

A NOVEL MULTIMEDIA INTERACTIVE APPLICATION TO SUPPORT ROAD SAFETY EDUCATION AMONG PRIMARY SCHOOL CHILDREN IN MALAYSIA

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Graphical abstract



Abstract

The interactive multimedia is considered as a very promising potential to aid primary school pupils in learning and teaching method in introducing road safety education. Although web based applications for road safety education are available, they are based on overseas countries where the rules and environment settings are different from Malaysia's environment. An effort to help pupils in interactively learning on road safety education in Malaysia has motivated this study. A framework encompass of learning theories, modules, multimedia elements and, usability and acceptance, has been developed and applied in an interactive multimedia prototype on road safety education called "FIQIR Road Safety". The prototype has been developed based on a primary school textbook "Cermat Tiba Selamat" by Malaysian Ministry of Education (MOE). FIQIR Road Safety has been designed and developed by utilizing multimedia elements to give an immersive experience to the user. It employs Watch, Learn and Play as the modules where the animations and activities represent actual traffic environment in Malaysia. The proposed framework hopefully can be a guide in developing interactive multimedia application such as FIQIR Road safety.

Keywords: Interactive multimedia, framework, road safety education

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1.0 INTRODUCTION

Road safety is an important issue around the world. Therefore it has been debated among participants in Global Ministerial Conference on Road Safety [1] during United Nation Conference 2010 that led to a declaration of a decade Global Action Plan for Road Safety [1]. As for Malaysia, Road Safety Plan 2006-2010 has been executed and lots of experienced has been undergone.

"Setiap hari, lebih daripada 3,500 pengguna jalan raya terkorban dan 137,000 lagi mengalami kecederaan akibat kemalangan jalan raya di seluruh dunia. Di Malaysia, angka kematian sebanyak 6,877 dicatatkan pada tahun 2011 yang telah membawa kerugian hampir RM9.0 bilion kepada ekonomi

negara. Secara purata, 19 orang terkorban setiap hari di Malaysia, menjadikan kemalangan jalan raya sebagai cabaran kesihatan yang serius kepada negara. Ini juga menunjukkan keperluan satu dasar tindakan yang berkesan" [1].

The statement in the above paragraph had shown urgent needs of efforts towards road safety. The government had spent a lot of efforts in planning the road safety action plan that will be derived from five (5) main pillars:

- Strategic pillar 1 – the management of road safety
- Strategic pillar 2 – mobility and a safer road
- Strategic pillar 3 – a safer transportation
- Strategic pillar 4 – a safer road user
- Strategic pillar 5 – the post accidents management

Road safety education needs to involve all related group in order to achieve effectiveness. According to SDERA (School Drug Education and Road Aware), a group set up by the Australian Government that focus on road safety education strategy [2] and they had come out with effective road safety education model as shown in Figure 1 below. Part of the model stressed on the curriculum that list out a few strategies that can be set up under curriculum part. They are:

- (i) Embed road safety education programs within a curriculum framework
- (ii) School management supports staff to implement road safety education
- (iii) Use student centered, interactive strategies
- (iv) Actively engaged students in skill development
- (iv) Inform parents of classroom programs
- (v) Help students to influence their peers as safe road users.

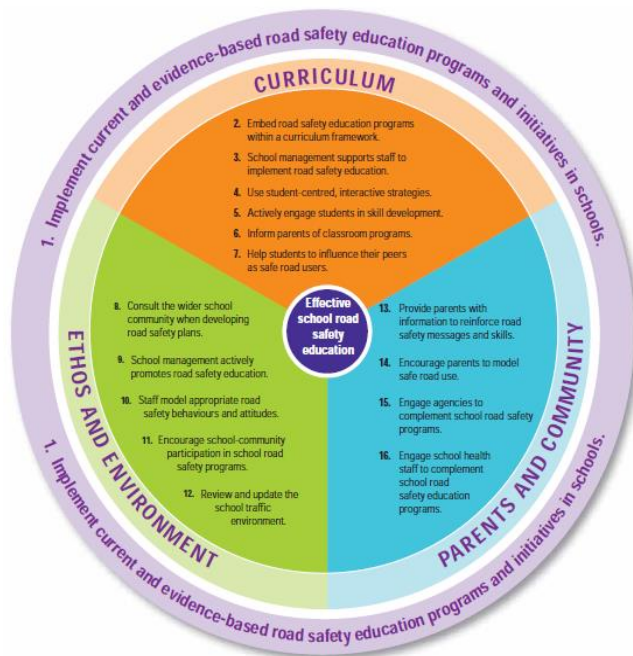


Figure 1 SDERA Road Safety Education Model

The government of United Kingdom (UK) also believe that road safety education is important. There is strong evidence that the most important factor in effective road safety education is that it should be practical and active and at the roadside [3]. Research with children has shown that they learn best when they are actively involved in their own learning about staying safer on the road [3]. They believed that road safety education will be effective if it is embedded throughout the curriculum and activities also resources for road safety education is realistic and relevant to children's lives.

Currently, in Malaysia, students is taught about road safety using a textbook named "Cermat Tiba

Selamat"[4]. Road safety education in Malaysia also supported by a few private companies program such as Shell that sponsored Shell Traffic Games and Petronas with StreetSmart Program. However, both of these programs are carried out in physical environment where learners need to be at the place that has been set up for the practices. It also gives different focus where Shell is more to school children aged 9-12 while Petronas is more to adult user.

In computer based invention, a group of researcher has published a virtual environment for road safety education named ViSTREET [5] that focused on kids aged between 12-14 in a few aspects on pedestrian skills such detecting dangerous situations, gap timing and finding safe place in a virtual settings.

So, there are still loopholes in multimedia interactive application for road safety education for standard two students that emphasis on daily routines of students with Malaysian environment in terms of object representation (sampel of vehicles, signage, attire etc). Therefore, an application named FIQR Road Safety has been developed to fulfill the loopholes. This paper will discuss further related works in this domain and the framework for FIQR Road Safety application as well as the design of the application.

2.0 RELATED WORK

In the United States, injury is the leading cause of death of children [6]. The longer life, the potential of deaths caused by injuries is higher than other causes including congenital anomaly [7]. Also, injuries caused by accidents are the main cause trauma to children [8] and require a large expenditure to manage it [9].

To reduce losses due to road accidents, early exposure to children about safety while on the road is necessary. According to Rosenberg and Global Road Safety Partnership [10, 11], experts have been recommending road safety education for children of primary school. In Malaysia, the actions taken and lessons have been made. For example, the subject of road safety is taught to students in year 2 primary schools.

With the increasingly rapid development of the internet and can be accessed anywhere and at any time as well as the increased use of computer and internet in schools, providing a space for interactive multimedia learning to helps primary school students learning about the road safety. Studies made by McComas *et al.* [12], using VR in learning the ways crossing the street and crossroads safely. The results of his findings show students can acquire these important skills in a simulated environment and applying it in a real environment. According to Rosenberg [10], the use of interactive multimedia is cost-effective in learning the safety of pedestrians and it can be widely used.

Ann et al. [13] express that interactive multimedia (IMM) represents a promising approach to traffic safety education, using interactive animations and video. Animations can encourage learner understanding when it is used in means that are consistent with the cognitive theory of multimedia learning. Figure 2 summarizes the cognitive theory of multimedia learning. The theory is based on three assumptions suggested by cognitive research: (1) dual-channel assumption-the idea that humans have separate channels for processing visual/pictorial representations and auditory/verbal presentations, (2) limited capacity assumption-the idea that only a few pieces of information can be actively processed by any one time in each channel and (3) active processing-the idea that meaningful learning occurs when learner engages in cognitive processes such as selecting relevant material. According to this theory, coordinated presentation of explanatory words and pictures is effective as it helps learner's cognitive processes [24], [25], [26].

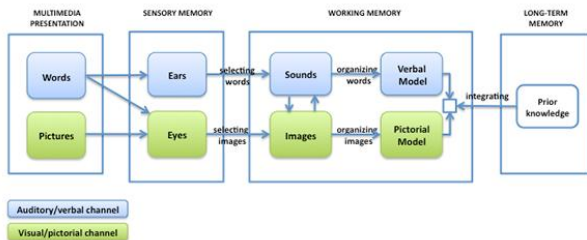


Figure 2 A Cognitive theory of Multimedia Learning

In addition, the major advantages of using IMM are its potential efficiency, cost-effectiveness and the ability to practice street crossing in a safe environment. Finally the IMM approach represents a potentially significant improvement over other currently available safety curricular. The strength of use IMM as discussed above, as a catalyst for use in this study.

3.0 RESEARCH FRAMEWORK

This research applied four components namely learning theories, modules, multimedia elements and usability & acceptance. These components are hopefully can be implemented as guidelines to the others to develop an interactive multimedia application.

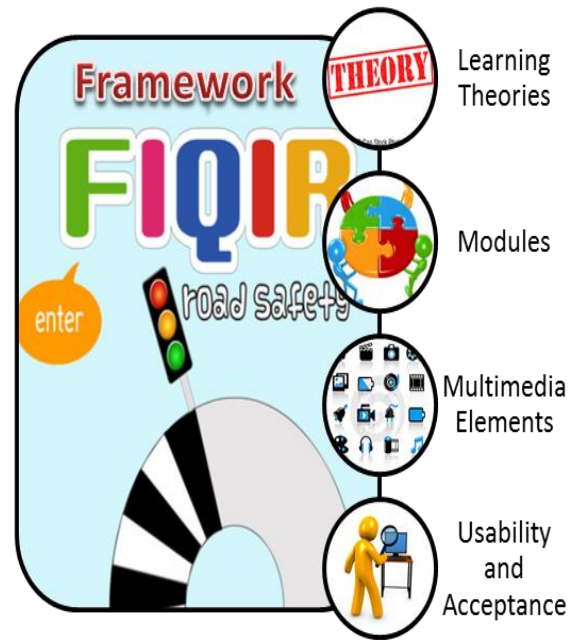


Figure 2 Research Framework for FIQIR Road Safety

3.1 Learning Theories

The theories of teaching and learning, road safety curriculum and related models were also studied in developing the ID model for FIQIR application. The design process that involves cognitive and constructive aspects of learning also been implemented using the cognitive theory of multimedia learning. The contents will be presented in a learning modules task based. The lesson scope will be on the introductory of road safety and basics of road signage in Malaysia.

3.2 Modules

Modules within the application include interactivity that involves the use of active texts and graphics connected to definitions, further information, other modules and so forth. Three learning modules were adopted through interactivity to ensure the children can learn regulations and good practice about road safety.

FIQIR merges the idea of actual environment with multimedia functionality to produce lively and interactive application to exercise learning by watching, playing, exploring, and having fun. This application is made up of three modules:

1. Watch

This module introduces the users on the road in Malaysia. The application integrates graphics, audio and animation in promoting the introductory part.

2. Learn

The module consists of two parts – the basics of road signage and categories of road signage. The users can explore these interactive sub topics and interact with the application to get more information.

3. Play

This module is designed and developed with the objective of testing and evaluating the children on their overall understanding of topics presented in the previous learning modules. The users were tested with three different forms of activities to ensure the understanding of the users – Guess Me, Fill Me and Drag Me. Children themselves can thus monitor their achievement and performance based on the feedback acquired from the tests or quizzes.

3.3 Multimedia Elements

Multimedia elements are one of the components in FIQIR application. Multimedia elements can be described as variety types of media used in presenting information to the audience including text, graphic, video, audio and animations. In this research, the author applied all the multimedia elements.

3.3.1 Text

Text is a common multimedia element used in any interactive multimedia application particularly for educational purpose. Text is the easiest to manipulate. However, there are a few general guidelines when used this elements which are be concise, use appropriate fonts, consider different type styles, be consistent, make the text readable and use restraint. In FIQIR application, text is used in every page consistently and minimizes to explain the contents. The text usage in this research functions as guided to clarify the metaphor of graphic icon, menu button, overview of the contents and so on.

3.3.2. Graphical Images

There are two types of graphic images which is vector and bitmap. In this research, both types of graphical images are implemented. The used of images to add emphasis, direct attention, illustrate concepts, and provide background content. In FIQIR application, the practices of graphical images are considered based on the user requirement.

3.3.3 Video

The element of video have two types which is analog and digital. A series of rapidly displayed images can be output as video. Digital video are used in the development of FIQIR application. According to [14], video technologies have the abilities to capture the rich contexts of teaching and learning, with the necessary perspective to observe and reflect. Video element in FIQIR is used to replace the text as a tool

to explain some of the contents which is hard to explain by words and to show real practice for certain tasks in learning about the road safety. The users can clearly see how that practical aspect has been carried out instead of they read the text without knowing how it is being done which can contribute to better understanding of that subject matters.

3.3.4 Audio

Audio is another element used in FIQIR application. Audio is suitable for this application because it can provide better quality of communication between user interface and the user [16]. When the quality is better, the user can gain information easily and smoothly. For this application, the audio is being captured via recording the actor's voice. The recorded voice is then processed using the sound editing software.

3.3.5 Animation

According to [17] a lot of information can be transferred by using moving image called animation because the eye-brains assembles a sequences of image and interprets them as a continuous movement. Animation can be defined as rapid display of images in sequence to create an impression of movement where it incorporates and draws inspiration from each of the other media [14]. In FIQIR animation can be used to help students learn more on how to understand better about the road safety because sometimes expressing ideas with texts or pictures only are not enough to make users more engage with the application.

FIQIR application incorporates a variety of media such as text, audio, graphics and animations in presenting the modules. The modules are able to motivate children due to the multimedia approach and hyperlinks provided in this application. The words and sentences used are easily understood and are based on children's reading ability. The application also adopted interactivity and navigation approaches to make sure children can interact with the application easily.

3.4 Usability and Acceptance

Usability is a concept in Human Computer Interaction (HCI) that refers to create any computer applications that easy to learn and easy to use through User-centered Design (UCD) process [18] [19]. UCD is considered especially important when creating new applications that need to be accepted by users.

According to [20] the usability concept consists of five main criteria namely easy to learn, easy to use, easy to remember, contain few errors and satisfaction. Meanwhile, [21] describe the usability criteria as effectiveness, efficiency, safety, utility, learnability and memorability. For this research, the authors have chosen usability criteria as learnability,

efficiency, memorability, errors and satisfaction. Table 1 shows the definition of those criteria.

Table 1 Usability criteria of FIQIR

Usability Criteria	
Learnability	Users must be able to learn easily even after a period of not having used it.
Efficiency	Users can carry out their tasks with a minimal number of steps.
Effectiveness	Users are able to complete the task and to achieve goals.
Errors	Users can overcome any errors by providing button for help and display suggestion through dialog box.
Satisfaction	Users must be fun to use the system to feel satisfaction

Usability is important feature in order to evaluate an application [22]. The results from the usability evaluation can be used to judge the application. The term evaluation generally refers to the process of gathering data about the usability of a design or product by a specified group of users for a particular activity within a specified environment. In term of FIQIR application, usability evaluation is a technique to identify user requirements and propose suitable solutions.

Before perform the evaluation, the authors determined the objectives of the evaluation. The planning for the evaluation is important in order to perform the evaluation smoothly. The objectives that have been identified for this research are as followed:

- To ensure that users easy to learn the functions of tool at the interface in order to offer smooth interaction. (Learnability)
- To make sure users can do their task efficiently by using help and also use hint for the button, then users can click in order to get more information. (Efficiently)
- To assured users can adequate to remember the flow of the content or page navigation. (Memorability)
- To ascertain users can explore the application with help button and dialogue box that can help them to settle the errors. (Errors)
- To make sure users get the required information quickly and accurately as well as a high level of interactivity. (Satisfaction)

Usability testing is a systematic way of observing actual and potential users of a product as they work with it under controlled conditions [20]. The FIQIR application was intended to be used for learning road safety in Malaysia for primary school pupils. Therefore, the evaluation of the usability is appropriately important. The questionnaire will be

formulated to test the usability based on suggested constructs adapted from traditionally associated usability engineering [23]. It will be implemented based on constructs and attitudes of students and teachers towards application. The study hypotheses will be tested by analyzing data from a sample survey. Data collected will analyzed using statistical software. Results of data analysis will be used to answer the research questions outlined to support this research.

4.0 THE PROTOTYPE

Based on the framework designed, a prototype of FIQIR Road Safety has been executed. The graphics is prepared using Adobe Illustrator while Adobe Flash is used for authoring process including creating the scene and animation. While audio editing software used in recording the narration and provide appropriate sound effects. FIQIR Road Safety has three main modules that utilized the multimedia elements. Figure 3 and Figure 4 are sample of screenshot. Details of each module are as discussed in the next part.

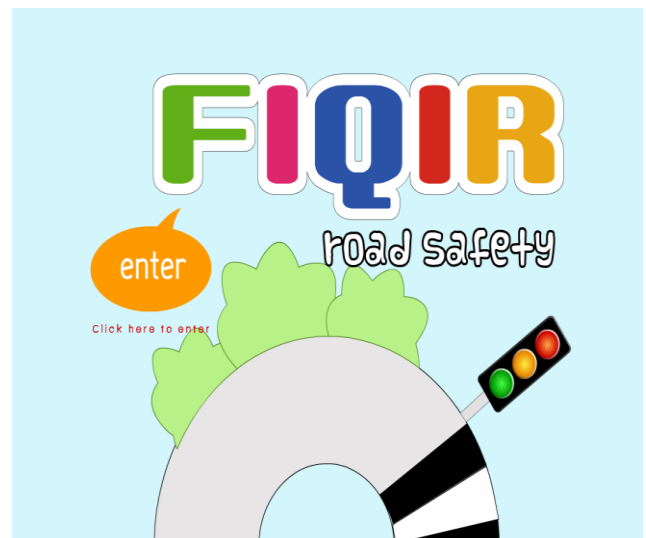


Figure 3 FIQIR Road Safety introductory screen



Figure 4 FIQIR Road Safety Main Menu

4.1 Watch

This module provides short 2D animations to visualize a student that walked to school. The character that used is a Malay girl that wearing a school uniform with head covers. This is common view at most of schools in Malaysia. The girl named Aima will explain each term that related to her and what she can see on her way to school. Narration is synced with the animation.

4.2 Learn

While for this module, the standard and common signage in Malaysia is shown according to its category. There are:

- Mandatory – all road users must obey towards this signage. Among example provided are one way street, follow this arrow, u-turn etc. Blue used as background and shape or graphic in white colour normally represents this category of signage.
- Cautionary – as reminder for the road users to be more cautious at certain area. Sharp corners, slippery road and T junction are examples for this category. Its normally used yellow color as the base and black for the shape on it.
- Prohibitory – this category purposely to prevent road users from doing things that not permitted. No u-turn, no entry and speed limit are parts of this group. The standard of signage color for this category is white, black and red. Depends on what signage it is, the base can be white or red.
- Temporary – this group used temporarily such as people working in front, please use left lane, right lane is closed are types of signage in this group. The

base of this kind of signage is orange and black for the graphic or shape.

e) Information sign – also known as signboard. This group is used to show the direction and place name to the road users. Blue is used as background while white is used for the text on the signboard

4.3 Play

Last module is provided to test what the students have learned throughout the first two modules. Three activities prepared that contained what had been shown in Watch Module and Learn Module. Guess Me, Fill Me and Drag Me approached a user with different skills. In Guess Me, users will be given some hint to guess the correct answer from choices given. While in Fill Me, students need to type the right answer. Moving the correct answer into a specific place is an activity in Drag Me.

5.0 CONCLUSION AND FUTURE WORKS

Road safety is a big issue throughout the world. Even though a highly secured vehicle is designed, it only will be secure with a good care and handling of it. A lots of efforts has been taken by all countries towards road safety either in designing the vehicles, constructing the road or educating the users of the road. Therefore it is very important to ensure that road safety education has been started from early years in life. Road environment is dynamic so an appropriate approach in educating road safety should be able to mimicking the actual environment. Multimedia technology has a great potential in visualizing the dynamic environment of road. It bring together learning in a fun way. It also has an immersiveness feature.

Working from that, a prototype of FIQIR Road Safety has been developed that utilized the multimedia elements to support road safety education among school children aged 7 to 8 years. Framework of the project has been constructed and parts of it have been executed. Next step of the project is to acquire technical review from the experts to improve this prototype. Later, an evaluation will be carried out in the aspect of usability of the prototype among school children. It is a hope this prototype can be enhanced and collaborate with road safety authorities of Malaysia to be embedded within the primary school curriculum.

Acknowledgement

FIQIR Road Safety has competed in Innovation Competition at University level and has won a silver medal. It also won Gold medal in International Invention and Innovation Exhibition (ITEX) 2015 (21-23 May 2015). We would like to thank the Center of

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