Student Engagement in Learning: A Preliminary Study on Digital Educational Application

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ABSTRACT In this modern age, more children are becoming frequent smartphone users. This research presents an approach to engage students with Digital Educational Games. The emergence of digital technologies has increased interest in education and the learning process. Particularly in e-learning, teachers face difficulties in promoting and engaging students in the learning process, and vice versa. However, thanks to new technology that incorporates new methods into the e-learning process overcomes these problems. The objectives of this study are to identify the features and guidelines for designing an engaging Digital Educational Games using qualitative method. A locally developed educational application was used in the preliminary study to identify the gamification elements on 15 participants, and seven elements were identified. A proposed guideline to encourage learning engagement from this study and literature review was suggested. This research shows gamification, which by hope future research can develop educational games that engages students to learn.

KEYWORDS: Mobile; E-learning; Gamification; Digital Educational Application; Engagement
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INTRODUCTION

As the technology moving to Industrial Revolution 4.0, the education field still has to face the challenge (Shahroom & Hussin, 2018), and the landscape of teaching and learning has changed. The technology and its contributions are evolving in the field of education quickly; however, it takes a new challenge with it. Lack of students' attention on the learning process is one of the educators' many concerns (Oke & Fernandes, 2020). Engaging the students with the learning process is critical as the learning outcomes (Hu *et al.*, 2008). The biggest challenge of the educators is capturing the student's attention. The lack of students' attention is one of the results of the learning material's lack of effectiveness. The old learning material does not really in helping the children by engaging in the learning process. This is due to the old material and method that is not attractive and motivates anymore to engage with the learning process, which needs to be more innovative, challenging and purposeful to engage them with learning (Philip, 2015); this supported by Shahroom and Hussin (2018), stated that students nowadays need more interested in an interactive way of learning. The old learning material leads to the lack of engagement with learning material, and this supported by Nepal and Rogerson (2020) learning material should be more interesting in order to engage the students to motivate them to learn. The students can learn more if they engage with learning material. The right or perfect tools can help the student engage with the learning material (Goss & Sonnemann, 2017). According to Adolfsson (2018), a special educator stated that the students are often engaged in school activities to develop better and learn their new skills.

RELATED WORKS

Engagement is the attention of the students on the learning material (Halverson & Graham, 2019). It will be easier to deliver the point if the system-apps can get the user's attention. To improve teaching

effectiveness, the education system should target develop e-learning methods to encourage high engagement with different learning styles (Valverde-Berrocoso, 2020). The learning outcomes may be affected by the user's actual time spent online (Perera & Richardson, 2010). This is supported by the results that show the user who spends less time online is performed less in academic (Davies & Graff, 2005). Sanne and Wiese (2018) define engagement as when the user wants to occupy a person's intention.

A study shows that student who attempted the quizzes online multiple times perform better, which perform more engagement on the e-learning materials (Baragash & Al-Samarraie, 2018). To put in a simpler way, e-learning is learning that conducted in through electronic platform typically the internet. It is the greatest advantage due to its availability, access, and cost-effectiveness (Isanaka, 2019). In a research done by Rodgers (2008), the interaction effects between the engagement of e-learning and personal characteristics. In general, the engagement and performance relationship's is complex, and the engagement is correlated with the grades of the students (Carini *et al*., 2006). In other words, the engagement focuses on the learner's attention for quite a long time, and without the engagement, learners or the user will not be able to complete the task (Mohamad *et al.*, 2017). According to Nepal and Rogerson (2020), the theory of engagement can be divided into few main areas: relate, create, and donate. This statement is supported by many empirical studies like those that the engagement level is significant to examine the performance of the student (Rodgers, 2008).

Within the domain of education, gamification research usually covers both psychological (Seaborn & Fels, 2015) and behavioral outcome (Denny & Ochsner, 2014). However, the learning outcome's effect is the most concern nowadays (Kozlinska *et al*., 2020). With the enhancement of the learning activity, the engagement can be increased, promoting high achievement (Mariia, 2016). Figure 1 shows the steps in applying the elements in gamification (Mohamad & Salleh, 2018).

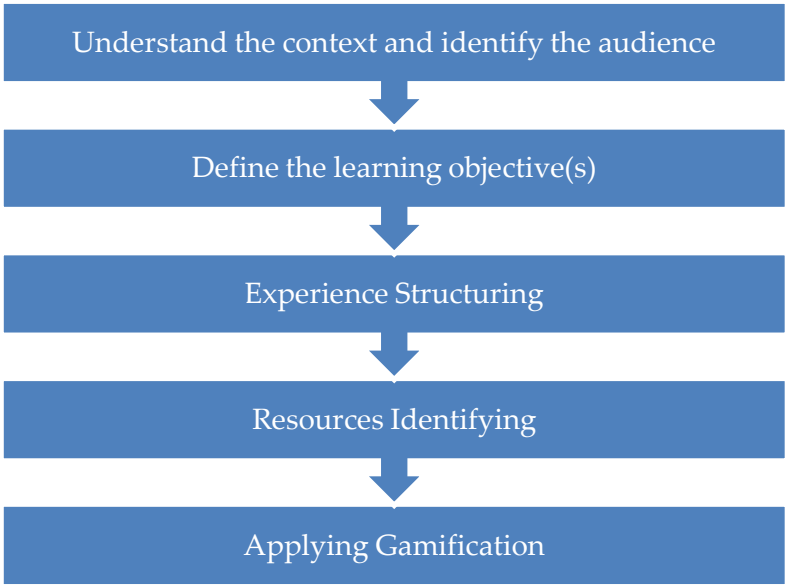

Figure 1. Process to Apply Gamification in Education

Figure 2 shows the prediction model on how gamification can affect the students' performance (Alomari *et al*., 2019). The application of gamification in the learning process has been proven to boost the participant's engagement and make the e-learning intuitively beautiful (Antonaci, 2019).

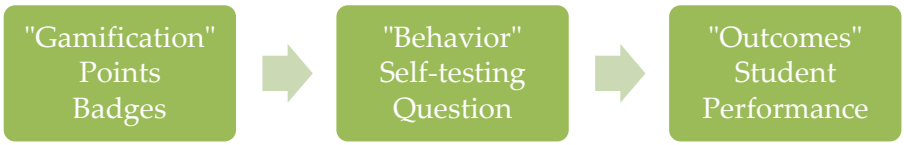

Figure 2. Prediction Model

Regardless of the subject or topic of learning, the learning method depends on the instructor. Figure 3 shows the use of gamification in learning (Antonaci, 2019). Research by Mohamad and Salleh (2018) has investigated the gamification element that can help to engage and the problem with the gamification technique. Past research shows that the less engagement with a student with the learning process is because of the student is treated as the ordinary user of the technology (Licorish, 2018), and most of the institution prefers to measure the level of achievement instead of the engagement of the student (Redmond *et al.*, 2018).

Figure 3. The Use of Gamification in e-learning

Figure 4 shows the instructor can follow the guideline to increase engagement using the gamification technique (Mohamad and Salleh, 2018).

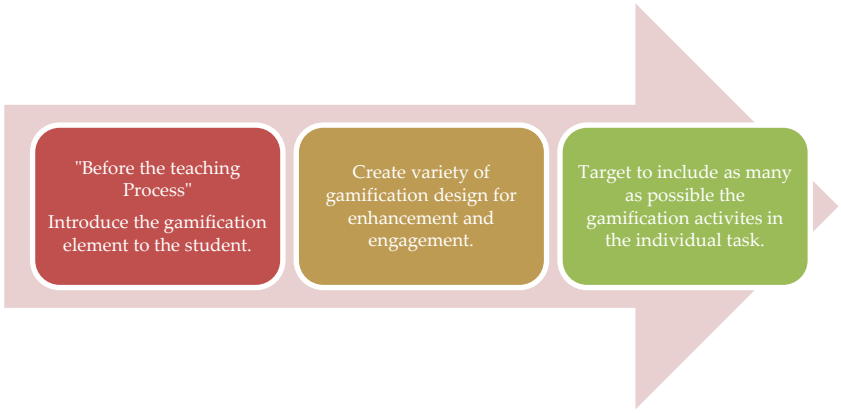

Figure 4. Steps for the Instructor for Engagement with Student

In a study, Mohamad *et al.* (2017) introduce the game design element in the e-learning system to increase user motivation and engagement. The study discusses the phase to be taken to apply the gamification into the system. They highlight that a successfully gamified e-learning system must understand the games' basic concepts such as the goal, reward, and progress. The learners are desired to achieve the goal and increase user engagement and motivation (Glover, 2013). The study proposed a model to introduce gamified e-learning related to software design, which follows the phase-in system development as displayed in Figure 5.

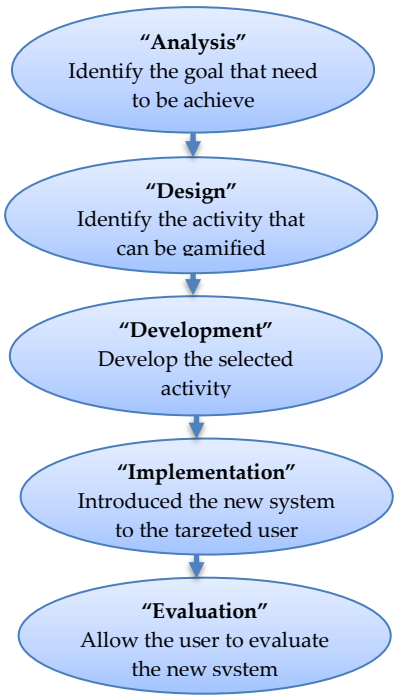

Figure 5. Phase to Introduced Gamification into e-Learning

According to Nah *et al.* (2014), gamification has proven to increase engagement between the specific task and e-learning. Gamification does not necessarily create a game. It can be defined as make education engaging. While gamification has multiple uses in commercial practices, it is found similar to the one in games. The paper focuses on the most appropriate techniques to apply to engage the user with the e-learning students will gain more motivation to study due to the more interactive method. The gamification method in the learning process stimulated them to study (Nah *et al.*, 2014). An important metric for gamification to succeed is the engagement, which has several metrics visit and total time per user are the example of metrics proposed for the e-learning process. Motivation and engagement of the user with the system can be improved by modification. By offering the combination of gamification and engagement, which stinger and long-term, it can generate positive behavior for the student. It can use to create an effect as well as an engaging e-learning application (Nah *et al.*, 2014).

A study by Dixson (2010) on what activities or interaction can lead to more high engagement of the student with the online courses set the scale to measure the engagement. This is supported by research that stated the observer needs to constantly monitor the user's engagement because when the user loses their attention, they might not focus again (Abidin *et al.*, 2018). Since they are no specific scale to measure the engagement, the first stage of the study was to develop a measurement scale for the engagement with the online course. The findings show that regardless of the type of activity, the students prefer the meaningful connection with the activities and the system. This is supported by the study that stated the people tend to remember the information that triggers their emotional response (Overton & Lowry, 2013). The new system will try to tackle the emotions of the children to engage with them so that they can engage with the apps monitor and monitor the engagement using the time taken spend on the app's study has been done to explore until which extent the engagement and the immersion of the challenge to the e-learning (Hamari *et al.*, 2016). The questionnaire was examined to study the level of engagement. The question asked to the challenge and the skills predict engagement and immersion, how engagement and immersion can perceive the learning, and how the engagement

and immersion can mediate and affect the challenge and skills on the learning. Serious games in learning are different from entertainment-oriented games, while they are enjoyable and designed for other purposes than entertainment (Hamari *et al.*, 2016). Playful and serious games often combine challenging activities to maximize one skill (Shernoff *et al.*, 2014). More complex and cognitive the challenges engage the student more deeply in learning by concentrate harder in the classroom. The skill in challenging also been proved to increase the motivation by extending the players capacity in game-based e-learning (Fullagar *et al.*, 2013). According to Sekreter (2017), students have high motivation when they get competent. Few studies measure psychological engagement in game-based, which is separated into few parts: behavior, cognitive, and emotional (Abidin *et al.*, 2018). Students who did homework game-based are more clearly engage in the activity compare who are not (Hamari *et al.*, 2016). Somehow, engagement in educational game-based been observed to be moderated by the gaming experience (Hamari *et al.*, 2016). A positive association between learning and engagement has been found in previous studies (Jabbar & Felicia, 2015). The engagement is indirectly contributing to the focus on grades on learning (Cheah, 2016). In a study by Humari *et al.* (2016), they study the impact of the operationalized as heightened challenge and skill and conclude that the educational video games can effectively engage the student in the learning activity and demonstrated by the concentration interest and the enjoyment during the process. The observation method can be used to measure the engagement in both individual and group engagement, especially for education purposes (Volpe *et al.*, 2005). The observation technique was used by Lee and Brophy (1996) and noted that the technique could provide details. Therefore, observation is the best way to get information from children because someone can learn so much about the children through observation (Booren, 2012).

Traditionally, education is only offered in the classroom, where the student has two communication methods with the teacher. The phone has been widely using a piece of technological equipment since the 1980s (Alqahtani & Mohammad, 2015). The use of the mobile phone in education is a clear example of the phone as the technological equipment (Alqahtani & Mohammad, 2015). Since iPhone was launched in 2007, the smartphone's engagement to enhance the learning process is noticed by educationalists (Abidin *et al.*, 2018). In a paper by Willacy and Calder (2017), a study has been done on students' engagement with Mathematics apps in Regional Health School (RHS). This is due to the interests of the educators in the innovation of mobile apps (Stathopoulou *et al.*, 2019). The study shows that mobile phone use influences the student positively. This is supported by a study that the mobile application can impact student performance (Alqahtani & Mohammad, 2015).

One of the most frequent questionnaires to get the data is Game Engagement Questionnaire (GEQ). The GEQ consists of three structure: core questionnaire, social presence module, and post-game, which must be administered immediately after the session ended (Jesselteijn *et al.*, 2013). This particular questionnaire provides a strong measurement of engagement with games. According to a journal by Jesselteijn *et al.* (2013), high engagement with the game can have a high impact on game-playing, and the GEQ is valid and reliable to measure player engagement with the game. Inchamnan (2016) introduced player experience to measure the scale, including physical, emotional, and narrative, to measure the player's presence satisfaction, as shown in Table 1.

Table 1. GEQ items

No	Items
1	I lost track of time
2	Things seem to happen automatically
3	I feel different
4	I feel scared
5	The game feels real
6	If someone talk to me, I don't hear them
7	I get wound up
8	Time seems to kind of standstill or stop
9	I feel spaced out
10	I don't answer when someone talks to me
11	I can't tell that I'm getting tired
12	Playing seems automatic
13	My thought go fast
14	I lose track of where I am
15	I play without thinking how to play
16	Playing makes me feel calm
17	I play longer than I meant to
18	I really get into the game
19	I feel like I can't just stop playing.

METHODOLOGY

This method focuses on identifying the gamification element and guidelines for creating an engaging design. Therefore, some data about the right gamification technique needed to be collected before deciding the design that could be used to encourage students to engage with educational game applications. The data will be gathered through a review of the literature as well as observation of the students while they play a simple existing game and fill out a questionnaire adapted from a previous study. The technique used to collect the data, which is observation, does not seem necessary by asking the student a simple question. Still, it is enough to watch the student use the existing app that is "Flashcard" application because of the existing apps on the play store. The student will be given the apps and will be observed. One can learn so much about the surrounding through observation (Urquhart, 2015).

Participant

The current apps will be tested on the children and the staff (teacher) from the community learning centre (CLC) PACOS at Taska Suasindak Penampang Sabah. A total of 10 children and five staff will use the existing apps to identify the gamification element that they prefer to have in the new educational game application. Children age five years old was selected to participant in this research because their ability of understanding and answering direct or simple question. In addition, the selected children should at least have some experience in interacting with smartphones.

Procedure

The questionnaire collects participant data related to engagement, motivation, and enjoyment. The first questionnaire in the preliminary study was adapted from the GEQ. The subjective experience of playing video games may be subjectively measured using the GEQ to help the participant get an accurate result (Granic, 2014). The data collected during the observation and the questionnaire were

then use in the development phase. There are only nine questions that will be adapted from the GEQ due to the question's relevance (Table 2).

Table 2. Game Engagement Questionnaire

No	QUESTIONS	YES	NO
Q1.	I lost track of time?		
Q2.	The game feels real?		
Q3.	If someone talk to me, I won't hear them?		
Q4.	I can't tell that I'm getting tired.		
Q5.	I play without thinking how to play		
Q6.	I feel calm when I play		
Q7.	I play longer than I meant to		
Q8.	I really get into the game		
Q9.	I really feel like I can't stop playing		

The following questionnaire that will be asked to the participant is the gamification element that they prefer to be included in the digital educational game (Table 3). The children and the staff will be observed when they use the current application, and the data will be collected using a questionnaire.

Table 3. Element of Game

No	QUESTIONS	YES	NO
1	Do you like leader board in your apps?		
2	Do you like badge in your apps?		
3	Do you like point in your apps?		
4	Do you like level in your apps?		
5	Do you like award in your apps?		
6	Do you like progress in your apps?		
7	Do you like challenge in you apps?		
8	Do you like action in your apps?		
9	Do you like rules in your apps?		
10	Do you like feedback in you apps?		
11	Do you like goal in you apps?		
12	Do you like avatar in your apps?		

RESULT AND DISCUSSION

Figure 6 shows the demographic data of 15 participants consisting of five teachers and 10 students. The majority of the participant is female, which are four students and five staff. All the students from the same age, five years old and the staff's age majority between 30-39 years old with a diploma in education and the longest teaching experience is almost 20 years.

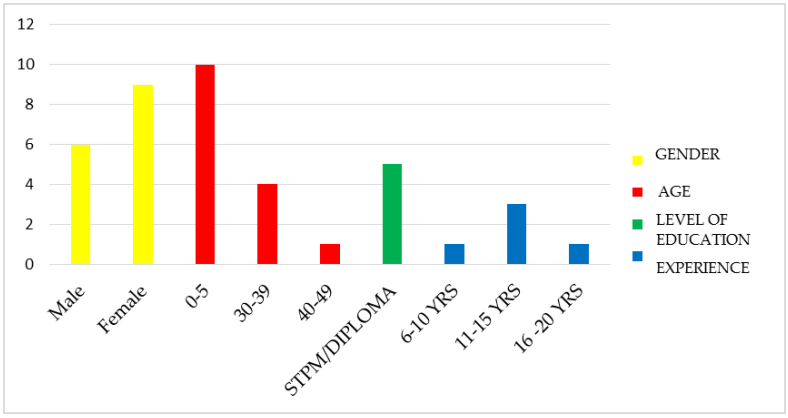

Figure 6. Demographic data of participants

During the study, the existing app use to see the engagement of the student with the app. The existing app are known as Kadazandusun Flashcards, a handy educational game app for the Kadazandusun ethnic in Sabah. This app is particularly to help children to learn their heritage language.

Analysis of Gamification Elements

Figure 7 shows the result of gamification's element collected from the participant. During the study, there was 12 elements of gamification asked 15 participants to be selected to include into the new mobile application.

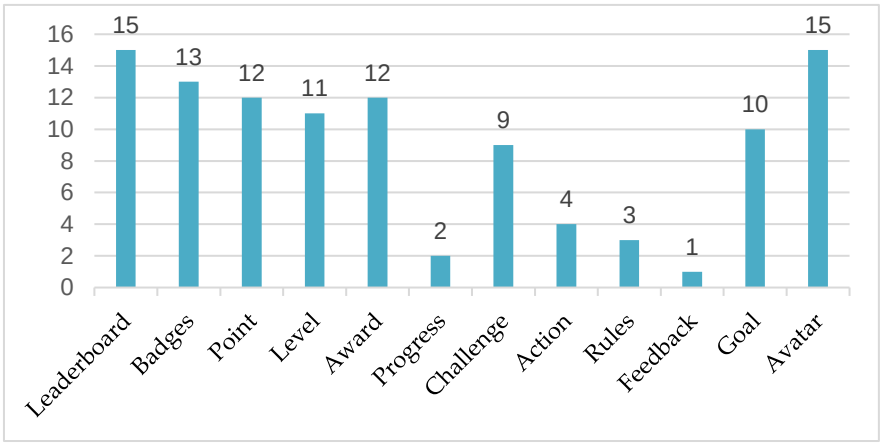

Figure 7. Element of gamification

The leaderboard and the avatar show as the favorite element chosen by the participant. The badges were chosen by 86.67% of the participant, followed by point and award with 80%. The level's element is chosen 73.3% by the participant, followed by 67.7% choose the goal and 60% choose the challenge. The participant less chooses the progress, action, rules and feedback. The high percentage element chosen by the participant will be implemented in the new educational game apps. From the element of the gamification result, it can be concluded that the user wants an interactive learning application to be use to achieve the goal of learning process.

Analysis of Game Engagement Questionnaire

Figure 8 shows the analysis of GEQ on the children's participants based on the current apps used on them. The result shows that 46.67% of the participant play the app without thinking due to not interactive app that do not tackle their focus to use the app to learn. 33.33% of the participants do not

feel tired using the app, and 26.67% of the participants agree that they play longer than they meant to and focus on the app. All of the participants, which is 100%, agree that they do not feel calm at all to use the app. The app does not include any "fun" element to tackle the user or to engage with the user to achieve the objective of the app. In terms of the app's function, the application does deliver the objective of teaching the engage, but it fails to motivate and engage the children.

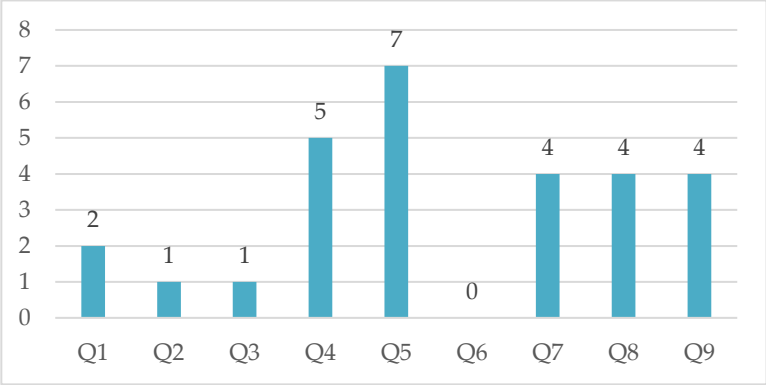

Figure 8. Analysis of Engagement

Proposed Guideline of Designing Engaging Educational Application

The guideline to develop the educational game application is based on previous study in the literature review and findings from the study. The proposed guideline as shown in Table 4 may be implemented into future educational applications.

Table 4. Suggested Guideline for the future Application

Guideline	Explanation (To be adapt)
The achievement should be fun	• User will get some award such as Badges if they tackle the goal and unlock the level. • Each achievement will contribute to the player's point
Less customization	• User can only select the avatar to make it less difficult.
Different difficulty for different levels.	• Challenges will make the application more fun due to different level of difficulty
Instruction	• Need to include simple instructions.

CONCLUSION

The engagement of the student in the learning process and material is a crucial topic in the educational field. The result of the engagement between them will affect the student's result. This study is to research the feature and the element of the gamification technique. More details about the gamification technique and the gamification element are explained briefly in the literature review. Most of the researchers have agreed on the definition of gamification, which contributes too many aspects. Many elements of gamification have been highlighted from the previous study that is noticeable. Research on gamification has been identified to help in the engagement of children with educational game applications. Few elements of gamification have been selected from the previous study for this study. During data collection, participants selected a few elements to be included in the newly developed educational game application. The feature of the educational game application is

identified in the literature review to develop a good learning application for the students and the previous work related to the educational application.

In conclusion, the contribution of the research contributing a suggested guideline to develop engaging educational applications. There are seven elements of gamification identified during the study to engage with the students, as shown in Figure 7. It is predicted the use of the mobile application has sustain growth in the coming years. Therefore, the researcher needs to keep enhancing the current application. Thus, future works will be implemented with the seven elements identified as a guideline for educational games development. Also, the participants for this study only involved five-year-old children; the next research may use a different age group to see the different results from the same level of participants and different age levels. In terms of research, this research applied the GEQ, to obtain more accurate results; future research may use other tools such as SPSS and PLS-SEM for statistical analysis or EEG to evaluate engagement.

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