Enjoyment as Gamified Experience for Informal Learning in Virtual Reality

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Abstract. Learning in the virtual world informally is still challenging due to some distracting factors. Previous studies show that there is a need for the learning process to informally learn using virtual reality in an enjoyable way through the gamified learning experience, as gamification enhances enjoyment whilst motivate the user to keep exploring the virtual world and learn things informally. This paper aims to discuss the concept of enjoyment as gamified experience for informal learning in virtual reality and propose the model development idea of enjoyable informal learning in virtual reality through the systematic literature review process. Through content analysis, this paper provides researchers with background information on gamification, enjoyment as gamified experience, enjoyable informal learning, virtual reality, virtual reality for informal learning, gamified learning versus game-based learning, related theories, and the initially proposed a broad methodology to be further explored for future study. Future studies may refer to this paper to conduct any related virtual reality system for learning informally in an enjoyable way to the user.

Keywords: Gamification · Enjoyment · Informal learning · Virtual reality · Gamified learning

1 Introduction

Gamification is a rapidly growing phenomenon that uses game mechanics as tools to motivate, engage and enhance gamified experiences [1] in non-game context instead in game context [2]. It is also essential to ensure that most gamified experiences are generally enjoyable [3]. In another word, it is a work of using game mechanics and elements that make the game fun and put them into an enjoyable productive activity, like enjoying learning new things informally [4, 5] or in other term it is called gamified learning [6]. From a theoretical standpoint, gamification can increases the visibility,

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performance information, comparability, and immediacy [7]. Visibility can be delivered through, for example, scores gained or badges obtained. Performance information enables comparability for users to access their current limit information from visibility, thus set a new target to mantain or improvise their performance. Immediacy means that users get real-time access or timely information.

Virtual Reality (VR) is one of the most effective platforms for informal learning. This is because over recent years, new development of software and hardware for VR such as Head Mounted Display (HMD) HTC VIVE, and Unity Game Engine, has leveled up the effectiveness of user immersion for entertainment, gaming, and even education. However, there is still an open issue for learning through VR [8]. Even though from previous studies, VR may increase user's receptivity and learning rates [9, 10], some findings opposed it like the increment of user's presence but reduce the capability of learning [11]. The findings from [11] tell that the viewed high-immersive VR was too hedonic to the user, which causes the user to get distracted from focusing on enjoy learning the content, but on the digital environment instead. Being excited and fun to get immersed in the virtual world for the first time also could be one of the possibilities that lead to the result. Hence, there is more room to be explored especially on enjoying learning things informally in a virtual world.

Therefore, this study implements VR by providing enjoyment as gamified experience for informal learning.

2 Literature Review

A previous literature study in related subjects is essential to observe the idea of the selected study. Hence, this section discusses the overview of enjoyment as gamified experience, enjoyable informal learning, virtual reality for informal learning, and the related theories.

2.1 Enjoyment as Gamified Experience

Enjoyment or enjoyable is related to intrinsic motivation [12] which is considered to be a motivation durable form that does not decrease much over time [13]. Therefore, numerous activities including learning aim to enhance the enjoyment by embedding game elements, which is what we called gamification.

Related previous studies have been done by [14] in two experiments. Experiment 1 measures whether game elements enhance enjoyment level and durability specifically for balance exercise. The results for experiment 1 proved that there was a significant result of enjoyment durability through gamification effects. Meanwhile, the game group enjoyment raised while enjoyment falls over time in the control group. Experiment 2 measures whether adding game elements to a walking exercise enhances the level and durability of exercise enjoyment. The results for experiment 2 proved that gamification enhanced enjoyment. However, there was no significant result of enjoyment durability through gamification effects. The conclusion from both experiments verified that enjoyment in an activity can be increased through gamification.

In addition, enjoyment experience also may occur from a variety of factors. It could come through mechanics, dynamics, and emotions [15]. A previous study by [16] showed that a good influence of game mechanics may provide a strong relationship between enjoyment and the duration of a game, but only when the player gain accomplishment. Meanwhile, not just mechanics but also dynamics past research has demonstrated to be a significant role in improving users' enjoyment and concentration [17]. Moreover, emotion is also claimed by [3] to be beyond enjoyment, which caters to positive emotions (e.g. excitement, surprise, triumph over adversity) and negative emotions (e.g. pity, anxiety). Figure 1 summarize the variable used in previous studies to measure enjoyment.

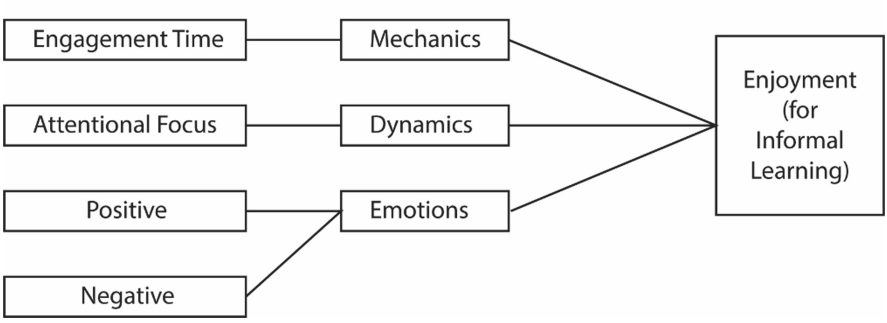

Fig. 1. Summary of key variables of enjoyment for informal learning from previous studies

2.2 Enjoyable Informal Learning

The term of enjoyable informal learning in some previous studies was defined as an experience (in general) where the viewer feels entertained and satisfied while gaining some knowledge at the same time [18, 19]. This study however has specifically defined the term as a gamified learning experience where the viewer feels entertained and satisfied while also gaining some knowledge at the same time. In another word, this term is used to paraphrase the flow of enjoyment as gamified experience for informal learning.

Generally, enjoyment does promote informal learning in many sectors with different purposes. For example, there was a previous study to measure the role of enjoyment in informal learning within the workplace [20]. In their study, the data for enjoyment activities and manager support from 206 respondents (i.e., managers) has been collected with a negative result on manager support for enjoyment. However, the study finds that there is a positive significant result for enjoyment activities with overall informal learning.

Other previous studies also have been done specifically in proposing a model for gamifying informal learning activities using interactive displays [21], to see which selected factors have the most contribution towards informal learning. Those factors are satisfaction, intention to participate, easiness, enjoyment, usefulness, and control. Through empirical evaluation, pre-post attitudinal surveys and cognitive tests, and observation data were recorded in the study. The result shows that user's knowledge acquisition,

intention to participate, satisfaction, and enjoyment are significantly improved, with enjoyment as the highest significant P value equal to 0.00. Although the focus and the medium used for the evaluation is not comparable to the immersive VR, the result from the study should be considered as one of the supporting pieces of works of literature for this research.

An instrument for enjoyable informal learning measurement also has been developed by [5], specifically for learning cultural heritage sites. The instrument had gone through content and face validity, followed by reliability analysis to make sure that the initially proposed instrument at an early stage is reliable to be used for the user testing stage. The instrument was later tested on their developed prototype application name AR@Melaka. Data from 200 respondents have been collected and the results show that most respondents were successfully able to experience enjoyable informal learning at a cultural heritage site by using the developed prototype. Although the study specifically focused on cultural heritage site, the core of the study which is the enjoyable informal learning experience should contribute to the body of knowledge in this research; especially on the validate instrument, which could be used to develop another version of enjoyable informal learning instrument specifically for another purpose and technology like VR.

Measuring enjoyable informal learning that caters to all sectors and purposes is not something that can be done in just one research because the learning domain even for informal learning is too vast. This is supported by [20] who claimed that there is still an incomplete understanding of the role of enjoyment in the learning domain, especially informal learning. Thus, there is a need to study each enjoyable informal learning for a specific purpose separately, like using different technology could also lead to different kinds of enjoyment experience for informal learning.

2.3 Virtual Reality

VR is defined as *"a real or simulated environment in which a perceiver experiences telepresence"* [22]. It refers to a computer-generated, information-rich, and three-dimensional environment that provides spatial navigation, enables user control to interact between user and virtual objects [23, 24]. There are four key elements in experiencing VR namely immersion, virtual environment, interactivity, and sensory feedback.

Immersion. There are two types of immersion levels in VR technologies, such as immersive and non-immersive [25]. Immersive VR enables users to experience fully immersive into the virtual environment [26, 27]. It could be in a form of mobile VR (e.g., Samsung Gear, Google Cardboard), high-end Head Mounted Display (HMD) (e.g., HTC Vive series, Oculus series, Samsung Gear, Samsung Odyssey, and Google Cardboard), and enhanced VR (e.g., a combined HMD with other devices such as data gloves, Kinect or bodysuit). On the other hand, non-immersive VR provide less immersive where the user can still aware and recognize the screen or a conventional graphics workstation such as Cave Automatic Virtual Environment (CAVE) system, desktop VR [28, 29], 360-degree videos, and panoramic videos [25]. There was also discussion among scholars about semi-immersive VR from using the CAVE system. However, literature in this

study only identified immersive and non-immersive VR exergame studies studied by previous researchers. Thus, this research defined VR immersion as in these two categories as suggested by Radianti et al. (2020).

Immersion is an essential feature in VR as it influences not just the user's sense of presence but also the whole context of user experience as well [30]. Speaking of presence, there is a concern by Basu (2019), mentioned that there is confusion between the term of immersion and presence among the VR community [31]. He further explained that immersion refers to a user's state of mind while presence refers to a user's subjective psychological response towards the system. The state of mind in immersion is a short moment of disbelief that enables the user to move at will in both the real and virtual world [31]. This short moment of disbelief could also relate to a lack of awareness of time and the real environment [32]. Meanwhile, the subjective psychological response in presence is a human response to a VR system with a certain level of immersion, or in a simpler sentence, it is a human reaction to immersion [33]. Immersion and presence might be different based on the above definition, but they are strongly related to each other. This is because a sense of "being there" in a virtual world indicates that the user can feel their body is "being physically there" in a virtual environment instead of the real environment.

Virtual Environment. A Virtual Environment (VE) is the content and the subject matter, represented in visual and/or aural to the user to be immersed in any virtual experiences including VR. It is a medium of communication with broad applications ranging from training and education to exploratory data visualization or analysis to entertainment [31]. The way the VE is presented to the user or the way the story flows at any given time is controlled by the VR system based on the interaction with the user itself [34]. For example, players will go through many different places with a different set of terrain in the VR tour. They will also listen to the three-dimensional audio such as waterfall and birds which is getting louder as they get near to it and vice versa as they passed it farther, which further enhances the user experience in VE. Of course, this is not only limited to the "outdoor" VE, but "indoor" VE as well.

Interactivity. Aside from immersion and VE, interactivity is also an important key to exploring a virtual world. Good interactivity in a VR system should be able to let the user engage with the virtual world and gain feedback appropriately based on their action or condition [31]. There is various form of interaction depending on the system subject matter (e.g., VE, virtual avatar, user interface) in VR system. For example, users can interact with the virtual avatar to get information such as a hint to the next level or learn some knowledge (e.g. historical) from the conversation.

Sensory Feedback. Playing computer games require a user to interact with the system using devices such as mouse and keyboard button most of the time. A good system will provide the programmed feedback based on the button pressed by the user. Sensory feedback does the same but using sensor devices and program instead of a button such as a 3-dimensional camera (e.g., Kinect) to detect movement, gesture, face recognition, facial expression, head, and eye gaze. Aside from visual, sensory feedback also could be in another form such as aural (i.e. spatial audio, voice recognition), and haptic (i.e. touch)

[31]. In another word, it is a method to communicate between humans and computers, which is through human senses.

2.4 Virtual Reality for Informal Learning

VR for informal learning has been studied over two decades ago [35], and nowadays there are numerous studies of VR for education, specifically for informal learning. As can be concluded in Sect. 2.2, learning informally has more significant value when the user learns enjoyably. However, most recent VR studies for informal learning does not support enjoyable informal learning experience, which discussed in the next paragraph.

To improve the learning experience and learning efficiency, a study by [36] has proposed a model of an experiential learning space with VR technology. The study also came out with the conception of experiential learning space with the combination of virtuality and reality. However, the presented paper does not mention any methodology on validation and evaluation of the proposed model, while also lacking literature resources that support the development of the model. Thus, it is suggested that the proposed model could be further studied with the consideration of adding other factors like enjoyment as a part of the learning experience in using VR.

As mentioned in the Introduction section earlier, there were opposite results by [11] where lesser knowledge gained but more presence occur in return. The results have been argued by [37] who claimed to use almost similar experiment that the respondents in [11] had to separate their attention between text and virtual environment, which led to various cognitive load, thus lower the gained knowledge. This is because the results by [37] show significant learning results in VR as the text in their experiment was given in form of cueing tips. The experiments also compared the use of VR with another two learning materials of paper and desktop display. It was found that learning processes are more efficient when using VR than reading texts on paper or interacting with 3D models on a desktop screen. However the measurement in the study is only based on the correct answers, as it is more into formal learning, while the study by [11] was informal learning with learning beliefs, satisfaction, knowledge, and transfer as its main variable to measure. Moreover, the study also does not include enjoyment as one of the factors for learning success.

Although VR has a great effect on the learning process, the learning material structure and organization in a virtual environment could still affect the advantage it. This is because the design of the virtual environment is perceived differently (abstract) to each user. It also has great potential to divert the user's attention from learning the content [37].

2.5 Gamified Learning vs Game-Based Learning

Gamification in the learning context can be referred to as gamified learning. There are similarities between gamified learning and game-based learning among scholars. However, both are not the same thing because each of them has a different approach to learning [6]. Gamified learning approaches focus on modifying or augmenting an existing learning process to develop a revised version that users perceived as game-like

[38], while game-based learning approaches are more into (serious) games implication [39].

Thus, gamification is not a (serious) game. In the context of learning, gamification is a procedure of changing existing learning processes by embedding game elements into them [6, 38, 39]. This study is applying gamified learning as one of the grounded theories discussed in the next subsections.

2.6 Related Theories

The subsection below discussed the related theories that explain the enjoyable informal learning process through game elements for gamified experiences.

Semiotics Theory. Semiotics is called "semeion" from a Greek word, mean signs. These signs are the perceived aspect of communication [40], such as visual (text, image, visual perspective, color, graphic, layout, shape, form, and texture) and aural (music, sound effect, and voice) [41]. This theory explains how the sign is perceived by the user to create a meaningful idea.

There were a few versions of semiotics theories, as discussed by [42]. However, this study found that the extended version of semiotics theory by Barthes [43] to be fit the bill more with the objective of this study. Barthes's theory explains that there is a first and second level of meaning. The first level is called denotation, followed by connotation for the second level. The idea from Barthes' theory is where the signification process from Peirce's theory [44] occurs once to operate iconic sign relationship at denotation level. An iconic sign is resembled and mimetic the object. It means that the user recognizes what kind of each subject they are perceived or exposed to. After that, the same signification process from Peirce's theory occurs once again to operate symbolic sign relationship at connotation level. The symbolic sign is where the "stand for" is understood through the convention. In another word, the sign is "stand for" something else.

This means that the user will recognize each of the objects in the virtual environment at the denotation level. After that on the connotation level, the user will identify the overall meaning behind all the denotation processes through the experienced event within the virtual environment. The identified overall meaning will trigger the learning process. It is important to explain how the learning process works continuously from semiotics theory because learning theory can provide a structure that guides strategies and activities of learning [45]. Thus, the next sub-section discussed on chosen learning theory for this study.

Constructivism Theory. This theory requires the learner to construct knowledge on their own [46], rather than receiving it [47]. It focuses on inventing, creating, developing, and constructing the knowledge [48], rather than transmitting the knowledge [49]. The learning process starts through experience [47] and pre-existing knowledge [50].

There are three major hypotheses concluded from to what extend learners participate in seeking meaningful knowledge, which agreed by many constructivist [48, 51]:

- Learning is the knowledge active formation obtained from experience and environment contact.
- Knowledge is constructed by the learner itself from their own experience and existing knowledge to find out a meaningful context.
- Meaningful knowledge is closely related to the experience. So learners will practice the knowledge in their lives.

Concerning this study, constructivism theory may impact informal learning in virtual reality through meaningful learning content and unique experience. However, to make the learning more enjoyable, this study also suggested the use of gamified learning theory which is discussed in the next sub-section.

Gamified Learning Theory. Gamified learning theory recommended one type of gamification, the inclusion of game fiction or narrative game, which can be used to enhance learning outcomes [52]. In another word, it is defined as the use of narration in a fictional game world [53] to improve instructional outcomes; as narration are much easier to accurately remembered than expository texts [52].

This study finds that gamified learning theory by [54] to be more in line with the objective of this study; as it is focused on gamification that can affect learning:

- Instructional content influences learning outcomes and behaviors.
- Behaviors/attitudes (enjoyment) influence learning.
- Game characteristics influence changes in behaviors/attitudes (enjoyment).
- Game elements affect behaviors/attitudes that moderate instructional effectiveness.
- The relationship between game elements and learning outcomes is mediated by behaviors/attitudes (enjoyment).

From this theory, enjoyment is placed in the behaviors/attitudes as a mediator between the relationship of game elements and learning outcomes. It is somehow explained how enjoyable informal learning could be achieved using VR technology in this study.

Flow Theory. Csikszentmihalyi (1990) is the founder of flow theory, where it has been defined as "the process of optimal experience" where the enjoyment experiences feels by the user through *"a sense of exhilaration, a deep sense of enjoyment that is long cherished, does not come through passive, receptive, relaxing times"* while fully concentrating on conducting a particular task [55]. The sense of flow is best to experienced at the moment when the user's body or mind is widely open to accept any challenging and worthwhile task [55]. There is little similarities with the definition of immersive as defined in Sect. 2.3. However, immersive has more focused on the telepresence experience where user feels like "being somewhere else", while the flow definition are much into a broader context.

In learning, the learner will experience flow at their optimal experience while performing full concentration in learning activity where the challenges are fully connected with their skills [56]. This means that the provided challenge must not exceed the user's capabilities. Else, users might not be able to experience flow due to the difficulties to reach the goal and complete the task. Therefore, in the context of gamified learning environment, there is need for consideration to maintain the user's optimal level on each provided challenge, to make sure the users can always be in the flow state in most of the time. Additionally, there are eight components that represent enjoyment phenomena in this theory [55] such as:

1. We confront tasks we have a chance of completing;
2. We must be able to concentrate on what we are doing;
3. The task has clear goals;
4. The task provides immediate feedback;
5. One acts with deep, but effortless involvement, that removes from awareness the worries and frustrations of everyday life;
6. One exercises a sense of control over their actions;
7. Concern for the self disappears, yet, paradoxically the sense of self emerges stronger after the flow experience is over; and
8. The sense of duration of time is altered.

3 Methodology

Research methodology is a systematic approach to solve the research problem. There is various type of research methodology in a vast research context. However, design science research is one of the best methodologies for this study because it focuses on an artifact-based creation that can provide a solution for the related problem [57, 58], where the form of artifact could be in constructs, model, method or instantiation [59].

This study adapt a design research methodology by Vaishnavi and Kuechler (2015) [60]. It consists of five main phases i) problem identification, ii) proposed solution, iii) design and development, iv) evaluation and v) conclusion as illustrated in "Fig. 1" (Fig. 2).

3.1 Phase 1: Problems Identification

Before the study begin, it is compulsory to determine who are the learners that will learn informally using the VR system. After that, a several questions with potential issues and problems in a form of questionnaires or semi-structured interview will be conducted in a *Preliminary Study*. After that, based on the results from the preliminary study, a research question will be formed to conduct a *Systematic Literature Review (SLR)*. The SLR will further address the issues and problems in the state-of-the-art among scholars, and to highlight the research gap. Issues or problems within preliminary studies and literature studies can be the gist of the research objectives and scopes through thematic analysis and content analysis (Fig. 3).

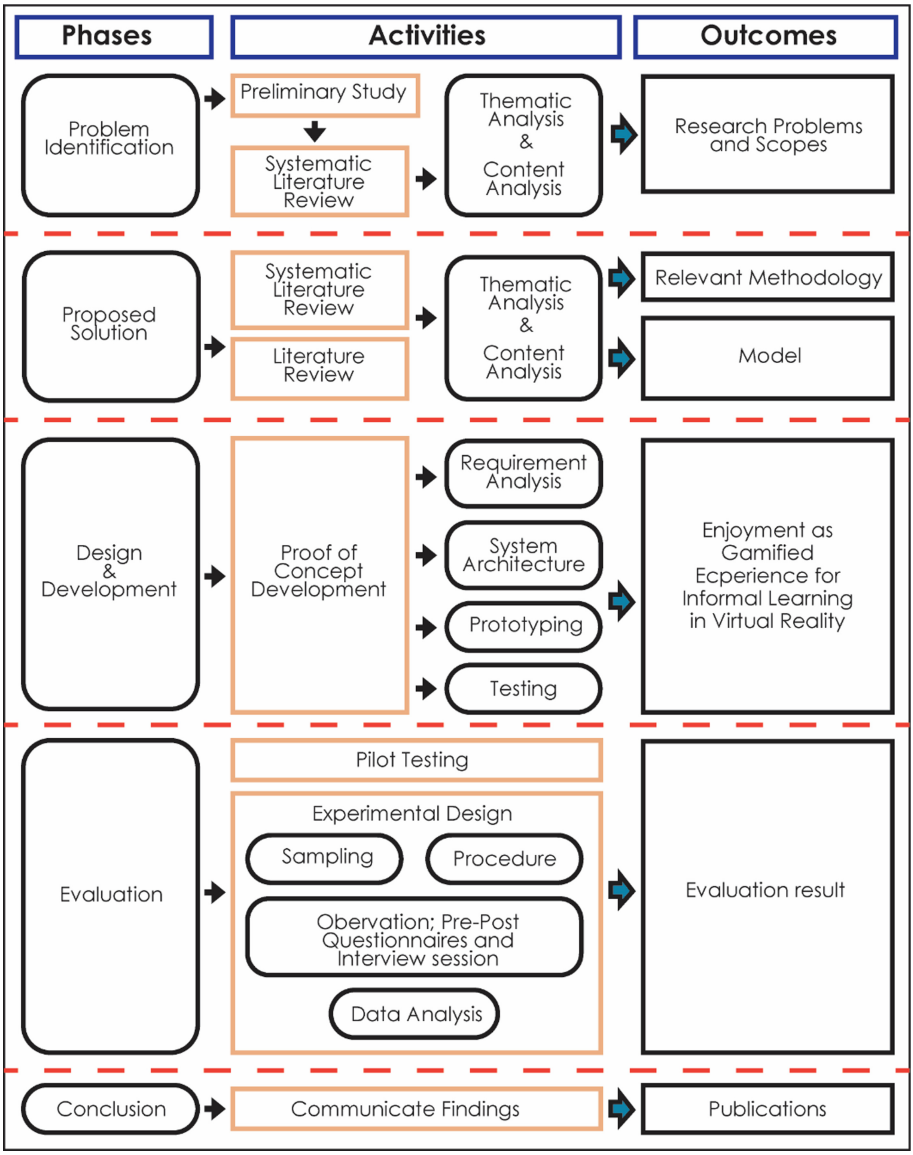

Fig. 2. The research framework

3.2 Phase 2: Proposed Solution

This stage proposed a solution for the identified problem in phase one. Once again, the findings of phase one should be reconfirmed that they are lacking in a particular scoped area in enjoyable informal learning using VR system. Once it is confirmed, another *SLR* will be conducted as a comprehensive method to determine the factors and characteristics of enjoyable informal learning in VR based on the scopes and objectives. A model will

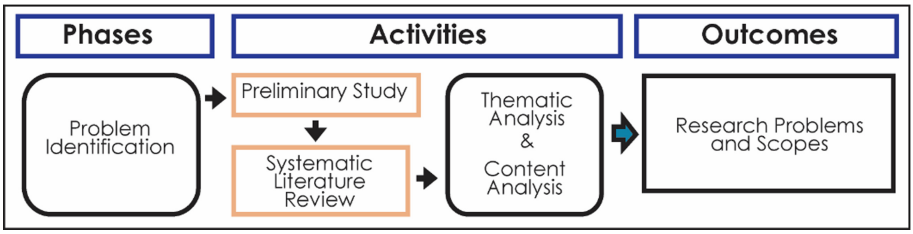

Fig. 3. Problem identification phase

either be produced as main contribution in this phase, or adapted, based on the required research objectives. Nonetheless, it will be a guide for the whole research process, especially to analyze the outcome variables in the evaluation phase. Along the way, a regular *Literature Review* will also be conducted to support the research objectives such as aforementioned grounded theories and the VR system in previous sections. This also includes other related content that needed to be expanded from identified SLR results. Thematic analysis and content analysis will be conducted to themed and organized the findings results to be discussed extensively (Fig. 4).

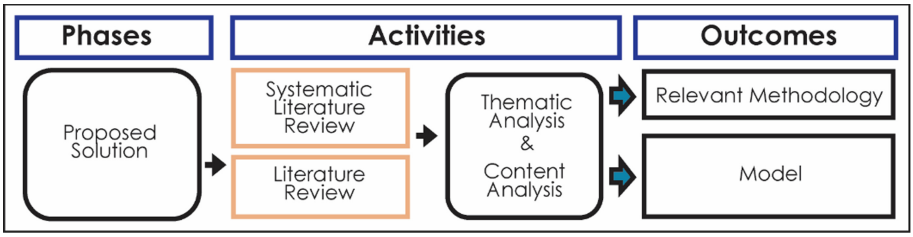

Fig. 4. Proposed solution phase

All the identified factors and features will be extracted, combined, and arranged to construct the hypothetical model, which will be reviewed later by experts to come out with the proposed model of enjoyable informal learning in VR. The selected experts have an experienced in either teaching, researching, or practicing for at least five year in related fields.

3.3 Phase 3: Design and Development

Previous processes resulted in the factors and features of the model. As proof of concept, the model will be tested by implementing it in a prototype development. *Requirement Analysis* will be conducted to determine the relevant evaluation content that reflect the objectives. The structure for the prototype also will be planned accordingly based on the the selected VR system and grounded theories. For instance, as suggested in flow theory, the developed prototype will be matches with the target user's competency (Refer to flow theory section). *System Architecture* is the main representation of the system, as the main purpose is to support the reasoning of the proposed system. *Prototyping* is the actual

phase for the development of the prototype. This is where the evaluated model will be implemented for enjoyable informal learning in the VR system. *Testing* is to find any error such as glitches or bugs on the developed prototype. Two experts with the same criteria as in model validation will test the prototype to ensure the developed system would be able to provide the evaluation resuls that answer the research objectives. Previous process might need to be repeated if necessary according to the experts comments. If there is no problem, the next phase will be conducted, which is the evaluation phase (Fig. 5).

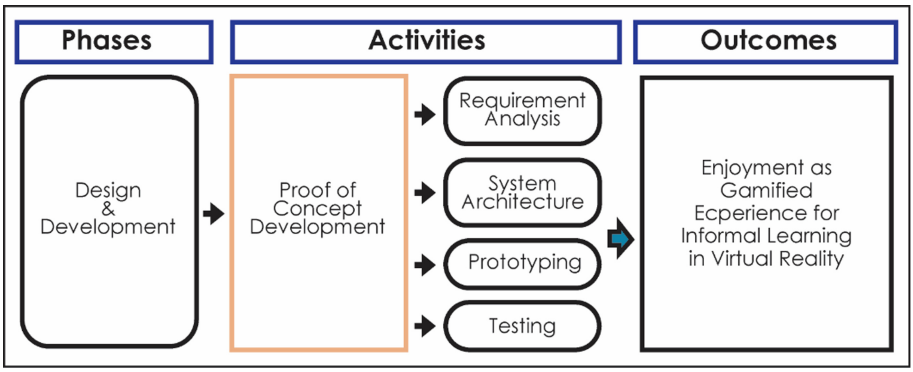

Fig. 5. Design and development phase

3.4 Phase 4: Evaluation

Evaluation will be conducted to determine the user's enjoyable informal learning on the usability of the developed prototype. A questionnaire to measure enjoyable informal learning in VR will be developed, reviewed by ten experts with the same criteria as in model validation and prototype testing. The developed ptotype and questionnaire will be tested by the user in *Pilot Testing* to ensure both are reliable to be used during the actual evaluation process. Sixty participants will conduct the final test on the developed prototype in an *Experimental Design.* All the participants will be briefed before the evaluation started. After that, they will be asked to complete a demographic pre-questionnaire. After the evaluation ended, each participants will be given the post-questionnaire, which is the developed questionnaire. Semi-structured interview also will be conducted to obtain subjective responds by the participants in a qualitative data. All the evaluation data will be collected and analyzed in descriptive, correlation, t-test, and ANOVA for the next phase (Fig. 6).

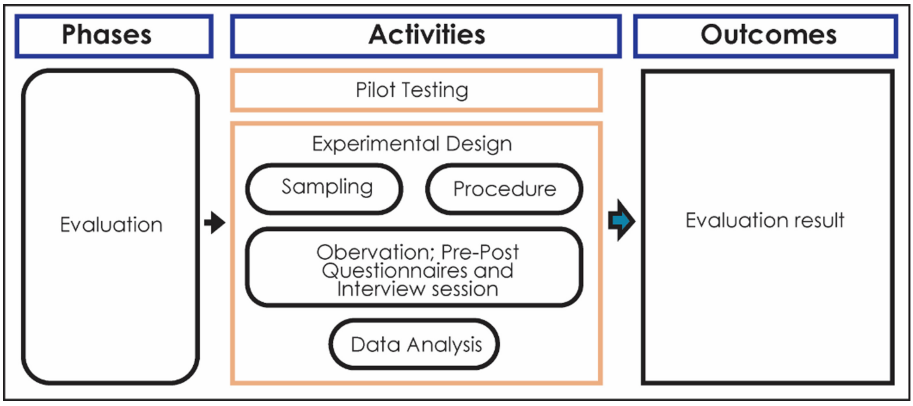

Fig. 6. Evaluation phase

3.5 Phase 5: Conclusion

The conclusion is the final phase in this study, where the overall findings of the study will be described and explained and formulated. The outcome and recommendation for future study will also be discussed and documented for future publications (Fig. 7).

Fig. 7. Conclusion phase

4 Conclusion

This article discussed the important concept of enjoyable as gamified experience for informal learning in virtual technology. It also explains the broad methodology for model development of enjoyable informal learning in VR technology through adapted research design, which can be applied for future studies. Different research content also could benefit from this study as long it is related to the learning-through-VR study.

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