Edutainment Game on Recycling

for Kids Using 3-D Visualisation

by

Syafiqah Binti Ali

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Business Information System)

May 2011

Universiti Teknologi PETRONAS
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CERTIFICATION OF APPROVAL

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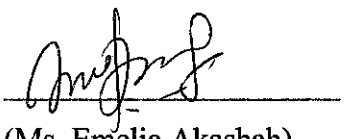
Approved by,



(Ms. Emelia Akashah)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
May 2011

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.

(SYAFIQAH BINTI ALI)

ABSTRACT

The 'Recycle Warrior' game is one such initiative that exposes children in Malaysia from age 10 to 12 years old to an authentic learning experience on recycling issues in a simulated, 3- Dimensional and exciting environment. The prototype is built with a story-line, challenges, and a reward system. It is expected to impart necessary knowledge on the concept and importance of recycling activities to the young children in order to increase the environmental consciousness among them as well as to motivate them to perform recycling activities in their life. This paper presents the analysis, design, implementation and evaluation of the prototype. It will first present a review of literature on recycling, edutainment game, comparison between 3-D and 2-D game, game genre and the children characteristics. It will then discuss on the research methodology adopted in conducting the research for the design requirements as well as the system methodology. The system is developed using "Thinking Worlds" which was developed by Caspian Learning. Besides that, the paper will also it will present on the implications and challenges that occurred throughout the development process as well as the recommendation for improvement of the game.

ACKNOWLEDGEMENT

First of all, I would like to say Alhamdulillah, for giving me the strength and health to perform this project. Not forgotten thanking to my family for providing everything, such as money, to buy anything that are related to this project work and their advise, which is the most needed for this project. They also supported me and encouraged me to complete this task so that I will not procrastinate in doing it. Then, I would like to thank my supervisor, Ms. Emelia Akashah, whose encouragement, guidance and support from the initial to the final level enabled me to develop an understanding of the subject comprises in the project. I would also like to thank Mr. Chris Barniggan and Mr. Lee Rustworth, the system developer of Thinking Worlds, for sharing their valuable time and for giving me helpful information on the tutorials to develop the game using the Thinking Worlds software. Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the project.

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CHAPTER 1
INTRODUCTION

1.1 Background of Study

Malaysia is experiencing rapid population growth and urban transformation over the last decade. The amount and types of solid waste have increased corresponding to the economic growth and improving living standard [1]. According to [2], Malaysia disposes 28,500 tonnes of municipal solid waste (MSW) directly into the landfills daily. This fact alone necessitates sustainable landfills to avoid adverse impacts on the population and the environment.

In order to reduce the amount of waste entering landfills, policymakers and governments have implemented various recycling and waste reduction programs such as source reduction, curbside recycling and drop-off recycling programs [3]. However, it was reported that public participation in recycling is still very low despite rigorous campaigns conducted by the government since 1993. At present, only five percent of solid waste generated in Malaysia was actually separated and recycled, although a large amount of Malaysian waste has the potential to be recycled [4].

The findings from studies conducted by [5] indicate that the households were not aware about the benefits of recycling and waste separation. Therefore, concerted efforts should be taken to raise environmental consciousness on the importance of recycling especially to the young children as the shaping of attitude, values, commitment and skills needed to preserve and protect the environment of individuals begins at an early age [6, 7].

Based on the statement above, schools, particularly in Malaysia have implemented Environmental Education (EE) across curriculum at primary and secondary level to educate the young generations on environmental issues [8]. Despite that, it was found that there were no significant changes produced in students' level of awareness, attitudes and behavior [9]. This is because these approaches were generally not coordinated and implemented effectively in the education system.

On the other hand, a lot of edutainment games on recycling was developed to assist in the learning of recycling concept and to overcome the unattractive learning of formal education. But, currently, most of the games provided in the market are in 2-Dimensional (2-D) graphics which unable to deliver the value of the subject to some of the children that are lack of visualisation on abstract concept.

Thus, the 'Edutainment Game on Recycling for Kids using 3-D Visualisation' is projected as the title of this project which will be focusing on recycling of solid waste. It is designed in order to give exposure to the children on the environment as well as to instill them with the importance of recycling in order to preserve the environment. In addition, it is also developed with the technology of 3-Dimensional (3-D) visualisation in order to help the children get the basic idea of what the topics is all about in a more effective and interactive manner.

1.2 Problem Statement

1.2.1 Problem Identification

The problems that have been identified regarding this issue are:

a) **Lack of participation among Malaysian citizens in recycling activities.**
Currently, the recycling rate in Malaysia is only around five percent [4]. Therefore, it is important to educate the community on the recycling concept especially to young children in order to have more effective impact in preserving the environment.

b) **Incompetence and non-effective EE programme conducted in schools.**
There were no significant changes produced in students' level of awareness, attitudes and behavior. [9]

c) **Most of current edutainment games on recycling are in traditional 2-D.**
Some of the children were not able to learn the value of the subject from current edutainment game provided in the market as they are lack of visualisation on abstract concept.

1.2.2 Significance of the project

a) **Assist in educating the importance of recycling to the young children.**
This project will be able to give exposure to the children on the environment as well as to instill them with the importance of recycling in order to preserve the environment and to ensure the sustainable development of the nation.

b) **Interactive use of 3- Dimensional technology.**
The children can benefit from the use of 3D technology, which makes instruction more visual and allows the children to be more attracted as well as participate actively in learning the related topics.

c) **Ease of use.**

The children can go through the lesson at his or her own pace (anytime & anywhere). Moreover, the content of this application is easy for the children to use.

1.3 Objectives and Scope of Study

1.3.1 Objectives

The objectives of this project are:

a) To educate the young children on solid waste recycling concept as well as its importance.

b) To determine the design requirements in order to develop a prototype for the topics identified.

c) To develop a platform to disseminate the information to young children using 3-D visualisation as it is more attractive and interesting to the users.

1.3.2 Scope of Study

The project involves the study of area:

a) Recycling issues especially in Malaysia in order to ensure the project is feasible and could be completed within the allocated time frame.

b) Target users for the application which are upper primary school students (age 10 to 12 years old). The game application also needs several features and functions that could be understood and observable by these types of users. This application will be based on learning through games which need an interaction from the users with the application. It is a combination of the contents materials along with 3-D visualisation game in order to make the children more attracted and fully utilize the application.

CHAPTER 2
LITERATURE REVIEW

2.1 Recycling

Recycling is the process of collecting used products from the field, disassembling them, separating them into categories of like materials (e.g. specific plastic types, glass, etc.), and processing them into recycled products, components, and/or materials [10]. It is also a part of the sustainable and effective waste management system for most of the cities in the world.

Recycling of solid waste is very important because it will ensure a clean, fresh and sustainable environment for all. It will also save the environment in Malaysia from degradation, obnoxious smells and methane gas [11]. Besides that, recycling process also helps in the stimulation of economic and technological development, conservation of natural resources and energy as well as the preservation of funds earmarked for waste disposal [12]. Moreover, recycling of solid wastes should be integrated into the existing and future waste management plans so as to yield the benefits of conservation of natural resources, saving of fossil fuels and prolonging lifespan times of disposal sites.

In addition, the country targeted that by Year 2020, the waste recycling activities will increase up to 22% [13]. This is accordance to the comprehensive national objective of shifting the waste hierarchy to more recycling and less disposal to landfills as shown in Figure 2.1.1 below:

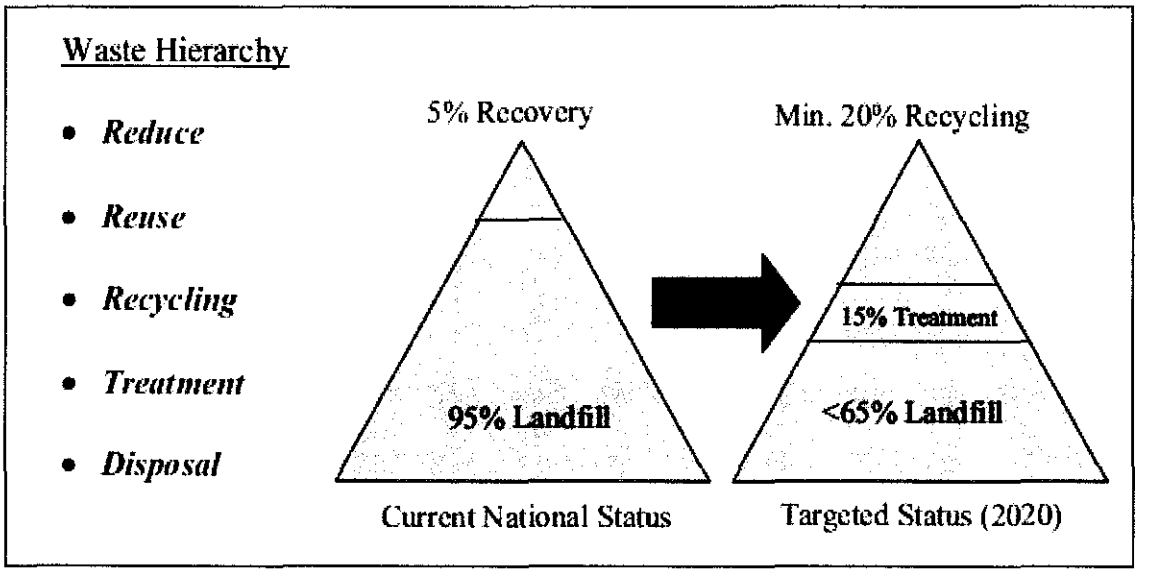

Figure 2.1.1: Current and targeted (Year 2020) Waste hierarchy for Malaysia

By 2020, 50% of municipal waste materials including at least paper, metal, plastic and glass must be recycled. That will say 50% of all municipal paper waste including newspaper waste and writing paper waste (and not only paper and cardboard packaging waste) has to be recycled. For nonhazardous construction and demolition waste the target is 70% of recycling. This target includes also wood from construction and demolition activities.

The authors [14], finds that the success of a recycling program largely depends on household participation and sorting activities. Moreover, they also suggested that promotion efforts (i.e. recycling education) should be aimed at children and community in general as it can increase recycling activities indirectly. Besides that, the development of long-term education programmes at school level is also important to educate the younger generation to direct them towards future consumption lifestyles and purchasing decisions that focuses on waste minimization. By disseminating information to the students, it is hoped that it would gather critical mass from their homes.

Malaysia supports the statements above, thus, recycling has been taught in formal education through EE since 1998 in the country. The programme was introduced in national system of Education, starting from standard 3 to 6 in primary schools [8, 9]. It is also was introduced through the infusion and integration approach, as well as introduced in relevant subjects such as English Language, Malay Language, Geography, Science. However, these approaches were generally not coordinated and implemented effectively. This happen because there was no specific policy on EE. EE is taught as a classroom subject per se. Moreover, teachers are not aware about the guidebooks for the implementation of EE as it was not widely distributed. Many classroom teaching do not create the awareness that is required to be instilled in the students [15].

Therefore, the project on "Edutainment Game on Recycling for Kids Using 3-D Visualisation" was initiated to overcome the problems occurred by the country in disseminating the information as well as the importance of recycling to the young children.

2.2 Edutainment

The term "Edutainment" has been used since in 1970s to indicate the use of computer games partly educational and to some extent entertaining [16]. According to New World Encyclopedia [17], edutainment is a form of entertainment designed to educate as well as to amuse. It is a "hybrid genre that relies heavily on visual material, on narrative or game-like formats, and on more informal, less didactic styles of address". Successful edutainment is evident by the fact that learning becomes fun and teachers or speakers educate an audience in a manner which is both engaging and amusing.

As edutainment is a combination of education and entertainment, this integration is primarily to create a motivating and successful environment for learning. Edutainment is a game used to teach particular knowledge. Edutainment had also been employed in games software including all type of electronic games such as computer games, console games, handheld and portable games. Seeing that, there is no doubt that edutainment is the field of today technology assembling to enhance interactivity and stimulate creative thinking. In addition, research performed by [18] finds that edutainment also increase the user attention and learning retention.

However, there are several critiques on the effectiveness of edutainment on which whether the edutainment software is really educational. The study by [19] examines on the educational power of edutainment software for young children and provides requirements that can help designers of new edutainment games to improve the educational quality of edutainment software. They said that to achieve powerful learning in children, high engagement or flow should be attained. Interaction or instruction should be provided within the application as it would evoke self- sustaining curiosity and interest in understanding new concepts or tasks. Playful learning can therefore function as an appropriate environment for young children to optimally learn new skills and concepts.

The project on "Edutainment Game on Recycling for Kids Using 3-D Visualisation" can also be justified as one of the edutainment elements as it provides with the education on recycling concept through interactive medium which is through game. The target people will become aware on how they will react in certain situation in their real life. As the development of the game application, the users are exposed to make a right decision before they could proceed with some action. The topic on recycling will be cover as it is important to educate the children on the importance of preserving the environment for future sustainability.

2.3 3-D Game Vs 2-D Game

Currently, there are already many types of games on environment and recycling in the internet. However, some of the children were not able to learn the value of the subject from current edutainment game provided in the market as they are lack of visualisation on abstract concept. In order to support this statement, the author has performed research on two of the edutainment game related to recycling, which are Recycle Roundup [20] and Eco-Pack: Recycling![21] that was developed by National Geographic and NoteNiks respectively.

Figure 2.3.1: Recycle Roundup

In Figure 2.3.1, the game is quite simple and straightforward. The users are required to drag and drop the trashes in the park into the right trash can in 2 minutes and get scores for each right move. The author finds that, the game is fun to play, but it does not show the importance of recycling and the impact of it to the environment.

Figure 2.3.2: Eco-Pack: Recycling!

While, in Figure 2.2.2, the Eco-Pack: Recycling! The game was developed for children age from 5 to 10 years old. These interactive games and activities help children identify garbage to be recycled in familiar environments like the beach, park, school and city. The figure above shows one of the activities included in the game which is (Recycle It?) in which the users are required to select the correct items to be recycle. Compared to the previous game, this game provides extra information related to recycling concept and environment in the form of text and static image.

However, based on the evaluation on the existing game applications, the author conclude that most of the edutainment game on recycling are generally in 2-D and it is quite simple in terms of it multimedia elements, the user friendliness of it and etc. Thus, interactive games using 3-D visualisation should be created in order to capture more attention among the users as well as to enable them to learn the subject effectively by helping them to visualize on the issues related to the environment.

There are several advantages of using 3-D graphics compared to 2-D graphics in game development. 3D computer graphics support children's learning motivation and their traditional as well as digital literacy development [22]. Other than that, the inclusion of 3D objects resulted in an improved and more appealing scene [23]. The results by [24] on military battlefield simulation stated that the implementation of 3D models decreased the time spent in learning the system and resulted a better view of the subject. Moreover, Kickmeier-Rust, et al., [25] proposed that, for teaching and learning purposes, 3D immersive games are basically superior to 2D games because the latter fail to hold a players attention for extended periods of time.

Therefore, graphic designers and implementers have been pushed to invest enormous efforts to make interactive 3D environments as aesthetically pleasant, detailed and realistic as possible attempting to reproduce the physical features and behaviors of the "real" world. According to [26], several interesting 3D virtual realities have been created with the above assumptions, e.g., Second Life.

2.4 Online Role-Playing Game

There are many game genres associated in developing computer or video games. In this sense it is very important to choose a game genre that suits these needs. Various studies have been conducted to analyze what are the suitable genres for educational applications [27]. As for this project, the game genre that will be use is Online Role-Playing Game (ORPG) as it is suitable for the target group which is children from age 10 to 12 years old.

Role-Playing Games (RPG's) are characterized by specific strategic and action contexts of play where each player takes on a role according to the game rules. Play actions and decisions happen through a spirit of discovery and learning. [28]. Role-playing provides a way to know to a greater than normal extent of the text and the interpretation of the available information at play [29]. Therefore it can be used to measure whether certain analytic forms reveal traits that are known to exist, something that is usually impossible in relation to a static text. Research done by [30] shows the players' progress of applying and developing their knowledge in several areas, such as their knowledge of the local history and the motivation behind the game setup was greatly enhanced. Another research done by [31] shows that RPG can be a very useful way of accompanying the collective learning process and RPG made the participants aware of their own responsibilities and encouraged them to engage in the learning process.

Besides that, the application game for this project will be develop in the form of online game due to rapid advancement in web-browser and internet technology. According to [22], online delivery or web-based training offers possibilities which are not available offline as it enables the live update of latest content. While, the data in a CD-ROM or stand-alone program is difficult to change or update once it is created since CDs are used to hold fixed collections of data. Moreover, the material expenses and development of online delivery is relatively lower than educational CD-ROM. The costs and time consumed in producing a CD and delivery of CD are the expenditures that can be reduced by using online delivery. In addition, with zero service charges in using the Internet to deliver the content, users can easily access to the learning content anytime at their own pace (portability).

2.5 Children Characteristic/Behaviour

As children are concern in this project, ones need to know their characteristic that will be useful in creating such an interactive game on recycling for them. In a magazine article by Sarah L. [32] stated that Maureen Haley, child therapist and author of 365 Perfect Things to Say to Your Kids says, "Brain development is activity-dependent for growth so a child needs to interact with their environment to cognitively, emotionally, biologically and socially grow into the best iteration of themselves."

The target group for this project is the upper level of primary school children (age 10 to 12 years old) which also known as late-middle childhood. This is because it is in line with the implementation of Environmental Education (EE) in Malaysia education system which starts from standard 3 to standard 6 in primary schools [8]. Educators also find that children should be accepted as an important component of ecological culture. In middle childhood, children begin to address more complex concepts such as loss of species and develop the courage to manage problems, challenges, investigations, and just manageable risk [33].

Moreover, the University of Chicago [34] has come out with the Developmental Characteristics and Interests of School-Age Children which range of 5 to 14 years old. It has been stated that the children with the range of age from 10 to 12 years old are beginning to develop view about social/global issues, enthusiastic about game especially the one that allow for self improvement, have a growing desire to assert individuality and independence, enjoy problem solving games and puzzle, also the rule based game, attract to something that are attractive and colorful stuff. All this characteristics will take into action in developing this game application.

CHAPTER 3
METHODOLOGY

3.1 Research Methodology

Throughout the project, the research methodology being used in discovering the idea is by collecting the secondary data (i.e. Reports, Articles, Journals & etc.). Data collected from these sources is then grouped in order to identify the requirements for the game such as recycling, edutainment, 3D game, ORPG and children characteristics.

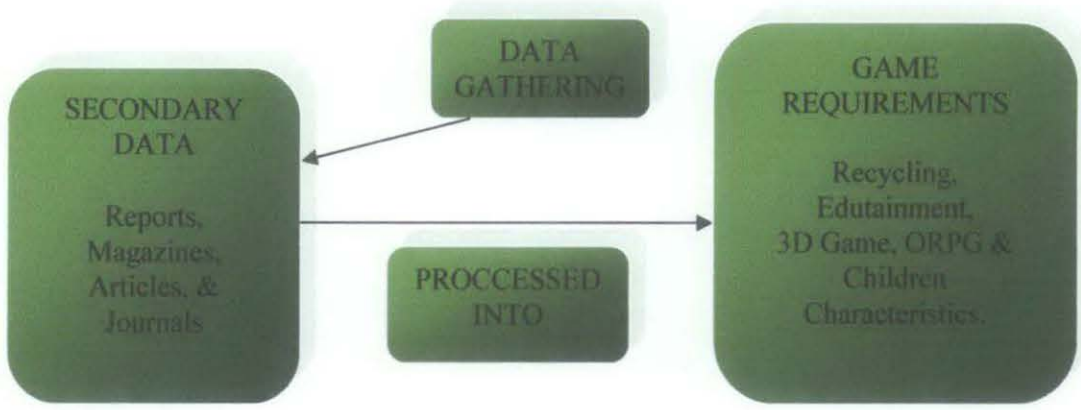

Figure 3.1.1: Research Methodology

In addition, surveys (please refer to Appendix I & II) are also being conducted during the data gathering process in order to determine the requirements needed in developing the game. The results of the surveys are included under 'Data Gathering and Analysis' section of the 'Methodology' part. Besides that, comparison between the tools used and type of similar games in the market are also being conducted in order to gain more requirements needed in developing the application.

For this project, the game will be created with such situation as in the real life of the children. This is needed to get the children familiarized and feel comfortable with the game application. The development of the game will be covered throughout the process of this project. Moreover, the user acceptance testing (UAT) also has been conducted after the completion of the application. The testing is conducted through a survey (please refer to Appendix III & IV) in order to find out the application usability and user acceptance of the application. The results of this testing is included in the 'User Acceptance Testing' section of the 'Results & Discussion' part.

3.2 System Methodology

As for this project, the system methodology that will be used in the development of the application is the prototyping methodology [35]. The steps occur in the methodology are as follow:

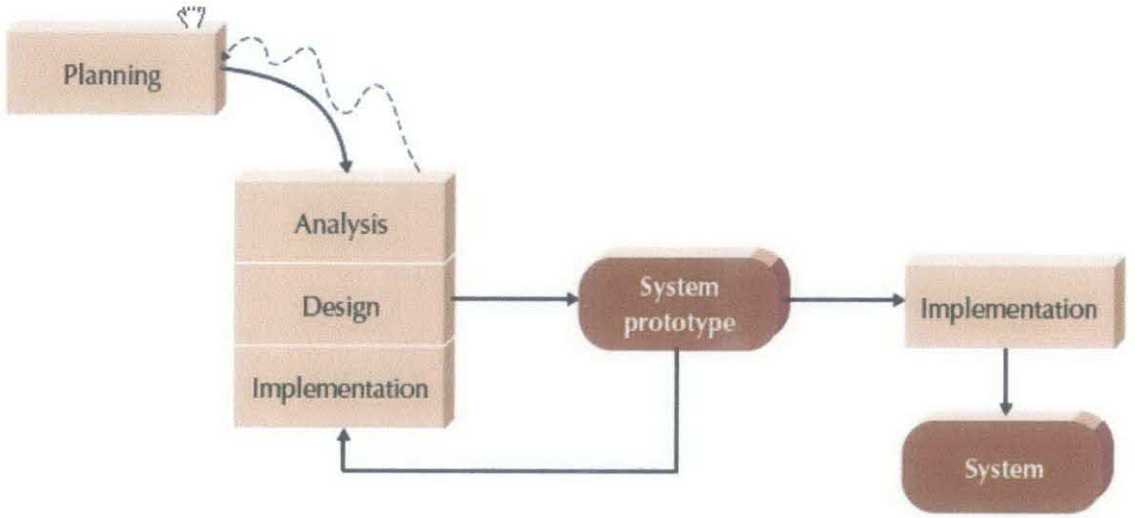

Figure 3.2.1: Prototyping Methodology

The prototyping-based methodologies carry out the analysis, design, and implementation phases concurrently, and all three phases are performed repeatedly in a cycle until the system is completed. With these methodologies, a basic analysis and design are performed, and work immediately begins on a *systemprototype,* a "quick-and-dirty" program that provides a minimal amount of features.

The first prototype is usually the first part of the system that the user will use. This is shown to the users and the project sponsor, who provide reaction and comments. This feedback is used to reanalyze, redesign, and re-implement a second prototype that provides a few more features. This process continues in a cycle until the analysts, users, and sponsor agree that the prototype provides enough functionality to be installed and used by the users. After the prototype is installed, refinement occurs until it is accepted as the new system.

The basic principles of prototyping are; it is not a standalone, complete development methodology, but rather an approach to handling selected parts of a larger, more traditional development methodology (i.e. incremental, spiral, or rapid application development (RAD)). It also attempts to reduce inherent project risk by breaking a project into smaller segments and providing more ease-of-change during the development process. Moreover, small-scale mock-ups of the system are developed following an iterative modification process until the prototype evolves to meet the users' requirements.

In addition, there are several advantages of using prototyping in software development (some are tangible and some are abstract) such as:

a) **Reduced time and costs**

Prototyping can improve the quality of requirements and specifications provided to developers. Because changes cost exponentially more to implement as they are detected later in development, the early determination of *what the user really wants* can result in faster and less expensive software.

b) **Improved and increased user involvement**

Prototyping requires user involvement and allows them to see and interact with a prototype allowing them to provide better and more complete feedback and specifications.

The key problem of prototyping is its fast-paced system releases challenge attempts to conduct careful, methodical analysis. Often the prototype undergoes such significant changes that many initial design decisions prove to be poor ones. This can cause problems in the development of complex systems because fundamental issues and problems are not recognized until well into the development process. A basic understanding of the fundamental business problem is necessary to avoid solving the wrong problem.

The phases or steps involved in the methodology are explained in detail as below:

a) Planning

The *planning phase* is the fundamental process of understanding *why* a system should be built and determining how to build it. It has two steps which are *project initiation* by which a *project proposal* is created to presents a brief summary of the project and explains how a system that supports the need will create business value. Next is *project management,* whereby the author creates a *work plan,* staffs the projects, and puts techniques in place in order to be able to control and direct the project through the entire System Development Life Cycle (SDLC). The deliverable for project management is a *project plan* that describes on how the application will be develop.

b) Analysis

The *analysis phase* answers the questions of *who* will use the system, *what* the system will do, and *where* and *when* it will be used. During this phase, the author investigates any current game application(s) available in the market that is related to environment or recycling, identifies improvement opportunities, and develops a concept for the new game application. This phase has three steps which are *analysis strategy, requirements gathering* and *documents submission. Analysis strategy* includes an analysis of the current system or game application and its problems, and then finds ways to design a new system. Next, is the *requirements gathering*, in which the analysis of this information, in conjunction with input from the target users and many other people, leads to the development of a concept for a new game application. Lastly, is the *documents submission* whereby the analyses, system concept, and models are combined together into a document called *extended project proposal*. After that, a document called *interim report* is created, which is basically a refinement of the *extended project proposal* based on the comments given by the supervisor and external examiners during the presentation of the earlier proposal.

c) Design

The *design phase* decides *how* the application will operate, in terms of the hardware, software, and network infrastructure; the user interface, forms, and reports that will be used; and the specific programs, databases, and files that will be needed. The design phase has four steps which are *design strategy, architecture design, database and file specification,* and *program design. Design strategy* clarifies whether the game will be developed from scratch (fully coding) or through existing software package. Next, the *architecture design* describes the hardware, software, and network infrastructure that will be used. After that is *database and file specification* which defines exactly what data will be stored and where they will be stored. Lastly, the *program design* defines the programs that need to be written and exactly what each program will do. This collection of deliverables (architecture design, interface design, database and file specifications, and program design) is the *system specification* that will be used by the author for implementation. At the end of the design phase, the feasibility analysis and project plan are reexamined and revised for further enhancement.

d) Implementation

The final phase which is the *implementation phase is* during which the game is actually built or purchase. This is the phase that usually gets the most attention, because for most systems it is the longest and most expensive single part of the development process. This phase has three steps. Firstly, the *system construction* is the steps in which the system or game application is built and tested to ensure it performs as designed. Since the cost of bugs can be immense, testing is one of the most critical steps in implementation. Next is the *installation* phase, the process of putting the application into practice. Lastly, is the development of *support plan* in which the plan usually includes a formal or informal post-implementation review, as well as a systematic way for identifying major and minor changes needed for the game.

3.3 Project Activities and Key Milestone

The project activities and key milestone are stated in the Gantt chart as follow:

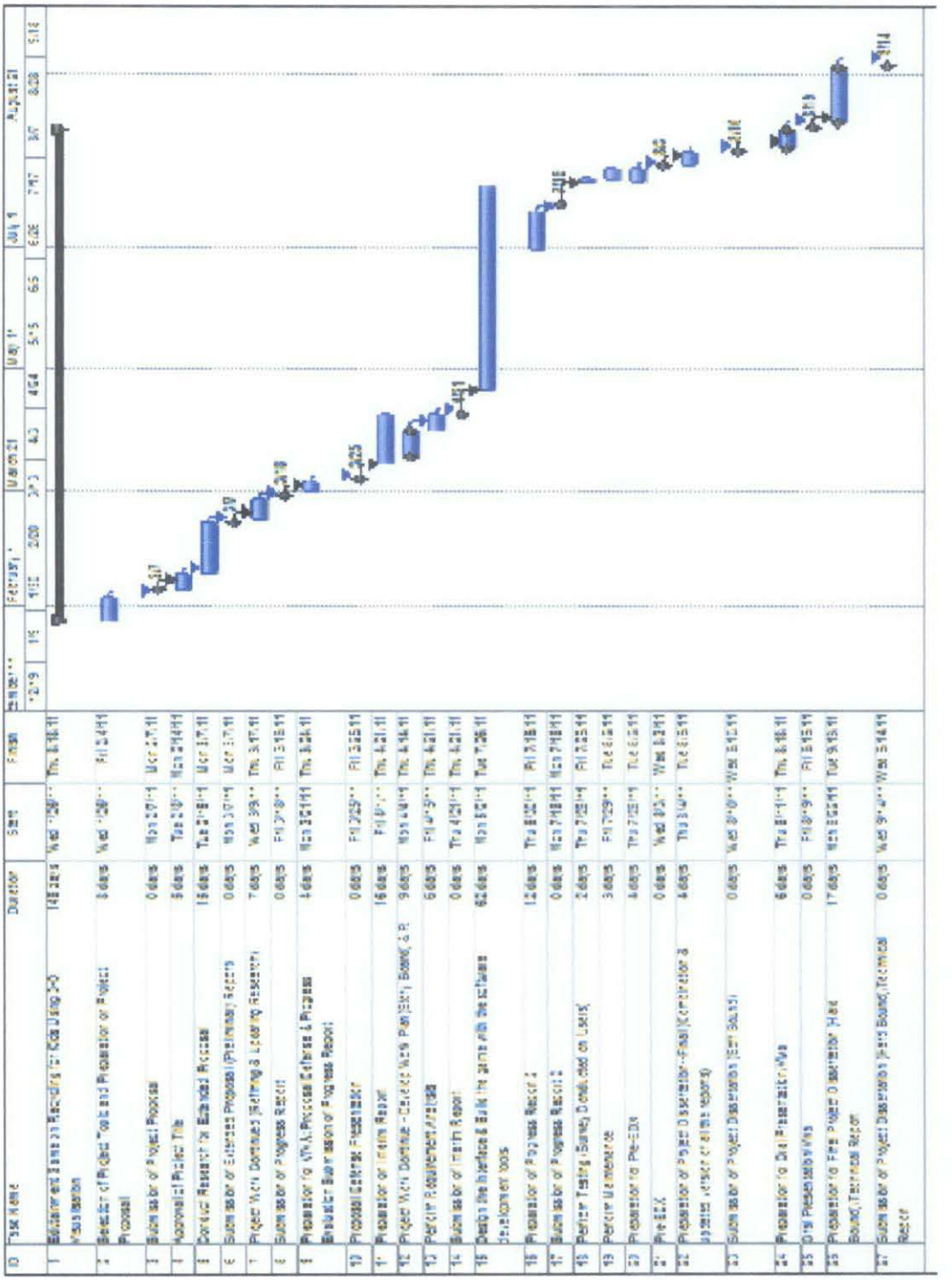

Figure 3.3.1: Gantt Chart of FYP Project Activities and Key Mileston

3.4 Tools Required

The specification of the tools used and its requirements are as follow:

a) Software Development Tools

- **Thinking Worlds** - an incredibly versatile and globally unique educational 3D sims & games engine and authoring environment. It allows the user to play, edit, create and even share games with other members of the Thinking Worlds community.
- **Paint.NET** – Image editing freeware that used to create layouts or textures for the interactions in the game.

b) Hardware and Software Requirements

- **Operating System :** Windows Me/2000/2003/XP/Vista/Server 2008/7
- **CPU Processor:** 1.0 GHz and above,
- **RAM:** 1GB and **Hard Disk Space:** 500MB
- .Net framework 2.0 and DirectX 9.0Modern graphics card with latest drivers and Direct3D support.

Figure 3.4.1: Thinking Worlds Software version 3.5.2

3.5 Data Gathering & Analysis

The author have conducted a survey (please refer Appendix I & II) among the target users of the application which is students from standard 4, 5 and 6. This activity was done in order to view the target users' perception on this project as well as to gather information for the requirements of the application. Due to the time and economic constrains, the surveys have only been conducted in Batu Gajah, Perak areas. There are two schools that the author have approached as the location to conduct the survey. The first school is located near the town area of Batu Gajah which is Sekolah Kebangsaan Toh Indera Wangsa Ahmad (SK Toh Indera Wangsa Ahmad) and another one is located near rural areas of Batu Gajah which is Sekolah Kebangsaan Bakap (SK Bakap). For this survey, a sample of 56 students (26 male and 30 female) was taken from SK Toh Indera Wangsa Ahmad and 60 students (30 male and 30 female) from SK Bakap. The sample was distributed evenly between age and gender except there is a lack of 4 male students from standard 4.

The results of the survey are as follow:

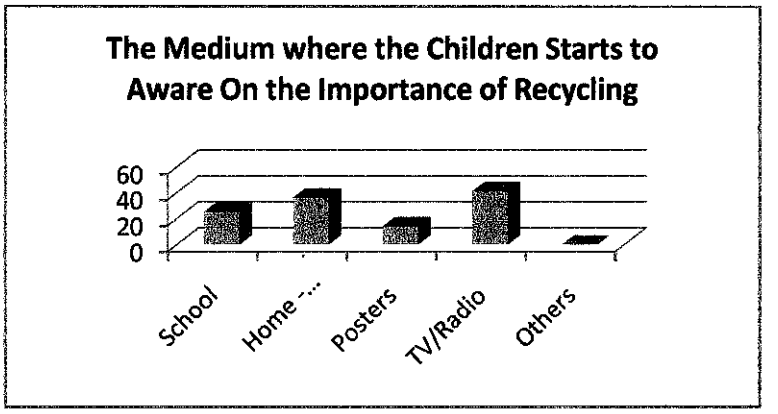

Figure 3.5.1: The Medium where the Children Starts to Aware on the Importance of Recycling

Based on the graph above, most of the students starts to aware on the importance of recycling through mass media such as television and radio. As for the second place, it is mostly happens at home which is usually through the parents.

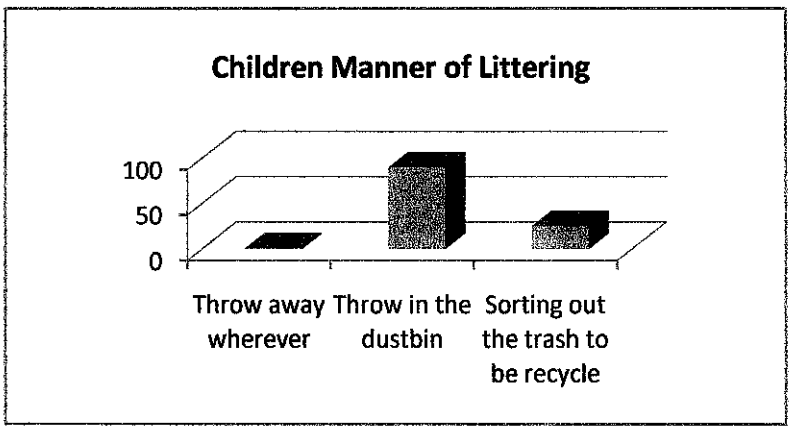

Figure 3.5.2: Children Manner of Littering

Based on Figure 3.5.2, most of the students handle the trash and rubbish by throwing it in the dustbin. Moreover, only moderate amount of students practice recycling and only a few of them throw the trash wherever they want. Thus, it shows that most of them still do not practice the recycling behaviour very well.

Besides that, the author discovers that most of the later results on the survey seem to contradict with the results in Figure 3.5.2. For example, most of the students answered that they have understood the concept as well as the importance of recycling very well. Moreover, the students also feels that their school education has successfully creates the awareness on the importance of recycling to them and that their school curriculum level of support in recycling behaviour is high.

This much later results might not be accurate since it is very subjective on what exactly the students understand about recycling. They probably only understand the basic information related to the issue rather than the actual process of recycling (i.e what happens to recyclable item after they place it in the recycling bin) and the difference between the items that can actually be recycle and non-recyclable item.

As for the results on the successfulness of the school education in creating the awareness and the school curriculum level of support, it is also seems to contradicts with other researchers [9, 15] results. This is probably due to the limitation of having the survey conducted only in Batu Gajah area (not throughout Malaysia). Moreover, it is probably due to the reason that the schools in Batu Gajah area are highly involve in creating awareness on the importance of recycling among the students. However, if based on Figure 3.5.2, there are still only a small number of students that actually practice recycling activities. The reason as to why this happens is because probably lack of facilities such as recycling centre and recycling bins provided in that area.

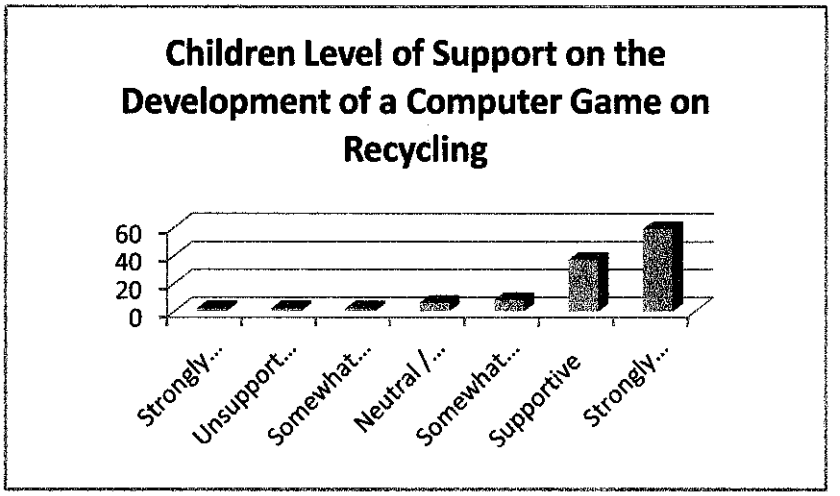

Figure 3.5.3: Children Level of Support on the Development of a Computer Game on Recycling

Other than that, the author also finds that the students strongly support in the matters that the public should put in more effort in performing recycling activities. In addition, it also seems that the students strongly supports this project (based on Figure 3.5.3) as they realize that recycling is very importance and that they should support any efforts in promoting recycling behaviour and activities.

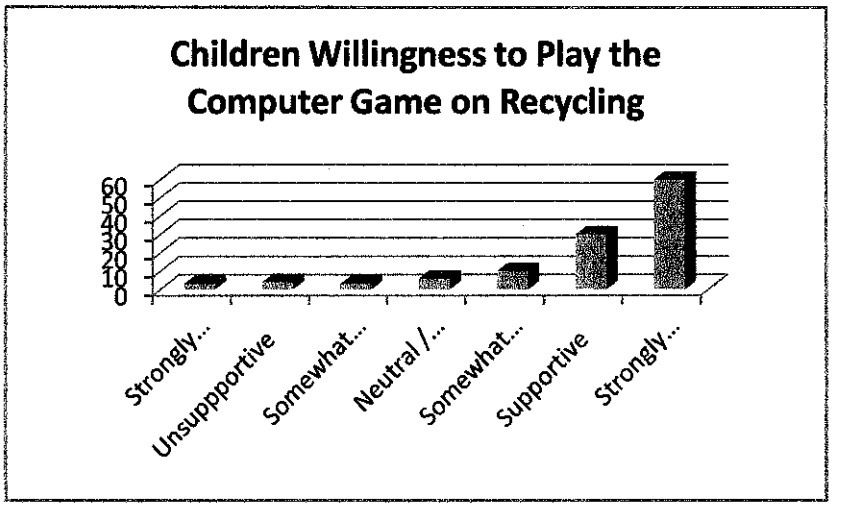

Figure 3.5.4: Children Willingness to Play the Computer Game on Recycling

According to Figure 3.5.4, the students also seems to be strongly supportive by agreeing that they will play the game after it was develop. Thus, it creates a market for this game to be applied despite that there a few of them seems not willing to play the game. This is probably because they never use a computer or playing a computer game before.

Based on the survey conducted, the author also finds that around 74% of the sample have or own a computer. There is a considerable amount of students that does not have a computer especially the ones that are located in rural area. Besides that, almost 96% of the students have used a computer previously and only a few of them never had an experience on using a computer. Moreover, around 94% of the students have an experience on playing a computer game. However, only 64% of them have played a computer game on the internet.

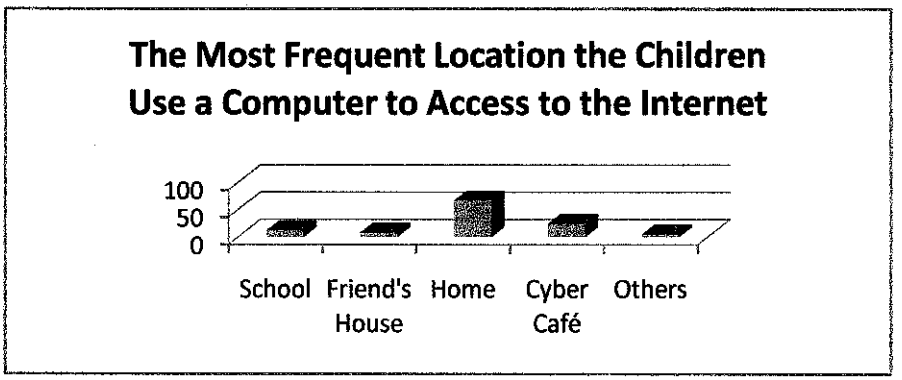

Figure 3.5.5: The Most Frequent Location the Children Use a Computer to Access to the Internet

In addition, the author also finds that the students usually use the computer at home to access the internet. As for the students that does not have a computer at home, they will usually go the the Cycber Café to access the internet and there are also a few of them that use the computer at school instead. Basically, it shows that the students will still try to have an access to the internet eventhough if they did not have a computer at home.

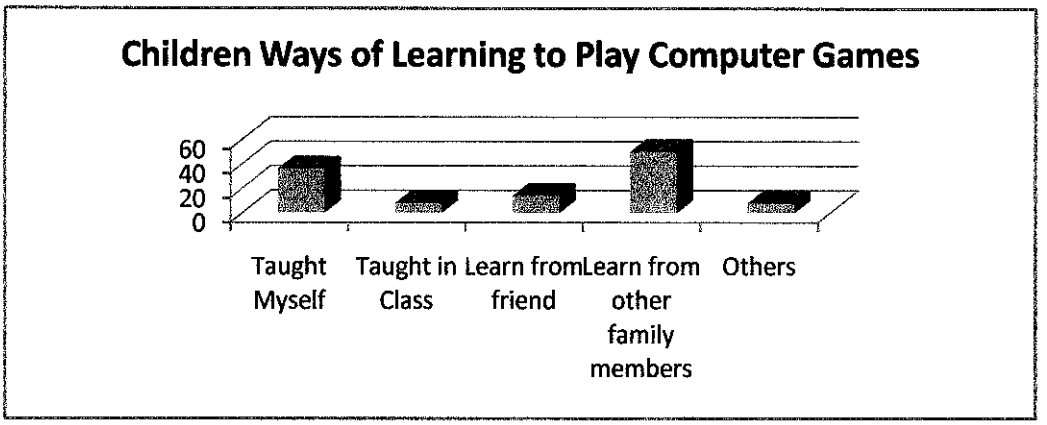

Figure 3.5.6: Children Ways of Learning to Play Computer Games

According to Figure 3.5.6, the children mainly starts to learn playing computer games from family members especially from the older brother or sister. Other than that, most of them learn to play computer games by themselves (i.e. through game tutorials and instructions) and only a few that still does not know how to play computer games.

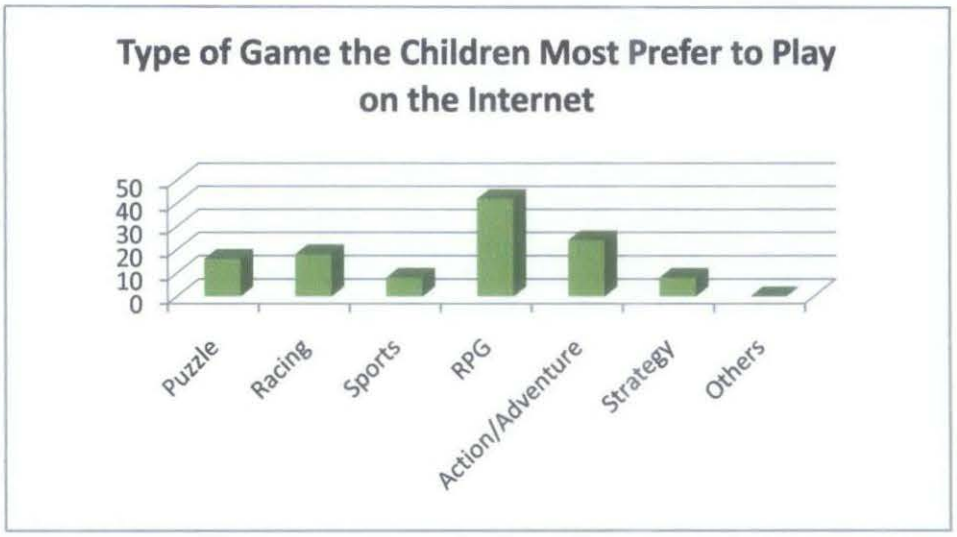

Figure 3.5.7: Type of Game the Children Most Prefer to Play on the Internet

Based on the graph stated above, when the children use the computer to access to the internet, most of them would prefer to play Role-Playing Game (RPG) for their leisure time. Thus, this result would really support the project in which the application will be develop as a RPG type of game. Besides that, a very high amount of children also likes to play action/ adventure type of game when they use the internet.

Besides that, the author also finds that there is a high number of students that prefer to play 3-Dimensional (3D) game rather than 2-Dimensional (2D) game. This result also strongly supports the development of this project. Below is the pie chart on the dimension of the game that the children prefer the most:

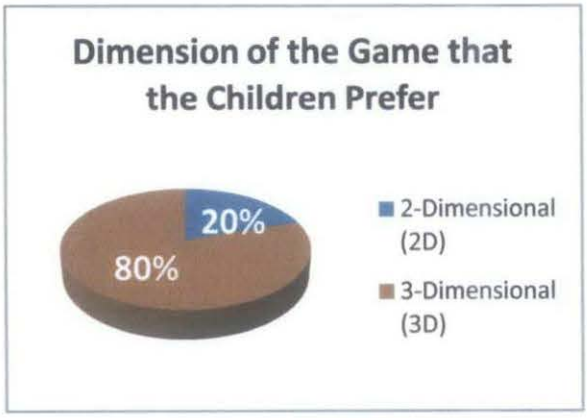

Figure 3.5.8: Dimension of the Game That the Children Prefer

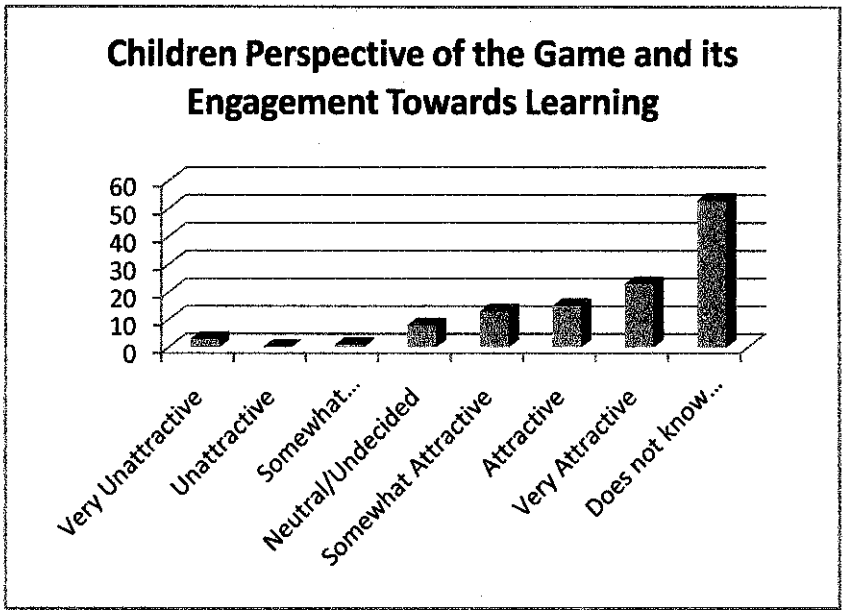

Figure 3.5.9: Children Perspective of the Game and its Engagement Towards Learning

The students have also been asked whether they have used or played any games on environment or recycling (CD or online). About 53% of them replied that they have used or played a game on environment or recycling and another 47 % replied that they never played any games related to it. Among those 53%, most of the students seem to think that the game they played is very attractive.

Moreover, during the survey was conducted, the children were asked to give some comment or features on the games that would attract them to play. These are their feedback:

- Able to learn new things (e.g. Sudoku – help to make oneself understand better about numbers and increase expertise related to numbers & Pro Evolution Soccer 2011 – able to gain extra information on soccer)
- Challenging (i.e. satisfaction of winning a task or mission that is difficult to overcome)
- Have rewards (i.e. collecting points/coins/stars)

- Looks and feels like it is real
- Have morale value (i.e. FarmVille – teaches on how to take own responsibility of the animals and crops in the farm)
- Train the brain to come up with strategy to win in a given situation
- Nice view of the environment (i.e. have many colours)

Other than that, they were also asked to give some comment or features on the game that would make them hate the game. These are their feedback:

- Too fast/too slow
- Too easy in winning a certain task/ activity – not challenging / build up any skills or level
- Too difficult / too complex – does not know exactly where to go, how to do the task, when to perform the task and etc.
- Game that have bad elements such as sexual and violence – give bad influence to the younger generation

Based on the survey conducted, most of the girls do not like to play sports game because they thought the game is for boys. Moreover, they stated that most of the games develop for boys are too fast or too difficult for them. As for the boys, they do not want to play girl-like games because it is too slow and easy for them.

Basically, the author will try to include all of the requirements derived from the analysis of the survey in the development of the game. This action occurs in order to meet the users' specifications of the game. The results on the analysis of the data gathering will be used to develop the design strategy for the game which will be explain further on the next section.

3.6 Design

3.6.1 Design Strategy

After all the research (literature review) and surveys have been conducted, the designing strategies for the development of the game have been identified by the author. Below are the design requirements that have been indentified:

a) Title

The title of the game is **'RECYCLE WARRIORS'** as the content of this game is to save the earth from degradation by imparting the behavior of performing recycling activities on the users.

b) Short Description

The main character will explore his/her house and find out the things in the house that can be used to recycle. He/she will also find out on extra information that related to recycling in the house such as what items can or cannot be recycled, why we should recycle, where we should recycle, and how to recycle those items. There will be 7 main sections in the game (will be explain later in the storyboard session).

c) Long Description

Detailed description of the game will be discussed later on in the storyboard session.

d) Game Type/Genre

Recycling Warriors will be develop as an Online Role-Playing Game (ORPG) based on the literature review and surveys results (high support for RPG). This game would also be develop using 3-Dimensional (3D) visualisation as most of the target users prefer to play the game in 3D as well as using 32-bit colour. As for

now, the game will be develop as a single player game due to time and expertise constraint.

e) Scenario

The scenario/setting of the game is mainly take place at a normal double-storey house in Malaysia. This scenario was initiated from the survey in Figure 3.5.1 whereby home (after the media) is one of the platform that most of the users starts to aware on the importance of recycling. In the house, there will also be electronic equipments such as television that will play videos related to recycling. This component is included in order to support the survey result whereby media is the number one platform that most of the target users start to aware on the importance of recycling.

As for the time setting, it would be at the present as it is to make the target users really feel what they are experiencing nowadays. Creating fully realized, prerendered cutscenes/scenario does a lot to set the proper mood and immerse the player in the story. By doing so, the player gets a glimpse of what the imaginary world of the game might "actually" be like. When gameplay begins, the player will hold those scenes in his/her mind's eye and see the visually impoverished, low-poly world of the game through those high-res images.

f) Title and Information Screen

The introduction or starting scene will tell the player about the story of the game, their missions in order to complete the journey successfully, and the player control.

Figure below is one of the sample scenarios in the game:

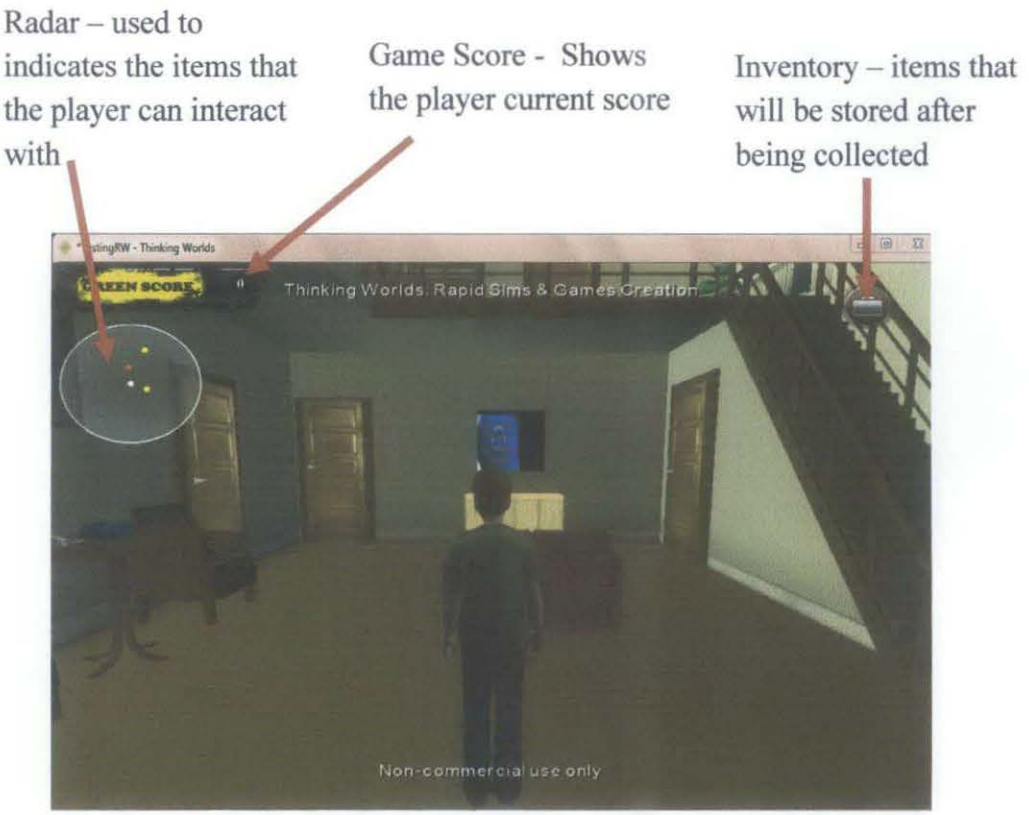

Figure 3.6.1: Navigation Screen

g) Audio Requirements

There will be a background music played throughout the game. There would also be other sound when the video clips included in the game are playing.

h) Main Character

The users can choose between two characters (male or female) at the beginning of the game in order to closer the gap between male and female players of the game. This requirement should be considered and included in the development of the game in order to make the players really feel that they are playing the role as it would not make sense for a female users to play a male character or otherwise. Based on Figure 3.6.1, it shows one of the main characters which is the male part. The main character can move in all four directions using arrow keys and run by

using SHIFT+ Arrow keys. The users can also click on the items located in the through the journey.

i) The basic requirements for the main character

Besides than the control of the players movement, there are also several other basic/ general requirements of the main character that will be included in the game. Examples of other basic requirements are radar that indicates special items, game score for answering provided questions and inventory to allocate the collected special items.

Radar - The character has radar on the top left side of the screen that used to show some colored dots which represent items that the character can interact with. The details of the dots are as follow:

- **Red** – critical items that can be recycle. All of them must be collected and then be placed in the correct recycling bins in the backyard. The player will get the scores for every right decision.
- **Yellow** – items that give more information on recycling issues. This item does not need to be collected. When the player click on this item, a window that ask multiple choice questions on recycling will appear on the screen. The player will get scores for every right answer.
- **Green** – electronic items that will play a video on recycling issues.
- **Blue** – a person that the character can interact with.

Game Score – Called as 'Green Score' is used to show the scores that the player obtains when he/she completed certain tasks and missions provided in the game. For example, answering correct answers to questions related to recycling, finding missing items and placing the right object at the right place. This function is included in the game because nowadays people are more likely to play game repetitively until they will get the highest score such as the "Angry Bird" game. However, this game thus not include the timer because it is more to learning based approach where the author objective to develop this game is for the users to learn

more things on recycling activities and make them more aware of its importance which will persuade them to impart it as their own behaviour. If the timer is included, the player will be distracted, as they will try to complete the game faster and does not actually concern on learning the content of the game. For example, they will try to answer the questions quickly without actually reading it and etc.

Inventory– A case or bag that holds the collected items that is critical in completing the journey in the game.

j) Define the beginning and end of a game level

A cutscene/description at the beginning of a section sets the stage for the action that follows. After all the task has been completed, a cutscene signals to the player that he/she has achieved the objectives of that level.

k) Give the player a reward

The players will get extra green points/score whenever they accomplish a specific task such as answering the right questions, perform the right task, and finding the missing items.

l) Introduce gameplay elements and provide the player with necessary clues

Providing a game player with the necessary clues and information that he/she needs to be successful is like providing a description with back-story information that makes the action of the story intelligible. The word "exposition" works in both contexts.

m) Victory Conditions

The player will win the single-player game by being able to collected all the critical items and place it in the right recycling bin in the end.

n) Hours of Gameplay

This single player ORPG game might will probably took about 1 to 2 hours to complete depending on the user skills of understanding and speed in performing the task. This requirement is included in developing the game because the author wants to focus on repetitive strategy. As the game can be completed in a short time, the user will probably be more attracted to play the game repetitively until they will get the highest score and understand the concept and the importance of recycling much better.

3.6.2 Storyboard Design

Overview

a) Backstory

Currently, the number of solid waste/trashes has been rapidly increasing due to the increment of human population. In order to reduce the amount of waste entering landfills and to maintain a sustainable development in the future, recycling activities must be implemented rigorously among the society as it is one of the easiest ways to preserve the environment. Recycling of solid waste is very important because it will ensure a clean, fresh and sustainable environment for all. It will also save the environment in Malaysia from degradation, obnoxious smells and toxic gas. Besides that, recycling process also helps in the stimulation of economic and technological development, conservation of natural resources and energy as well as the preservation of funds earmarked for waste disposal. Raymondo and Reymina have been chosen as the recycle warriors in order to protect the earth from the bad implications of produced trashes. It has been their destiny to assist in achieving the nation sustainable development by starting to implement the recycling activities as their own behavior from just a simple step, right at their own home in Malaysia.

b) Objective

The player need to learn and really understand the concept of recycling as well as its importance by collecting all the recyclable items that are shown as red colored dots in the radar, and then place the items in the right recycling bins in order to complete the journey. Throughout the journey, the player will also need to complete several other tasks such as finding the missing items (i.e. a key to unlock the door of a room) and to answer several questions on recycling issues in order to gain more green points.

c) Characters

1) Main characters

Raymondo (Male Character) or Reymina (Female Character)

Age: 11 years old

Personality: Both are brave and intelligent as well as very active and joyful

2) Other characters are Mom, Dad, Alyssa (Sister), Kevin (Brother), Nanny, Melissa and etc. → these are non-playable characters. There are used to interact with the main character in order to help him/her to perform certain tasks and to understand about recycling better.

Storyboard Frame:

Game	Sequence	Scene	Page 1 /5
		Artist Syafiqah Ali	Date 06/23 /2011
Shot	Image	Description / Interaction	Time
1		Starting scene used as the title screen whereby the user can make the decision to start the game or go to 'How to Play' scene in order to know the story and controls of the game. If the user chooses to start the game, the user will then be asked to choose the main character of the game.	1 min
2		"How to Play" scene whereby the user learn about the control of the main character as well as the backstory of the game. After this scene is completed, the user will be asked to choose the main character.	5 – 10 min

Table 3.6.1: Storyboard 1 (Introduction scene)

Game	Sequence	Scene	Page 2/5
		Artist Syafiqah Ali	Date 06/24 /2011
Shot	Image	Description / Interaction	Time
1		Location: The main hall of a double- storey house. The player is standing at the center of the main hall. Then the story window pop out and the user need to click on it until it ends. Music: background music is as the camera zoom to the player. There will also a video playing on the television.	5 min
2		The player can collect the red colored dot item, answering questions when clicking on the yellow dot item as well as going to the other scene when clicking on it. This scene will end when the user jump to the other scene such as the kitchen.	20 min

Table 3.6.2: Storyboard 2 (Home: Main Hall scene)

Game	Sequence	Scene	Page 3 /5
		Artist Syafiqah Ali	Date 06/25 /2011
Shot	Image	Description / Interaction	Time
1		The player meets with his/her sister or brother depending on which character that the player chooses. Mellisa/Kevin: This character will have a conversation will the player on something related to recycling issues such as "By recycling 1 ton of paper, you could save the energy of an average Malaysia usage up to 9 months."	5 min
2		The player can collect the red colored dot item, answering questions when clicking on the yellow dot item as well as finding a missing item (a key) that will unlock a scene. This scene will end when the user go back to the main hall.	25 min

Table 3.6.3: Storyboard 3 (Home: Living Room)

Game	Sequence	Scene	Page 4/5
		Artist Syafiqah Ali	Date 06/26 /2011
Shot	Image	Description / Interaction	Time
1		After the player went to the kitchen, he/she will see the Mom character was busy cooking in the kitchen. After that, she will approach the player and then they will start a conversation.	5 min
2		The player can collect the red colored dot item and answering questions when clicking on the yellow dot item. Moreover, the player will then perform an action which is throwing the food waste in the waste bin and a window will come out on the screen that gives information related to this scenario.	30 min

Table 3.6.4: Storyboard 4 (Home: Kitchen)

Game	Sequence	Scene	Page 5 /5
		Artist Syafiqah Ali	Date 07/01 /2011
Shot	Image	Description / Interaction	Time
1		The player will meet with his/her dad whereby they will have a conversation with that character which will give them a task or a mission. Dad: a sample phrase by this character is "Could you my watch and give it to me? I need to go to work right now, but I can't if I don't have my watch."	5 min
2		The player can collect the red colored dot item, answering questions when clicking on the yellow dot item as well as finding missing item which is his/her dad watch which is located at other scene. A window will come out on the screen after the player return the missing item to his/her dad. This scene will end when the user go back to the main hall.	30 min

Table 3.6.5: Storyboard 5 (Home: Parents Bedroom)

Game	Sequence	Scene	Page 6/5
		Artist Syafiqah Ali	Date 07/02 /2011
Shot	Image	Description / Interaction	Time
1		At first, this scene is locked and the player cannot enter this room. To enter this room, the player must find a key located somewhere in the house and then unlocked the door to enter this room. After the player enters the room, the character Kevin/Melissa will approach the player and a conversation will occur.	5 min
2		The player can collect the red colored dot item, answering questions when clicking on the yellow dot item as well as watching videos on the laptop that is related to recycling. This scene will end when the user go back to the main hall.	20 min

Table 3.6.6: Storyboard 6 (Home: My Bedroom)

Game	Sequence	Scene	Page 7/5
		Artist Syafiqah Ali	Date 07/03 /2011
Shot	Image	Description / Interaction	Time
1		The player will enter this scene through the kitchen scene, and then he/she will meet the nanny and a conversation will start between them.	5 min
2		The player can collect the red colored dot item and .answering questions when clicking on the yellow dot item This scene will end when the user able to complete all of the tasks and place the collected item in the right bin which is located at the backyard. A window will come out on the screen stating that the player has completed their journey.	20 min

Table 3.6.7: Storyboard 7 (Home: Backyard)

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Results (Prototype)

After all the planning, analysis and design process has been conducted, the prototype of the game has finally been completed by 11th of August. All 7 sections of the game which is the introduction and character selection, main hall, living room, kitchen, parents' bedroom, player's room and backyard are all already been completed.

As the author explained previously, the software development used in developing the application is Thinking Worlds. By using Thinking Worlds, the author has less difficulty in creating the game as it is easier to navigate and maintain the development of the game. The process on how the application by using Thinking Worlds is being developed is; firstly, after downloading and opening the software, the author will need to create a new learning journey that will be used for the game. Then, the author will choose the scene and the main character of the game. The chosen scene will then appear on the screen for editing activities. Below are some of the samples on the process of using the software:

Figure 4.1.1: Create new learning journey

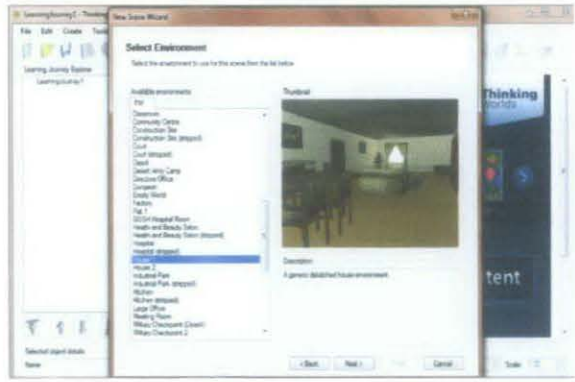

Figure 4.1.2: Choose scene and main character

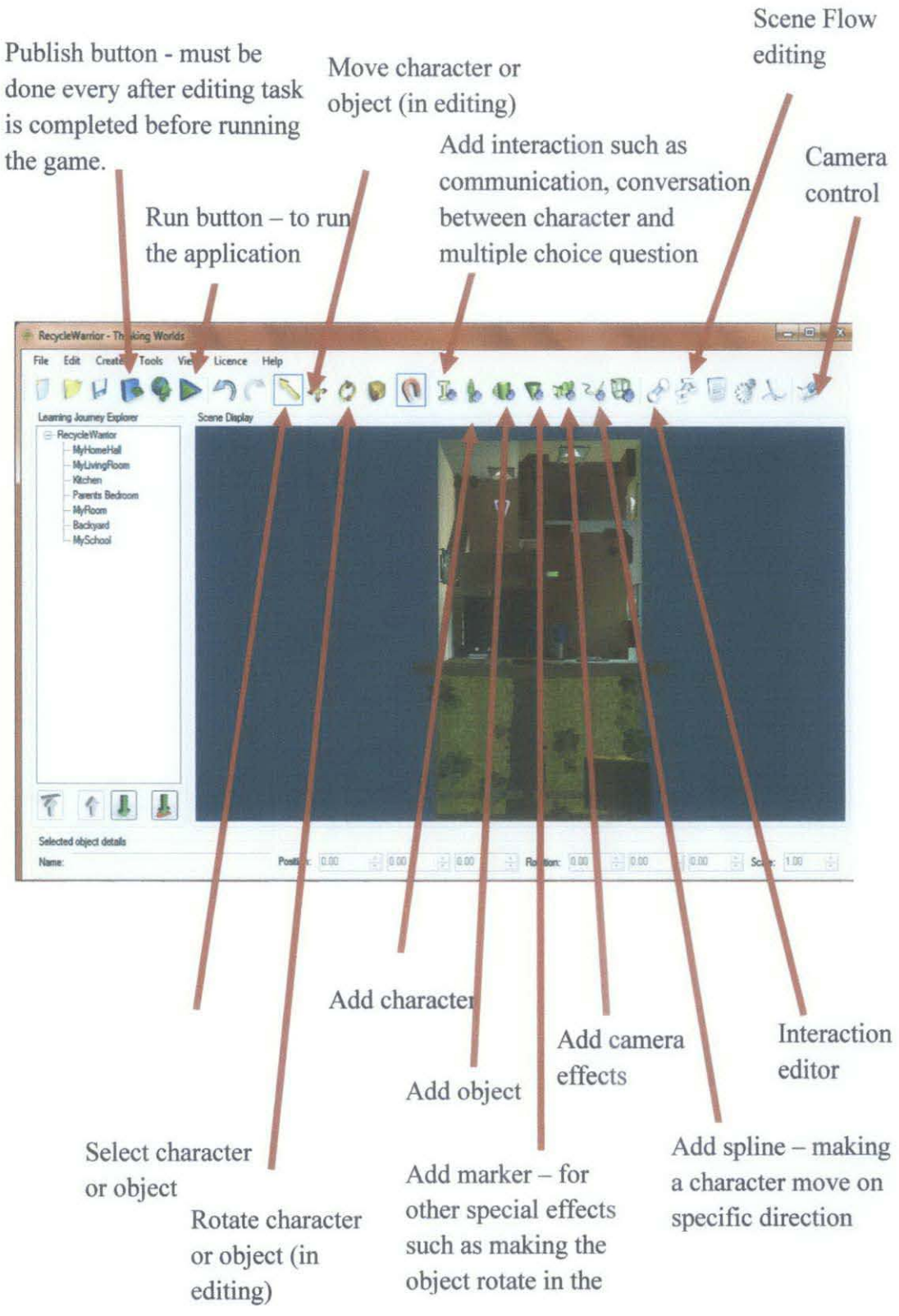

Figure 4.1.3: Thinking Worlds Navigation

Below are the results of the prototype and its flow:

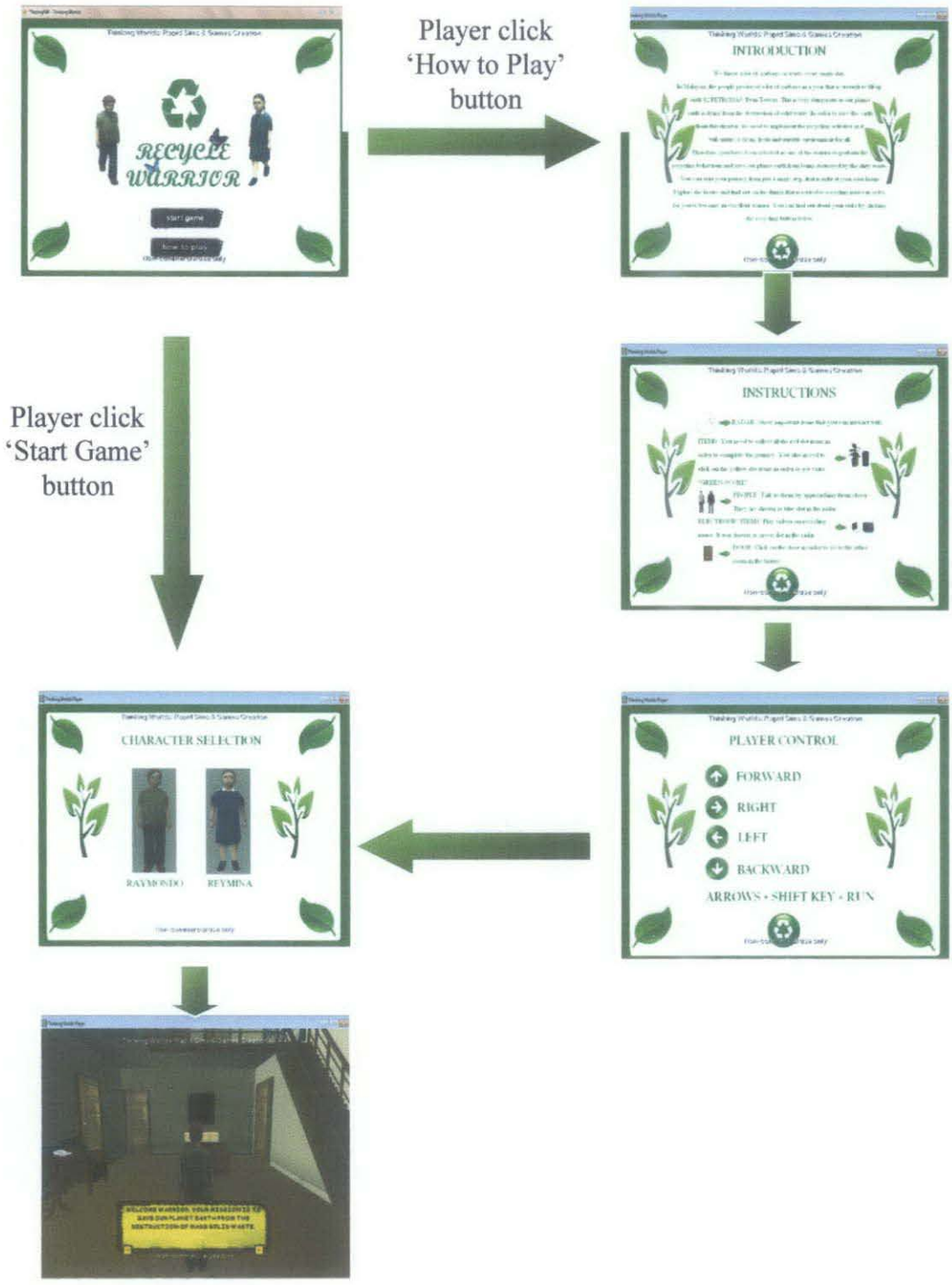

Figure 4.1.4: Prototype flow

Based on Figure 4.1.4, when the player runs the application, he/she will be prompted with a starting scene whereby he/she can choose whether to start the game directly or to learn the instructions of the game. If the player clicks on 'Start Game' button, he/she will then directly be prompted to the character selection scene where the player can choose the main character of the game and then start to play the game. If the player click on 'How to Play' button, he/she will be prompted to the introduction scene that describes the backstory of the game. Then, when the player clicks on the recycle symbol in order to continue the game, he/she will then be prompted to the instructions scene that shows the instructions of the game. Next, the player will go to the player control scene that shows the player on how to control the main character. After that, the player will continue to the character selection scene and then starts to play the game.

The flows of the scenes after the player arrives at the main hall are not exactly in a linear form. The player have the right to choose on what he/she want to do fist, whether answering questions in the main hall or directly go to the other section in the house. This function is made available in order to make it more realistic as the player can also go to any part in their house in their real life. However, there are certain part whereby the player needs to play according to the flow such as finding his/her key room somewhere in the house in order to unlock the player room and perform the given tasks.

Basically the story goes on like this; as the player pass through the introduction scene, he/she will automatically be at the center main hall of the house and a communication statement will come out on the scene which welcomes the player such as follow:

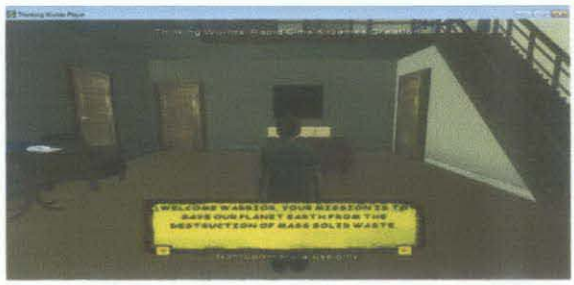

Figure 4.1.5: Starting scene in Main Hall of the house

After the player finish clicking the welcoming message, the radar, game score and inventory icon will pop out on the screen. The reason why the author chooses a house as the main background/scene/ location of the game is because based on Figure 3.5.1, it seems that most of the target users starts to aware about recycling starting at their home besides other than television and radio. Therefore, this scene is chosen to make the users to feel more realistic and recognize as well as learn on the things that they can do relating to recycling right at their own home. For example, the users can recognize the common things that are available in their home which can be use to recycle as well as the non-recyclable items. Moreover, videos are included in this game that shows the video on recycling as the user perform normal activities such as watching television, using a computer and etc.

Next, the player need to collect all the red colored dot items shown on the radar at the top left side of the screen and finally place them at the correct bins located at the backyard section. As the player approach the items closer, a small round button will appear on the screen, and when the player click on it, a window will come out which prompt the player on whether he/she wants to collect the item or not. Below is a sample screen when the player wants to collect the item:

Figure 4.1.6: Collecting an item

After the player click on the item, it will be automatically moved to the inventory section that shows extra information on the collected item and the number of collected item such as follow:

Figure 4.1.7: Item in inventory

The player can also go to the yellow dot colored item and click on it. The yellow colored dot item is not collectable. When the player click on that item, a multiple choice question will appear which will be asking the player several questions related to the recycling activities. For each questions that the player answer correctly, scores will be given to the player and it will be shown at the game score indicator. Below is one of the samples of the multiple choice question session:

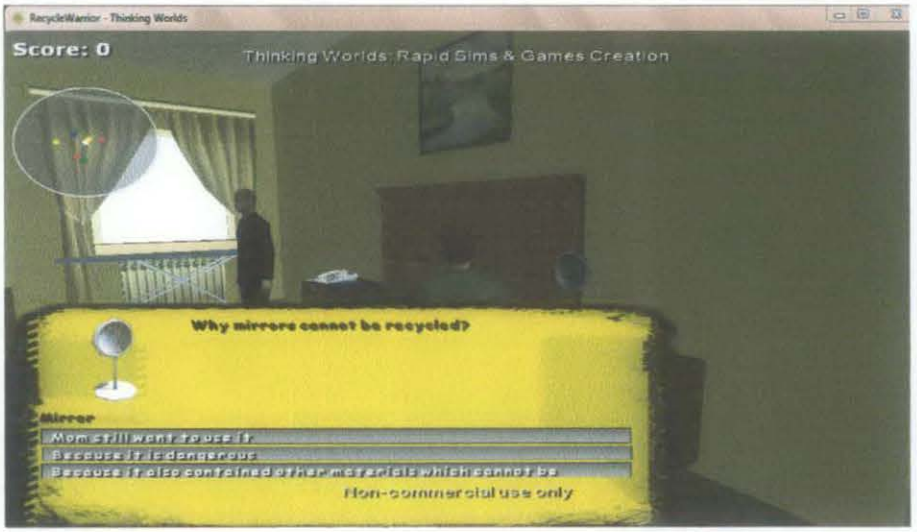

Figure 4.1.8: A Sample of Multiple Choice Questions

Besides that, the player needs to click on the doors in the house in order to go to the other section of the house. Example of the scenes that shows this activity are shown as follow:

Figure 4.1.9: Jump to other Scene

Figure 4.1.10: Other Scene

Moreover, in the other scene such as the "Living Room", the other character will approach the player when the player is getting closer to the character at a certain distance. A conversation window will appear on the screen between the player and the character which somehow will help the player to understand better on certain issue related to recycling. Shown below is the sample of a conversation session:

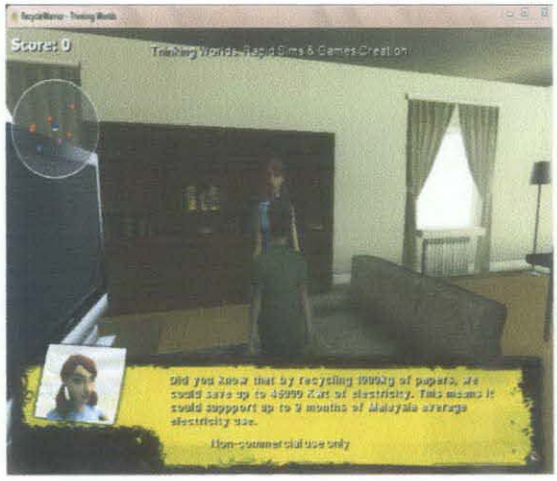

Figure 4.1.11: A Sample of a Conversation between the Player and other Character

The game was developed without using fully coding from the scratch. By using Thinking Worlds, the author can create the storyline of the game by just using the scene flow nodes that is available in the software. As for now, the storyline of the game follows the story that the author has already create during the storyboard design. Some screenshots on the story line are as follow:

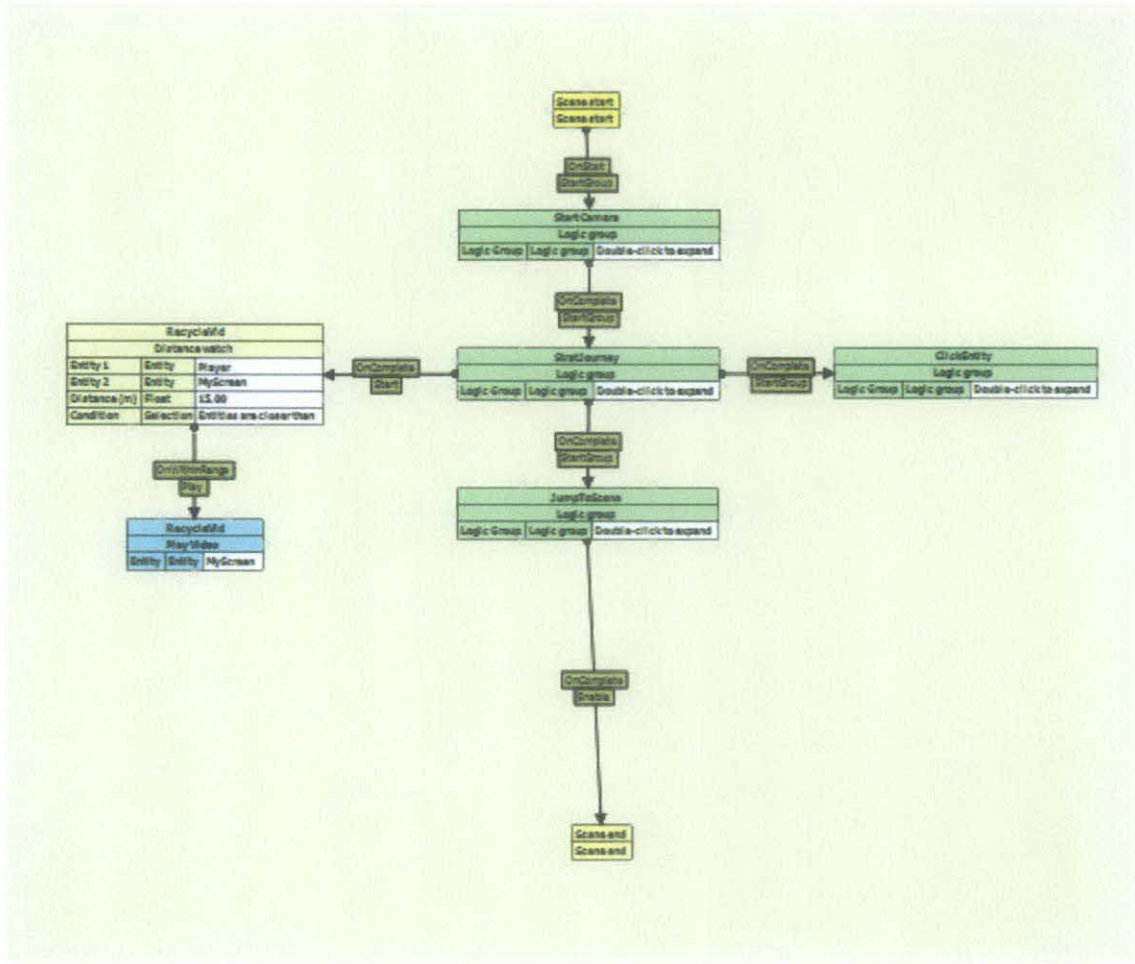

Figure 4.1.12: Main storyline

Figure 4.1.12 shows the main storyline of the game. As the reader could see, the green colored nodes are actually a group node which groups together other nodes used to create the story of the game. This node is used to make the game storyline looks simpler and easier to read. When clicking the nodes, more detailed flows are shown as follow:

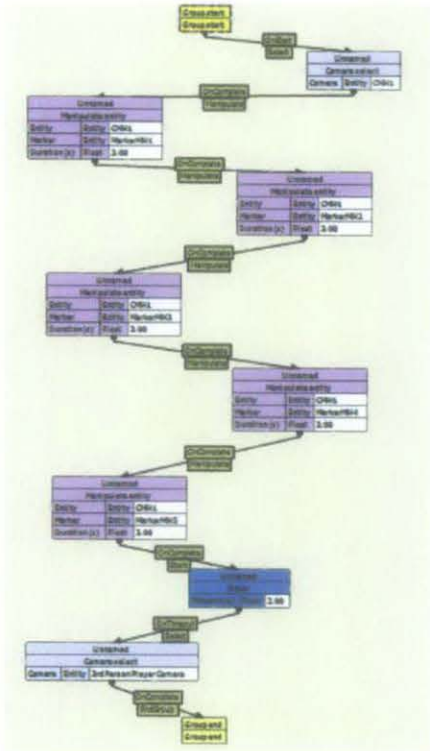

Figure 4.1.13: Camera Movement

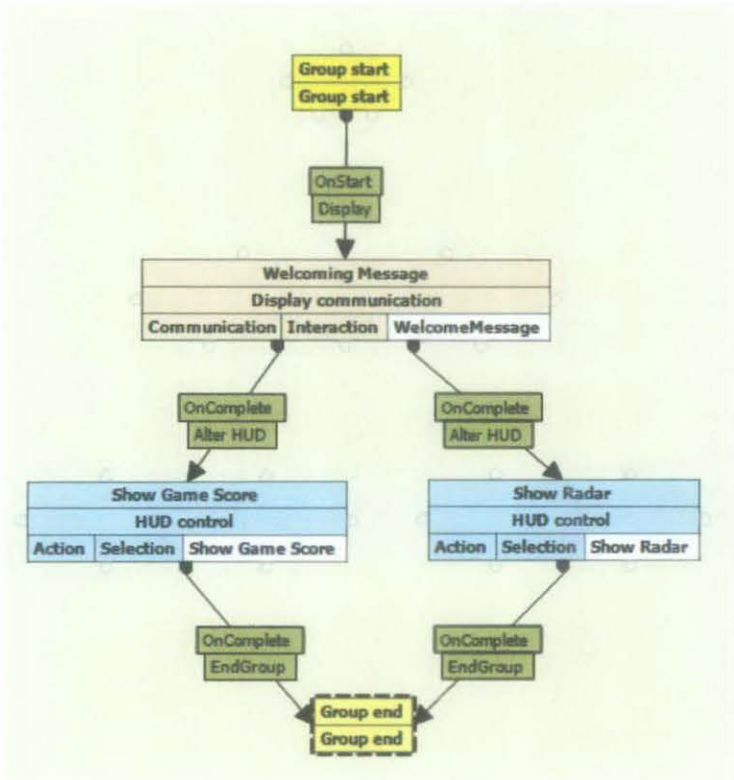

Figure 4.1.14: Displaying radar and game score

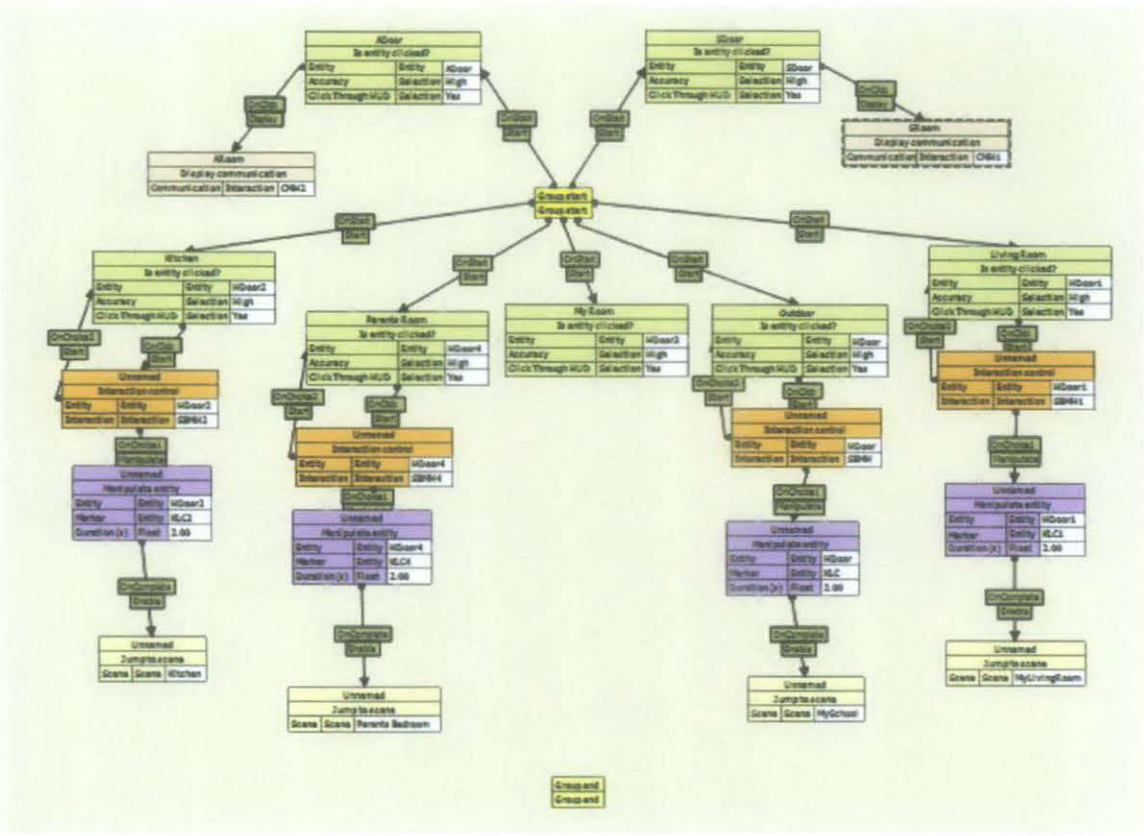

Figure 4.1.15: Jump to the other scenes

Basically, this is all the specifications that contained in the game. All of the interactions/conversation, instructions, videos are combined together in order to develop the game as planned and to make the content of the game more motivating towards the users. The author also includes some background sounds in the game in order to make it more engaging and fun to play.

4.2 User Acceptance Testing (UAT)

4.2.1 Results and Discussion

The author have conducted the user acceptance testing (please refer Appendix III & IV) among the target users of the application in order to evaluate the effectiveness and efficiency of the application as well as the user acceptance towards the application. The testing was conducted through a survey on 11th of August in two different environments. Around 30 students of SK Toh Indera Wangsa Ahmad in which 10 students represent each standard 4, 5 and 6 are involved in this survey. First, the author took a sample of 6 students from those 30 students whereby their performance and controls of 'Recycle Warrior' are being observed by the author. After that, the application prototype and questionnaires are distributed to those 30 students for them to use at their home. The author then collects the questionnaires from the students on the next day in order to give the students ample time to use the application and answer the questionnaires.

The results of the testing are focused into four main parts which are; the users perceptions on the usefulness of Recycle Warrior in educating them about recycling issues and its importance, the users perception on the realism of 3D environment used in the application, the users perception on the ease of use of Recycle Warrior, and the users perceived enjoyment while playing Recycle Warrior. Basically, the results of the testing are as follow:

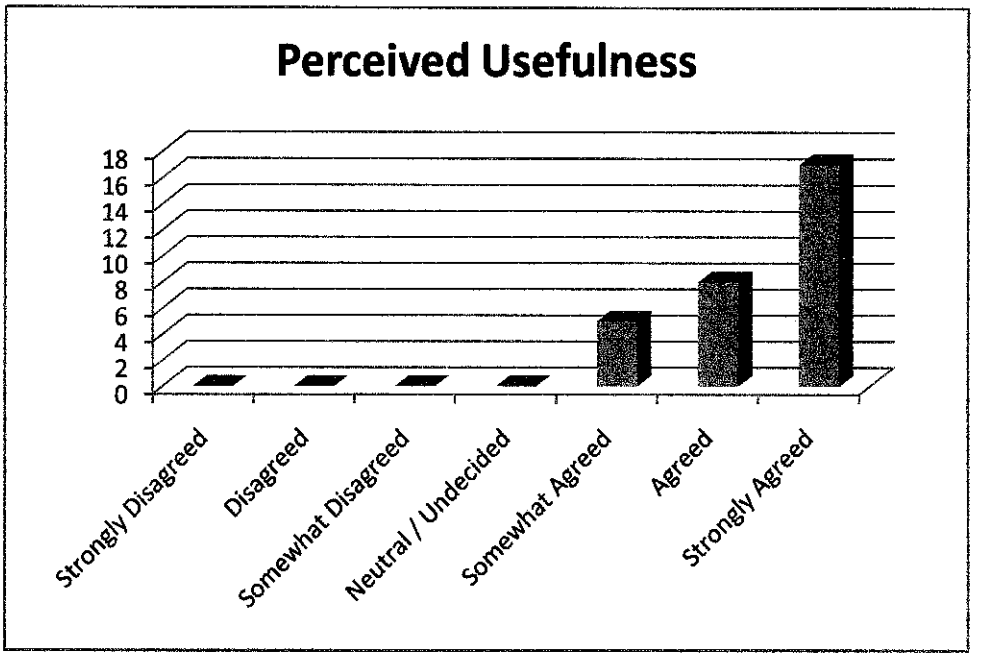

Figure 4.2.1: Participants Perceived Usefulness of Recycle Warrior

The graph above is the general results on the users' perception of the usefulness of Recycle Warrior in which it includes 3 sub-questions that test on these criteria. It seems that most of the participants strongly agreed that Recycle Warrior is very useful to them in order for them to learn new and interesting information on recycling. Most of them also strongly agreed that Recycle Warrior helps them to improve their understanding on the concept of recycling and its importance. Moreover, the users perception of the quality of information (facts and figures, sounds and videos) provided by 'Recycle Warrior' is also high.

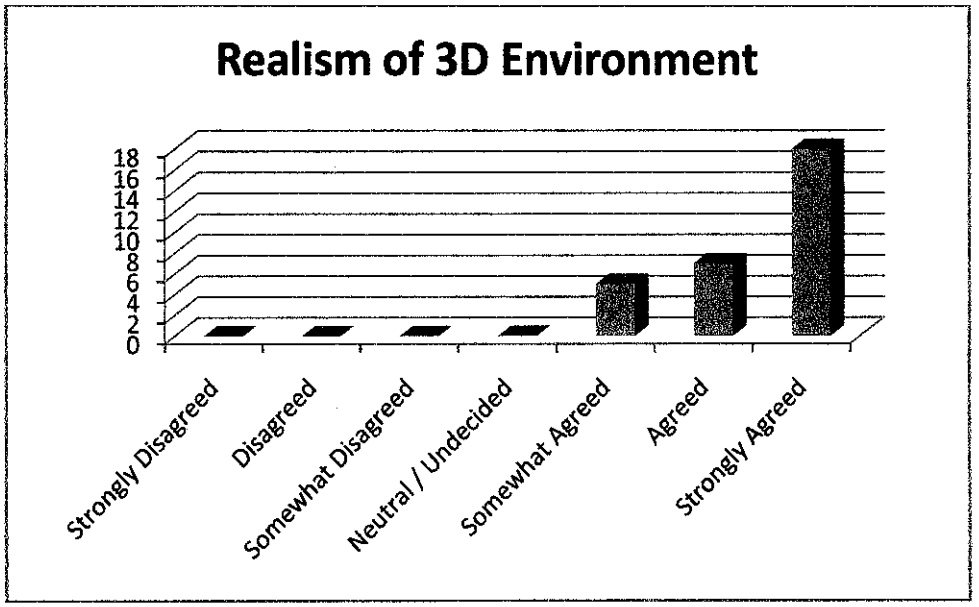

Figure 4.2.2: Participants Perception on the Realism of 3D Environment used in Recycle Warrior

Based on Figure 4.2.2, most of the users strongly agreed that the 3D environment used in the game are very realistic and engaging to them. Most of them felt "carried off" by the 3D virtual environment. It is as if they are a part of the 3D virtual environment which also enables them to project themselves into a particular role and tasks. Besides that, the surround sound used in the game also is a key engagement feature, and the participants reported that this added to the enjoyment of the game.

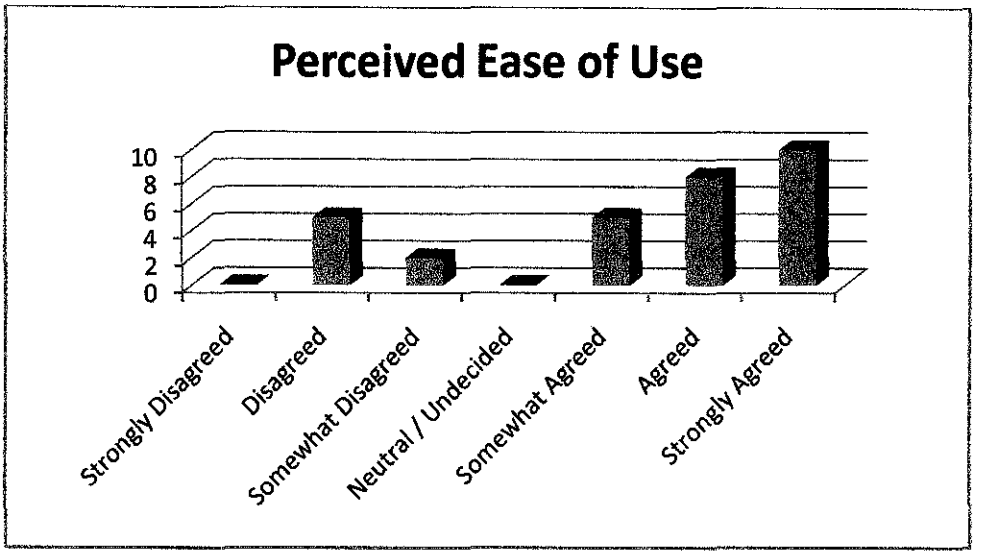

Figure 4.2.3: Participants Perceived Ease of Use of Recycle Warrior

The graph above shows that most of the users strongly agreed that it is easy for them to learn how to use Recycle Warrior and become skillful at it in a short period of time. However, there also several students that does not seem to agree that Recycle Warrior is easy to use. This is probably because the language used in the game is in English and whereby most of the users are Malays instead, in which some of them have fairly low level of understanding the language.

As for the users that do not have much problem on the language, it seems that most of them found the controls and the overall game easy to understand. The instructions provided enabled the users to rapidly gain a level of experience starting from a novice. However, some difficulties were experienced when finding the missing items and when they accidently click on an item a few meters further away. The accuracy of the game is fairly low whereby the ability for an activity to occur according to users wish seems impended slightly. This can be improved by a more complete calibration phase that better takes into account the current accuracy of the 'Recycle Warrior' configuration. Another improvement that will help to solve this issue is to place markers on the item to better physically define the physical locations of the missing items.

Besides that, the users found that the game was appropriate and understandable. In addition, out of the 30 students testing the prototype of the game, only 7 asked questions for further instruction and another 3 for clarification about the game-play. This demonstrates that the concept of using Recycle Warrior is intuitive and simple for users to learn. This is reinforced by the fact that 20 users managed to complete the game within less than 1 hour on the first usage. The author envisages that this level would be the first and easiest level of an extended game.

Another point that the author found during the testing is that the participants have an overall improved performance with increasing amount of game-play. This also demonstrates that the participants were able to gain further skills in the game and system over repeated use. This criterion also helps to improve the users understanding on the contents provided by the game. Overall, the author feels that these results demonstrate that the concept of using Recycle Warrior is graspable for novice users.

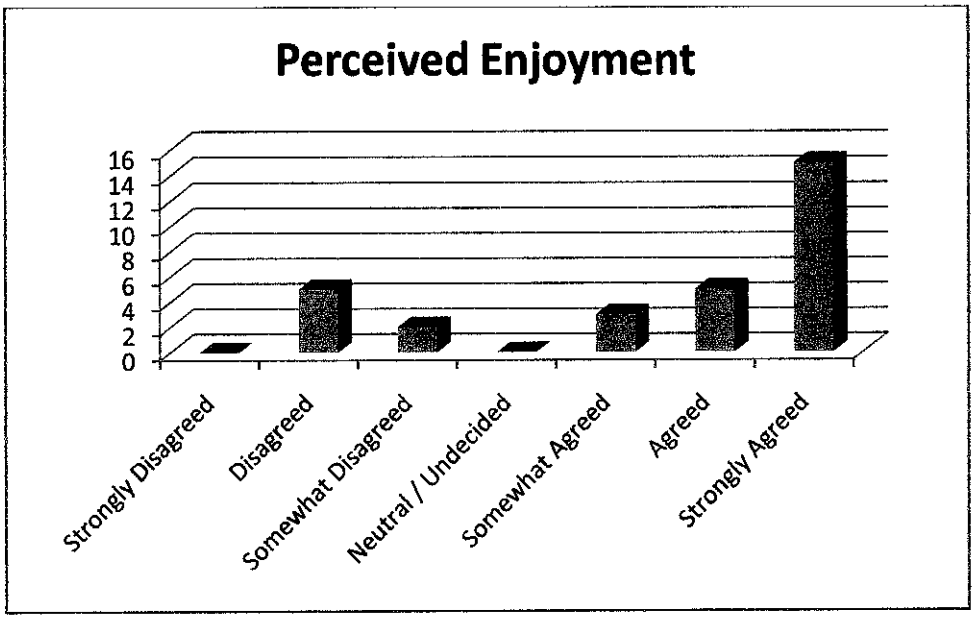

Figure 4.2.4: Participants Perceived Enjoyment on Recycle Warrior

Based on the Figure 4.2.4, most of the users reported enjoying playing the game and that it makes learning more interesting. They also agreed that Recycle Warrior gave a lot of enjoyment to them. Moreover, most of the users would play the game again if they had access to it. They would also recommend Recycle Warrior to their friends and family members. However, there are also a few students that does not seems to enjoy the game very much as they are unable to understand the game-play of the game due to the usage of English language.

Basically, all of the results presented above demonstrated a clear improvement in enjoyment of learning about recycling issues through 'Recycle Warrior', and the participants were able to quickly understand how to operate the 'Recycle Warrior' gaming application.

4.2.2 Recorded Comments of Participants

Comments by the participants were recorded during the testing and on the survey form. The author recorded comments on paper while the participant was playing the game, and the participant recorded their own personal comments on the survey sheet. There were fourteen total comments recorded. Comments by the participants were viewed as statements, and it is used to provide insight into areas of improvement for 'Recycle Warrior'. Two people commented that the 'Recycle Warrior' was kind of slow to them and that certain activity was performed when they accidentally clicked the item a few meters further away, indicating that the application accuracy was fairly low while they were playing. Besides that, multiple participants commented that some form of physical marker on the screen would be useful to help finding the related items while playing. This is because some of them had problems/difficulties in finding the missing items in order to complete the tasks.

There were fewer positive comments written on the survey forms, but verbal comments to the author following the experiment suggested that nearly all the participants enjoyed the game and had a unique gaming experience. One participant commented that the technology was "great", even though the content of the game was very basic compared to the other modern online games. Another participant suggested there should be more levels in the game. This indicates they would like to see the game further developed, and that it could be made to be even more fun.

4.3 Challenges and Limitations

There have been several challenges during the development of the game. As the author proceeds on the designing of the application process, several factors have occurred that made the author to change the tools used to develop the application which then affects the actual/initial plan of the application as well as the story of the game.

At first, the author use Game Studio A8 as the tools to develop the game. Then, the author changes the software to Platinum Arts Sandbox. Lastly, which what the author is currently using is Thinking Worlds version 3.5.2.

These changes occur due to several factors such as:

- Limited amount of time to learn the programming language used in game development as well as to develop the application at the same time.
- Hardware used by the author (Acer mini notebook) does not support the heavy requirements of the game development tools.
- No funds allocated to buy the actual software since the cost for game development tools is quite high for the author. The author is only able to use the free version of the software which leads to limited functions and abilities.

So, in the end, the author used Thinking Worlds since this is the closest appropriate game development tool that fulfills the author specification and limitations. However, this software is also a free version. Therefore, there are several limitations to the process of developing the game such as limited number of models available, include watermarks (no copyright/licensing rights), and does not have access to more advanced features of the software.

Moreover, the author also encountered several other challenges and limitations while performing the survey and user acceptance testing among the target users as the coverage is concentrated at only one location which is Batu Gajah and most of the students are Malays which has lower understanding on the usage of English language.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This paper presents on the analysis, design, implementation and evaluation of an edutainment game. The increasing generation of Municipal Solid Waste (MSW) has long been a critical issue in Malaysia. One of the ways to prevent this phenomenon from getting worse is by performing recycling activities. However, it seems that there is no significance increases in terms of the recycling participation rate eventhough the government have implement EE programmes in primary schools since 1988. To address these issues, the 'Recycle Warrior' an edutainment game on recycling was developed. It aims to educate the young children on solid waste recycling concept as well as its importance in order to preserve the environment and to ensure the sustainable development of the nation.

Moreover, the aim of the study is to identify the design requirements for the game in order to meet the user specifications of the game and to make it interesting to the users. The results of the survey suggested that all developed hypotheses were accepted, indicating positive and significant relationships between variables. The relationship between constructs pointed that the effect of entertainment elements on learning such as 3-Dimensional visual, sounds and video. Similarly, the relationship between participation and interaction also leads to powerful learning experience.

5.2 Recommendations

There are several recommendations that the author has thought to be included in the application for future improvement (some based from the results of UAT). One of the recommendations is to add more levels and making the games more challenging. For example, the author probably would like to add few other scenes in the game such as the 'Playground' and 'School' for future development. This is because based on Figure 3.5.1, school is the next resources where the students starts to actually aware on recycling after media and home. The author wants to make the player/ target users to be familiarize with common location that they can be and learn what they can actually do on recycling in those locations that they usually went in their real life. This is to make them actually used and impart the things that they have learned in the game into their real life. Besides that, the author would like to recommend that the game should be built as multiplayer game for future development in order to make it more realistic as it has real-time interactions among the players and an effective help-function should be build for assistance in case the players will occurred with some kind of difficulties while playing the game. Moreover, since the game might be covering bigger scopes and takes longer time to complete, functions such as save game and load game should also be included in the future development of the game.

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APPENDICES

APPENDIX I

Final Year Project Survey (for Standard 4, 5, & 6 students)

Section A: Demographic Information

Please tick [/] in the box given.

1. Age ☐ 10 ☐ 11 ☐ 12

2. Gender ☐ Male ☐ Female

3. School Location ☐ Town ☐ Rural

4. Living Place Location ☐ Town ☐ Rural

Section B: Student awareness on recycling

1. Where does your awareness on the importance of recycling starts?

☐ School ☐ Home – Parents ☐ Posters ☐ TV/Radio

☐ Others, please specify: _____

2. Your manner of littering (handling rubbish/waste)

☐ Throw away wherever ☐ Throw in the trash bin ☐ Sorting out the trash to be recycle

For questions 3 – 10 below, please tick [/] for your corresponding responses.

1 = Strongly Disagreed
2 = Disagreed
3 = Somewhat Disagreed
4 = Neutral/ Undecided
5 = Somewhat Agreed
6 = Agreed
7 = Strongly Agreed

No.	Question	1	2	3	4	5	6	7
3.	Do you understand the concept of recycling very well?							
4.	Do you understand why recycling is important?							
5.	Do you practice recycling?							
6.	Do you agree that education in school is successful in making you aware of the importance of recycling in preserving the environment?							
7.	Do you agree that the school curriculum does not promote recycling behavior/is not lean to the love of environment?							
8.	Do you think people should be making more of an effort to recycle?							
9.	Do you think a recycling game should be build in order to help you understand more on the importance of recycling?							
10.	If the game is build, would you like to play it?							

Section C: Survey on the student usage of game

1. Do you own a computer?

☐ Yes ☐ No

2. Have you used a computer?

☐ Yes ☐ No

3. If yes, have you played computer games before?

☐ Yes ☐ No

4. Have you played computer games on the internet?

☐ Yes ☐ No

5. How frequently do you play computer games? (Please tick one answer)

☐ About once a month ☐ About once a day

☐ More than once a month ☐ More than once a day

☐ More than once a week ☐ I normally do not play computer games

6. How much time do you spend normally per game session playing the game without taking any breaks?

☐ Less than 1 hour ☐ Less than 6 hours ☐ Others, please specify: _____

☐ Less than 3 hours ☐ More than 10 hours

7. In which of the place do you most frequently use a computer to access to the internet?

☐ At school ☐ At home ☐ Others, please specify: _____

☐ At friend's house ☐ Cyber Cafe

8. How did you learn to play computer games?

☐ Taught myself ☐ Learn from friend ☐ Others, please specify: _____

☐ Taught in class ☐ Learned from other family member

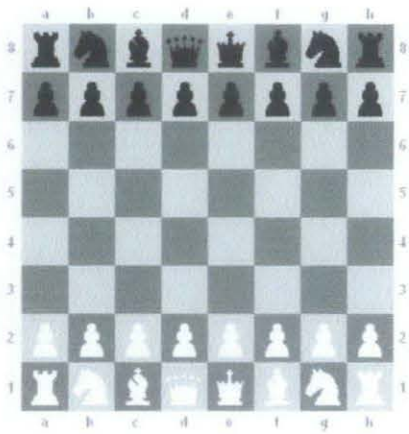
9. Which type of game do you prefer to play on the internet?

☐ Puzzle ☐ Role-Playing Game (RPG) ☐ Others, please specify: _____

☐ Racing ☐ Action/Adventure

☐ Sports ☐ Strategy

10. Based on the picture below, which computer chess board game that you prefer?



☐ 2-Dimensional (2D) ☐ 3-Dimensional (3D)

11. Have you ever try any game (CD or online) on environment or recycling?

☐ Yes ☐ No

12. If yes, what do you think of the game and the engagement towards learning?

☐ Very Unattractive ☐ Neutral /Undecided ☐ Very Attractive

☐ Unattractive ☐ Somewhat Attractive ☐ Does not know because never play the game

☐ Somewhat Unattractive ☐ Attractive

13. Do you play games for pure entertainment only?

☐ Yes ☐ No, I play games for educational purposes as well.

14. Do you think it enhances any learning skills by playing games?

☐ Yes ☐ No

15. Do you prefer learning through games rather than learning through exercises and books?

☐ Yes ☐ No

16. Is there any game that you most prefer (favourite)? What is it?

☐ Yes, please specify:_____ ☐ No

17. If yes, why do you like those games you like? What are some of the features that makes you like it?

18. Is there any game that you hate in particular? What is it?

☐ Yes, please specify: _____ ☐ No

19. If yes, what are some features of the games that makes you hate it?

APPENDIX II

Projek Akhir Tahun: Soal Selidik Mengenai Penerimaan Pengguna (untuk pelajar darjah 4, 5, & 6)

Bahagian A: Maklumat Demografi

Sila tandakan [/] di dalam petak yang disediakan.

1. Umur	☐	10	☐	11	☐ 12
2. Jantina	☐	Lelaki	☐	Perempuan	
3. Kawasan Sekolah	☐	Pekan	☐	Pendalaman	
4. Kawasan Tempat Tinggal	☐	Pekan	☐	Pendalaman	

Bahagian B: Kesedaran pelajar terhadap 'Kitar Semula'

1. Di mana kesedaran anda mengenai kepentingan kitar semula bermula?

☐ Sekolah ☐ Rumah – Ibu bapa ☐ Poster ☐ TV/Radio

☐ Lain-lain, sila nyatakan: _____

---

2. Cara anda membuang sampah

☐ Buang merata-rata ☐ Buang di dalam tong sampah ☐ Susun sampah-sampah untuk di kitar semula

---

Bagi soalan 3 – 10 di bawah, sila tandakan [/] yang berkaitan sebagai respon anda.

1 = Amat Tidak Setuju
2 = Tidak Setuju
3 = Lebih Kurang Tidak Setuju
4 = Neutral / Biasa Sahaja
5 = Lebih Kurang Setuju
6 = Setuju
7 = Amat Setuju

No.	Soalan	1	2	3	4	5	6	7
3.	Anda memahami konsep kitar semula dengan sepenuhnya.							
4.	Anda memahami sebab-sebab mengapa kitar semula itu penting.							
5.	Anda mengamalkan sikap kitar semula.							
6.	Pendidikan di sekolah berjaya membuatkan anda sedar akan kepentingan kitar semula dalam menjaga alam sekitar.							
7.	Kurikulum di sekolah tidak mempromosikan sikap untuk kitar semula.							
8.	Orang ramai patut lebih berusaha untuk melakukan kitar semula.							
9.	Permainan komputer mengenai kitar semula patut di bina supaya dapat membantu anda lebih memahami mengenai kepentingan kitar semula.							
10.	Anda akan bermain permainan mengenai kitar semula tersebut jika permainan itu di bina.							

Bahagian C: Penggunaan komputer di kalangan pelajar

1. Adakah anda mempunyai sebuah komputer?

☐ Ya ☐ Tidak

2. Pernahkah anda menggunakan komputer sebelum ini?

☐ Ya ☐ Tidak

3. Jika ya, pernahkah anda bermain permainan komputer sebelum ini?

☐ Ya ☐ Tidak

4. Pernahkah anda bermain permainan computer yang terdapat di 'internet'?

☐ Ya ☐ Tidak

5. Berapa kalikah anda bermain permainan komputer?

☐ Sekali dalam sebulan
☐ Lebih dari sekali dalam sebulan
☐ Lebih dari sekali dalam seminggu
☐ Sekali dalam sehari
☐ Lebih dari sekali dalam sehari
☐ Saya tidak pernah guna permainan komputer

6. Berapa banyak masa yang anda habiskan semasa bermain permainan computer tanpa mengambil istirehat?

☐ Kurang dari 1 jam ☐ Kurang dari 6 jam ☐ Lain - lain, sila nyatakan: _____
☐ Kurang dari 3 jam ☐ Kurang dari 10 jam

7. Di mana tempat yang paling anda sering menggunakan computer untuk mengakses 'internet'?

☐ Sekolah ☐ Rumah ☐ Lain - lain, sila nyatakan: _____
☐ Rumah Kawan ☐ Cyber Cafe

8. Bagaimanakah anda belajar untuk bermain permainan computer?

☐ Belajar sendiri ☐ Belajar dari kawan ☐ Lain – lain, sila nyatakan: _____
☐ Belajar di kelas ☐ Belajar dari ahli keluarga yang lain

9. Apakah jenis permainan yang anda lebih memilih untuk bermain di 'internet'?

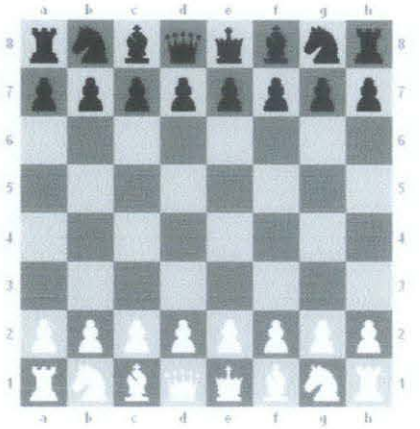
☐ 'Puzzle' ☐ 'Role-Playing Game (RPG)' ☐ Lain - lain, sila nyatakan:

_____

☐ 'Racing' ☐ 'Action/Adventure'

☐ 'Sports' ☐ 'Strategy'

10. Berdasarkan gambar rajah di bawah, permainan catur computer yang manakah anda inginkan?



☐ 2-Dimensi (2D) ☐ 3-Dimensi (3D)

11. Pernahkah anda mencuba permainan (CD atau 'online') mengenai persekitaran atau kitar semula?

☐ Ya ☐ Tidak

12. Jika ya, apa pendapat anda mengenai permainan tersebut dan penglibatannya terhadap pembelajaran?

☐ Sangat Tidak Menarik ☐ Neutral/ Biasa Sahaja ☐ Sangat Menarik

☐ Tidak Menarik ☐ Agak Menarik ☐ Tidak Tahu Kerana Tidak Pernah Bermain Permainan Tersebut

☐ Agak Tidak Menarik ☐ Menarik

13. Adakah anda bermain 'game' untuk hiburan semata-mata sahaja?

☐ Ya ☐ Tidak, saya juga bermain 'game' untuk belajar sesuatu perkara.

14. Adakah anda setuju bahawa 'game' dapat meningkatkan kemahiran belajar anda?

☐ Ya ☐ Tidak

15. Adakah anda lebih suka belajar menggunakan 'game' daripada belajar melalaui buku teks dan latihan?

☐ Ya ☐ Tidak

16. Adakah anda mempunyai 'game' yang paling anda suka? Apakah ia?

☐ Ya, sila nyatakan:_____ ☐ Tidak

17. Jika ya,mengapa anda suka bermain 'game' tersebut? Apakah ciri-ciri 'game' tersebut yang membuatkan anda meminatinya?

18. Adakah anda mempunyai 'game' yang anda tidak gemari?Apakah ia?

☐ Ya, sila nyatakan: _____ ☐ Tidak

19. Jika ya, apakah ciri-ciri pada 'game' tersebut yang membuatkan anda tidak menyukainya?

APPENDIX III

Final Year Project Survey on User Acceptance Testing (for Standard 4, 5, & 6 students)

Section A: Demographic Information

Please tick [/] in the box given.

1. Age	☐	10	☐	11	☐ 12
2. Gender	☐	Male	☐	Female	
3. Living Place Location	☐	Town	☐	Rural	

Section B: Functionality Requirements

For questions 1 – 10 below, please tick [/] for your corresponding responses.

1 = Strongly Disagreed
2 = Disagreed
3 = Somewhat Disagreed
4 = Neutral/ Undecided
5 = Somewhat Agreed
6 = Agreed
7 = Strongly Agreed

	No.	Question	1	2	3	4	5	6	7
Perceived Ease of Use	1.	Learning to use Recycle Warrior is easy for me.							
	2.	It is easy for me to become skillful at using Recycle Warrior.							
	3.	I find it not difficult to get Recycle Warrior to do what I want it to do.							
	4.	I find Recycle Warrior to be flexible to interact with.							
	5.	It takes only a short time to learn the specific functions of using the Recycle Warrior.							
Navigation	6.	The controls for the game confused me.							
	7.	I found the instructions in the game very helpful.							
	8.	I did not know when the game ended.							
Game specification	9.	There were parts of the game that didn't make sense.							
	10.	The pace of the game is appropriate.							

Section C: Performance Requirements

For questions 1 – 10 below, please tick [/] for your corresponding responses.

1 = Strongly Disagreed
2 = Disagreed
3 = Somewhat Disagreed
4 = Neutral/ Undecided
5 = Somewhat Agreed
6 = Agreed
7 = Strongly Agreed

	No.	Question	1	2	3	4	5	6	7
Perceived Usefulness	1.	I would find it useful to use Recycle Warrior to learn new and interesting information on recycling.							
	2.	The facts and figures in the game are very useful to me to understand about recycling issues better.							
	3.	The sound and video used in the game are also very useful in understanding about recycling as well as its importance.							
Relative Advantage	4.	Using Recycle Warrior enables me to learn new and interesting information on recycling more quickly.							
Outcome Expectation	5.	By using Recycle Warrior I would find more information on recycling that interests me.							
	6.	Recycle Warrior helps me to improve my understanding on the concept of recycling and its importance.							
	7.	Recycle Warrior helps to motivate me to perform recycling activities.							
Perceived Behavioural Control	8.	I have the necessary resources to use Recycle Warrior.							
	9.	I have the knowledge necessary to use Recycle Warrior.							
	10.	Recycle Warrior is not compatible with the computer that I use.							

Section D: Interface Quality Requirements

For questions 1 – 10 below, please tick [/] for your corresponding responses.

1 = Strongly Disagreed 4 = Neutral/ Undecided 7 = Strongly Agreed
2 = Disagreed 5 = Somewhat Agreed
3 = Somewhat Disagreed 6 = Agreed

	No.	Question	1	2	3	4	5	6	7
Interface Quality	1.	The font size is too small/too big.							
	2.	The use of colours are very attractive.							
	3.	The graphics used in the game are very attractive.							
	4.	The sounds and videos included in the game are very attractive.							
	5.	When I am using Recycle Warrior, I feel "carried off" by the 3D virtual environment							
	6.	When I am using Recycle Warrior, I feel as if I am part of the 3D virtual environment.							
	7.	When I am using Recycle Warrior, I feel deeply about the 3D virtual environment.							
	8.	Using Recycle Warrior enables me to project myself into a particular role.							
	9.	Using Recycle Warrior enables me to project myself into a particular character.							
	10.	Using Recycle Warrior enables me to project myself into a particular task.							

Section E: Other Requirements

For questions 1 – 10 below, please tick [/] for your corresponding responses.

1 = Strongly Disagreed 4 = Neutral/ Undecided 7 = Strongly Agreed
2 = Disagreed 5 = Somewhat Agreed
3 = Somewhat Disagreed 6 = Agreed

	No.	Question	1	2	3	4	5	6	7
Behavioural Intention	1.	Assuming I had access to Recycle Warrior, I intend to use it.							
	2.	I will play Recycle Warrior frequently in the future							
	3.	I would recommend this game to my friends and family members.							

Anxiety	4.	I feel apprehensive about using Recycle Warrior.							
	5.	It scares me to think that I could lose a lot of information using Recycle Warrior by hitting the wrong key.							
	6.	I hesitate to play Recycle Warrior for fear of making mistakes I cannot correct.							
Perceived Enjoyment	7.	Recycle Warrior makes learning more interesting.							
	8.	I like playing Recycle Warrior.							
	9.	I enjoyed playing Recycle Warrior.							
	10.	Recycle Warrior give a lot of enjoyment to me.							

Section F: General Questions

1. Please state the features that you liked in this game.

2. What are the features of this game that you didn't like about?

3. Have you faced any problem when using the game?

☐ Yes ☐ No

4. If the answer to the previous questions is 'yes', then please state about the problem below:

5. Please provide us with your suggestions for improvement.

APPENDIX IV

Projek Akhir Tahun: Borang Soal Selidik (untuk pelajar darjah 4, 5, & 6)

Bahagian A: Maklumat Demografi

Sila tandakan [/] di dalam petak yang disediakan.

1. Umur	☐	10	☐	11	☐ 12
2. Jantina	☐	Lelaki	☐	Perempuan	
3. Kawasan Tempat Tinggal	☐	Pekan	☐	Pendalaman	

Bahagian B: Kefungsian 'Recycle Warrior'

Bagi soalan 1 – 10 di bawah, sila tandakan [/] yang berkaitan sebagai respon anda.

1 = Amat Tidak Setuju
2 = Tidak Setuju
3 = Lebih Kurang Tidak Setuju
4 = Neutral / Biasa Sahaja
5 = Lebih Kurang Setuju
6 = Setuju
7 = Amat Setuju

	No.	Soalan	1	2	3	4	5	6	7
Persepsi Terhadap Kemudahan Penggunaan	1.	Belajar menggunakan 'Recycle Warrior' adalah amat mudah bagi saya.							
	2.	Ia adalah mudah bagi saya untuk menjadi mahir dalam menggunakan 'Recycle Warrior'.							
	3.	Saya mendapati ia tidak sukar untuk mendapatkan 'Recycle Pahlawan' melakukan apa yang saya ingin ia lakukan.							
	4.	Saya mendapati 'Recycle Warrior' sangat fleksibel apabila saya berinteraksi dengannya.							
	5.	Saya hanya mengambil masa yang singkat untuk mempelajari fungsi-fungsi tertentu untuk menggunakan 'Recycle Warrior'.							
Pemanduan arah	6.	Saya berasa keliru dengan kawalan untuk permainan 'Recycle Warrior'.							
	7.	Saya mendapati arahan dalam permainan sangat membantu untuk menyelesaikan tugas yang diberikan.							
	8.	Saya tidak tahu apabila permainan berakhir.							
Spesifikasi Permainan	9.	Terdapat beberapa bahagian di dalam permainan ini yang tidak masuk akal bagi saya.							
	10.	Kelajuan rentak permainan adalah sesuai bagi saya.							

Bahagian C: Prestasi 'Recycle Warrior'

Bagi soalan 1 – 10 di bawah, sila tandakan [/] yang berkaitan sebagai respon anda.

1 = Amat Tidak Setuju
2 = Tidak Setuju
3 = Lebih Kurang Tidak Setuju
4 = Neutral / Biasa Sahaja
5 = Lebih Kurang Setuju
6 = Setuju
7 = Amat Setuju

	No.	Soalan	1	2	3	4	5	6	7
Persepsi Terhadap Kebergunaan	1.	Saya mendapati 'Recycle Warrior' berguna untuk digunakan bagi mempelajari maklumat yang terkini dan menarik mengenai kitar semula.							
	2.	Fakta-fakta dalam permainan ini adalah sangat berguna kepada saya untuk memahami tentang isu-isu kitar semula dengan lebih baik.							
	3.	Bunyi dan video yang digunakan dalam permainan ini juga sangat berguna dalam memahami maklumat mengenai kitar semula serta kepentingannya.							
Kelebihan	4.	Saya dapat mempelajari maklumat yang menarik dan terkini mengenai kitar semula dengan lebih cepat apabila menggunakan 'Recycle Warrior'.							
Hasil Jangkaan	5.	Saya dapat mengetahui maklumat yang lebih lanjut mengenai kitar semula yang menarik kepada saya dengan menggunakan 'Recycle Warrior'.							
	6.	'Recycle Warrior' membantu saya untuk meningkatkan pemahaman saya pada konsep kitar semula dan kepentingannya.							
	7.	'Recycle Warrior' memotivasikan diri saya untuk melaksanakan aktiviti kitar semula dalam kehidupan seharian.							
Persepsi Terhadap Kawalan Tingkah Laku	8.	Saya mempunyai sumber-sumber yang diperlukan untuk menggunakan 'Recycle Warrior'.							
	9.	Saya mempunyai pengetahuan yang diperlukan untuk menggunakan 'Recycle Warrior'.							
	10.	'Recycle Warrior' tidak serasi dengan komputer yang saya gunakan.							

Bahagian D: Kualiti Permukaan 'Recycle Warrior'

Bagi soalan 1 – 10 di bawah, sila tandakan [/] yang berkaitan sebagai respon anda.

1 = Amat Tidak Setuju
2 = Tidak Setuju
3 = Lebih Kurang Tidak Setuju
4 = Neutral / Biasa Sahaja
5 = Lebih Kurang Setuju
6 = Setuju
7 = Amat Setuju

	No.	Soalan	1	2	3	4	5	6	7
Kualiti Permukaan	1.	Saiz perkataan terlalu kecil atau besar.							
	2.	Penggunaan warna yang sangat menarik.							
	3.	Grafik yang digunakan dalam permainan ini adalah sangat menarik.							
	4.	Bunyi dan video dalam permainan ini adalah sangat menarik.							
	5.	Apabila saya menggunakan 'Recycle Warrior', saya merasa terbawa-bawa oleh persekitaran maya 3D permainan ini.							
	6.	Apabila saya menggunakan 'Recycle Warrior', saya merasa seolah-olah saya sebahagian daripada persekitaran maya 3D permainan ini.							
	7.	Apabila saya menggunakan 'Recycle Warrior', saya merasa dengan mendalam tentang persekitaran maya 3D permainan ini.							
	8.	Recycle Warrior membolehkan saya untuk memprojeksikan diri saya ke dalam peranan tertentu yang terdapat di dalam permainan ini.							
	9.	Recycle Warrior membolehkan saya untuk memprojeksikan diri saya ke dalam peribadi tertentu yang terdapat di dalam permainan ini.							
	10.	Recycle Warrior membolehkan saya untuk memprojeksikan diri saya ke dalam tugas tertentu yang diberikan dalam permainan ini.							

Bahagian E: Ciri-ciri Lain Berkaitan Dengan 'Recycle Warrior'

Bagi soalan 1 – 10 di bawah, sila tandakan [/] yang berkaitan sebagai respon anda.

1 = Amat Tidak Setuju
2 = Tidak Setuju
3 = Lebih Kurang Tidak Setuju
4 = Neutral / Biasa Sahaja
5 = Lebih Kurang Setuju
6 = Setuju
7 = Amat Setuju

	No.	Soalan	1	2	3	4	5	6	7
Niat Tingkah Laku	1.	Saya ingin menggunakan 'Recycle Warrior'.							
	2.	Saya akan bermain 'Recycle Warrior' dengan kerap pada masa akan datang.							
	3.	Saya akan mengesyorkan permainan ini kepada kawan-kawan dan ahli keluarga.							
Kebimbangan	4.	Saya berasa khuatir untuk menggunakan 'Recycle Warrior'.							
	5.	Saya berasa takut sekiranya saya akan kehilangan banyak maklumat yang berguna dengan menekan kekunci yang salah apabila menggunakan 'Recycle Warrior'							
	6.	Saya teragak-agak untuk 'Recycle Warrior' kerana takut melakukan kesilapan yang tidak dapat dibetulkan.							
Persepsi Terhadap Keseronokan	7.	'Recycle Warrior' menjadikan pembelajaran mengenai isu-isu kitar semula lebih menarik.							
	8.	Saya suka bermain 'Recycle Warrior'.							
	9.	I berasa seronok bermain 'Recycle Warrior'.							
	10.	'Recycle Warrior' memberikan keseronokan kepada saya.							

Bahagian F: Soalan Umum

1. Sila nyatakan ciri-ciri yang anda suka pada permainan ini.

2. Apakah ciri-ciri pada permainan ini yang anda tidak suka?

3. Pernahkah anda menghadapi sebarang masalah apabila menggunakan permainan ini?

   ☐ Ya ☐ Tidak

4. Jika jawapan anda kepada soalan sebelum ini adalah 'ya', maka sila nyatakan tentang masalah tersebut dibawah:

5. Sila berikan cadangan anda untuk penambahbaikan permainan ini.