

APPLYING SERIOUS GAME ELEMENTS TO ENHANCE FLOOD SAFETY TRAINING MANAGEMENT

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ABSTRACT

One of the critical elements of catastrophe preparedness could be a training of the disaster responders and a society. However, conducting live disaster training is expensive and labor-intensive. Hence, a serious game (SG) may offer a possible solution as a technique of disaster and safety education. Training is one of the areas where by serious games must have a combination of elements may lead to the productive development of serious games. There are serious games that have been developed; however, there is a lack of elements in the game fewer use elements of scenario and feedback. Therefore, this work gamifies the topic of flood safety management an element of predictability that can be utilized as a gaming element involving time limits to reduce the amount of flood destruction and loss of life. This paper aims to describe a process to evaluate the model of a serious game for flood safety training based on the gaming elements using the Inter-Rater Reliability (IRR) method. The overall result of IRR percentage has gained 93% compared to the existing works and has proven. The hypothesis that serious games have a positive impact as a pedagogic tool on the educational and training process.

Keywords: *Serious game; Training; Flood; Preparedness; Inter-Rater Reliability.*

1. INTRODUCTION

Flood has been one of the most recurring and devastating natural disasters experienced in Malaysia. Flood disasters are phenomena that occur either suddenly or suddenly directly or in time [1]. Continuous humanitarian operations involving government and non-governmental organizations are sent to impacted areas [2]. Flood disaster is the most frequent occurrence of natural disaster recorded annually in the media in Malaysia [3]. Floods have affected many lives and properties. Usually, children and adults are typically affected the most by the flood due to a lack of knowledge and planning [4]. So the Malaysians, especially adults, need to be aware of the importance of preparing for floods mentally, emotionally and physically. One way to prepare is through training. Training, new skills, and knowledge are provided to communities which in turn builds more resilient communities. The new technology in the training sector is using serious games that can describe the real flood situation. Serious game training has its

primary objective to help players with an alternate training method to learn and retain skills.

Serious games are commonly considered an effective instrument for enhancing the training process by increasing players' motivation [5]. According to [6][7], These fail to provide domain content to attain the game 's goals, as they focus more on entertainment. In the case of serious games for training, they are designed to solve problems in practice and involve motivation components provided when the user is playing the games. To develop a serious game, there's a need to consider the game design model. Some serious games for training have been developed. However, there is a lack of research that focuses on game elements that can motivate players to draw attention to the game being developed [8]. In addition, Previous serious games used for training have less use element of scenario and feedback that make the game less successful for training purposes [9]. Besides that, these fail to provide domain content to attain the game 's goals, as they focus more on entertainment.

This is because the games do not involve experts in providing domain content within the game [10] [11]. This paper aims to describe a process to evaluate the model of a serious game for flood safety training based on the elements of serious games and psychology readiness, which can motivate civilians to be aware of the importance of flood preparedness in terms of safety.

The main contribution of this paper is as follows; Section 2 presents the background study where flood disaster preparedness, serious game training, inter-rater reliability, and percentages of the agreement is discussed; Section 3 provides the proposed methods and its analyses; Section 4 discusses the comparative results and the performance; and the paper concludes in Section 5.

2. BACKGROUND OF STUDY

First, we present the understanding of flood disaster preparedness as the main topics for safety training. Second, we present the potential use of serious games in safety training purposes. Third, we present the concept of Inter-Rater Reliability (IRR) as one of the consistency measures to quantify inter-rater reliability, whereby it has been measured as a percentage agreement, determined as the number of score agreements divided by the total number of scores.

2.1 Flood disaster preparedness

Preparedness for flood disasters is defined as personal protective measures that can be formed to protect against unprepared circumstances that can impact an individual's life and belongings [12] [13]. In psychological and material factors, the flood disaster preparedness generally focuses mainly on physical preparation and action to build a healthy environment for oneself and the family members.

The worldwide volatile climate phenomenon and its deadly effects depending on each situation's severity have strengthened the importance of psychological planning. An awareness of the person's psychological reactions and others is essential to be prepared and in charge. Efficient flood disaster response preparation gives that greater trust confident individuals to provide considerable assistance to family members and other individuals who may not be prepared for a flood disaster. Psychological and behavioral training can enhance the capacity to think as rationally as possible. It in effect would re-duce the

risk of serious injury due to accidents and thus decrease the loss of life [14].

According to [14], The distinction between physical preparedness and psychological preparedness derives from the intra-individual state of preparation, anticipation, and knowledge of psychological preparedness. Psychological preparedness is one of the most critical factors required for tracking and adjusting individual reactions before, during, and after a flood to improve individual behavior and psychological reaction [15]. Psychological preparedness has been stressed as an important method for natural disaster resilience.

2.2 Serious games for training

Serious games for training aim to keep interest in training activities high by making them more enjoyable for users [16]. Serious games facilitate “training by doing”, allowing the player to exercise, thus creating the experience and acquiring new skills [17].

Besides that, serious game for training allows players to learn concepts through the game and build skills. The immersive environment allows players to practice and compete so that maintaining knowledge and implementing what is learned in a simulated scenario makes the educational experience a success. In addition, Serious games for training integrate technologies that allow for continuous monitoring. Therefore, those responsible for curriculum delivery will review in-depth the learning process and its success in achieving objectives.

For the more, serious game training has been used in many fields such as the medical field, focusing on how the doctors will be trained to communicate with patients better while treating them [18] and serious games simulation for training in epidural anesthesia using haptic device [19]. Besides that, in the safety field the developed a serious game training trains the safety skills in a fire privately to individuals [20]. The serious game in forensic investigation training emphasizes security aspects based on the police academy training procedures worldwide [21] and serious game training to provide a simulated environment to face the real situation on the battlefield [22].

2.3 Inter-Rater Reliability (IRR)

The Inter-Rater Reliability refers more specifically to the consistency of measurement that involves raters. The concept of “agreement among

raters" is reasonably simple, and for many years IRR was measured as the percentage agreement among the data collectors. The value of rater reliability lies in the fact that it reflects the degree to which the data obtained in the analysis are exact depictions of the measured variables [23]. Although various methods have been used to quantify inter-rater reliability, it has historically been measured as a percentage agreement, determined as the number of score agreements divided by the total number of scores. Inter-rater reliability is the level of agreement between raters or judges. If everyone agrees, IRR is 1 (or 100%), and if everyone disagrees, IRR is 0 (0%).

There are several approaches for calculating IRR, for example, percentage agreement. Cohen introduced the kappa coefficient in 1960 to measure a chance-corrected nominal scale agreement between two raters. Since then, the literature has suggested various extensions and generalizations of this measure for inter-rater agreements [24].

2.4 Percentage agreement

The percentage of agreement is the simplest measure of inter-rater agreement. It is calculated as the number of times a set of ratings agree [25] [23]. The advantages of percentage agreement are that it is easy to quantify and can be used for any calculation scale of any kind. Percentage agreement measures of inter observer agreement or "reliability" have traditionally been used to summarize observer agreement from studies using interval recording, time-sampling, and trial-scoring data collection procedures.

3. MATERIALS AND METHOD

The methods used in this study are literature studies and interviews. The interviews were conducted using the unstructured interview method - an informal interview containing unplanned questions. The unstructured interview technique was developed in the disciplines of anthropology and sociology as a method to elicit people's social realities. In the literature, the term is used interchangeably with the terms, informal conversational interview, in-depth interview, non-standardized interview, and ethnographic interview. The model has been designed based on the previous paper [26] and was evaluated using Inter-Rater Reliability (IRR) techniques. The Inter-Rater reliability test is accomplished by obtaining the agreement between raters in the testing process [27]. The model is validated by eight experts

comprising of four game experts and four psychologist experts.

Experts were given a question with a detailed appendix of each of the elements listed in the question as a reference for the expert to understand the research. Because the expertise in the field of game and psychology is different, the questions are divided into three parts. The first part is the game element (answered by the game expert), the second part is the psychological element (answered by the psychologist expert) and the third part combines game and psychological elements (answered by game and psychologist experts) to produce a complete model.

4. RESULT AND DISCUSSIONS

The designed model of serious game for flood safety training [26] has three important component elements. The three components include the aspect of serious games, elements of psychology readiness, and motivation element.

4.1 Components in designing serious games

4.1.1 Element of serious games

There are five serious game elements; namely scenario, feedback, challenge, reward and enjoyment. Table 1 summarizes the element of serious games.

Table 1: Element of Serious Game

Element	Description
Scenario	<ul style="list-style-type: none"> Element of scenario is important to describe situations in the game [28]. Element of scenario is the "context" in which the game takes place [29]. Some events that occur in the scenario can enhance the training [30]. Scenarios in a game can show game progress over time [9]. The use of more than one scenario in serious games for training can enhance players' intrinsic motivation [30]. It is possible to build a resilient trainer with various training scenarios, who can adapt to a variety of situations [30].
Feedback	<ul style="list-style-type: none"> Feedback occurs when a player acts on a task [31]. Feedback is information the player has obtained concerning the action taken [32]. By providing feedback the player can determine whether the action taken is correct or incorrect [31]. Feedback received allows the player to evaluate whether or not the task is completed successfully [33].

	<ul style="list-style-type: none"> The function of feedback in the serious game is to give players an intrinsic motivation to keep playing [34] [33]. Feedback can create interaction between players and games [35]. Corrective feedback helps players know about their game performance [36]. Explanatory feedback is one of the corrective feedback that occurs when players take in-game action and receive feedback that clearly describes the quality of their results [37]. Explanatory feedback will give the right or wrong answer and then explaining why the answer is correct or wrong [37].
Challenge	<ul style="list-style-type: none"> Challenges are in game tasks that because players want to keep playing [38]. Players need to complete assigned tasks to finish the game [38]. The ability of the player to deal with the challenges presented depends on the decision taken to complete the task [39] [40]. Making decisions is an important challenge in a game [39] [40]. If a player makes a mistake in their decision they will not be able to continue the game [39] [40]. Challenges can tell players what actions they have taken that are right or wrong [39] [40]. Challenges will test players' skill level to make choices [39] [40]. Challenges make the game more interesting [39] [40]. Playing challenging games will fulfill the intrinsic motivational needs of the player in terms of performance and management [41]. Challenges arise when there is a problem, players can plan and choose different strategies to resolve the problem [41]. Elemental of challenges make players don't get bored and don't give up easily [41].
Reward	<ul style="list-style-type: none"> Elements of rewards should be used in serious games to motivate players to continue playing [42]. Players need to be rewarded to keep their interest in the game aimed at boosting the player's intrinsic motivation [16].
Enjoyment	<ul style="list-style-type: none"> The main player emotion is enjoyment when playing games [43]. Enjoyment is classifiable as attitude toward a complete experience with cognitive and affective psychology [44]. Game designers need to create games that will bring joy to players [43]. There is a need to add new items to the game to make the game more enjoyable [16]. Exciting games provide a platform for players to enjoy and can lead to greater intrinsic motivation [16]. Elements of enjoyment are generated

	by using music or sound effects that make users enjoy playing the game to the end [45].
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4.1.2 Element of psychology readiness

The element of psychology readiness is in terms of cognitive, affective and psychomotor. From a study [46] all the elements were adapted and improved in relation to the preparedness of the community from a psychological perspective relating to a flood disaster. This study emphasized on the community preparedness to cope with the disaster. From the perspective of psychology, psychology readiness preparation is important in discussing the level of readiness [47]. Psychology readiness explains human preparations' need for internal and external interaction. Psychology readiness is based on three theories, namely cognitive theory, affective theory and psychomotor theory. All these theories influence one another and generate human action towards something as it occurs in the issue of human preparedness for flood disaster. Table 2 summarizes the elements of psychology readiness.

Table 2: Element of Psychology Readiness

Element	Description
Cognitive	<ul style="list-style-type: none"> Cognitive seeks to understand how humans gain knowledge of themselves and the world, how they represent knowledge in the mind and brain, and how they use this knowledge to guide behavior [48]. Evaluate individual skills [49].
Affective	<ul style="list-style-type: none"> Elements of affective involve human feelings [50]. Describes human emotions [51].
Psychomotor	<ul style="list-style-type: none"> The potential of physical maturity or preparation and cooperation to do something [52]. Exhibits physical actions (body movements and touch) to support cognitive growth [51].

4.1.3 Element of motivation

Motivation is defined as a process that enables one person to engage in activities on a regular basis [53]. Serious games are not ad-hoc motivational but to ensure motivation, they must obey particular elements. The ARCS motivation model by [54] has been chosen to theoretically assess player motivation in the serious game for flood safety training. Keller exploited current psychological motivation research to identify four motivational components: Attention, Relevance, Confidence, and

Satisfaction. ARCS motivation model was used in games and training and was also tested in various studies at all levels of education and in many different cultures. (e.g. [55, 56, 57]), and therefore, it is of some importance to our study. Table 3 summarizes the elements of the ARCS model of motivation.

Table 3: Element of ARSC Motivation

Element	Description
Attention (Hold the players' interest and attention)	1. Perceptual Arousal [58] <ul style="list-style-type: none"> Real-world Examples [58]. <ul style="list-style-type: none"> Use related and specific examples about content. Incongruity and Conflict [54]. <ul style="list-style-type: none"> Provide an example which does not seem to illustrate a given concept [54]. Go against players' past experiences or provide opposite point of view. 2. Inquiry Arousal [58]. <ul style="list-style-type: none"> Active participation <ul style="list-style-type: none"> Provide player with role playing activities. Inquiry <ul style="list-style-type: none"> Give player tasks to allow them to do brainstorming or critical thinking. 3. Variability [58]. <ul style="list-style-type: none"> Use a variety of scenarios and tasks to sustain interest.
Relevance (The training process should show the usefulness of the content so that players can bridge the gap between content and the real world)	1. Goal Orientation [58]. <ul style="list-style-type: none"> Perceived Present Worth [58]. <ul style="list-style-type: none"> Explain why and how this content helps the players today. Perceived Future Usefulness [58]. <ul style="list-style-type: none"> Explain why and how this content helps the players in the future. 2. Motive Matching [58]. <ul style="list-style-type: none"> Needs Matching <ul style="list-style-type: none"> Assess players to get better understanding. 3. Experience <ul style="list-style-type: none"> Link to Previous Experience [59]. <ul style="list-style-type: none"> Tell players how new learning will use existing skills Give learners a sense of continuity by allowing them to establish connections between new information and what they already know. Modeling [58]. <ul style="list-style-type: none"> Show players role models using the content that you present to improve their lives.
Confidence (Increase players' confidence to gain useful experience)	1. Learning Requirements [58]. <ul style="list-style-type: none"> Communicate Objectives and Prerequisites <ul style="list-style-type: none"> Provide player with standard training criteria so that they can establish positive expectations and achieve success. 2. Success Opportunities [58]. <ul style="list-style-type: none"> Facilitate Self-growth [58]. <ul style="list-style-type: none"> Give players opportunity to be successful by providing multiple and

	varied experiences. <ul style="list-style-type: none"> Provide Feedback [58]. <ul style="list-style-type: none"> Give players feedback about their improvements and deficiencies during the process so that they can adjust their performance. 3. Personal Control [58]. <ul style="list-style-type: none"> Give Learners Control <ul style="list-style-type: none"> Players need to get control over their training process so that they can feel that their success.
Satisfaction (Players should be satisfied with what they achieved during the training process)	1. Extrinsic Reward [59]. <ul style="list-style-type: none"> Provide players with positive feedback, rewards, and reinforcements. 2. Intrinsic Reinforcement [58]. <ul style="list-style-type: none"> Encourage intrinsic enjoyment of training experience so that players have information and experience. 3. Equity <ul style="list-style-type: none"> Provide motivating feedback (praise) immediately following task [55].

4.1.4 Mapping the element model

These three components are linked using concept mapping [60] in which the game element is combined with the psychological element to produce the motivational element. The motivational element was adapted from the ARCS model [54]. According to [61], players will continue to play when they are motivated. As a result, the combination of all three components involved in the serious game of flood safety training can enhance the awareness level of flood safety training among civilians. Table 4 summarizes the mapping of the element model.

Table 4: Mapping The Element Model

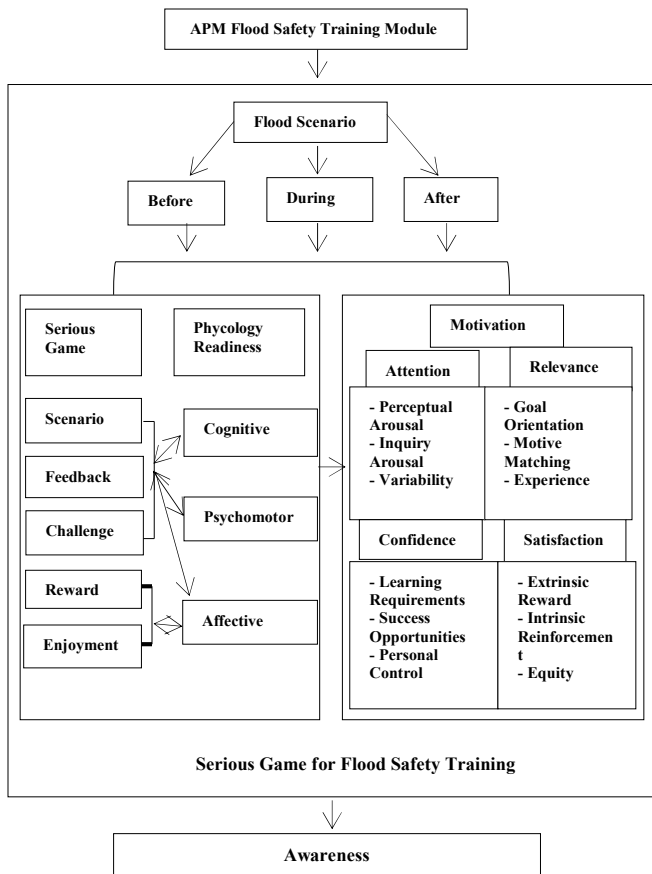
Element Serious Game	Element psychology readiness	Element Motivation (ARCS)
Scenario	Cognitive	Attention <ul style="list-style-type: none"> Perceptual Arousal Inquiry Arousal Variability
	Affective	
	Psychomotor	
Challenge	Cognitive	Relevance <ul style="list-style-type: none"> Goal Orientation Motive Matching Experience
	Affective	
	Psychomotor	
Feedback	Cognitive	Confidence <ul style="list-style-type: none"> Learning Requirements Success Opportunities Personal Control
	Affective	
	Psychomotor	
Reward	Affective	Satisfaction <ul style="list-style-type: none"> Extrinsic Reward Intrinsic Reinforcement Equity
Enjoyment	Affective	Satisfaction <ul style="list-style-type: none"> Extrinsic Reward Intrinsic Reinforcement

		Equity
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Figure 1: Model of Serious Game for Flood Safety Training

4.2 Model of Serious Game for Flood Safety Training

The proposed model shown in Figure 1 has three main components as discussed previously; that are essential in the model of serious game for safety training. The three components include the element of serious games, the element of psychology readiness and the element of motivation. Each item in these three elements is linked using concept mapping [60]. The model of serious game for flood safety training will be used to develop a serious game based on the flood training modules set by the Civil Defence Force of Malaysia (APM). The tasks in the game are designed according to the appropriateness of the flood training modules to help players adapt to the game environment. The combination of all three components involved in the serious game can motivate players. As a result, the serious game can provide civilians with awareness of flood safety training.



4.3 Model validity result

Different results are shown based on the three different parts of the question.

4.3.1 Analysis Result of Game Elements

As a result of the first part of the serious game element, the IRR percentage is 1 (100%). Table 5 shows the IRR results for the game elements.

Table 5: Expert Agreement Analysis of Game Element

No	Element Serious Game	A	B	C	D	A	A	A	B	B	C	D
1	Scenario	1	1	1	1	1	1	1	1	1	1	1
2	Feedback	1	1	1	1	1	1	1	1	1	1	1
3	Challenge	1	1	1	1	1	1	1	1	1	1	1
4	Reward	1	1	1	1	1	1	1	1	1	1	1
5	Enjoyment	1	1	1	1	1	1	1	1	1	1	1

A, B, C, D= Expert

Continue...

Agreement	Number Of Agreement
6/6	6
6/6	6
6/6	6
6/6	6
6/6	6
Total	30
	1
IRR Percentage	100%

4.3.2 Analysis Result of Psychology Readiness Element

The second part was the psychology readiness element and the IRR percentage which was 0.83 (83%). Table 6 shows the IRR results for the element of psychological readiness

Table 6: Expert Agreement Analysis of Psychology Readiness Element

No	Element Psychology Readiness	A	B	C	D	A	A	A	B	B	C	D
1	Cognitive	1	1	1	1	1	1	1	1	1	1	1
2	Affective	1	1	1	1	1	1	1	1	1	1	1
3	Psychomotor	1	1	1	0	1	1	0	1	0	0	0

A, B, C, D= Expert

Continue...

4.3.3 Analysis Result of Motivation Element

The third part was the motivation element and the IRR percentage which was 1 (100%). Table 7 shows the IRR results for the element of motivation readiness.

Table 7: Expert Agreement Analysis of ARSC Motivation Element

No	Element Motivation	A	B	C	D	A	A	A	B	B	C
						B	C	D	C	D	D
1	Attention	1	1	1	1	1	1	1	1	1	1
2	Relevance	1	1	1	1	1	1	1	1	1	1
3	Confidence	1	1	1	1	1	1	1	1	1	1
4	Satisfaction	1	1	1	1	1	1	1	1	1	1

A, B, C, D= Expert

Continue...

Agreement	Number Of Agreement
6/6	6
6/6	6
6/6	6
6/6	6
Total	24
	1
IRR Percentage	100%

4.3.4 Analysis Result of Mapping Model

Finally, the results show that the percentage of IRR on the elements model of the serious game for flood safety training was 0.93 (93%). A rule recommended by various experts emphasizes that when using a percentage of consent, the value from 75 to 90 percent indicates an acceptable level of agreement [62] [63] [64]. Therefore, the IRR results obtained have shown that the percentage indicates an acceptable level of agreement. Table 8 shows the IRR results for all elements in the serious game model for flood safety training and table 9 shows calculation of average for the expert agreement.

Agreement		Number Of Agreement				
6/6		6				
No	Element	Element	Element	A	B	C
	Serious Game	Psychology	Motiyasi			
		Readiness	15			
1	Scenario	Cognitive	Attention	1	1	1
	IRR Percentage	Affective	Attention	1	1	1
		Psychomotor	Attention	1	1	1
2	Challenge	Cognitive	Relevance	1	1	1
		Affective	Relevance	1	1	1
		Psychomotor	Relevance	1	1	1
3	Feedback	Cognitive	Confidence	1	1	1
		Affective	Confidence	1	1	1
		Psychomotor	Confidence	1	1	1
4	Reward	Affective	Satisfaction	1	1	1
5	Enjoyment	Affective	Satisfaction	1	1	1

D	E	F	G	H	A	A	A	A	A	A	A	B	B	B	B
					B	C	D	E	F	G	H	C	D	E	F
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 8: Expert agreement analysis of mapping model

A, B, C= Expert

Continue...

D, E, F, G, H= Expert

Continue...

Continue...

Agreement	Number Of Agreement
28/28	28
28/28	28
21/28	21
28/28	28
28/28	28
21/28	21
28/28	28
28/28	28
21/28	21
28/28	28
28/28	28
21/28	21
28/28	28
28/28	28
Total	441
	0.93
IRR Percentage	93%

B	B	C	C	C	C	C	D	D	D	D	E	E	E	F	F	G
G	H	D	E	F	G	H	E	F	G	H	F	G	H	G	H	H
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	0	1	1	1	0	1	1	0	1	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	0	1	1	1	0	1	1	0	1	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	0	1	1	1	0	1	1	0	1	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

shows the elements of the serious game according to expert's feedback.

Table 10: Expert Feedback of Serious Game Element

Element	Description
Scenario	<ul style="list-style-type: none"> • Players need to understand and feel the situation in the game to make the decision easier. • Scenario is a key element in every game. • If the scenario is not clearly described it will make it difficult for players to improve their training. • Each exercise should have clear objectives and the training mechanism is also very important to obtain a more accurate response.
Feedback	<ul style="list-style-type: none"> • The role of feedback in serious games to provide players with intrinsic motivation to keep playing depends on the level of difficulty.
Challenge	<ul style="list-style-type: none"> • The challenge will not be a problem. Problems will only occur if the objectives of the challenge are not clearly stated.
Reward	<ul style="list-style-type: none"> • The reward element should be used in serious games to encourage players to keep playing because rewards are a motivation to keep playing a game.
Enjoyment	<ul style="list-style-type: none"> • It would be nice if the game could immerse itself in the game.

Table 11 shows the elements of psychology readiness according to expert's feedback.

Table 11: Expert Feedback of Psychology Readiness Element

Element	Description
Cognitive	<ul style="list-style-type: none"> • Cognition involves mental processes.
Psychology	<ul style="list-style-type: none"> • Suggestions of behaviour or actions. • Behaviour is the result of a cognitive and effective process and is also influenced by the individual environment.

Table 9: Calculation of Average Expert Agreement

Analysis of Mapping Model (<i>Inter-Rater Reliability Mean</i>)
Average for the expert agreement
$\text{Average} = (28 + 28 + 21 + 28 + 28 + 21 + 28 + 28 + 21 + 28 + 28) / (28 \times 11)$ $= 287/308 = 0.93 \text{ or } 93\%$
Inter-Rater Reliability Percentage is 93%

4.4 Expert feedback

In addition, the results from the expert's feedback were also considered and analyzed for the improvement of the model of serious games for flood safety training. The feedback will be used to update the model in future works. The feedback on the description of some elements of the model according to the expert's perspective and expert experience in game design are presented. Table 10

Finally, the rater also provides feedback to improve the model. Table 12 shows the experts' feedback of model.

Table 12: Expert Feedback of model

Expert	Description
1	Model produced is appropriate but in psychology often uses cognitive, affective and behavioural elements (actions). When using the term "Psychomotor" it better describes the process of physical development. Therefore, it is recommended to change the term "psychomotor" to "behaviour" or "action".
2	The study model needs further clarification for the study of Phd. Find previous research models for reference.
3	The scope of the study needs to be further expanded to reach the Phd level of study.
4	The study model needs to be refined.

5. THE RESEARCH NOVELTY

The basic thing that needs to be addressed in an effort to make the civilians aware of the importance of flood preparedness is through disaster education [65]. However, disaster education that uses traditional training is not sufficient to provide experience to civilian. A study conducted by [66] found that traditional disaster education failed to motivate early adults to do safety preparedness. Furthermore, the study [67] provided disaster education in the form of storytelling. However, this cannot motivate the civilians because it does not actively involve them to obtain information and experience. Therefore, in order to achieve the objective of providing awareness, much more appropriate methods should be taken into account in order to motivate them to understand and accept easily the information presented. The use of more interactive methods can inspire civilian to receive knowledge related to flood preparedness [68] [69] [70].

According to [71], serious games are suitable to be used to provide awareness of an issue while entertaining. In addition, according to [72], serious games have the potential to be used to meet training objectives because they are much more effective in imparting cognitive knowledge and skills as compared to the conventional teaching methods [73]. Therefore, the use of serious games in the form of appropriate training is used by the civilians to do flood preparedness exercises. The main objective of using serious games for training is to provide alternative training methods to acquire new skills

while having fun in order to achieve training objectives [75].

6. CONCLUSIONS

This study aims to develop serious flood safety training that allows users to do training and at the same time receive information about floods. The game was developed to motivate and give awareness to the civilians about the importance of flood preparedness from a safety aspect. Three flood scenarios were designed according to the actual flood situation to encourage more frequent feedback to improve the process of transferring information and skills to players because feedback can generate motivation to practice. Furthermore, the serious game is designed based on the Civil Defense Force (APM) modules and validation from APM experts to ensure such accurate information content to generate motivation for players. The proposed serious game model for flood safety training has three main elements: serious, psychological, and motivational. All elements of this model are required to produce serious games that can be used as training and information delivery in building skills based on the flood's actual situation. This is expected to raise awareness among the general public especially adults between 18-30 years old, about the importance of flood preparedness in safety training. This research's contribution is hoped to be beneficial Civil Defense Force (APM) towards a more effective media information provider and provide awareness to the public to be much more alerted, prepared and knowledgeable in terms of safety in the face of future floods. The model can also be adapted to develop a serious game for training in other fields and purposes. For future phases, verified models will be used to develop a low fidelity prototype. Subsequently, the low fidelity prototype will be validated using the cognitive walkthrough method to measure the usability of a serious game for flood safety training overall.

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