



## GUIDELINE FOR CHILDREN'S COMMUNITY LEARNING APPLICATION USING GAMIFICATION

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### ABSTRACT

In this era, technology is rapidly evolving, with many innovations and creations being produced rapidly. This can be seen in how tech companies and brands continue to release new tech products every year. Application software is one of the most popular tech products. Most people use application software because it assists us in accomplishing our daily tasks. As each application software provides specific functions for personal, business, and educational purposes, many applications software can be used by people from various backgrounds and ages. While assessing learning at all levels of education is critical for tracking progress towards an education institution target, measuring children's development and learning at the start of school is especially important for equity. Gamification is already widely used in cutting-edge technology, showing that the current approaches have gamification in the right way but do not take into account some necessary keys to get a more effective gamified process for success. Also, gamification has seen successful implementation in various subject matters and age groups. However, studies specifically examining gamification and second language acquisition were not as prevalent. Thus, this study proposes a guideline for children's community learning applications using gamification. A mixed method using EEG and a questionnaire were used to identify the guideline. The simulation uses a ready gamification app focusing on the Kadazan-Dusun learning language. Results show that four variables are highly engaged with the children and high to moderate engagement with the teachers. Also, six main gamification categories were incorporated: achievements, virtual gifts, rewards, status, real-time and profiles. Hopefully, this guideline may help developers, and more gamification applications for children will develop teaching and learning tools.

**Keywords:** EEG, engagement, social, mechanics, dynamics, emotions

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### 1. INTRODUCTION

Technology and economic development have hugely impacted the education world. A cynic would say that technology has done nothing to the education world. Students still need to go to school, the teacher still needs to provide lectures, and you still see the same behaviour in class – students

chatting with friends, sleeping, or daydreaming. Though the basis of classic experiences in the classroom is still the same, technology has great support and changed how teaching and learning are done inside or outside the classroom – digital learning tools, extended classes, recording lectures and a whole lot of other learning tools that is 24 hours a day and seven days a week.



With the way of future education is heading, we no longer depend on a single learning platform. Classroom, web, computer application and mobile application has become an integrated part and important part of learning. It allows individualized learning where students can learn at their own pace or self-guided. Used of computers and other educational tools can facilitate learning as well as social interaction. Besides e-learning, technology has now enabled mobile learning and gained instant popularity (Sharrab et al., 2013). This motivation will greatly impact the quality of learning and learners' engagement with the education platform. Olson (1997), the "location, location, location" is likely to become "motivation, motivation, motivation", for it has become an important factor that educators can target to improve learning.

Statistica has issued a recent report on time spent by children in the United Kingdom according to their age and media. Children aged 3 to 4 spent a fairly large amount of time playing games, about 5.9 hours per week. And, of course, a higher amount of time spent among older children with kids aged 12 to 15 spent about 12.2 hours per week playing video games. Little children are creative and love exploring, experimenting and fantasizing (www.statistica.com). All this can be offered by playing video games. Because of the popularity of games among children, educators have been introducing gaming elements to a non-gaming environment in the field of education. This is known as gamification. The definition of gamification is "the use of game design elements in a none game context" thus,

therefore, differentiating gamification from a serious game (full-fledged game).

## 2. LITERATURE REVIEW

### 2.1 Gamification

A report in New York Times by Richtel (2010) stated that one of the main reasons for drop-out in education is boredom or lack of engagement. This often escalated to the absenteeism pattern where each absence made the student unlikely to return to school. Escalating the problem, children nowadays are being distracted by technology such as the Internet and smartphones. However, it is not all negative about technology; technology used correctly has made wonders in many fields, including education. Tablets and smartphones have become important support tools for children's learning and physical senses (Cha & Seo, 2018). For example, a device may assist children's visual and psychomotor skills (Li et al., 2009). Besides, the Internet has allowed education anywhere, and physical presence is no longer an issue. E-learning is no longer a trend but a must adoption by any education means institution.

There are two important elements in education: 'environment 'and 'motivation ' (Vero & Puka, 2017). According to William (2011), children need to be exposed to various motivating experiences and variables regularly to ensure that motivation is optimized.

There is, however, a limitation of e-learning. From a pedagogical point of view, e-learning is not able to transmit emotion, motivate or engage students as a teacher could. For this



fact, e-learning must therefore be able to compensate for the lack of feeling, stimulus or emotional interaction that it comes with (Selvina, 2022).

According to Gok et al. (2016), gamification is a powerful tool that allows engagement with peers, keeps people's attention and assists activities in reaching their desired outcome. Gamification refers to using the game element in a non-game context by increasing the engagement between humans and computers (Khaleel, 2016). Activities that run over a long period are not appealing, especially in children's learning. However, combining game elements with small divided tasks can create a more efficient way to motivate people. Such gamification has found ways in education and is a topic of ongoing research. The right gamification elements can engage students, as children like a challenge and allow parents or students to monitor their progress (Alsawaier, 2018).

In general, gamification is implementing game elements towards non-game contexts. For this study, the definition of gamification suggested by Kim et al. (2017) is the best fit for this study as it touches on the concept of gamification in the context of learning and education.

## 2.2 History of Gamification

It has been cited that the study about gamification goes back to 1980 when a researcher called Thomas Malone published a paper entitled What Makes Things Fun to Learn? A study of intrinsically motivating computer games. This study was set to answer two questions:

1. Why are computer games so captivating?

2. How can the features that make computer games captivating be used to make learning fun, especially e-learning.

In Malone (1980), a game appeals to children because it has elements that attract and keep them hooked. He categorized the elements into three categories: challenge, curiosity and fantasy. The interaction between fun and learning is important. Some features could be added to the instructional environment, making them more fun than instructional (Malone, 1980). This has then become an interesting subject for future research and study area.

Nick Pelling, a computer programmer and creator, used the word gamification in 2002 as a coincidence. He wondered if he might use the game user interface on commercial electronic devices, making it more entertaining and faster. Pelling founded the company Conundra Ltd in 2003, aimed at pursuing gamification, but had to close it because of a lack of customer interest (Pelling, 2011).

However, others disagreed and believed that Rajat Paharia, the founder of the gamification platform fixation Bunchball, is the founder of gamification. Paharia founded the company in 2005, specializing in developing gamification technology solutions. Thus, Paharia is widely recognized as the concept's founder (Bunchball, 2010). Not until 2010 that the gamification concept generates a kind of general curiosity, shown in the number of hits of online gamification searches. There is also a sudden increase in the number of academic papers published. However, whether gamification is effective is still a constant debate. There are many knowledge gaps regarding whether



gamification is effective or only a hype (Hamari et al., 2014). The concept is applied in most fields nowadays, especially business and education. It is becoming a mechanism of motivating people to stay engaged in a particular event or activity.

### 2.3 Types of Gamification

Most papers categorized types of gamification into two types. A study suggests that gamification can be divided into two types which are reward-based gamification and social gamification (Thiel, 2016a). Reward-based gamification aims to motivate people by rewarding them with badges or points and displaying the achievements of individual users on leaderboards (Thiel, 2016b). Social gamification involves the effects of social aspects (e.g., social identity, social influence, social interaction), which are encouraging to see (Hamari & Koivisto, 2015).

Reward-based gamification is very common in video games, computer games, and mobile gaming. It is a motivational technique to keep someone engaged in something (Buckworth et al., 2007). A common type of reward used in the reward-based gamification system is points/scores (Lewis et al., 2016) and achievements/badges/medals. These points can be gained by completing tasks or based on performance. Other than that, rewarding badges and medals for achievements are usually given through the technology platform if someone reaches a particular level (Kamel Boulos et al., 2015; Nevin et al., 2014). Sometimes points and achievements are combined, where the person is required to accumulate points according to the task

requirements to achieve something for a badge or medal.

Social gamification is often seen in social media platforms, although some education platforms are starting to implement this type of gamification. In social media platforms, features such as making connections or friends, rating other users' activities, and sharing have game-like elements (Pellikka, 2014). The mentioned features can motivate social media platform users to gain more connections or friends and create content that gets many likes and shares. As for education platforms, Udemy enables learners to submit their work and have their tutors and peers give feedback about their work. Upon receiving feedback, learners reflect on their work (Xiao & Lucking, 2008) and feel motivated to improve their work, which positively impacts their learning performance (de-Marcos et al., 2017).

### 3. RELATED WORKS

Gamification and serious game give a lot of similar benefits. Both have been known to increase engagement, motivate and inspire the person playing or using the application/game.

Gamification blends game mechanics or elements into traditional e-learning. For example, traditional e-learning has modules to complete an online course; plain and simple to go through module by module until the finish. It is up to the student of her own will to complete the course. Whereas if we blend in gamification, a student may get a 'badge' after completing each sub-module and you have to gain enough 'badge' before



you can unlock the second module in the course.

Although gamification and games offer some overlapping benefits, gamification is not a serious game, though these two aspects always get tangled together. Serious games refer to a game developed with a specific aim, for instance, to improve learning. This can be in various fields like healthcare, military training, corporate training, and even in various levels of education as well as society as long as there is a need for such application.

Marczewski (2013) in his research had classified serious games into four different parts:

1. Simulator game, a visual representation of a real-life event and used as a safe practice for competency-related training such as for aviation or military industry
2. Teaching games, a game to teach the certain players topics
3. Means game, a game that is to promote the meaningful message
4. Purposive game, game such as in the medical field, has a real-world outcome by being played.

Gamification, as explained earlier, is not a game. Nacke and Deterding (2017) have explained that games and gamification are placed in different areas of the spectrum. When more and more elements are added to it, it will start moving towards the "whole" side and may become the game itself.

Other researchers have heavily discussed the most common game elements introduced in e-learning, including points, leaderboards, challenges, level achievement and time-

based activities (Strmecki et al., 2015). Some authors have also identified other components like narration, technology, interactivity and storytelling.

Even before technology made a wave in education, elements in gamification have been used for many years to motivate learners. For instance, when they did well, teachers used a gold star next to children's names. It makes use of the competitive instinct that we have (Strmecki et al., 2015).

Learning is an active process and often requires time; it requires motivation to begin and continue. According to Sailer et al. (2017), in the psychology field, human motivation can be distinguished into two types:

- Intrinsic motivation: Motivation that derives from the core. Beuchert et al. (2020) mentioned that when learners are interested in what they are learning and the learning process itself, which innate psychology of self-determination and competence).
- Extrinsic motivation: Motivation that derives from the world. Redding (2013) said extrinsic motivation is a psychological perspective that assumes learning is best directed with a report card, celebrating achievements such as conducting award ceremonies.

In a serious game, learning happens when playing through the game, so it replaces the teaching process and takes the role of the instructor (Landers, 2014). Gamification is different; it does not replace any existing teaching process, but it enhances and complements it by providing challenges and engaging students (Jääskä & Aaltonen (2022). This statement has also been



supported by Seaborn and Fels (2015), saying that gamification does not need serious content as it does not try to teach any specific skill. However, it increases students 'motivation in the learning process.

Though what gamification offers in education seems very appealing, gamification does not alter or promote any behavioural change. Hamari et al. (2014) reported that there is research that found the effect of motivation that gamification is not something long-term at all. When the gamification element is removed from a learning process, students will return to their old behaviour since there are no more reward offers and engagement from them will decrease (Seaborn & Fels, 2015).

#### **4. RESEARCH METHODOLOGY**

Data will be collected from the participants from children. The children are asked to test the apps to gain input about their experience with the app based on the developed instruments.

##### **4.1 Participants**

The current apps will be tested on the children from TABIKA KEMAS who are between the age of 5 and 6. According to Piaget (1932), children aged 2-7 years old are in a pre-operational stage where they start to learn language and symbols. Cherry (2014) said children aged four could already understand situations at multiple points.

##### **4.2 Procedure**

The data collection for this study is conducted as a mixed method, both quantitative and qualitative. Quantitative data collection is done using the developed instruments, while qualitative data collection is done using an electroencephalogram device. Richards (2014) defines the qualitative method as studying people and their behaviour by going there in their natural setting. The participants will be asked a series of questions in the preliminary study using the instruments developed after using the application—the application used as proof-of-concept gamification.

##### **4.2.1 Qualitative Method Using Electroencephalogram**

Validation and verification are made to ensure that the system meets the previous phase's specifications. The software will be tested using the Black-Box testing method to ensure it performs smoothly. According to International Software Testing Qualifications Board (ISTQB), Black-Box testing is functional or non-functional testing without reference to the internal structure of the component or system. Unit testing and System testing are performed. Furthermore, the effectiveness of the developed mobile learning application with students will be evaluated using Electroencephalography (EEG). The application used to evaluate the effectiveness is Effective Learner, downloaded from PlayStore. Effective Learner is an app with the NeuroSky MindWave headset to monitor learning effectiveness by measuring the focus level. The device used to pair with the application is MindWave Mobile2, manufactured by Neurosky. The device was connected via Bluetooth and will detect the tiny electrical





impulses, or brainwaves, then analyses by the Effective Learner application. The Effectiveness Tracker shows the current focus level and effectiveness as six different colour-coded levels and provides a session report, which includes a time plot of the effectiveness for the duration of the study and a pie chart of different colour percentages. There will be ten participants involved in the evaluation. After each individual completes the evaluation, they will be interviewed to collect their perception of their experience of using the application. The result from the focus group will be analyzed at the end of this phase. The deliverable of this phase is the mobile

learning application and the evaluation result on the effectiveness of the mobile application.

#### 4.2.2 Quantitative Method Using Questionnaires

Two questionnaires were made for this study for the students and teachers. Both the questionnaires for the students and teachers measure their mechanics (Broer), dynamic (GEQ), emotion (EEQ), and social (SPGQ). Table 1 and Table 2 show the instruments used in the questionnaire for the students and teachers.

**Table 1: Instruments used in the questionnaire for students**

Instrument	Question
Mechanic	I think I can decide what I should do next.
	I find it difficult to complete some tasks in this app.
	I think I want to compete with the others.
	I have a curiosity when using this app.
	This app encourages me to learn and master certain skills.
	I feel the need to strive to get encouraging results.
	I get a meaningful experience when playing this game.
	I strive to cultivate or develop something.
	I get rewarded in any form from this app.
	I feel like getting involved or re -engaging with this app.
Dynamic	I don't realize time passes.
	I feel different (more courageous, not shy, etc.).
	I feel scared.
	The application feels real.
	I can feel tired after playing for a long time.



	Using this app makes me feel calm.
	I feel like I can't stop playing.
	I use the app without having to think much about how to use it.
	I didn't realize people greeted me.
	Time seems to stand still or stop.
Emotional	I feel focused while using the app.
	I find it easy to get used to using this app.
	I feel emotionally stressed while using the app.
	I find it hard to understand how the app works.
	I feel that this app provides a fun challenge.
	I feel conscious of being in the real world while playing.
	I am aware of myself in my environment.
	I see events happening around me.
	I felt as if I was separated from the world around me.
	I feel like being more in the app environment than in the real world.
Social	I feel jealous of others.
	I find out about other people.
	I enjoy playing because there are other friends.
	When others are happy, I am happy too.
	I empathize with others.
	I feel connected to others.
	I admire the others.
	I feel revenge.
	I envy the others.
	I pay attention to the others.

**Table 2: Instruments used in the questionnaire for teachers**



Instrument	Question
Broer	I am satisfied with the achievement.
	I completed a challenging task.
	I get a feeling of being capable or efficient.
	I get encouraged to learn/master a skill.
	I feel like my emotions are becoming positive.
	I get the feeling that there is a purpose.
	I had the chance to collect something.
	This application documents user behavior (previous activity).
	I got meaningful feedback from this app.
	This application uses fixed rules.
	I have to work hard and focus to get successful results.
	Applications provide different results.
	I get reward points from the app.
	I have a measure of progress in the application.
	I know a clear goal/idea of what to do next.
	I have to complete some work in a set of challenges/quests/missions/tasks.
	I feel able to complete a set of challenges with the division of tasks provided.
	The app has a progress board display (leaderboard).
	I have the opportunity to work with others.
	I was asked to do a group assignment.
	I have a curiosity when using this app.
	I am able to cultivate or develop something.
	I can decide what to do next.
I feel like competing with the others.	
I feel like getting involved or re-engaging with this app.	
GEQ	I don't realize time passes.



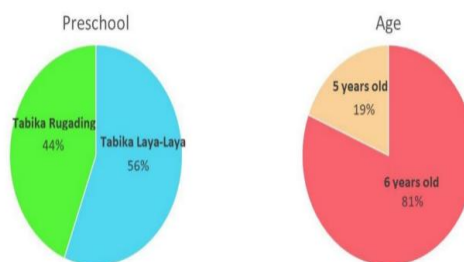
	I feel different (more courageous, not shy, etc.).
	I feel scared.
	This application feels real.
	I can feel tired after playing for a long time.
	Using this app makes me feel calm.
	I feel like I can't stop playing.
	I use the app without having to think much about how to use it.
	I didn't realize people greeted me.
	Time seems to stand still or stop.
EEQ	I find it hard to understand how the app works.
	I feel focused while using the app.
	I find it easy to get used to using this app.
	I feel emotionally impressed while using the app.
	I do not feel the desire to make progress in the application.
	I felt a strong sense of the app world until I was unaware of my surroundings.
	I feel that this app provides a fun challenge.
	I feel the sense gained from playing the app.
	I feel that the app responds quickly.
	I feel like I have control over using the app and playing.
IEQ	I realized I was in the real world while playing.
	I am aware of myself in the environment.
	I see events happening around me.
	I felt the urge to stop playing and see what was going on around me.
	I felt as if I was isolated from my surroundings.
	I feel like being more in the app environment than in the real world.
	I found myself becoming so involved that I didn't realize that I was also using control.

SPGQ	I feel jealous of others.
	I find out about other people.
	I enjoy playing because there are other friends.

Tables 1 and 2 are the final constructs and instruments used further in this study. The two instruments have been validated based on the review of experts and also run as a pilot. This study takes about 20 – 30 minutes to answer the questions in the two developed questionnaires.

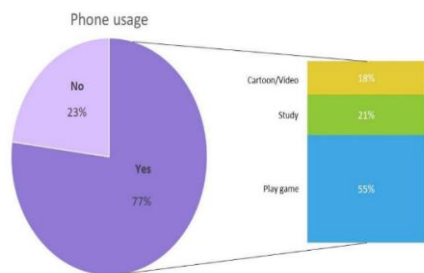
Two preschools for the field study were conducted at Tabika Laya-Laya and Tabika Rugading, with 19 and 24 students, respectively. Children aged 5 (8%) and 6 (35%) were interviewed from both preschools. Figure 1 shows the demographic data for the participants of the study.

**5. RESULT AND DISCUSSION**



**Figure 1: Demographic data of participants**

From the study, it is found that the majority (77%) of the children use phones and the rest do not (23%). The children that use phones use them primarily for playing games (55%), studying (21%), and watching videos (18%). Figure 2 shows the phone usage of children.



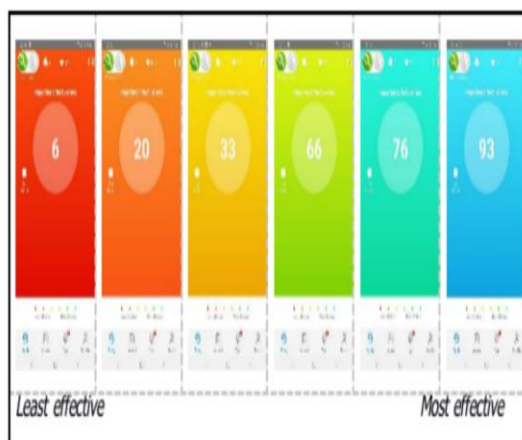
**Figure 2: Phones usage by children**

**5.1 Result from EEG**



The application used to evaluate the effectiveness is Effective Learner. It is used with the NeuroSky MindWave headset to monitor learning effectiveness by measuring the focus level. The headset will detect tiny electrical impulses or brainwaves and then analyze them with the Effective Learner application. The Effectiveness Tracker shows the current focus level and effectiveness as six different colour-coded levels and provides a session report, which includes a

time plot of the effectiveness for the duration of the study and a pie chart of different colour percentages. In the report, the learning effectiveness is represented in six colours from most to least effective: blue, green, yellow-green, yellow, orange and red. Figure 3 below shows the effectiveness scale. After each individual completes the evaluation, they are interviewed to collect their perception of their experience using the application.



**Figure 3: Effectiveness Scale**

**Table 3: Preschool students EEG results**

Preschool	ID (Student)	Effectiveness (%)
Tabika Rugading	A01	69.6
	A02	36.0
	A03	90.3
	A04	35.6
	A05	77.5
	A06	86.9
	A07	84.9

	A08	44.5
	A09	52.4
	A10	62.3
	A11	83.5
Tabika Laya-laya	B01	43.5
	B02	32.9
	B03	56.5
	B04	29.9
	B05	65.6
	B06	77.6
	B07	92.0
	B08	55.7
	B09	74.3
	B10	83.5
	B11	90.1
	B12	60.7
	B13	87.1
	B14	68.0

Based on Table 3, it is found that average records are 65.65% of the effectiveness of gamification. The total of respondents that recorded effectiveness of 50% and above is 67.45%.

## 5.2 Results:

The participants' answers are then analyzed to know their engagement level with the variables. Tables 4 and 5 show the data for the student and teachers/parents, respectively. The level of engagement from the Likert scale analysis can be interpreted as follows:

- i. 1.00-1.8 – Least engagement
- ii. 1.81-2.6 – Less engagement
- iii. 2.61-3.4 – Moderate engagement
- iv. 3.41-4.2 – High engagement
- v. 4.21-5 – Highest engagement

**Table 4: Students data**

Variables	Mean Score	Engagement Level
Mechanics	3.8	High Engagement
Dynamics	3.7	High Engagement
Emotions	3.7	High Engagement
Socials	3.5	High Engagement
Total Mean	3.68	High Engagement

**Table 5: Teachers/Parents data**

Variables	Mean Score	Engagement Level
Mechanics	3.9	High Engagement
Dynamics	3.5	High Engagement
Emotions	3.4	High Engagement
Socials	2.7	Moderate Engagement
Total Mean	3.3	Moderate Engagement

Based on the results, the children are more engaged with the app than the teachers. The high engagement level for children is because they enjoy games more than the teachers.

## 6. CONCLUSION

This research has shown that implementing specific gamification categories can produce a highly engaging application based on quantitative results from the Questionnaire and EEG testing. In this study, six main gamification categories were incorporated. There are achievements, virtual gifts, rewards, status, real-time and profiles. Thus, future works should try to apply the

guideline in developing others' application and test with the wider age of children from 5 to 12 years old, from preschool to the primary school level. Thus, gamification increased students 'engagement and motivated them to learn. In conclusion, this study provides a guideline on the important gamification elements and the method of testing for building a gamification application for children, specifically for community learning applications, which is the focus of this study.



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