tanika J. Sci. & Technol. 30 (1): 621 - 640 (2022)

PERTANIKA JOURNALS

SCIENCE & TECHNOLOGY

Journal homepage: http://www.pertanika.upm.edu.my/

Conceptual Paper

A Conceptual Framework for Road Safety Education using Serious Games with a Gesture-based Interaction Approach

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ABSTRACT

Road accidents among children are one of the factors that cause mortality. An interactive manual has been developed to solve the problem. However, reports show that most road safety programs are displayed conventionally and unsuitable for almost all target users. In order to minimise the negative effect of road accidents on primary school students, early prevention programs need to be set up to overcome the problem. The natural user interface is a current technology that could be implemented in road safety education. Thus, this research aims to develop a conceptual framework by integrating gesture-based interaction and serious games towards road safety education, which will hopefully meet the road safety syllabus to tackle primary school students. All the proposed conceptual framework elements are identified through a systematic literature review and existing theories and model analysis supported by the experts' review. This research's main finding will be a conceptual framework of user engagement in road safety education through serious games with a gesture-based interaction technology approach. This conceptual framework would be a reference for road safety designers or developers to build an application for road safety by considering user engagement through gesture-based interaction, learning theory, and serious games at the same time.

Keywords: Gesture-based interaction, road safety education, serious games

ARTICLE INFO

Article history:
Received: 28 July 2021
Accepted: 16 November 2021
Published: 10 January 2022

DOI: https://doi.org/10.47836/pjst.30.1.34

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ISSN: 0128-7680
e-ISSN: 2231-8526

INTRODUCTION

Every day, thousands of people lose their lives on the road. By 2020, the fatality for road crashes in Malaysia is estimated to reach 10,716 deaths if there is no drastic intervention or initiative to address the rising fatality rate (MIROS, 2018). For a long time, road users have seen and read about road accidents on social media, but users are still unaware of the importance of safety education among children. Many child pedestrians killed or seriously injured in road accidents have become a global issue. Hence, more actions need to be taken using various technologies and media. Education through the media only involves one-way communication or communication without interaction. Educating primary school students from an early age using technology is highly suitable because technological devices and connectivity have pervaded all aspects of our lives. The application needs to avoid miscommunication and attract user attention or engagement. User engagement is a key concept in developing user-centred interface applications that refer to the quality of the user experiences while conducting the interaction captured by the technology. Therefore, a new learning environment needs to be set up to increase learners' interest, especially among primary school students.

Serious Games (SG) are related to the Game-Based Learning (GBL) term in teaching approach and skill implemented in various types of domain areas or informal learning while play (Fuchslocher et al., 2011). In general, a serious game offers fun learning that can be applied in life and various fields of knowledge (Bolognesi & Aiello, 2020). Therefore, SG has increasingly been used to enrich learning and development for academic purposes (Mohd et al., 2018). A Natural User Interface (NUI) allows designing products that appear and feel as natural as possible to the user. A NUI aims to create a seamless interaction between humans and machines since one of the characteristics is user-centred. In this study, SG is defined as attributes that embrace game technology that enriches learning development and utilises game technology using the Gesture-Based Interaction (GBI) approach, which is part of natural interaction. Aliprantis et al. (2019) defined the natural interaction interface as the platform that allows users to interact similarly to real life, enables the learning process, and acquire mental load and training. Through this new application framework, the research aim is to implement a NUI through GBI and serious game attributes in handling the road safety problems mapped with learning theories. The Input-Process-Outcome game model inspires the conceptual framework by Garris and Driskell (2002).

ROAD SAFETY EDUCATION

The increasing number of road accidents and death among children is one of the focus problems in Malaysia (Hamid et al., 2017). Malaysia is one of the countries that participated in the Global Ministerial Conference on Road Safety held in Moscow on 19th and 20th

November 2009. This conference aimed to overcome issues related to road safety. Our country created the sequel to this conference, Decade Action for Road Safety, or in Malay known as 'Tindakan Sedekad'. Part of the contents in Decade Action for Road Safety covers from 2011–2020 are focused on the behaviour of road users, education for road safety, and pre-response of road accidents. Many programs have been carried out to change people's behaviour, including promoting helmets that follow SIRIM standards and mandating vehicle seat belts. Starting from 2019, the road safety department, with the help of the Ministry of Education, has applied these modules for primary and secondary schools. These modules are included in the *Bahasa Melayu* subject and used in 24 selected schools. For secondary school students, the modules were implemented in the year 2020. The modules were implemented based on the Context, Input and Process, and Product (CIPP) model, which is needed to determine the level of knowledge and skill in road safety among primary students.

The study by Kamarudin et al. (2020) found that road safety education, such as crossing the road, is very important to implement for school students, especially students who walk from school to home. One suitable type of education in implementing Road Safety Education (RSE) for primary school students is adventure education. Adventure education implements the experiential learning process in which people construct knowledge through direct experience, practising skills, and strengthening values (Shih & Hsu, 2016). Therefore, to design efficient strategies for road safety, a good framework needs to be applied. According to Hughes et al. (2016), the efficient strategies include two main components, which are; 1) policy tools to improve road safety, such as enforcement and education, and 2) components that involve humans, vehicles, and equipment. Thus, a new conceptual framework might be a potential guideline to develop excellent and effective road safety strategies. The road safety strategies suggested include three main components based on previous research studies, namely:

1. Components of road safety—the components can consist of humans, vehicles, equipment, and the environment, which are the main factors that cause traffic accidents in Malaysia.
2. Characteristics—The critical character in road safety strategies is age. Based on the theories of Jean Piaget, children's behaviour patterns in road traffic are differentiated between the following four levels of development (Afifah & Hossain, 2016) known as sensorimotor stage, preoperational stage, concrete operational stage and lastly formal operational stage.
3. Policy tools—consist of programs/projects, engineering, education.

More details about road safety strategies are illustrated in Figure 1 below.

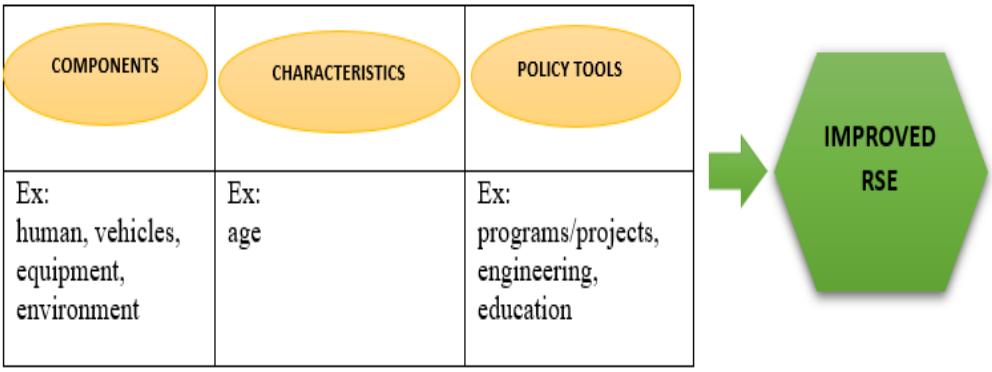

Figure 1. Road Safety Strategies in RSE

One of the components in road safety strategies that have been famously implemented is the Safe System Approaches originate from Haddon Jr (1980), comprising a 9 cases matrix to define the risk factors of an injury in three categories: the individual, the agent, the environment, and the moment of the action: before, during and after the accident. All traffic safety factors could be found in the Haddon matrix: the personality of the driver (before), an agent, such as speed (before and during), environments, such as bad infrastructures (before) or bad emergency services (after) (Assailly, 2017).

The next strategy in RSE is using characteristics that focus on the target audience's age level of development. In Malaysia, based on the CIPP model, the level of development mainly focuses on secondary school and primary school students. It means that RSE in Malaysia focuses on the concrete operational and formal operational stages in development. For concrete operational, the strategies in conveying the materials of RSE need to incorporate inductive logic. Traffic education can be exposed to them at this stage but in actual or simulated conditions rather than theoretically in a classroom. In the formal operational stage, the age of the users is 12 years old and over. On this level, children can think abstractly. They are aware and able to detect their position and assess and avoid risks from their surroundings. In other words, they can understand the complex rules of traffic.

The CIPP model is one of the policy tools implemented in Malaysia. The purpose is to generate the baseline usage for schools, teachers and students. Through this module, the students will be influenced by traffic information, the signals related to road safety, and the next steps to follow, focusing on the youngest generation. In addition, there have been several attempts in the literature to explain the cause of accidents and injury severity.

Another sample of the policy tools in Malaysia is a campaign carried out by Allianz Malaysia. The campaign emphasised the five elements of road safety; understanding basic road safety rules and traffic signage, crossing roads safely and understanding traffic hazards, understanding the traffic light indications, proper wearing of helmets for cyclists and motorcyclists, and getting into the habit of wearing seatbelts. The Allianz Road Safety Tips Booklet is another initiative of Allianz Malaysia that aims to further our efforts to instil road safety awareness among children by reaching a bigger audience. The booklet was developed internally by Allianz Malaysia with consultation from Jabatan Keselamatan Jalan Raya (JKJR). It provides handy tips on road safety for children aged 4 to 12 years old.

SERIOUS GAMES

SG is a game designed for a primary purpose other than pure entertainment. The main aims of SG are learning and behaviour change (Connolly et al., 2012). Based on Mohd et al. (2018), there are 12 basic building blocks according to the educational view as features of the framework of a serious game, which are:

1. Interaction—The engagement in learning explains how the players adapt and manipulate the games' elements. The players need to deal with the situation and implement interaction.
2. Reward—Incentives for the learner, a must-use attribute in games. This attribute will motivate the players to upgrade their knowledge and level in playing the games.
3. Practice and drill—The game structure provides the exercises and games that implement the learning process's repetition concept. This attribute will enforce learner memory and challenge.
4. Incremental learning—The design of learning contents is organised in incremental order. The flow of the game was structured from novice stage to master level.
5. Linearity—Learning is arranged sequentially, which focuses on knowledge delivery (the content of learning).
6. Attention span—Duration time of players, can engage with the content structure and solve the task at the level provided.
7. Transfer of learnt skill—Implementing skills learned previously in novice stage and practice to a new learning environment.
8. Scaffolding—The learning environment splits the learning problem into subproblems and offers support and help during the learning process.
9. Learner control—The learning process can be controlled by the player. The player can repeat or continue the learning process based on try-and-error learning.
10. Accommodating the learner's style—The learning process was structured to match the player's development level.

11. Scenario-based learning—Learning materials for the players were designed based on real-life. The players will gain more knowledge when exploring the contents close to their environment.
12. Intermittent feedback—Just-in-time feedback for learning

One of the models in constructing SG is the Input-Process-Outcome Game Model (Garris & Driskell, 2002), as in Figure 2, which emphasises three main phases.

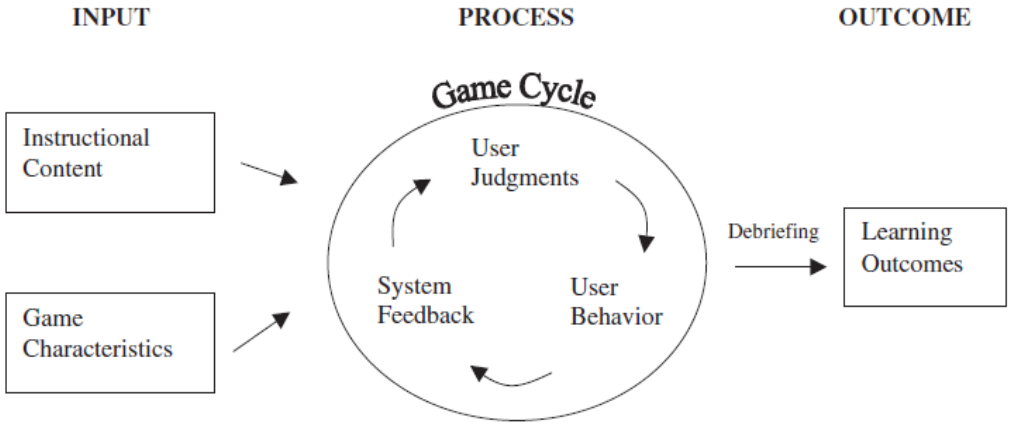

Figure 2. Input-Process-Outcome Game Model (Garris & Driskell, 2002)

First, the learning model's input consists of two components: instructional content and game characteristics. Instructional content refers to the elements used in the selected contents, which will help the knowledge acquisition process as proper guidance in designing SG (Tsikinas & Xinogalos, 2018). The authors also mentioned that some of the researchers used the term game characteristics as game attributes that assist in the learning process and the learner's engagement. For example, the use of scaffolding attributes is assistance that the learner might need during gameplay. The second phase is where the process is implemented through games cycles. The cycle will repeat in eliciting the gameplay match with the player (system feedback), for example, like engagement or fun (user judgement) and change learners' behaviour (user behaviour) towards the given task, which finally brings to the specific learning outcome. Furthermore, in the game cycle, the researchers will extend the pairing contents with appropriate games features. Finally, in the last phase, the learning outcome is achieved. According to Wilson et al. (2008), the learning outcome achieves targeted learning goals beneficial to trainers, instructors, practitioners, and learners.

LEARNING THEORIES

Learning theories provide a framework for understanding how people learn the contents. Serious gaming is similar to other well-known learning methods that need to be established on prominent learning theories to improve learning outcomes (Pourabdollahian et al., 2012). According to Masethe et al. (2017), traditional learning theories, such as behaviourism, constructivism, and cognitivism, are considered the foundation theories in the teaching and learning process.

Behaviourism theory is well known as the study of behaviour that can be observed and measured. Research has shown that agents can regain attention during drops in engagement. Research by Szafir and Mutlu (2012) found that embodied agents offer great potential to interact using the full range of human communicative behaviour. The behaviour involved is verbal and nonverbal. Verbal acts are, for example directing questions, using humour, and addressing students, while nonverbal acts can be seen through expressions, gestures, eye contact, smiling, posture, and proximity (Velez, 2008). Stavrev (2016) suggested that including new gameplay levels can improve the students' behaviour near and on the road. According to the behaviourism theory, the human mind is considered a 'black box' because responses can be observed quantitatively while completely ignoring thinking processes occurring in the mind (Khowaja, 2017). The game attributes relevant to behaviourism theory are interaction, reward, practice, and drill. In general, there are two interaction strategies in implementing interaction attributes to capture the active user: event-based and state-based (Serrano-laguna et al., 2016). Through the event-based strategy, one way to measure interaction is by analysing the user logs, while in state-based strategy, the specific frequency by users that were played repeatedly in the games state. Meanwhile, reward attributes in the game encourage the learner, keep motivation high, and include scores, permission, property, and reputation (Westera, 2019). The last attribute under this learning theory is practice and drill, which involves repeating learning exercises and practices until the learning goal is achieved (Kurniawan et al., 2019).

Constructivism theory is a learning theory found in psychology that suggests that learners construct knowledge from their experiences (Mohd et al., 2018; Olusegun, 2015). In other words, the students may learn new information and increase what they already know with the idea that students can be taught and can affect the attitudes. Piaget's constructivist learning theory has had a wide-ranging impact on learning theories and teaching methods in education (Olusegun, 2015). When dealing with constructivism, the common nature that we do are asking questions, exploring, and assessing what we know. For example, in the classroom, the constructivist view of learning can implement many different teaching practices. In the most general sense, the learning process encourages students to use active techniques, such as experiments and applying real-world problem solving to create more knowledge. Later on, the students reflect and talk about what they

are doing and how their understanding is changing. Scaffolding is one of the attributes of serious games that allows real-world problem solving while experiencing the game being played by the user. According to Obikwelu (2017), scaffolding is the guidance required in bridging the gap between what a child knows and what he is supposed to know. Basically, the standard game's design that implements scaffolding is divided into subproblems. The last attribute that can be mapped in constructivism is learner control. Learner control is the learner as an active processor of information. In constructivism theory, the learner's role is to construct new ideas from current or past knowledge (Alqurashi, 2018).

Cognitivism theory is the learning process as an internal and active mental process, which develops within a learner and increases mental capacity and skills to learn better (Mcleod, 2001). In contrast, ineffective cognitive processes that result in learning difficulties are remembered and impact an individual's lifetime. The literature on interactivity and relative frameworks reviewed by Hart (2014) mentioned that psychology's cognitive model can be drawn and can change over prolonged use and time. As Garris and Driskell (2014) stated, the user gets hooked on cognitive processes that are triggered and beneficial for learning. In developing cognitivist theory instruments, an existing knowledge structure must be present to compare and process new information for education. The attributes that match cognitivism are incremental learning, linearity, attention span and transfer of learnt skills. In incremental learning, the attribute provides the learning materials and introduces the learning activities by increasing the level of knowledge in achieving subject materials learning outcomes (Tsita & Satratzemi, 2018). For example, when the children know numbers, they are taught how to do addition and subtraction processes. Next, linearity is the game design needs to have a start and an end. The execution process will be conducted step-by-step, such as users need to do task A and then task B. Meanwhile, attention span concerns the cognitive processing and short-term memory loads placed upon the learner by the game. These loads need to be carefully calibrated to the target learner. Lastly, the transfer of learnt skills is the support provided by the game to enhance the application of previously learnt knowledge to other game levels.

There have been many conflicts in designing educational games entertaining and sustaining the learning aspects (Ahmad et al., 2015). For this reason, the concept of learning through experience is implanted by embedding the experiential learning theory. Three primary game attributes found from this theory are accommodating the learner's style, scenario-based learning, and intermittent feedback (Mohd et al., 2018). Accommodating learners style attributes refer to the contents in the games, which need to be designed to suit the audience. For example, the medium and sources used need to be suitable to create the game applications for children. Lastly, the intermittent feedback by Tsita and Satratzemi (2018) is the extent to which every interaction that provides feedback should be defined. These feedback attributes are very important to ensure the goal can be achieved by playing the games.

GESTURE-BASED INTERACTION

User interfaces allow the user to use modalities, such as touch, gestures or voice. Based on Liu (2010), the characteristics of a NUI are: 1) User-centred; 2) Multi-channel; 3) Inexact; 4) High bandwidth; 5) Voice-based interaction; 6) Image-based interaction; and 7) Behaviour-based interaction. The two characteristics relevant to the RSE environment are user-centred and behaviour–based characteristics from the seven characteristics listed. The user-centred characteristic involves a multi-stage problem that requires analysis and how the users see in using the interface and test the validity of their assumptions concerning user behaviour in real-world tests with real users. In a short story, user-centred characteristics study the users' needs, wants, and limitations at each stage of the interface design process. Meanwhile, the behaviour-based characteristic is interactions in the communication process with the user, such as using gestures.

Over a decade, GBI has become the modern interface implemented in various fields. As adapted from Ackad et al. (2014), good approaches to design gesture-based interaction design are: 1) Apply simple and memorable gestures so that passers-by can learn and apply them easily; 2) Gestures need to be quick to allow for fast and accurate navigation through the application; and 3) Gesture set needs to be socially acceptable for use in a public space and within crowds. The researchers also explained that gestures are interesting for communicating with a machine because they are compact and represent human-machine interaction. According to Card (2014), levels of abstraction for gestures can be divided into five: 1) Device abstraction like an application that uses a surface multi-finger stroke device; 2) Transformation that includes application command 3) Signal coding by using gestures, 4) Sensing, such as mutual capacitance; and lastly 5) Physical properties.

Past studies have found that the gesture level of abstraction frequently used by researchers is signal (Bilban et al., 2017; Chang et al., 2015; Chang et al., 2011; Hsu & Iacsit, 2011; Rodrıguez, 2015; Savari et al., 2016; Stavrev & Terzieva, 2015). Nevertheless, most of the researchers agree that though the famous gesture level is through signals, the gestures can involve many types of gestures, such as a hand (Bilban et al., 2015; Chang et al., 2011; Rodrıguez, 2015), whole-body (Hsu & Iacsit, 2011; Motiian et al., 2015; Savari et al., 2016), and upper-level body (Chang et al., 2015). A sample of simple and easy gestures is shown in Figure 3. As mentioned by Kang et al. (2015), to represent the gestures to the users, many forms can be taken: 1) Using *emblems* like 'thumbs up' or 'ok'; 2) Using *beat*s that support structure discourse, such as 'on the other hand' or 'first'; and 3) *Representational* gestures that convey meaning by using *deictic* gestures that point to actual features in the real world, *iconic* like shapes or actions, or *metaphonic* to express meanings and relations.

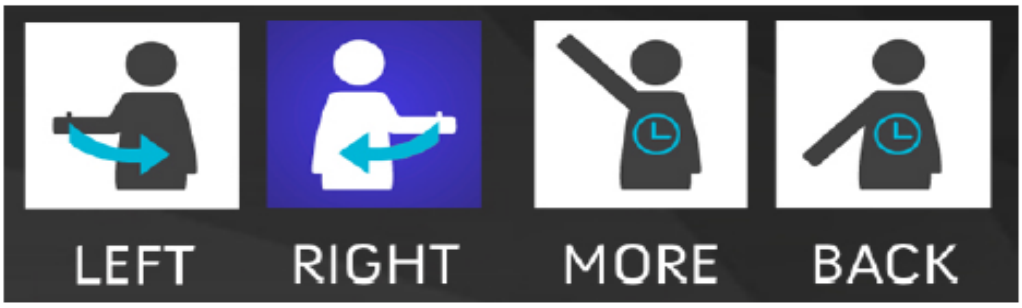

Figure 3. Simple and easy gestures to follow by children (Ackad et al., 2014)

METHODOLOGY INSTANCES OF THE PROPOSED FRAMEWORK

The proposed framework consists of three phases. First, instructional content using GBI and serious game attributes is incorporated into the learning model and mapped with the learning theories summarised in Table 1.

Table 1

The description summary of SG attributes mapped with learning theory and gesture-based interaction

Serious Game Attributes (SGA)	Learning Theory (LT) / Learning approach	Gesture-based interaction	Description Summary
Accommodating the learner's style (SGA1)	Experiential Learning	User-centred	Learning process using simple gestures to tackle children (focusing on primary school students)
Scenario-based learning (SGA2)	Experiential Learning	User-centred	Learning where the learner can feel like an extension of their body through hand gestures. Players gain knowledge through experience by practising the skills learned.
Scaffolding (SGA3)	Constructivism	Behaviour-based	Support, such as hints, is provided in the game—help solve the question.

Table 1 *(Continue)*

Serious Game Attributes (SGA)	Learning Theory (LT) / Learning approach	Gesture-based interaction	Description Summary
Learner control (SGA4)	Constructivism	Behaviour-based and User-centred	Self-learning and active learning are based on the learning option chosen by users. There are three levels provided in the prototype.
Interaction (SGA5)	Behaviourism	Behaviour-based and User-centred	Provide the interface elements that are required to deal with interaction. The design interface is designed not to be too crowded with multimedia elements
Incremental learning (SGA6)	Cognitivism	Behaviour-based and User-centred	The games material can be upgraded while playing—one by one level in sequential order.

As indicated in Table 1, the newly founded theories are SGA, learning theory, and GBI can be mapped together to implement RSE. Two SGA that support experiential learning is SGA1 and SGA2, which focus on user-centred where the learning process is using simple gestures as suggested by (Ackad et al., 2014) and by constructing knowledge through direct experience, practising skills, and strengthening values (Shih & Hsu, 2016). SGA3 and SGA4 are mapped with constructivism learning theories that focus on behaviour-based in which SGA3 deals with support in the games and SGA4 learners construct knowledge from their experiences (Mohd et al., 2018; Olusegun, 2015). Meanwhile, SGA5 is mapped with behaviourism learning theory in which the element enhances skills and motivates the user to keep playing the game (Mohd et al., 2018), and SGA6 is mapped with the cognitivism theory where both SGAs focus on behaviour-based and user-centred in different ways in which the learning process is delivered progressively, and the learning is broken into simpler and manageable tasks (Mohd et al., 2018).

In the second phase, learners implement four main functions in the RSE module: *scenario-based environment, interactivity gestures, module by level,* and *quizzes.* The scenario-based environment focuses on two scenarios that are suitable for children, which are the implementation of traffic safety (Afifah & Hossain, 2016; Ben-bassat & Avnieli, 2016; Chiang et al., 2019; Mark & Al-Mansour, 2018; Salwani & Sobihatun, 2014; Stavrev & Terzieva, 2015) and traffic signs (Rawi et al., 2015; Assailly, 2017; Koekemoer et al.,

2017; Mark & Al-Mansour, 2018; Salwani & Sobihatun, 2014; Stavrev & Terzieva, 2015). Meanwhile, the preparation of gesture conditions is based on the level development as suggested by Jean Piaget, who proposed the development of content based on the age of the user's level. Considering this theory, there are seven gestures used to cue the users namely (a) CLICK (b) MOVE (c) LEFT (d) RIGHT, (e) MORE, (f) BACK (g) STOP.

Table 2

The description of gestures used in the level of application

Level	Gestures	Action
1	CLICK	to choose answer
	MORE	to get hint/help
2	MORE	to get hint/help
	LEFT	move to the left
	RIGHT	move to the right
	BACK	reverse
	STOP	stop movement
	MOVE	walk/move
3	CLICK	to choose answer
	MORE	to get hint/help
	LEFT	move to the left
	RIGHT	move to the right
	BACK	reverse
	STOP	stop movement
	MOVE	walk/move

In the first level of the games, the users are introduced to two simple gestures to ensure they can practise using gestures before advancing to a higher level. The gestures used are CLICK and MORE. In the second level, users are allowed to use six gestures: MORE, LEFT, RIGHT, BACK, STOP, and MOVE. Meanwhile, in the last level, users can use seven gestures, i.e. MORE, LEFT, RIGHT, BACK, STOP, MOVE, and CLICK. Finally, in LEVEL 1, users are exposed to simple gestures as in Figure 4.

Quizzes are a form of games that are applied in this framework in which the goal is to test the knowledge and the engagement in this framework. There are three types of quiz structures implemented to see the growth of knowledge, abilities, and skills in the RSE domain.

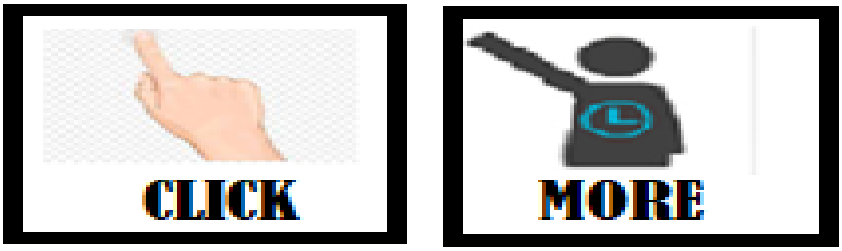

Figure 4. Simple gestures for primary school students for level one.

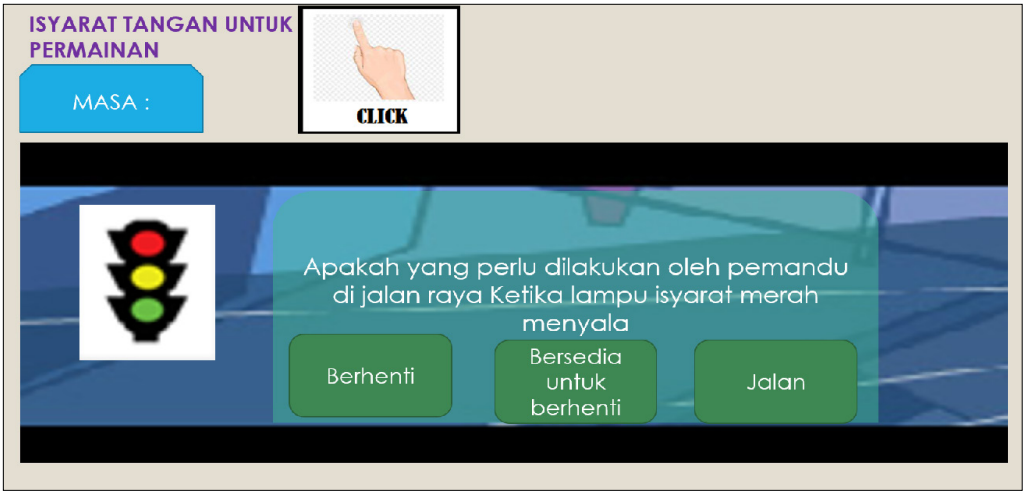

Figure 5. Example of a question in level 2 quiz.

Finally, in the last phase, the learning outcome will be shown on the screen using learning analytics to analyse the score, time, hint, gestures used, and activities view for each user that plays the application.

PROPOSED CONCEPTUAL FRAMEWORK FOR ROAD SAFETY EDUCATION USING SERIOUS GAMES WITH GESTURE-BASED INTERACTION APPROACH

Road Safety Education's conceptual framework using SG with a GBI approach is inherited from studies about natural user interfaces focusing on gestures and design, SG design and concepts, and learning theories in learning through the games. First, the conceptual framework incorporates certain features or characteristics of natural user interfaces that detail known as GBI include *user-centred* and *behaviour-based interaction*, the attributes

of SG, which are *accommodating the learner's style, scenario-based learning, interaction, learner control, scaffolding*, and *incremental learning* and supported by learning theories and approaches that match with SG in which the theories embedded in the framework are *experiential learning, constructivism, behaviourism* and *cognitivism*. Second, the RSE module features content using four main features: *scenario-based environment, interactivity gestures, level* and *quizzes* in interface design to ensure the users' engagement and in understanding the contents more effectively. All features are extracted based on literature findings that focus on the safety of street crossing and traffic safety signs. Finally, the framework implements learning analytics to capture engagement data by measuring the user performance using the *score*, *time*, *hint,* and *activities view* in the RSE prototype.

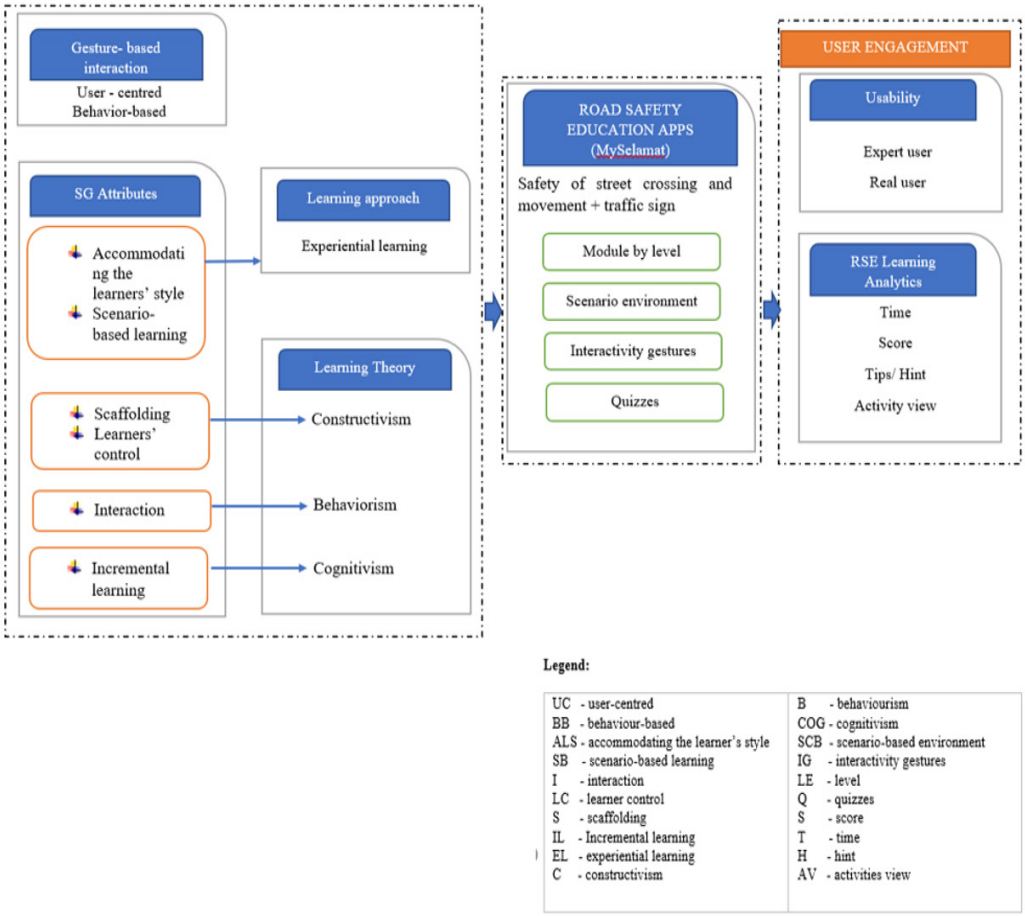

Figure 6. Proposed Conceptual Framework for Road Safety Education using Serious Games with Gesture-based Interaction Approach

The proposed conceptual framework is based on the expert's review containing five main components: *I. Gesture-based interaction, II. Serious Games Attributes, III. Learning Theories and Approach, IV. Road Safety Education Apps (MySelamat), V. RSE Learning Analytics and usability (User Engagement).* Each component used here consists of elements and parameters as illustrated in the conceptual framework Figure 6. The expert's review based on *Natural User Interface, Serious Games, Multimedia, Computer Science, Information Technology, Human-Computer Interface and Road Safety Education* were gathered in giving the opinions and perceptions on the proposed elements and parameters in each component. The selection of experts was based on the research conducted using Google Scholar, ResearchGate and Google search engine. These experts also provided recommendations in helping to clarify the framework. The invitation to participate in the expert review study was sent to several participants, and six experts from 20 showed their willingness and commitment.

The scope of this activity is to find the appropriateness of the proposed elements and parameters in each component. Altogether, the expert review contained 21 quantitative and 21 qualitative questions. The result of the quantitative recommendations is shown in Figure 7 and Figure 8 below, and the names of components used can be referred to in the legend for Figure 6.

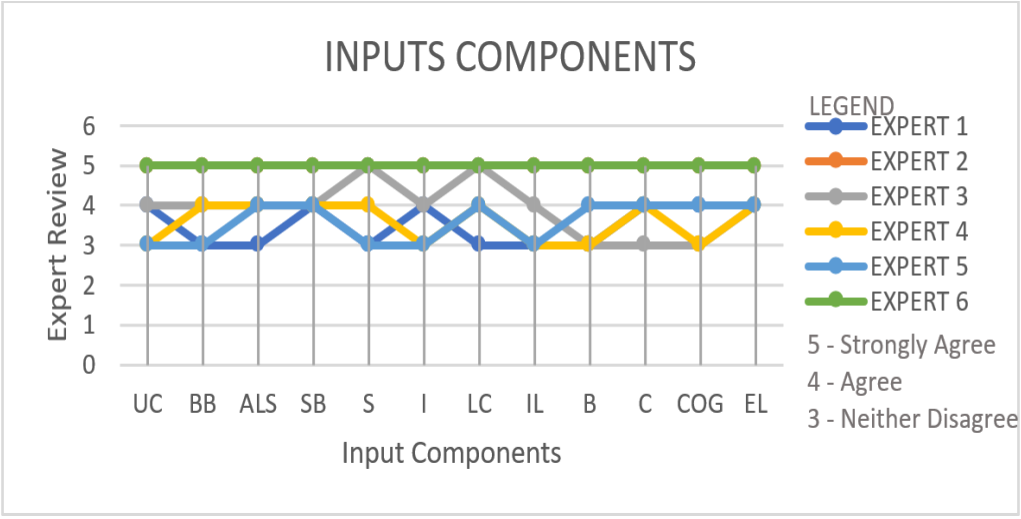

Figure 7. Expert review for input components in the framework

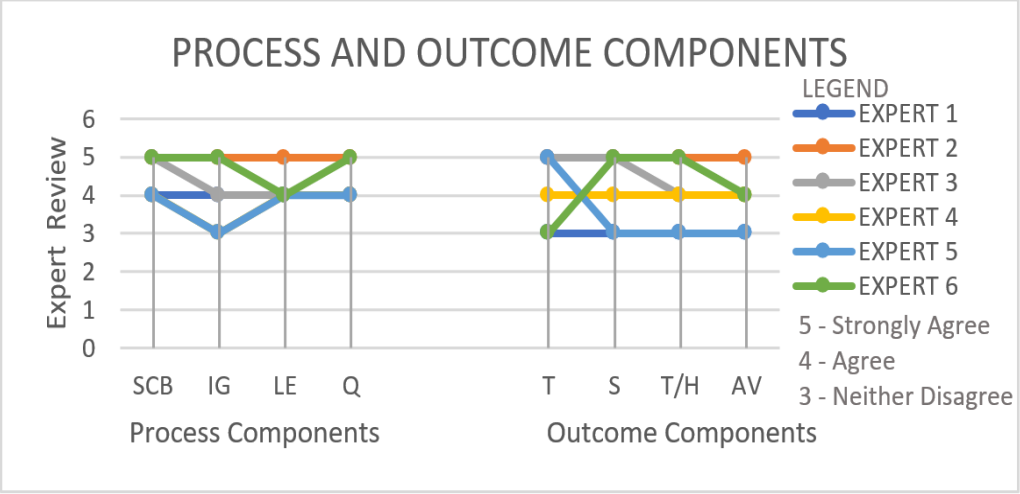

Figure 8. Expert review for process and outcome components in the framework

Table 3

Frequency of responses selected from expert review feedback

Expert Review / Components	Strongly Agree (5)	Agree (4)	Neither Disagree Nor Agree (3)	Total
Input Component	27	26	19	72
Process	8	14	2	24
Outcome Component	9	7	8	24
Total	44	47	29	120
Percentage (%)	36.7	39.2	24.1	100

A total of 120 descriptive responses were collected from the expert feedback. Approximately 36.7% of experts strongly agreed, 39.2% agreed, and 24.1% neither disagreed nor agreed with the suggested components implemented in the conceptual framework—the detailed result of the feedback selected as shown in Table 3 above.

CONCLUSION AND FUTURE WORKS

Road accidents showed the increasing numbers that bring users to deaths and serious injuries in Malaysia. Therefore, an alternative RSE needs to be done at the early age of the users. The presented framework highlighted the importance of using a GBI to tackle

primary school students by adopting SG attributes mapped with learning theories in the RSE Module features. This paper presented the methodological instances of the proposed framework to produce a learning outcome that effectively manages engagement by using usability test and RSE learning analytics that analyses and report the data about learners and their contexts in the RSE application. The proposed framework is intended to overcome road safety prevention programs displayed conventionally and not suitable for all target users. This paper also discusses the expert's review opinion, whereby 36.7% strongly agree, 39.2% agree, and 24.1% neither disagree nor agree with the components used in the proposed conceptual framework. Therefore, future work should implement the proposed framework by involving GBI with specific body gestures and can be extended with more scenarios of RSE that match the target audience's problem with the help of SG attributes.

ACKNOWLEDGEMENT

The authors want to express their gratitude to the experts who have participated in the study with their valuable comments.

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