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## Assesment of Children Enjoyment in Game-Based Road Safety Education Apps

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### Abstract

According to WHO figures, road traffic injuries are the leading cause of death for children and young adults aged 5 to 29. It is the second leading cause of death among Malaysians aged 5 to 14. Thus, governments have always taken comprehensive road safety measures, such as including a Road Safety Education (RSE) curriculum in Malaysia's primary and secondary schools. Most RSE modules, on the other hand, are based on traditional methodologies and are provided in a verbal teaching and learning mode. Most non-interactive campaigns include traditional mass media advertising such as television, radio, and billboards, which are also considered less interesting. These strategies are technically unfeasible and insufficiently entertaining to spark children's interest in learning about safety. Because of this, a game-based application prototype has been made to help people learn RSE. It has been assessed by measuring the acceptance of the game by using 30 schoolchildren as respondents. An EGameFlow model was adopted in the experiment as it evaluates the user's learning cognition of delight while playing a game. The respondents were evaluated on seven factors: focus, a clear purpose, feedback, a challenge, autonomy, immersion, and knowledge progress. The results and conclusions point to a positive outcome where most of them, which is 80%, agreed that the game is enjoyable and helps in providing the RSE.

**Keywords:** Road Safety Education, Game Based Learning, Computer Game, Game Enjoyment, EGameFlow Model

## Introduction

The traffic accidents involving children in the past few years is unpleasantly high all around the world. According to WHO data, road traffic accidents are the leading cause of death among children and young adults aged 5 to 29 (Global Status Report on Road Safety 2018, n.d). It is the second leading cause of death in Malaysian children aged 5 to 14 years (Othman *et al.*, n.d.). Furthermore, 93% of road fatalities occur in low- and middle-income countries, despite the fact that these countries own around 60 percent of the world's vehicles (Global Status Report on Road Safety 2018, n.d). In 2000, more than 40 000 people were killed and over than 1.7 million injures due to road accidents in the European Union (Othman *et al.*, n.d.). According to Malaysian Statistic Department, traffic accidents involving children who are pedestrians were enlisted as the fifth major cause of death in 2005 to 2008. In 2014, there were 476 196 road crashed with 6674 number of death reported in Malaysia (Dragutinovic & Twisk, n.d.). The concern that young children will be the primary victims of vehicle accidents has resulted in the establishment of Road Safety Education (RSE) in Malaysia. In relation to that, the Malaysian Institute of Road Safety Research (MIROS) is an established body that plays an important role in the RSE program. The syllabus is being taught in a forty-minute class by teachers who have undergone training in prior (Dragutinovic & Twisk, n.d.). It has been implemented stage by stage in all primary schools in 2010. In addition, to support this effort, many other RSE programmes are conducted by private companies such as Petronas, Shell, and Toyota, and non-government (NGOs). The primary goal of the RSE is to educate and expose children to road safety because it is one of the most effective ways to protect them from traffic hazards (Mani *et al.*, 2014; Othman *et al.*, 2015). It is viewed as an alternative to decreasing the number of injuries and deaths amongst young road users (Percer, 2009; Goniewicz & Lasota, 2021).

Pedestrians, especially children, are exposed to fatal accidents and danger because they are unaware of traffic rules and regulations (Noradiah *et al.*, 2005; Kulanthayan *et al.*, 2016). They need to cope with the presence of cars on the road and safety. The RSE is significant as it plays an important part in educating children about road safety (Singh *et al.*, 2016). However, most RSE modules are based on traditional approaches where they are delivered in a verbal teaching and learning mode. Traditional mass media campaigns, for instance, television, radio, and billboard advertisements are also in non-interactive mode. These methods are undependable and not interesting enough in order to promote excitement in introducing safety awareness among children (Abdul Rawi *et al.*, 2015). In recent digital advancements, educational programmes are mostly delivered effectively through game-based apps. The game offers great interactivity to the participants as there are many task types and challenge levels (Shaari *et al.*, 2015). Learning through games may enhance motivation by giving participants a chance to take part actively in learning and by increasing concentration among learners (Tobias *et al.*, 2014). Furthermore, it can enhance understanding and problem-solving in learning (Lie & Chen, 2013). Over the past few years, findings from many studies show that games promote learning across multiple disciplines and ages (Lie & Chen, 2013; Pavelko *et al.*, 2022). Games are effective because of what they embody and what learners participate in while playing them. Learners will play a game where they are put in a meaningful situation and must give immediate feedback, take charge, and plan strategically (Ramadan & Widayani, 2013) while enjoying the game.

A computer game is defined as an interactive entertainment experience running on computers, game consoles, or other electronic devices such as mobile phones or tablets (Shaari *et al.*, 2015). In games, participants are usually given a mission and they need to achieve a predetermined goal (Van, 2006). The interactivity occurs when the computer operates as an opponent and referee or between two agents with identical interests in which the agents communicate via sharing queries, results, and feedback on the results (Li, 2005; McCamish, 2018). Another benefit to the player is that it leads to improvements in some cognitive and psychomotor processes (Crawford, 1997). On top of that, the learning experience can be as immersive as playing games by using computer games (Sweetser & Wyeth, 2005; Westera, 2019). Other research mentioned that computer games offer a positive impact when they encourage student imagination and support the learning process as well (Sandford & Williamson, 2011). Enjoyment is a vital element in any activity, especially games. Communication scholars and media psychologists state that enjoyment is a positive response from a person towards media technologies and content (Kirriemuir & Mcfarlane, 2003). There are a few components to defining enjoyment as stated by (Ritterfeld, 2009) challenge, curiosity and mystery, clear goals, social interaction, diversion, fantasy, and arousal. An enjoyable game can be a super effective alternative to learning by replacing the old way of learning. Fu *et al.* ran an experiment on the apps that they developed, and the enjoyment was measured using an EGameFlow model (Fu *et al.*, 2009). The model is reliable in ensuring enjoyment is brought to the learner (Klimmt *et al.*, 2009). This model is adopted in this study, where it has been used to evaluate the user's learning cognition of enjoyment while playing a game. It is made up of seven elements: concentration, a clear goal, feedback, a challenge, autonomy, immersion, and knowledge improvement. Table 1 shows a detailed explanation of all the elements in the EGameFlow model. This research developed a prototype in which the visual is represented in a two-dimensional (2D) and named '*iLintasPintar: A Child Pedestrian Safety Game*'. The following sections present the methodology and the experimental result of the enjoyment assessment of this game.

## Methods and Materials

### Participant

30 respondents from a primary school participated in the assessment. They were selected because they had experience playing computer games. Twenty of them are male and the remaining 10 are female. Another inclusion criteria for this assessment requires all respondents to have undergone the RSE module prior to the assessment.

### Procedure

Respondents have been briefed on the assessment procedure and a demo has been conducted beforehand. There is no time limit specified for each player to complete the game, but generally they complete the game session within 10 minutes. After they finished the game play, they filled in the questionnaires. The questions were presented in two bilingual languages, English and *Bahasa Malaysia*. Three sessions of 10 respondents per each session. Overall, the assessment took about 2 hours to complete.

### Instrument

There are eight elements measured in the EGameFlow model, but this assessment only took seven of them as social interaction elements have been excluded. Questions about 36 items

are presented in Table 1. Each item was rated on a five-point Likert scale ranging from strongly disagree to strongly agree.

Table 1  
*Element measured in the instrument*

Element	Item No	Criteria
<b>1. Concentration</b> Player can focus on the task	C1	Most of the gaming activities are related to the learning task.
	C2	No distraction from the task is highlighted.
	C3	Generally speaking, I can remain concentrate in the game.
	C4	I am not distracted from tasks that the player should concentrate on.
	C5	I am not burdened with tasks that seem unrelated.
	C6	Workload in the game is adequate.
<b>2. Clear goal</b> The game provides clear goals to be achieved	G1	Overall game goals were presented in the beginning of the game.
	G2	Overall game goals were presented clearly.
	G3	Intermediate goals were presented in the beginning of each scene.
	G4	Intermediate goals were presented clearly.
<b>3. Feedback</b> Player can receive immediate feedback	F1	I receive feedback on my progress in the game.
	F2	I received immediate feedback on my action.
	F3	I am notified of new task immediately.
	F4	I am notified of new event immediately.
	F5	I received information on my success (or failure) of immediate goal immediately.
<b>4. Challenge</b> The game must be challenging and suits player's skill level	H1	The game provides "hint" in text that helps me overcome the challenge.
	H2	The game provides online support that helps me overcome the challenges.
	H3	The game provides video or audio auxiliaries that help me overcome the challenge.
	H4	The difficulty of game increases as my skill improved.
	H5	The game provides new challenge with an appropriate pacing.
	H6	The game provides different levels of challenges that tailor to different players.
<b>5. Autonomy</b> Player is given control over their actions	A1	I feel a sense of control and impact over the game.
	A2	I know next step in the game.
	A3	I feel a sense of control over a game.
<b>6. Immersion</b> Player should be able to sense of deep experience but effortless	I1	I forget about time passing while playing the game.
	I2	I become unaware of my surrounding while playing the game.
	I3	I temporary forget worries everyday life while playing the game.
	I4	I can become involved in the game.
	I5	I feel emotionally involved in the game.

involvement in the game	I6	I feel viscerally involve in the game.
<b>7.Knowledge improvement</b>	K1	This game increases my knowledge.
Player should improve their knowledge after playing the game	K2	I catch the basic idea of the knowledge taught.
	K3	I try to apply the knowledge in the game.
	K4	The game motivates the player to integrate the knowledge taught.
	K5	I want to know more about the knowledge taught.

**Results and Discussion**

The result shows that 63.3% of the respondents strongly agree that the elements and tasks comprised in the game are related to RSE. More than 50.0% agree and strongly agree that they can stay focused on each of the tasks at hand. 50.07% strongly agree that they remain focused throughout the game. Most of them agree that the game tasks do not burden them and that the workloads are adequate and playable. The next element that is being measured is whether the goals of the game are clear or not. 50% of the respondents agree and strongly agree that the goal is noticeable and clearly identified. This explains why the player gets a clear picture of the task, and it is clearly explained at the beginning [16]. Feedback is a vital element in a game for players to determine their distance and progress, or if they lose, they might follow the right direction (Fu *et al.*, 2009). Thus, in terms of interactivity, the result shows that this game provides feedback to the participant to monitor and identify their latest game progress. 46.7% of participants agree that they received information on users’ success (or failure) of immediate goals immediately as the scoring is shown consistently. The element of challenge represents the difficulty that the game offers to the users. 40% of the respondents agree that the game provides hints to overcome challenges. Most of them strongly disagree that it provides online support as this game is intended to be a standalone and offline game. 50% agree when it comes to elements of support in the form of video and audio that facilitate their participation during the challenge endurance. 53.3% agree that the game is becoming increasingly difficult as their skills improve. The other 50% agree that it imposed different levels of challenges and tailored player abilities. Table 2 presented the overall result.

Table 2  
Mean score and frequency (%) of all elements

Element	SD	D	N	A	SA	M. S	S. D
1	1.10	7.22	13.32	42.78	35.55	4.04	0.87
2	0.00	0.00	13.90	40.53	45.55	4.32	0.71
3	0.55	2.77	26.10	44.45	26.10	3.93	0.82
4	10.00	4.45	13.88	46.67	24.85	3.72	0.81
5	1.10	1.10	15.57	50.00	37.77	4.11	0.79
6	0.55	6.10	18.88	47.23	27.23	3.95	0.84
7	1.98	0.00	14.68	50.66	32.68	4.10	0.79
<b>Total Mean</b>						<b>4.02</b>	

\*SD-Strongly Disagree, D-Disagree, N-Neutral, A-Agree, SA-Strongly Agree, M. S – Mean Score, S. D – Standard Deviation

Autonomy is all about the sense of control of the game by the player. The results show that 50% of respondents believe they have control and influence over the game. 50% of them strongly agree that they can anticipate the next step in the game and that this creates confidence in them. Most of them agreed that they gradually felt a sense of empowerment in the game. The positive results from this element indicate that this game is on the right track and feasible for navigation. 60% of them did not realise that time was passing. This shows that they were enjoying themselves playing the game. This is evidence that the game is interesting and grabs players' attention. Besides, 46.7% of the respondents strongly agree that they have become unaware of their surroundings while playing the game. This is yet another indication that they are completely immersed in the game. The following table (Table 3) shows the overall results of the experiment and Figure 1 depicts the scores.

Table 3  
Total mean score of all elements

Element	Total Mean
Concentration	4.04
Goal Clarity	4.32
Feedback	3.91
Challenge	3.72
Autonomy	4.11
Immersion	3.95
Knowledge Improvement	4.10
<b>Overall</b>	<b>4.02</b>
<b>Percentage of Overall Mean Score</b>	<b>80%</b>

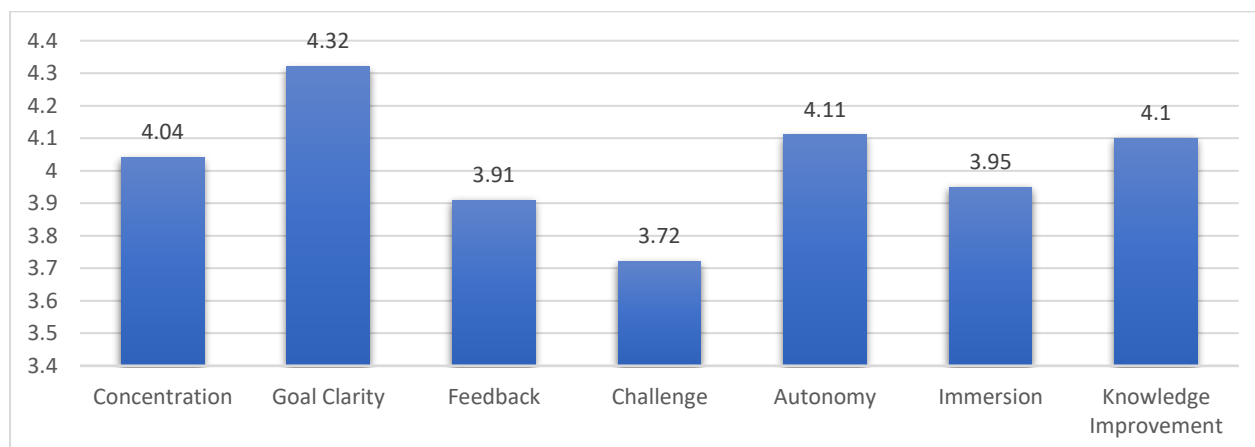


Figure 1. Total means score of all elements

### Conclusion

This study ran an experiment on the RSE apps, and respondents' enjoyment values were measured using an EGameFlow model. In the model, the parameters that are measured are concentration, having a clear goal, getting feedback, having a challenge, being independent, being immersed, and learning. Most responders strongly agreed that the game's content and objectives are pertinent to RSE. The clarity of the game's objectives has the highest average score, indicating that it is the most valuable element. In addition, it had the lowest standard deviation, showing that there was the least discrepancy between the opinions of the subjects.

The aspect of challenge is the least effective, and the disparity between perspectives is notably significant. While the ranges of other parameters were indeed acceptable, Thus, the design of the application will continue to be enhanced, with a focus on the elements that contribute to the overall enjoyment of the game. In particular, the elements of challenge and feedback interaction will be addressed and improved. Nevertheless, it is noted that respondents did mention that while playing the game, they did not notice that time was going by. This demonstrates that the game is engaging and holds the players' attention.

Findings from the EgameFlow model, on the other hand, reveal that the method was used to estimate the level of enjoyment from the user's perspective. This, however, demonstrates that the model assesses learning objectives through subjective assessment which is based on individual perceptions. For this reason, an objective measurement that assesses knowledge and validates achievement of the game's learning objectives is required. It is suggested that in future studies, learning should be judged both subjectively and objectively to get more accurate results about how well a game helps people learn. Nonetheless, the EGameFlow scale results can be utilised as a guide for both game and pedagogical design applications.

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