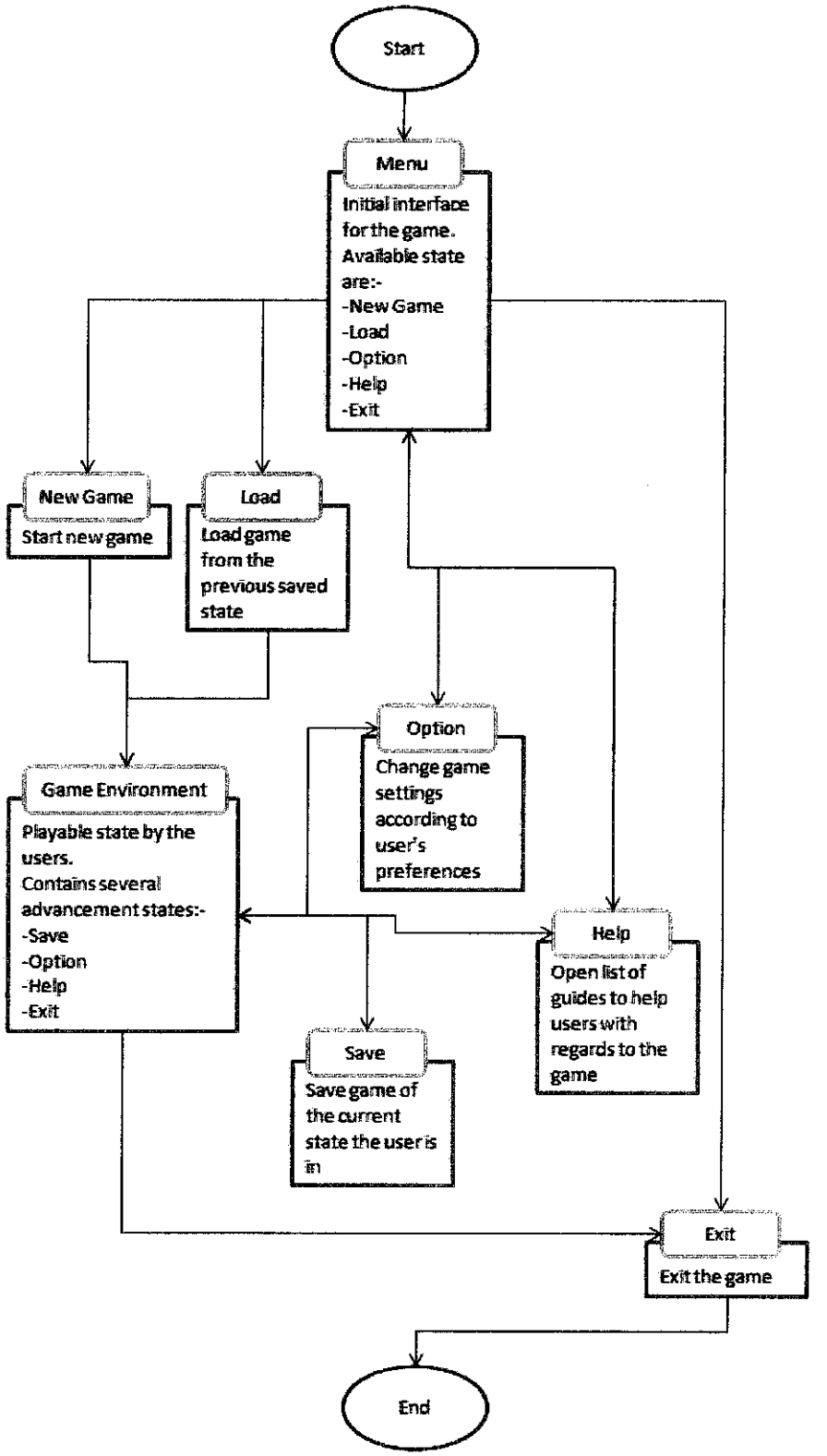

Figure 4.2: Gameflow for chemistry mobile game-based tutorial application

4.3 Early Sketches

The developer had also produced some early sketches on how the game will be developed later. Figure 4.3 describes the first draft off the game's menu. It will contains 'Start','Load','Option','Help' and 'Exit' as describe in the gameflow, Figure 4.2. The name 'Akamia' is choosen as the game name due to the resemblance as the word 'alchemy', which means *'The medieval forerunner of chemistry, based on the supposed transformation of matter, esp. that of base metals into gold.'* Alchemy is widely used in fictions and games.

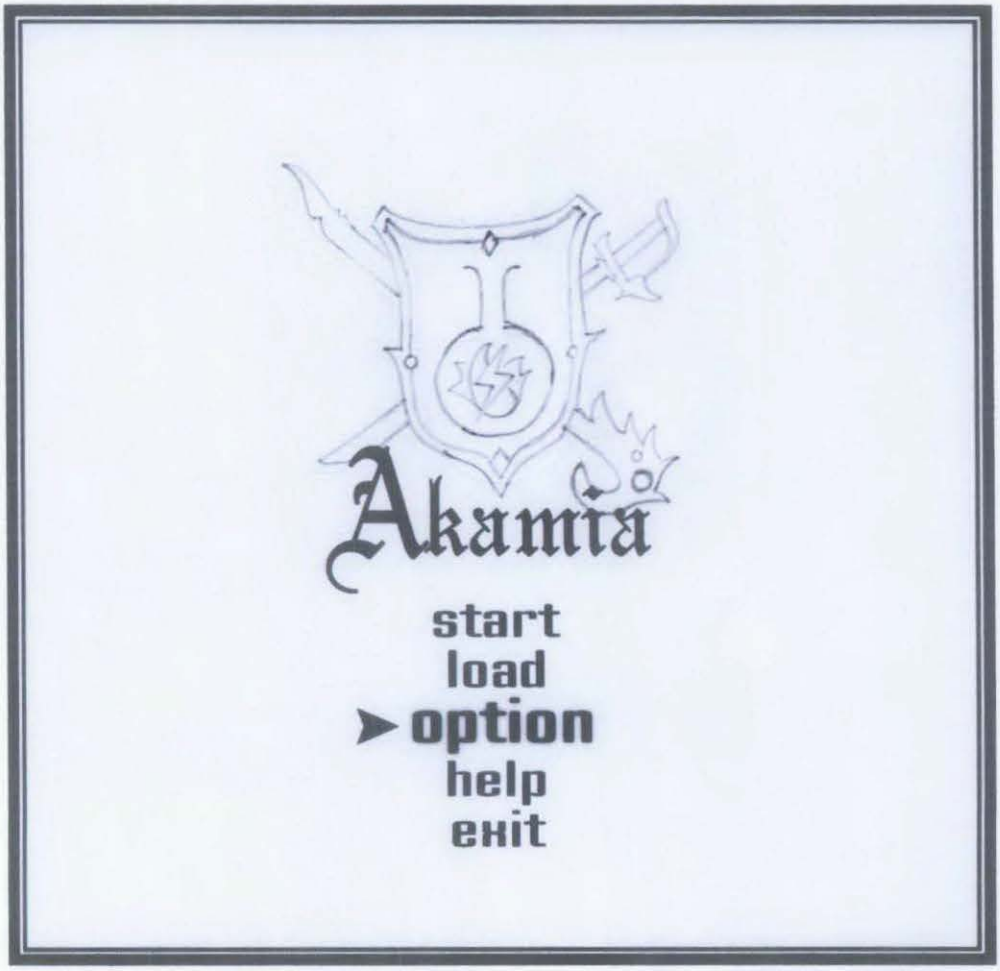

Figure 4.3: First draft off the chemistry mobile game-based tutorial application

Figure 4.4 describe the environment the game will be developed. In this draft, it describe that the main character (the spiky-hair guy) is having a conversation with his teacher (the one wearing the pointy hat).

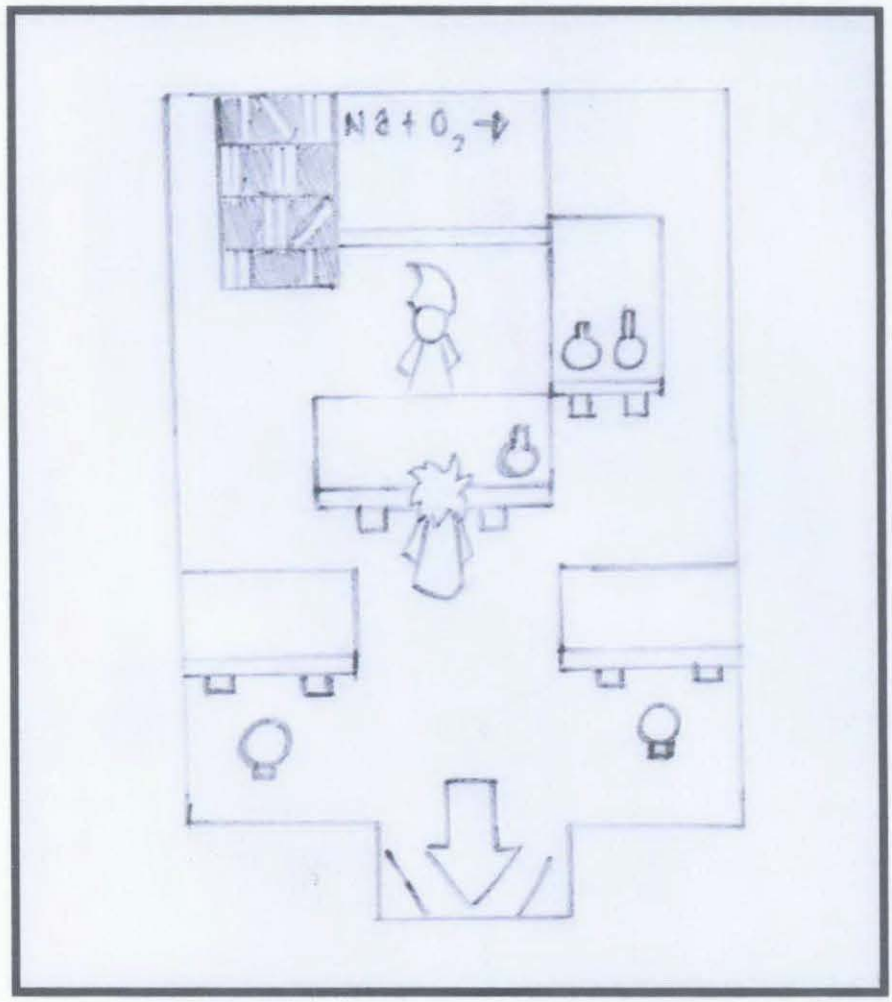

Figure 4.4: First draft on the environment of the game

There will also be some conversation involves in the game. Figure 4.5 describes the first draft of the conversation happens in the game. It is actually related to Figure 4.4, where R. Adrablaze is actually the main character's teacher.

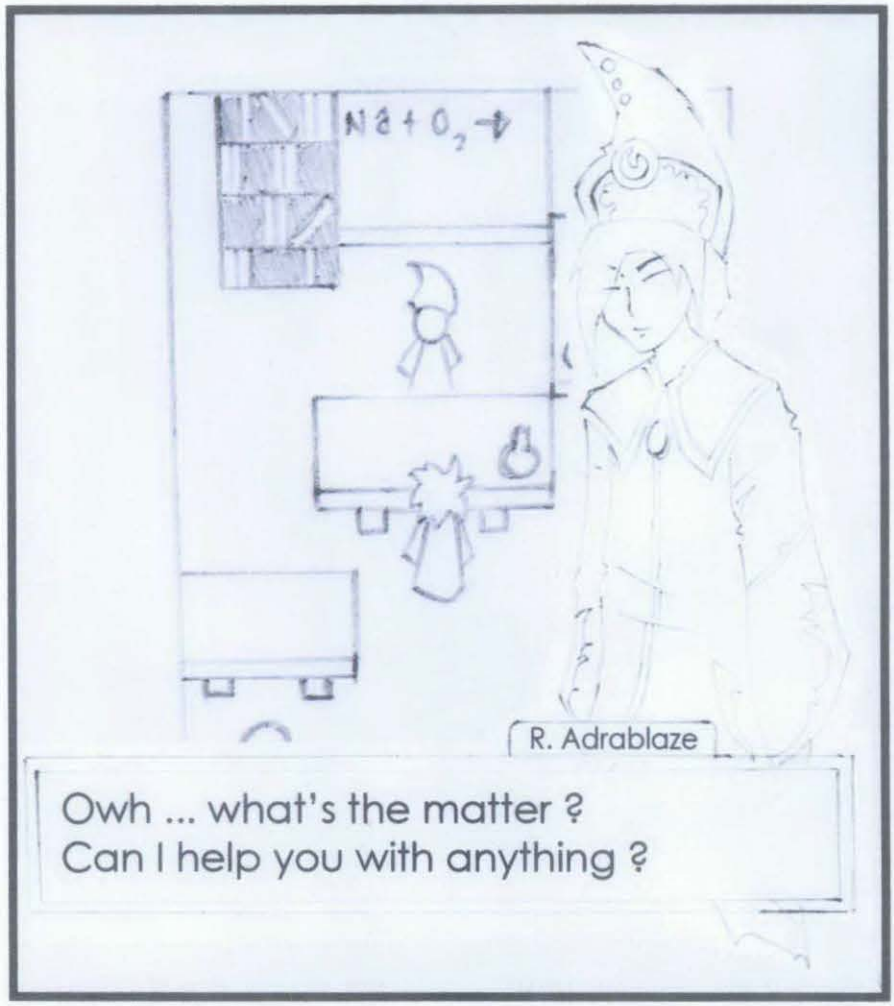

Figure 4.5: First draft on conversation in the game

Battle and combat will took place in the game as the user advance throughout their journey deeper and deeper into the game. Figure 4.6 explains the first draft of a battle scene for the main character. It describe that the main character is somewhat of a magician, holding a staff, preparing to fight with two giant mushrooms.

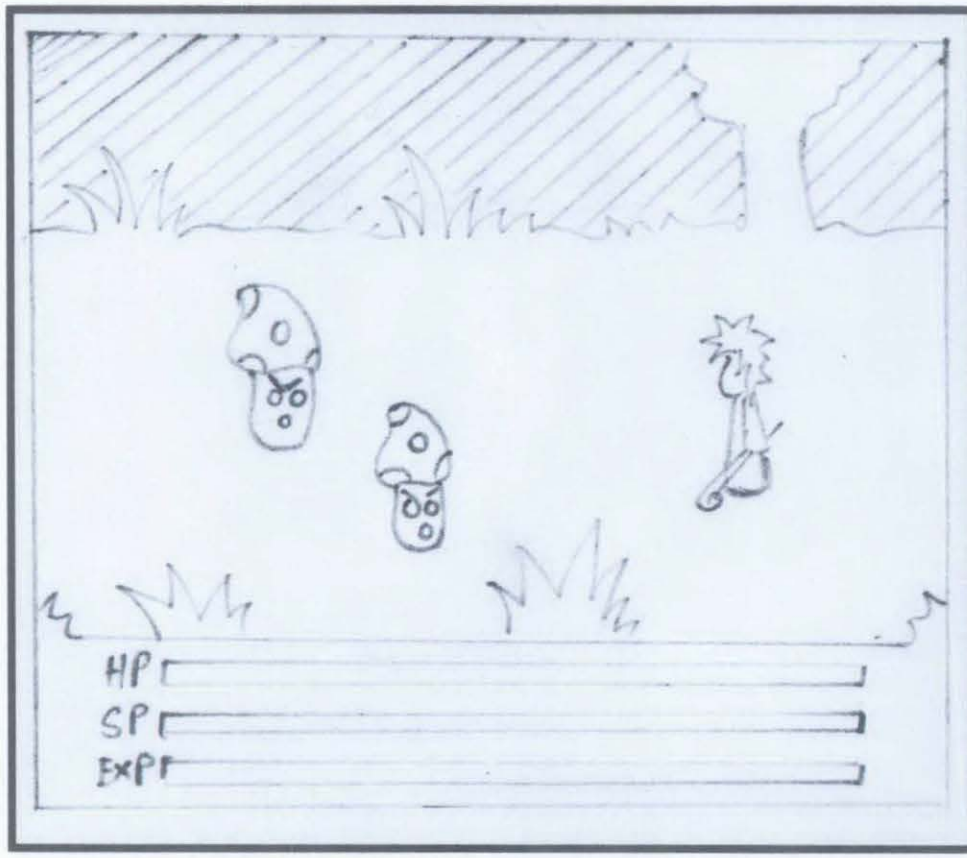

Figure 4.6: First draft of the battle scene in the game

In order to develop a learning based type of game, the game should introduce the same material that the target user (form four students) is learning in school. Hence, a type of pop-quizzes of short and simple question will be asked to the user while they are advancing throughout the game. In Figure 4.7, it describes that during a battle scene, a random question with regards to the subject of chemistry will be popped-out, and asking the user to answer it in a given time. It will be made compulsory for the user to answer the pop-quiz. If they manage to answer it correctly, they will be granted with rewards in order to help them throughout the game, but if they fail, nothing will happen and they can continue the game as usual. Penalty is not been given in order not to discourage the user regarding the game.

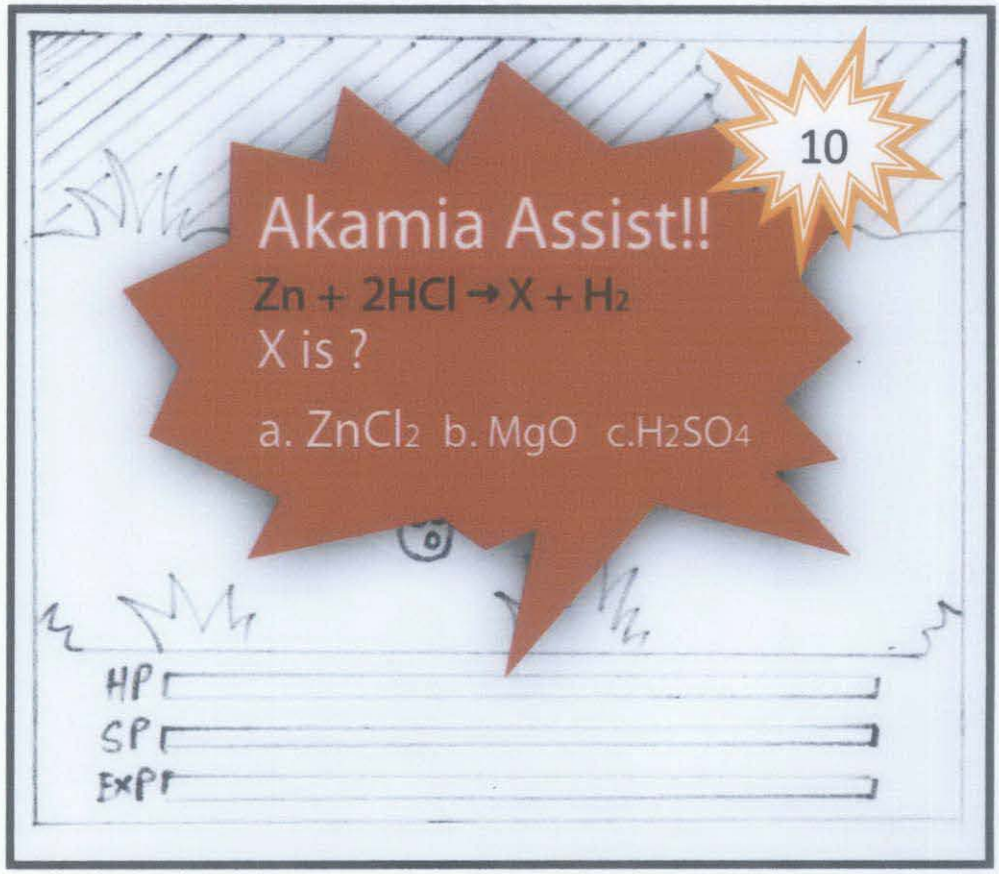

Figure 4.7: First draft on chemistry pop-quiz in the game

4.4 Survey Results

In fulfilling the objectives, a survey has been conducted to a group of form five students which are taking the chemistry subject for their Sijil Pelajaran Malaysia (SPM). The survey has been conducted on 40 students, 24 male and 16 female from various backgrounds. Extensive analysis had been prepared for this report and it is presented below.

4.4.1 Motivation in Learning Chemistry

From the survey, the respondents seem to be motivated in learning chemistry. The result shows that the distribution is inclined to "very motivated in learning chemistry". This also can be shown that majority of the students, which contributes 40% of the total number of students is answering scale number 6, given scale number 7 being very motivated in learning chemistry.

4.4.2 Tendency in Playing Games

From the survey, the distribution of the result is equally distributed between the scales. However, 30% of the students answered scale number 6, which is slightly interested or tendency in playing games.

4.4.3 Subtopic Difficulty

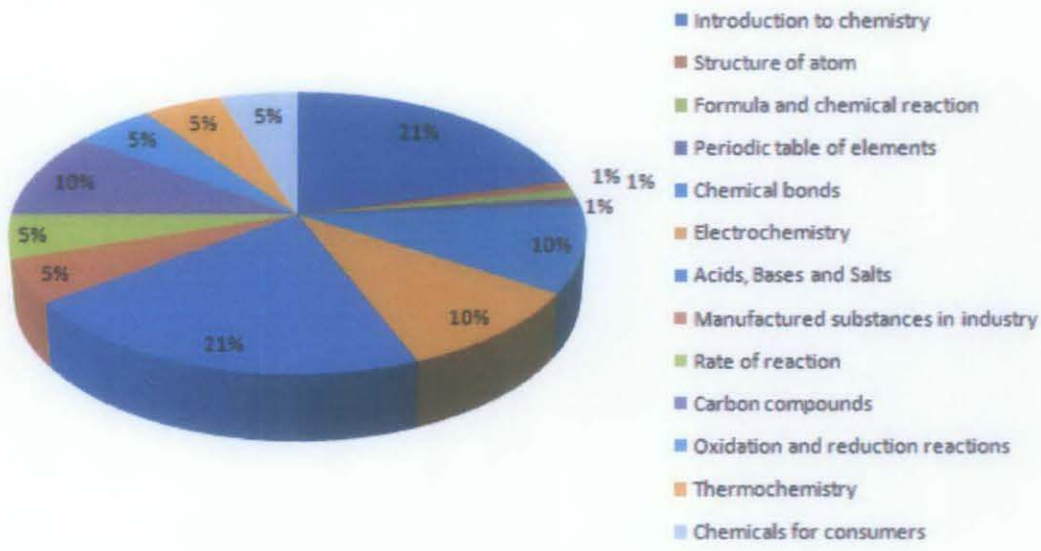

Figure 4.8: Rating of the Difficult Sub-topic in the Chemistry Syllabus

From Figure 4.8, majority respondents answered that most of the subtopics of chemistry are easy or relatively easy except for three subtopics, which are Chemical bonds, Electrochemistry and Acids, Bases and Salts. This had given the researcher insights on how to arrange the questions in the game which hoping to provide users of increasing difficulty of questions as the game progress.

4.4.4 Problems in Learning Chemistry

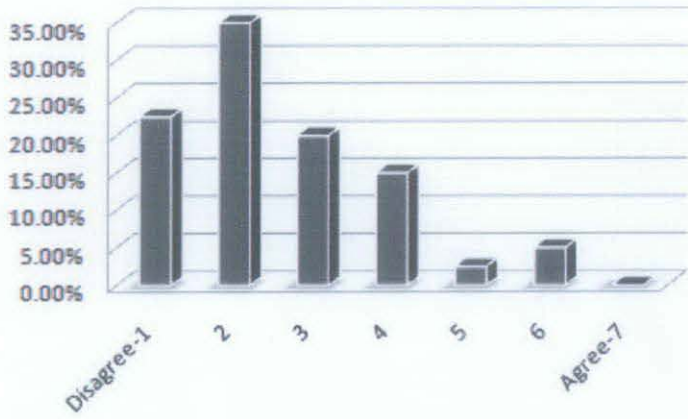

Figure 4.9: Problem - Chemistry is Boring/ No Interaction between Students and Teachers

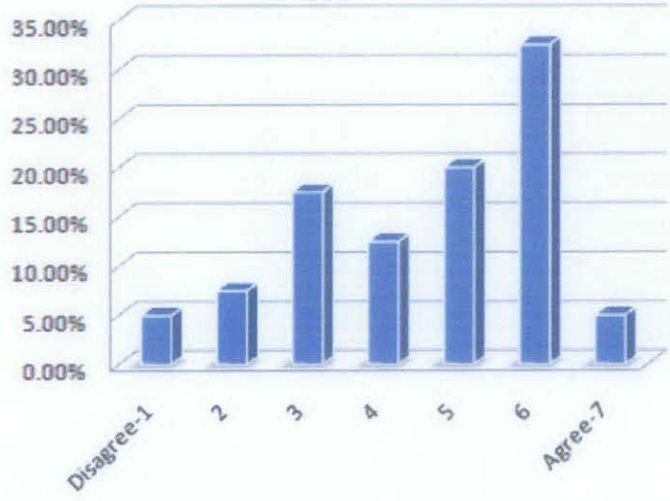

Figure 4.10: Problem - Chemistry Have Lots of Things need to be remembered

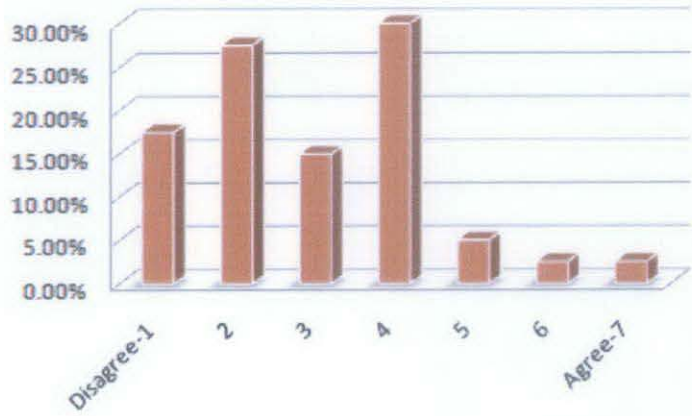

Figure 4.11: Problem - Students Have No Interest due to Conventional Teaching Method or Old Text Books

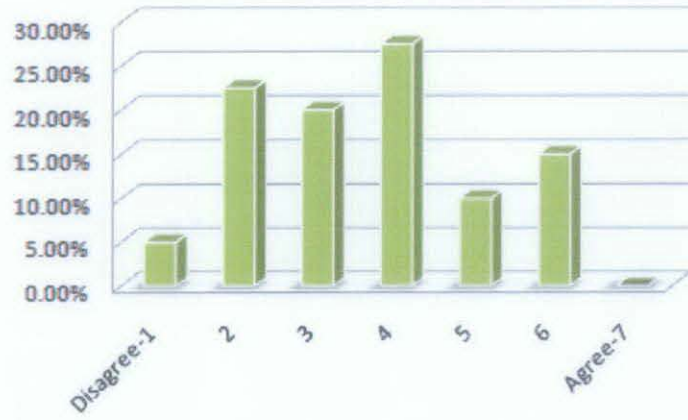

Figure 4.12: Problem - Chemistry Have Tough Calculations

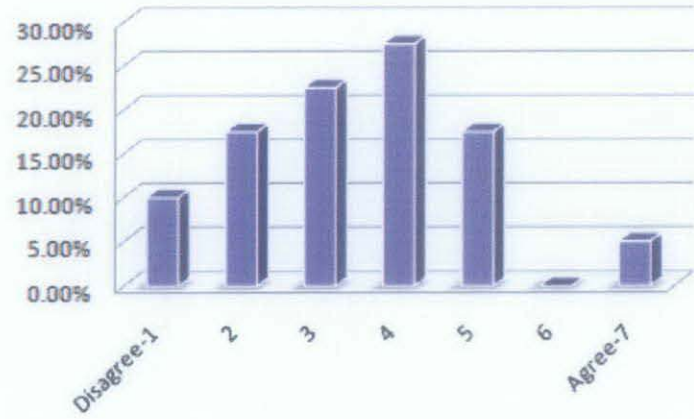

Figure 4.13: Problem - Chemistry is hard to Understand or Contains Unclear Description

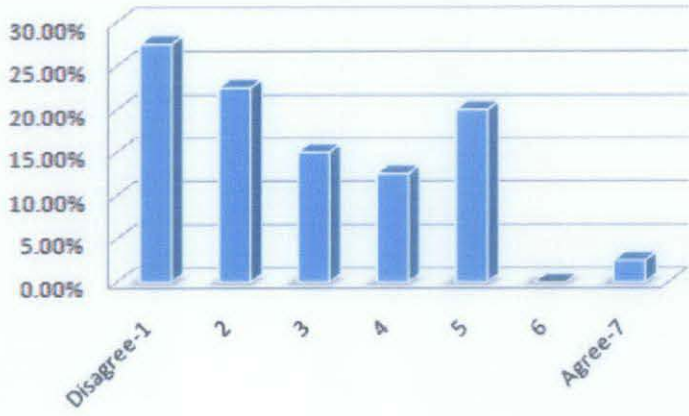

Figure 4.14: Problem - Chemistry is lacking of teaching Aid

Figure 4.9, Figure 4.10, Figure 4.11, Figure 4.12, Figure 4.13 and Figure 4.14 describes the percentage in which the students chose either the proposed problem is the real problem the students is facing in learning chemistry. From the figures, majority of students proclaimed that the only problem which they encounter during the lessons of chemistry is the difficulty in remembering the terms and chemistry's nomenclature, which has been described in Figure 4.9. They also need to remember the experiment's procedure in order for them to get better marks in exam. This has proven the problem statement proposed by the researcher of how chemistry, which contains lots of things to be remembered, produces difficulties in learning chemistry.

4.4.5 Best Genre for Chemistry Game

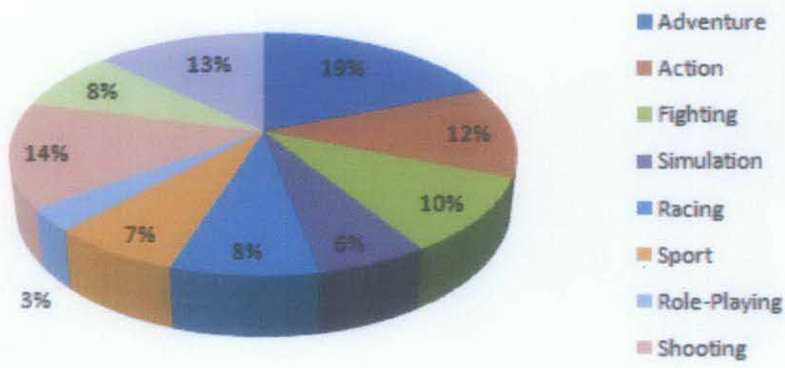

Figure 4.15: Genre Suitable for Chemistry-based Game

From Figure 4.15, the researcher is able to determine the type of game which will suit to the student's preferences. According to the table, only adventure, action, shooting and strategy type of genre is being rated as the best genre to use in order to develop the game. Hence, from this result, the researcher had decided to develop the game in the mix genre of adventure, action and strategy.

4.5 Deliverable's Interface

The planned project deliverable, which is an action/ adventure/ role-playing type of Android™ game had been successfully coded and delivered. The main interfaces or screenshots of the game are as follows:-

4.5.1 Start Screen

Figure 4.16: Akamia Start Screen

Figure 4.16 is the start screen of Akamia. It is the first screen the user will encounter after successfully installed the game towards their Android™ device. The Start Screen contains the New Game and Load button, which will redirect user either to create a new game, after successfully, entered the hero's name, or either to load previously saved game respectively.

4.5.2 Main Screen

Figure 4.17: Akamia Main Screen

Figure 4.17 shows the main screen of Akamia. This will be the screen where users will be spending most of their time playing Akamia. The main screen sets the playable-character, which is the hero and the non-playable-character, the NPC. The user can move the hero by clicking the tiles in the game; however, some places are unwalkable due to the mechanic of the game. Example such as, the hero cannot be moved to a tile which contain a cabinet or desk. In this screen, the users will find the NPC, which is important in setting the flow of the game. The NPC will be responsible for giving tasks and quests, which if the hero successfully solved it, rewards will be given then. The hero then can be transfer to other screens by moving it to the connective tile such as doors or cave's mouth. In later screens, the hero will meet the Monsters, which the hero can fight and obtain items and experiences in order to successfully journey through the game until the end.

4.5.3 Conversation Screen

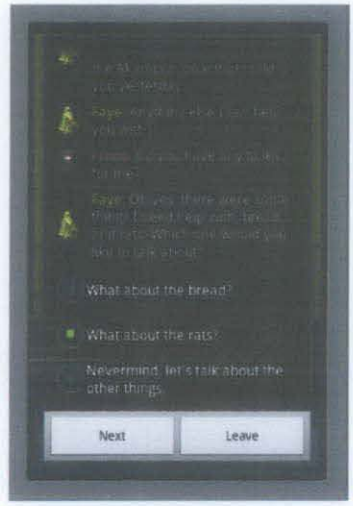

Figure 4.18: Akamia Conversation Screen

Figure 4.18 shows the conversation in Akamia. The conversation screen shall appear once the hero touches with the NPC. The conversation is important in order to explain things happening in Akamia and also for the giving quests to hero.

4.5.4 Hero Overview Screen

Figure 4.19: Akamia Hero Overview Screen

Figure 4.19 shows the hero overview screen. The screen can access by clicking on the hero icon on the bottom-left of the Akamia main screen. This screen will list the important hero status such as the health point (HP), the action point (AP) and the hero's level. Once the hero level up, which is by gaining the required amount of experience per level, users can click on the Level up button and choose any rewards given, intentionally to increase the user proficiency especially in battle with the monster. The Quest button will direct the user to a screen, showing the entire relevant quest in which the hero had initiated.

4.5.5 Inventory Screen

Figure 4.20: Akamia Inventory Screen

Figure 4.20 shows the inventory screen of Akamia. Here, it will list all the items obtained by the hero. Some of the items, such as weapons and equipments can be equipped by the hero and to be used in battle, whereby these equipments will enhance the hero's proficiency in battle such as boosting attack. Other items, which are called ETC, some of them is needed for questing purposes and the rest of them can only benefited the player by selling it to the merchant NPC.

4.5.6 Battle Screen – Encountering Monster

Figure 4.21: Akamia Battle Screen - Monster Encounter

Figure 4.21 shows one of the battle screens. This screen will appear only when the hero firstly initiated the battle with the monster. At this screen, it gives the freedom in either to attack the monster or not. It also provided the information regarding the monster under the Info button, and it will list down the entire important monster's status such as the monster's HP and its difficulty.

4.5.7 Battle Screen – Akamia Assist

Figure 4.22: Akamia Battle Screen - Akamia Assist

Figure 4.22 shows the Akamia Assist screen, in which it can only appear when the user click on the OK button in monster encounter screen, which is to accept the act of attacking the monster. The Akamia Assist screen will randomly generate Chemistry pop-quiz type of question, developed according to the survey of the difficult sub-topic of Chemistry (refer to Figure 4.8). The screen is set to be un-returnable, which means that the user cannot escape from answering the question. If the users answer it correctly, a type of reward will be given, but if it is wrong, nothing will happen. Penalty is avoided in order not to demoralize the users.

4.5.8 Battle Screen – Reward for Akamia Assist

Figure 4.23: Akamia Battle Screen - Akamia Assist Reward

Figure 4.23 shows the reward given to the hero due to correct answering of the pop-quiz in Akamia Assist screen. In this figure, it can be seen that the hero has been blessed by the skill of Regeneration, in which it will help to replenish the hero's HP and AP. Referring to the previous screen, the hero's HP is left halved (refer to Figure 4.21 and Figure 4.22). However, this action can only be triggered if the hero was the first one who initiate the battle, if it is the other way around, Akamia Assist will not happen.

4.5.9 Shop Screen

Figure 4.24: Akamia Shop Screen

Figure 4.24 shows the screen for the shop in Akamia. In this screen, user can actually buy or sell unwanted stuffs. The screen is triggered when the hero speaks to the merchant NPC, for Figure 4.24; the hero has triggered this screen by approaching the blacksmith, the merchant NPC who sell weapons and equipments. Some quests might ask the hero to buy some items from the merchant NPC and delivered it back to the quest giver.

4.5.10 Save Screen

Figure 4.25: Akamia Save Screen

Figure 4.25 shows the save screen in Akamia. The screen can be triggered by selecting it from the Menu button on the device. There are 4 slots available in order for users to save the game. The saved game then can be played back by using the Load button in the start screen (refer to Figure 4.16).

4.6 Usability Testing

Referring to section 3.3, the results of the usability testing being conducted are as Figure 4.26.

Figure 4.26: Level of Usability Achievement

Figure 4.26 explains the percentage of achievement towards the three elements of Usability which are Learnability (60%), Efficiency (70%) and Satisfaction (75%). From these results, the researcher had discovered that the main problem for the game is the lack of game flow. Respondents seem to get lost once they enter the game world. However, once they had learn the design or the architecture of the game, they can get a grasp on the matter and able to perform the same task in a better manner. The respondents seem satisfied with the game's interface as it is not confusing and misleading. Hence, in order to improve the game in a better manner, introduction of the game is essential to be given at the early stage, once the user arrived into the game world.

CHAPTER 5

CONCLUSION

The developed game is intended to provide like a tutorial type of learning for students to learn and master the subject of Chemistry effectively. In a sentence, the learning can be executed by the repetition of quizzes, providing challenges and rewarding students for their motivation by giving in-game benefits.

In conclusion, the developer is hoping that the developed chemistry game-based application will bring a lot of benefit especially to the target user, the form four and form five students which are taking the subject of chemistry for their SPM examination. It is also hoped that the game will be able to nurture and develop student's interest in the field of chemistry, hence increasing the student's motivation in learning chemistry.

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APPENDIXES

Questionnaire regarding student's views on conventional ways of teaching chemistry.

Intro:-

This questionnaire is intended in providing the researcher valuable information with regards to the topic mentioned. This questionnaire will be evaluating respondent opinion with regards to:-

1. The problems in learning chemistry, with regards to either the topics itself or the conventional way in teaching chemistry.

2. Student's backgrounds on mobile gaming, and opinions on applying game into the subject of chemistry.

Section 1: Background

1. Please tick the correct options:-

a) Gender: [ ] Male [ ] Female

2. Please state the grade that you have achieved in the last test/exam:-

_____

3. Please circle the option which would best describe your motivation in learning chemistry, giving 7 is the highest

Not motivated at all Very motivated

1 2 3 4 5 6 7

4. Please circle the option which would best describe your tendency in playing games (especially mobile games) during leisure time, giving 7 is the highest:-

Not interested in games						Playing games all the time
1	2	3	4	5	6	7

Section 2: Evaluation on chemistry

1. Please evaluate the given subtopics of chemistry by its difficulty, given 1 is the easiest and 7 is the hardest (can skip if did not learn the topic before):-

		Easiest						Hardest
a.	Introduction to Chemistry	1	2	3	4	5	6	7
b.	Structure of Atom	1	2	3	4	5	6	7
c.	Formula and Chemical Equation	1	2	3	4	5	6	7
d.	Periodic Table of Elements	1	2	3	4	5	6	7
e.	Chemical Bonds	1	2	3	4	5	6	7
f.	Electrochemistry	1	2	3	4	5	6	7
g.	Acids, Bases and Salts	1	2	3	4	5	6	7
h.	Manufactured Substances in Industry	1	2	3	4	5	6	7
i.	Rate of Reaction	1	2	3	4	5	6	7
j.	Carbon Compounds	1	2	3	4	5	6	7
k.	Oxidation and Reduction Reactions	1	2	3	4	5	6	7
l.	Thermochemistry	1	2	3	4	5	6	7

m. Chemicals for Consumers 1 2 3 4 5 6 7

2. Please evaluate the problems that you encounter during the learning of chemistry, either disagree or agree with it, giving 7 is the strongest agreement:-

a. Learning chemistry is too boring/ no interaction between students and teachers

Strongly disagree Strongly agree

1 2 3 4 5 6 7

b. Too many things (elements, nomenclature) that need to be remembered

Strongly disagree Strongly agree

1 2 3 4 5 6 7

c. No interest in learning chemistry due to teaching methods/ text books

Strongly disagree Strongly agree

1 2 3 4 5 6 7

d. The calculations need to be performed in chemistry are tough

Strongly disagree Strongly agree

1 2 3 4 5 6 7

e. Chemistry is hard to understand/ fail to get clear descriptions

Strongly disagree Strongly agree

1 2 3 4 5 6 7

f. Lack of teaching aid or materials used by teachers

Strongly disagree Strongly agree

1 2 3 4 5 6 7

g. Others (please specify)

_____

_____

Section 3: Evaluation on game in chemistry

1. Based on the problems, the researcher are proposing to implement games in the learning of chemistry since it will promote motivation and increase in the student's interest for chemistry, what do you think about it?

Excellent Not the best option

1 2 3 4 5 6 7

2. Rate the genre of games below in describing which would mostly suit to the subject of chemistry based in your preferences:-

		Best						Bad
a.	Adventure	1	2	3	4	5	6	7
b.	Action	1	2	3	4	5	6	7
c.	Fighting	1	2	3	4	5	6	7
d.	Simulation	1	2	3	4	5	6	7
e.	Racing	1	2	3	4	5	6	7
f.	Sport	1	2	3	4	5	6	7
g.	Role-playing	1	2	3	4	5	6	7
h.	Shooting	1	2	3	4	5	6	7
i.	Puzzle	1	2	3	4	5	6	7
j.	Strategy	1	2	3	4	5	6	7

Questionnaire used during Usability Testing.

Intro:-

This questionnaire is intended in providing the researcher valuable information with regards to the topic mentioned. This questionnaire will be evaluating respondent opinion with regards to:-

1. The usability of the game developed which will be divided into three main categories, which are learnability, efficiency and satisfaction.

Section 1: Background

1. Final result of chemistry subject (from matriculation/SPM/foundation) _____

2. Motivation in learning chemistry previously: -

1 2 3 4 5

Very Motivated Not Motivated At All

3. Motivation in playing RPG (Role Playing Game), Strategy, Action type of game: -

1 2 3 4 5

Very Motivated Not Motivated At All

Section 2: Usability Testing - Learnability

1. Is it easy for you to be able to navigate through the game at the first view?

1 2 3 4 5

Very Easy Very Difficult

2. Is it easy for you to get the concept of the game when you first try it?

1 2 3 4 5

Very Easy Very Difficult

3. Is it easy for you to get the game's information, such as the quests/ items/ NPCs (Non-playable character)?

1 2 3 4 5

Very Easy Very Difficult

4. Rate the overall easiness to play the game?

1 2 3 4 5

Very Easy Very Difficult

Section 3: Usability Testing - Efficiency

1. How fast can you grab the concept of the game, eg the storyline, the battle method, or the tasks of the game?

Very slow Very fast

1 2 3 4 5

2. Is it easy for you to understand those concepts (as in Question 1)?

Very difficult Very easy

1 2 3 4 5

3. Regarding Question 2, is it easy for you to perform back the tasks/ concepts?

Very difficult Very easy

1 2 3 4 5

4. Describe the overall efficiency of the game, which is the rate of easiness to perform back the methods/ concepts learnt?

Very difficult Very easy

1 2 3 4 5

Section 4: Evaluation on satisfaction

1. Rate the pleasantness of the game's interface, such as the location of the button?

Very unpleasant Very pleasant

1 2 3 4 5

2. Rate the pleasantness of the game's color to the eye?

Very unpleasant Very pleasant

1 2 3 4 5

Section 3: Opinion on research's implementation

1. It is easy to grab the concept of the chemistry pop-quiz during the battle method?

Very difficult Very easy

1 2 3 4 5

2. It is easy to remember and reimplement the battle concept next time you are involved in a battle?

Very difficult Very easy

1 2 3 4 5

3. Rate the interface of the battle method, either it is pleasant or not?

Very unpleasant Very pleasant

1 2 3 4 5

4. Rate the research implementation, either it is suitable to be implemented or not?

Very unpleasant Very pleasant

1 2 3 4 5

Sample codes for generating Akamia Assist, written in Eclipse under Android™ SDK.

```
package com.gpl.rpg.AndorsTrail.activity;

import java.util.Random;

import com.gpl.rpg.AndorsTrail.AndorsTrailApplication;

import com.gpl.rpg.AndorsTrail.R;

import com.gpl.rpg.AndorsTrail.context.ViewContext;

import com.gpl.rpg.AndorsTrail.context.WorldContext;

import com.gpl.rpg.AndorsTrail.controller.CombatController;

import com.gpl.rpg.AndorsTrail.controller.ItemController;

import com.gpl.rpg.AndorsTrail.model.actor.Player;

import android.app.Activity;

import android.app.AlertDialog;

import android.content.DialogInterface;

import android.content.Intent;

import android.os.Bundle;

import android.view.View;

import android.widget.Toast;

public class akamia_assist extends Activity {

        private WorldContext world;

        private ViewContext view;//changed

        /** Called when the activity is first created. */

        @Override

        public void onCreate(Bundle savedInstanceState) {

          super.onCreate(savedInstanceState);

                AndorsTrailApplication app = AndorsTrailApplication.getApplicationFromActivity(this);

                this.world = app.world;

                this.view = app.currentView.get();//changed

                setContentView(R.layout.main);

                akamia_trivia();

                // TODO Auto-generated method stub
```

```
        }
        public void akamia_help(int randomSkill){
                final CombatController c = view.combatController;
                 final Player player = world.model.player;
                if(randomSkill == 1||randomSkill == 2||randomSkill == 3||randomSkill == 4||randomSkill == 5){
                        c.executeMoveAttack(0, 0);
                        Toast.makeText(akamia_assist.this, "Correct !!", Toast.LENGTH_SHORT).show();
                        Toast.makeText(akamia_assist.this, "Akamia's Crusher - perform an attack to the monster",
Toast.LENGTH_LONG).show();
                }
                else{
                        player.setMaxAP();
                        player.setMaxHP();
                        Toast.makeText(akamia_assist.this, "Correct !!", Toast.LENGTH_SHORT).show();
                        Toast.makeText(akamia_assist.this, "Regeneration - replenish hero's HP and AP ",
Toast.LENGTH_LONG).show();
                }
        }
        public void akamia_trivia(){
                AlertDialog.Builder alert = new AlertDialog.Builder(akamia_assist.this);
                alert.setTitle("Akamia Assist !!");
                int randomQuest = 0;
                Random rQ = new Random();
                randomQuest = rQ.nextInt(10) + 1;
                if(randomQuest == 1){
                alert.setMessage("What is the electron valence for electron configuration of 2.8.8.2 ?");
                alert.setCancelable(false);
                alert.setPositiveButton("+2", new DialogInterface.OnClickListener() {
                public void onClick(DialogInterface arg0, int arg1) {
                        akamia_help(1);
                        akamia_assist.this.finish();
    }
  });
```

```
alert.setNeutralButton("+1", new DialogInterface.OnClickListener() {

public void onClick(DialogInterface arg0, int arg1) {
        Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
        akamia_assist.this.finish();
}
});
alert.setNegativeButton("0", new DialogInterface.OnClickListener() {
public void onClick(DialogInterface arg0, int arg1) {
        Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
        akamia_assist.this.finish();
}
});
AlertDialog alerts = alert.create();
alerts.show();
}
else if(randomQuest == 2){
alert.setMessage("The change from the solid state to the gaseous state is called?");
alert.setCancelable(false);
alert.setNeutralButton("Evaporation", new DialogInterface.OnClickListener() {
public void onClick(DialogInterface arg0, int arg1) {
        Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
        akamia_assist.this.finish();
}
        });
alert.setNegativeButton("Sublimation", new DialogInterface.OnClickListener() {
public void onClick(DialogInterface arg0, int arg1) {
        akamia_help(2);
        akamia_assist.this.finish();
}
});
        AlertDialog alerts = alert.create();
        alerts.show();
}
```

```
        else if(randomQuest == 3){

        alert.setMessage("A chemical bond formed by sharing of electrons is a/an");
        alert.setCancelable(false);
        alert.setPositiveButton("Ionic bond", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
});
        alert.setNegativeButton("Covalent bond", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    akamia_help(3);
                    akamia_assist.this.finish();
    }
});
                    AlertDialog alerts = alert.create();
                    alerts.show();
        }
        else if(randomQuest == 4){
        alert.setMessage("H2O is the chemical formula of");
        alert.setCancelable(false);
        alert.setPositiveButton("Salt", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
});
        alert.setNeutralButton("Water", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    akamia_help(4);
                    akamia_assist.this.finish();
    }
                    });
```

```
        alert.setNegativeButton("Sugar", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                akamia_assist.this.finish();
    }
});
        AlertDialog alerts = alert.create();
        alerts.show();
        }
        else if(randomQuest == 5){
        alert.setMessage("Which of the following compounds is ionic ?");
        alert.setCancelable(false);
        alert.setPositiveButton("CH4", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                akamia_assist.this.finish();
    }
});
        alert.setNeutralButton("NaCl", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                akamia_help(5);
                akamia_assist.this.finish();
    }
                });
        alert.setNegativeButton("HCl", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                akamia_assist.this.finish();
    }
});
        AlertDialog alerts = alert.create();
        alerts.show();
        }
        else if(randomQuest == 6){
```

```
        alert.setMessage("What is the electron valence for electron configuration of 2.8.6 ?");
        alert.setCancelable(false);
        alert.setPositiveButton("-2", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    akamia_help(6);
                    akamia_assist.this.finish();
    }
});
        alert.setNeutralButton("-1", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
                    });
        alert.setNegativeButton("0", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
});
        AlertDialog alerts = alert.create();
        alerts.show();
        }
        else if(randomQuest == 7){
        alert.setMessage("The name of the compound with the formula KCl is");
        alert.setCancelable(false);
        alert.setPositiveButton("Potassium Chloride", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    akamia_help(7);
                    akamia_assist.this.finish();
    }
});

        alert.setNegativeButton("Potassium Chlorate", new DialogInterface.OnClickListener() {
```

```
        public void onClick(DialogInterface arg0, int arg1) {
                Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                akamia_assist.this.finish();
    }
});
        AlertDialog alerts = alert.create();
        alerts.show();
        }
        else if(randomQuest == 8){
        alert.setMessage("The first element in the modern periodic table is");
        alert.setCancelable(false);
        alert.setPositiveButton("Helium", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                akamia_assist.this.finish();
    }
});
        alert.setNeutralButton("Lithium", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                akamia_assist.this.finish();
    }
                });
        alert.setNegativeButton("Hydrogen", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                akamia_help(8);
                akamia_assist.this.finish();
    }
});
        AlertDialog alerts = alert.create();
        alerts.show();

        }
        else if(randomQuest == 9){
```

```
        alert.setMessage("The least reactive elements of the periodic table are");
        alert.setCancelable(false);

        alert.setPositiveButton("Alkali Metals", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
});
        alert.setNeutralButton("Transition Metals", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
                    });
        alert.setNegativeButton("Noble Gases", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    akamia_help(9);
                    akamia_assist.this.finish();
    }
});
        AlertDialog alerts = alert.create();
        alerts.show();

        }
        else{
        alert.setMessage("H2SO4 is");
        alert.setCancelable(false);
        alert.setPositiveButton("Sodium carbonate", new DialogInterface.OnClickListener() {
        public void onClick(DialogInterface arg0, int arg1) {
                    Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                    akamia_assist.this.finish();
    }
});
```

```
                alert.setNeutralButton("Sulfuric acid", new DialogInterface.OnClickListener() {

                public void onClick(DialogInterface arg0, int arg1) {
                        akamia_help(10);
                        akamia_assist.this.finish();
                }
                        });
                 alert.setNegativeButton("Water", new DialogInterface.OnClickListener() {
                public void onClick(DialogInterface arg0, int arg1) {
                        Toast.makeText(akamia_assist.this, "Wrong answer!!", Toast.LENGTH_SHORT).show();
                        akamia_assist.this.finish();
                }
        });
                        AlertDialog alerts = alert.create();
                        alerts.show();
                }
}
}
```