Educating Children about Internet Safety through Digital Game Based Learning

Sarah Farhana Juhari and Nor Azan Mat Zin

Abstract— In this vast informatics era, children are introduced to the cyber world at a very young age making them vulnerable and more exposed to the dangers and risks from the Internet such as data theft, inappropriate content (pornography, violence and advertisement), spam emails, phishing emails and cyber bullying. The objective of this study is to design and evaluate a game prototype to educate children about Internet safety. Adobe Flash CS3 was used as the development software. Result of the effectiveness of the game test show that there is a significant increase (23%; p<0.5) in students' knowledge on Internet safety after using the game. Results of usability evaluation showed that the game has a good design with mean scores for usability aspect of playability (4.04), ease of use (4.1), effectiveness (4.09), user friendly (4.25), interactivity (3.61) and interface design (4.07).

Index Terms— Digital game based learning, Internet safety, game development.

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1 INTRODUCTION

CHILDREN and teenagers have been reported to spend a considerable amount of time on the Internet, whether at home or at school. The Internet is being used for learning purposes, playing computer games, social networking and online purchasing [1]. Although children are using the Internet extensively, several researches [2,3] have shown that the level of understanding and awareness on Internet safety amongst young Internet users are still at a low level. They are involved in risky activities such as giving personal information and photos to strangers, meeting strangers, surfing inappropriate websites (pornography, violent and racist content), cyber bullying and purchasing items online without permission from their parents [1].

A research conducted on primary school students aged 7 to 11 years from 5 schools found that they have some awareness towards Internet safety, but their understanding is not compliant to the concept of Internet safety that has been issued by the United Kingdom [3].

Parents play a big role to solve the problem. Most of the parents state that they do take precautions by supervising their children's activities such as chatting and also restricting access to inappropriate websites. They also place the computers at public area in the house. Besides that, they spend time to discuss about Internet safety with their children [2]. Children are supposed to be immersed in a surrounding interactively where they are given experience and taught on how to solve the problems involving Internet safety. They could be better prepared if they can recognise risky situation on the cyberworld and the steps to solve it [3].

Computer games can be seen as a method to educate children on Internet safety because of the positive effect shown on users visual spatial ability, cognitive and motivation [4]. Computer games are also popular among children and teenagers and it is considered a trend. A research involving 341 students aged 10 to 15 years from Selangor found that 92.1% of them have played computer games and it is a favourite activity among them [5].

This paper will discuss about the design and development of a game software prototype named "Pengembaraan Dunia Siber" (Cyber World Adventure) that is intended to educate the children and increase their awareness about Internet safety.

2 BACKGROUND OF THE STUDY

2.1 Internet Risks

Although Internet can be an exciting and useful tool, it has its downside, especially on young users. According to several research [1,3,4] children are exposed to risky activities such as communicating with strangers, and revealing their personal information, meeting strangers offline, visiting inappropriate websites and cyber bullying. These risks can be categorised into three ; content, contact and conduct. These categories are further divided into four groups; commercial, aggressive, sexual and values[6].

There are a lot of rules and guidelines on Internet safety which can be retrieved by both parents and children. This research looked into the guidelines from Cybersecurity Malaysia, and also the International Telecommunication Union (ITU). Cybersecurity Malaysia is an agency under the Ministry of Science and Innovation Technology (MOSTI) that was developed to increase awareness among the citizens on Internet safety. ITU is a specialised agency under the United Nations which is responsible for information and communication technologies. Table 1 summarise these important internet

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safety guidelines.

These guidelines can be categorised into five activities; surfing the Internet, social networking, chatting, online purchasing and email. It is integrated into the game as learning content.

TABLE 1. INTERNET SAFETY GUIDELINES

Activities	Guidelines
Surfing the Internet	• Have to conform to parents rules and regulations • Report to parent upon finding inappropriate web content • Ignore and be wary of popups
Social Networking	• Do not add strangers • Guard personal information safely • Limit sharing pictures to close friends
Chatting	• Be wary of strangers • Get parents' permission to meet online friends • Ignore insulting messages and report to parents
Online Purchasing	• No purchasing without parents consent
Email	• Do not open emails from strangers • Scan emails that contain files

2.2 Digital Game Based Learning

Digital game based learning (DGBL) is a marriage between the learning content and computer game [7]. There are some other terms related to digital game based learning. Fabricatore [8] pointed out that in edugaming, the content intended to be learned by the user has to be inserted into the gaming activity and there should be no gap between both the learning and gaming activity. Serious games are games that are developed not for the sole purpose of entertainment, but for other important cause such as education and training [4]. There are a few criteria that must be followed and implemented in the development of digital game based learning :

1. Rules and Goal: Rules and goals make the game unique. It gets the player motivated to play it. The objective and goal are usually described at the beginning of a game such as to collect certain objects and defeat the enemy [7,8].
2. Narrative Context: The back story and narrative makes a game more lively and realistic. It effectively captures the player's emotion hence making them a part of the game and become immersed [7].
3. Interactivity: Feedbacks can be presented by points and life score, graphical and audio. An effective game can give feedback to the user through the characters and objects [9].
4. Conflict and challanges: Players are supposed to solve the problems that they face while playing the game. Then the game provides the player with a different problem. This cycle will continue enabling the player to be an expert in the subject matter [10].

2.3 Adventure Game

Games can be categorised into several genres such as action, adventure, fighting, role-playing, simulations, sports and strategy. Although usually, this taxonomy is not easy to apply because some games fall into more than one category. For example, most of the sports games contain information to manage the team and combine simulation with characteristics of the strategy games [9].

Adventure game is an interactive story about a character whom the player controls. The character has the fictional world to explore and solve problems and by solving the problems they advance to the next level. They also interact with characters in the game to gain information [11].

2.4 Game Learning Theory

The learning theories incorporated in digital game based learning are the reason why digital game based learning is educational. Learning theories in digital game based learning have evolved from the first generation, mainly focusing on learning through practicing skills, reinforcement and conditioning based on the behaviourism theory [12].

The second generation, are games supported by the cognitivist approach. People have underlying schemas that represent what have been learned. By scaffolding , chunking and multimedia information, the game can present materials in ways that the players can learn effectively. The 2nd generation also includes interest in meta-skill: such as problem-solving, analysing, perceiving, and spatial ability, that makes it different from the previous generation [12].

The third generation focuses more on the social cultural context. Knowledge is situated in its context, hence knowledge is a product of its context, activity and culture within which it is developed and used [12]. In Internet safety, it is important that the Internet users do not only identify and know the dangers and risks, but they also have to learn how to interact with other people such as and use different tools. By implementing the situated cognition theory, the main points and content of Internet safety can be delivered to children.

It is also important to gain the interest from the players to play and continue playing the game. The elements of motivation in ARCS model by which comprises of Attention, Relevance, Confidence and Satisfaction [13] are related to the quality of a good game discussed earlier. Attention of the player can be attained by interesting rules and goals. Then player can see the relevance due to the relatable narrative context and their confidence can be increased when they are provided and supported by appropriate feedback. Satisfaction will come to the players who have completed the game and overcome the challenges in the game.

Motivation is related to the state of flow which Csikszentmihalyi describe as a state of complete absorption or engagement in an activity and refers to the optimal experience [14] With an effective learning environment, learner will be able to acquire flow experience and the flow experience can certainly

stimulate motivation.

2.5 Internet Safety Games

Several games about educating Internet safety have already been developed and launched on the Internet. Among them are Cybercadet, Cyberfriends both developed by Cybersafe Malaysia, Shrink the bully (AT&T) , Top Secret (Common Sense Media) and Anti-Phishing Phil (Wombat Securities Technology) . All of the games are developed using Flash and contains interesting multimedia elements. Most of the content are related to the basic guidelines when using the Internet such as interact with friends only, spam emails, social media and inappropriate websites but there are not combined into one single game. Therefore, improvement can be made in terms of interactivity, content and the storyline. Table 2 summarizes the Internet safety game.

TABLE 2. INTERNET SAFETY GAMES

Game	Genre	Content
Cybercadet	Quiz	Basic Internet safety
Cyberfriend	Simulation	Social networking website guideline
Shrink the bully	Quiz	Basic Internet safety
Top Secret	Role-play	Social networking website guideline
Anti phishing Phil	Role-play	Phishing URLs

3 METHODOLOGY

The objective of this research is to design, develop and evaluate a game software to educate children about Internet safety. This research adapted the DGBL-ID (Digital Game Based Learning Instructional Design) model [15] and rapid prototyping which allows the development time and to be minimized. Fig. 1 shows the DGBL-RP (Digital Game Based Learning – Rapid Prototyping) model.
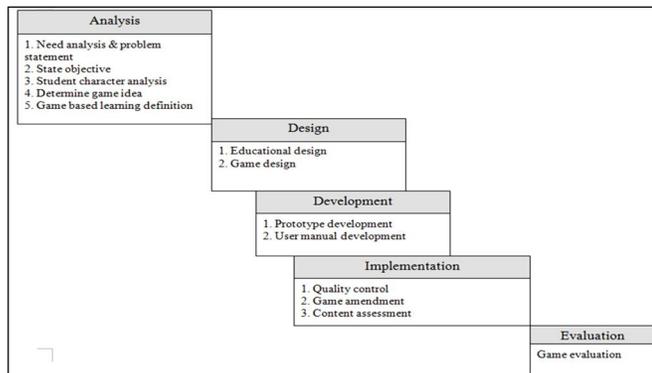

Fig. 1. DGBL-RP Model

3.1 Analysis

In this phase the problem and the needs of the research is identified.

3.2 Design, Development and Implementation

These three phases occur concurrently. The design phase proposes the storyboard of the game prototype. Development needs to have a thorough planning and analysis to ensure that it can meet its intended objective. Based on the storyboard, the development process is done using Adobe Photoshop to design the characters and Cool Edit Pro is used to edit the audio needed for the game. Adobe Flash CS3 is the authoring tool, putting together all the elements and programming the game. The implementation phase was conducted several times involving 8 respondents, which are students aged 10 to 12 years. The prototype was played by them and their comments and feedback are recorded and then ammendments were made to the prototype. Besides that, the game was also reviewed by a content expert from Cybersecurity Malaysia.

3.3 Evaluation

This is the last phase conducted to determine the effectiveness of the game by looking at their understanding on Internet safety and to gather usability feedback from the intended users on the game.

4 CONCEPTUAL MODEL

The design of the conceptual model as shown in Figure 2 is to help guide the game development process. The game conceptual model comprises of the pedagogical part and the game part. The pedagogical part is the integration of both the learning theory and the Internet safety content. The game part includes the elements of a good game; rules and goals, narrative context, and the game genre, which is adventure. Both parts combined will create the flow condition that is to be experienced by the users. The users will then be motivated and the learning objective thus can be achieved.
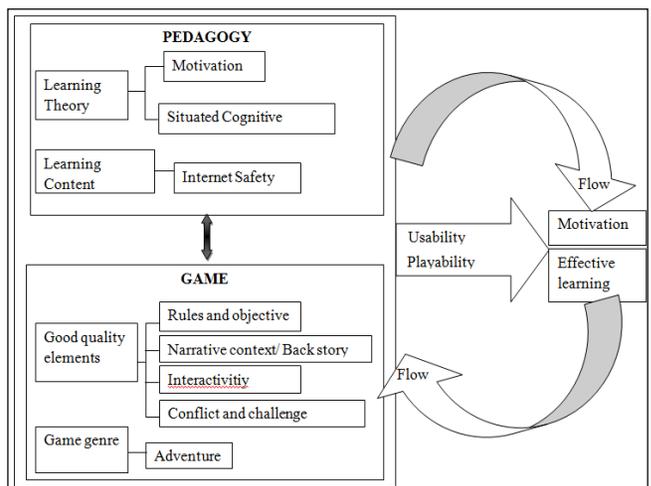

Fig. 2. Game Conceptual Model

5 CYBERWORLD ADVENTURE GAME

Cyberworld Adventure is an adventure game where the

player has to control the main character, Haziq that is transferred and lost in the cyberworld after clicking a pop-up advertisement. This game has four levels. Each level has a different look and feel to it and has its own objective based on the Internet safety guideline described earlier. The player has to pass each level and complete each task given to win the game. Table III shows each level and its objective.

TABLE 3. Game Levels and Objectives

Level	Title	Objective
1	Laluan Siber (Cyber Path)	Players will identify inappropriate websites and delete popups
2	Bandar Siber (Cyber Town)	Players will identify personal data that is not to be revealed to strangers
3	Laman Social (Social Site)	Players will demonstrate appropriate behaviour in social websites
4	Kotak Emel (Email Box)	Players will demonstrate appropriate behaviour in using email.

The first level, named Cyber Path, starts with Haziq arriving in the digital world. Haziq has to go through the path without entering any websites that are inappropriate. He also has to delete pop-ups that interfere his journey. In the second level, the nemesis of the game named Mr. Hacker steals Haziq's personal information including his address, telephone number and email. His mission is to find all the information back. The third level named Social site is where Haziq has to go through the Social Site to find his friends and family. The player has to help him identify and add only his friends and not strangers.

Fig. 3. Level 1 of Cyberworld Adventure

In the final level, Haziq has to find an email from his mother to open the locked door. But he has to follow the guidelines such as avoid spam email, scan email and open email from the people that he knows.

6   Results and Discussion

The evaluation process includes two parts; to test the effectiveness of the prototype and to look evaluate the usability aspect of the game. 31 respondents (14 boys and 17 girls) who are school children aged 10 to 12 years are selected using purposive sampling. The evaluation is conducted in a computer laboratory at a learning centre. After a briefing on the procedure , they were given a set of pre-test. After they finished answering the pre-test, they were asked to play the game for about 45 minutes. Finally, they were given a post-test which is equivalent to the pre-test. Sample questions are shown in Fig. 4:

Fig. 4. Level 1 of Cyberworld Adventure

Table 4 shows that the average score for the post-test is higher in comparison to the score of the pre-test with 23% increase.

TABLE 4. Test Result

Test	Pre-test	Post-test
Mean Score	7.58	11.23

Further analysis using the paired t-test statistical analysis was conducted using the IBM SPSS statistical analysis software. The paired t-test is commonly used to compare how a group of subjects perform in two different test conditions. Table 5 shows the t-test analysis.

TABLE 5. t-Test Analysis

Test	N	x	S	t
Pre-test	31	7.58	2.27	8.041
Postest	31	11.23	2.75	

The result shows that the difference in the mean score between the pre-test and the post-test is significant ($t(31)=8.041$, $p<0.05$). So it can be concluded that the game is effective to enhance the respondent's knowledge on Internet safety.

To evaluate the usability of the game, a questionnaire with 27 items that measured the usability and playability of the game in a Likert scale of 1 to 5 was used (1 indicated strongly disagree and 5 indicated strongly agree). Table 6 shows some of the items in the questionnaire.

TABLE 6. T-TEST ANALYSIS

No.	Item
	(A) USER FRIENDLY
1	The navigation menu helped me in playing this game
	(B) INTERACTIVITY
2	The buttons function when I click it
3	The keyboard functions when I use it
	(C) DESIGN
4	I like the font used in this game
5	The background image is interesting
	(D) PLAYABILITY
6	I like the story in this game
7	I can control the character in this game

No.	Item
	(E) EASE OF USE
8	I can understand the words in this game
9	There is a help function in this game
	(F) EFFECTIVENESS
10	I know more about Internet safety

The aspect of usability includes user-friendly, interactivity, design, playability, ease of use and effectiveness. The mean score for each aspect was analysed. Table 7 shows the mean score of each aspect evaluated. The students were agreeable to all of the usability aspects that received mean of 4.03. The interactivity aspect received a 3.61 mean score which is the lowest. This can be attributed to the confusion of using both the mouse and keyboard to control the some parts of the game.

TABLE 7. USABILITY TEST RESULT

No	Usability Aspect	Mean Score
1	User-friendly	4.25
2	Interactivity	3.61
3	Design	4.07
4	Playability	4.04
5	Ease of use	4.1
6	Effectiveness	4.09

CONCLUSION

This paper has discussed the design and development of an educational game prototype named "Pengembaraan Dunia Siber" (Cyber world Adventure) which is developed based on the conceptual model. Based on the evaluation result, it can be concluded that the game can be used to increase knowledge among children about Internet safety. It is hoped that in the future, further research can be done to look at the long term effect of this game towards children's attitude and behavior and to evaluate it on a larger sample, since this game was only evaluated on a small sample of students. The game model can also be used to develop educational games in other field.

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