

The development of grade 5 students' reading comprehension using gamification within brain-based learning.

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Abstract

The aims of this study were to 1) develop the students' reading comprehension using gamification within Brain-based learning (BBL), 2) explore the students' opinions regarding their attitude towards this instruction, and 3) find the relationship between the student's reading comprehension ability and the student's opinions toward this instruction. The participants were 24 of grade 5 students selected by using purposive sampling. The methodology was pre-experimental research involving a one-group pretest-posttest design. The research instruments were 6 lesson plans, the reading comprehension pre- and post-test, the questionnaire, and the semi-structured interview. The relative gains scores were used to compare the students' progression in reading comprehension. The Pearson correlation was employed to find the relationship between the post-test scores and the questionnaire scores. Furthermore, thematic analysis was used for analyzing the interview result to gain in-depth details of the student's opinions.

The results of this study revealed that the mean scores of reading comprehension increased from 11.17 to 23.38 after using this intervention. The average progression gain score was 42.93 indicating that students had moderate progression. Meanwhile, this intervention enhanced students developing reading ability. Additionally, the questionnaire results showed that students had positive opinions toward this intervention. Additionally, the interview results also showed that this instruction can improve vocabulary knowledge reading comprehension, and create motivation. Furthermore, the correlation between reading scores and students' opinion scores is significantly related. In conclusion, all findings prove that this intervention is an effective way to improve reading ability and promote positive attitudes toward learning English.

Keywords: reading comprehensionability, brain-based learning, gamification

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Introduction

All nations rely on globalization due to the rapid development of technology and global media becoming an inevitable trend in the present world; hence globalization affects the Thai nation, Thai society, and Thai economy (Choomthong, 2014). Varaporn (2018) stated that English gained more importance because it is one of the indicators of a country's economic growth productivity in the era of globalization. According to global trends, English plays a crucial role in the Thai education as we widely teach English in institutions, schools, and colleges in Thailand (Darasawang, 2007).

The Ministry of Education of Thailand (2008) has realized that the English language is an essential language subject for students at all levels since English serves as a tool for communication, interaction, and understanding the world. All Thai students are required to emphasize English in four areas. One of the areas is reading skill.

In Thailand, reading skills receive a focus as the foundation of learning English in higher education. The Basic Education Core Curriculum (A.D.2008) indicates that Thai students should understand the texts, and accurately tell the main idea after reading stories (Ministry of Education, 2008). Many Thai educators urge that reading is a vital skill used for studying and working. For example, the ability to read critically is a precious skill in the 21st century. Thai students should have the ability to reason, criticize, and evaluate text (Varaporn, 2018). Darasawang (2007) also stated that English reading is essential for Thai students who wish to engage in postgraduate study. Furthermore, English reading is a basic requirement in all careers and professions due to the expanding number of international companies. (Chall, 1996; Nitsaisook, 2003).

Regarding the ordinary national educational test (O-NET) for grade six students in the academic year 2015-2020, teaching reading English in Thailand has been unsuccessful as the average O-NET score for English remains the lowest at 39.24%. Thai educators identified the reading barriers among Thai students as three main points. First, Thai students do not understand the language syntax and reading strategy. Second, students lacked the motivation to read the text. Lastly, teachers use inadequate English reading instruction, making students lack the motivation to learn (Indra & Kaveerat, 2019; Sornprasert & Chusanachoti, 2019). Thus, to better improve reading comprehension ability, the teacher should create an approach that can enhance students learning.

The same reading comprehension problems also exist at Ban Kok Mai Ngam Song Serm Wittaya School. The English competency of the students was lower than the school criterion. The O-NET results of grade six students in the academic years 2015-2020 were lower than Thai national scores. The researcher observed that the majority of students had low English proficiency because students had difficulties in improving their ability to comprehend the texts and make inferences which are crucial things of reading comprehension. There are three main factors that make students unsuccessful in improving their reading comprehension ability. First, students cannot recognize words' meanings and lack vocabulary knowledge. Second, students lack the motivation to learn because students are from rural areas, and they use the E-Sarn dialects in their families. Students think English is difficult and far from their life. Finally, some students live with their grandparents who have a low level of English proficiency. They cannot support students in learning English.

As mentioned above, the researcher believes that all these problems will be resolved if teachers exploit reading comprehension instruction properly. The researcher has studied previous studies and found that several researchers mentioned that Brain-based learning (BBL) has many advantages, such as developing academic achievement, retaining knowledge (Eladl & Saad, 2019; Khanthap & Bhiasiri, 2012). Thus, the researcher implemented BBL instruction to improve students' reading ability. This instruction allowed students to improve their whole brain functions through various activities, such as brain gym activities, singing a song, making gestures, gamified, and group work activities.

BBL is a strategy based on the principle of whole-brain processing. This approach involves maximizing learning, whole-brain function, and how the brain learns (Jensen, 2008). This approach rests on the belief that learning begins at birth. Not all students learn in the same way, which means they will construct their knowledge in various learning situations and contexts. (Caine & Caine, 1994; Cain & Crowell, 1999). Many researchers (e.g., Suratreungchai & Thongsorn, 2021; Talungjit, Jaiman & Thammachat, 2019) studied how BBL enhanced students learning. The data revealed that BBL could improve their reading ability for several reasons: for instance, better-created motivation, providing them with a relaxed learning environment, and engaging positive emotions. Furthermore, ElAdl and Saad (2019) and Haghighi (2013) mentioned that an established

learning environment with the BBL principle could improve their knowledge retention, extend their motivation, and keep their memory long-lasting.

Even if BBL has been created for two decades, the idea of using brain functions to enhance students learning is still popular at the elementary level. However, BBL activities sometimes cannot grasp the students' participation for the whole time in this course. According to Malone and Lepper (1987), there are three main components to create instinct motivation and grasp the students' participation, including challenges, curiosity, control, and fantasy. Gamification also has all these important components like Malone and Lepper mentioned. Thus, to fill this gap, the researcher also integrated gamification into the BBL teaching steps. The use of gamification serves as a tool to motivate students on learning.

Gamification is an application of game design elements that would nurture and drive the learning procedures to create an engagement of learning and help generate good behavioral and learning outcomes (Hamari, Koivisto, Sarsa, 2014; Kapp, 2012). Moreover, game elements can boot the work environment more attractive, gratifying, and applicable than other techniques. Several studies (e.g., Sawaengkit, Phongploenpis & Mahimuang, 2020; Tragoonkasemsook, 2016) indicated that gamification could develop students' attitudes toward learning English because this approach can motivate, engage, and reinforce students' learning. Moreover, several studies (e.g., Castro & Kimhachandra, 2019; Bhagiar & Leo, 2018) indicate that students had more achievements after using the gamification approach than the traditional style.

According to the previous studies mentioned above, both BBL and gamification have a positive impact on ESL students. Therefore, the integration of gamification and BBL instruction is a promising tool to enhance reading comprehension as well as foster language learning motivation. Numerous researchers investigated the positive impact of BBL on the elementary level (Khamkaew, Chantarachit & Phoklin, 2017; McNamee, 2011). Additionally, some researchers also implemented BBL with a secondary level of education (Talungjit, Thammachat & Jaiman, 2019). Furthermore, other studies have been conducted studies using BBL with other techniques to improve reading comprehension. For example, Boonamee (2020), Khieosawat, Thongsorn, and Suratreungcha. (2021) studied BBL with scaffolding in improving students' reading

comprehension. Chanthalat et al. (2020) studied BBL with a mind map to develop reading comprehension skill. Apart from the BBL, gamification is an effective tool to enhance students learning English. Some researchers (e.g., Chen et al., 2020; Castro, 2019; Ling, 2018; Kapp, 2012) mentioned that the use of gamification could improve listening skill, reading skill, and vocabulary knowledge as well as foster motivation because the students will be motivated by the various tasks that students have to complete in each stage of gamification. Students will learn and retain their knowledge by getting rapid feedback and redoing tasks in the game. However, there are relatively few studies on gamification and BBL that concentrate on improving students reading comprehension in Thailand. None to date has been conducted on this area further. Thus, the researcher attempted to investigate how does gamification within BBL be able to improve reading comprehension. Then, the present study focused on three main research questions as follows:

- 1) To what extent does the gamification within BBL instruction help students learn reading comprehension effectively?
- 2) What are the students' opinions regarding their attitudes towards using Gamification within BBL in improving their reading comprehension?
- 3) Is there a relationship between the student's reading comprehension ability and the student's opinions toward gamification within BBL instruction?

Research design

1.Participants

The participants of this study were 24 of grade 5 students who enrolled in the English 5 course at Bann Kok Mai Ngam Songserm Wittaya School. The researcher employed purposive sampling to select these participants. The selection of these participants had three main reasons. First, grade 5 students were at the appropriate level to improve reading comprehension. Second, grade five students had low reading comprehension levels based on the previous English achievement test from the English 4 course. Meanwhile, grade five students face problems with reading comprehension. Moreover, the students need to take the O-NET English test next semester.

2 .Data collection

2.1 Before the implementation of using gamification within BBL instruction.

1) The English reading comprehension pre-test

The English reading comprehension pre-test was developed to test the reading comprehension ability of grade 5 students before using this intervention. The test was administered before using the intervention, and it took approximately 1 hour. The score of the test indicated the reading comprehension ability before using the intervention.

2.2 After the implementation of using gamification within BBL instruction.

1) English reading comprehension post-test

The English reading comprehension post-test was implemented after using this intervention. It consists of the same questions and passages in the pre-test. The English reading comprehension pre-and post-test scores were compared using the relative gain scores to analyze the student's progression on developing reading comprehension.

2) The semi-structured interview

The researcher volunteered 12 students to conduct the semi-interview at the end of this course. The interview lasted approximately 20 minutes.

3) The students' opinions questionnaire

The researcher employed the questionnaire to the 24 participants at the end of this course to examine the students' opinions and scores toward using gamification within BBL instruction. The student spent 15 minutes to complete the questionnaire.

3.Procedures

The research procedures consist of two phases which are constructing the research instruments and implementing gamification within BBL instruction as follows.

In constructing the research instruments phase, the researcher studied the theoretical, literature to create the research framework of this study and construct the research instruments. After that, the researcher sent the research instruments to experts, and advisors to validate instruments. Then, implementing of the gamification within BBL instruction phase, the researcher employed the pretest. After that, students studied reading comprehension with six lesson plans. Then, the researcher employed the post-test to examine the student's reading ability after using this intervention. Finally, the researcher implemented the students' opinions questionnaire, and the semi-structured interview to elicit their opinions toward this intervention. The quantitative data were

analyzed using descriptive statistics, and the relative gains scores. For the qualitative data, the researcher utilized thematic coding by analyzing the keywords and describing the students' opinions toward gamification within BBL.

The results of this study

1.Results of the gamification within BBL instruction to help develop students' reading comprehension.

To explore the effect of gamification within BBL instruction on developing grade 5 students' reading comprehension. The relative gain scores were used to analyze the students' progression as Table 1 below.

Table 1 The results of the pre-test and post-test English reading comprehension

The Pre-test scores(X_1)	The Post-scores (X_2)	Different scores ($X_2 - X_1$)	The relative gain scores $RG = \frac{100(x_2 - x_1)}{Y - x_1}$	Results
11.17	23.38	12.21	42.93	Moderate progression

Table 1 shows obviously that the students' post-test mean scores are higher than the students' pretest mean scores. The mean scores of reading comprehension increased from 11.17 before the intervention to 23.38 after the intervention. The average progression gain scores were 42.93, indicating that students had moderate progression.

Table 2 below reveals that 33.33 % of 24 students got relative gains scores above 51 %, indicating that students make high progress with reading comprehension. While 66.67% of 24 students got relative gains scores above 26%, indicating that students make moderate progress with reading comprehension.

Table 2 The progression level of English reading comprehension.

The relative gain scores	The progression level	Amount	The percentage
76 % - 100 %	Very high	-	-
51 % - 75 %	High	8	33.33
26 % -50 %	Moderate	16	66.67
0.1 – 25 %	Low	-	-

2.Results of the students' opinions regarding their attitudes towards using Gamification within BBL in improving their reading comprehension.

2.1 Quantitative data

The researcher analyzed the students' opinions from the questionnaire in four dimensions, including course content, course activities, course materials, and the usefulness of the course. Table 3 reveals that the overall mean score of students' opinions toward this intervention was 3.79 (SD = 0.79), which represents the agreed level that the students have positive opinions toward course content, course materials, and course activities, and the usefulness of the course. The highest students' opinion scores given by the majority of the students were on course activities (4.00), course materials (3.81), the course content (3.69), and the usefulness of the course (3.65) respectively.

Table 3 The overall scores of students' opinions toward the instruction

Dimensions	Mean	S.D.	Meaning
1. course content	3.69	0.74	Agree
2. course materials	3.81	0.69	Agree
3. course activities	4.00	0.88	Strongly Agree
4. the usefulness of the course	3.65	0.84	Agree
Overall	3.79	0.79	Agree

2.2 Qualitative data

The data obtained from the semi-structured interview presented the students' opinions into two main categories as shown in Table 4 below.

Table 4 Summary of the student's opinions toward gamification within BBL instruction

Categories 1	Sub-categories 1
Benefits of using gamification within BBL instruction	- Student's vocabulary knowledge improvement
	- Student's reading comprehension ability improvement
	- Students' engagement
Categories 2	Sub-categories 2
	-Barriers to team collaboration

Challenges of using gamification within BBL instruction	-Poor and slow internet connection
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Benefits of gamification within BBL instruction

1) Student's vocabulary knowledge improvement

All participants commented that this instruction helped them learn new vocabulary. They can identify the meaning of new vocabulary. In addition, they could comprehend the text because they were familiar with the words as one of the participants stated:

“...This instruction helped me to pronounce and identify words better...” P6

2) Student's reading comprehension ability improvement

The participants mentioned that this instruction enhances reading comprehension ability. They enjoyed various activities. All activities helped them comprehend the text as one of the participants stated:

“...I like singing songs, making gestures, and playing Kahoot game. It recalled the details in the story. And I better understand the text...” P9

3) Students' engagement

The interview results also reveal that the participants enjoyed class activities. The activities can engage them to read more. Furthermore, the instruction made the whole class continually active and engaged in doing activities as one student narrated.

“...I am enjoying doing gestures, sing a song. The activities help me learn actively and recognize the new vocabulary...” P4

The challenges of the gamification within BBL instruction

1) Barriers to team collaboration

A minority of participants stated that they had encountered obstacles when collaborating with their teams, as two participants stated:

“...Some classmates didn't participate in work. They often talked with other...” P5

2) Poor and slow internet connection

Few participants reported that They could not access the applications due to unstable internet signals as one participant stated:

“...Sometimes, I couldn't log in the Kahoot due to poor internet signal. P5

3.Results of the test relationship between the student’s reading comprehension and students’ opinions toward using gamification within BBL

Table 5 the correlation between the reading test and students’ opinions questionnaire

Correlations			
		Posttest	Questionnaire
Posttest	Pearson correlation	1	.517**
	Sig. (1-tailed)		.005
	N	24	24
Questionnaire	Pearson correlation	.517**	1
	Sig. (1-tailed)	.005	
	N	24	24
**. Correlation is significant at the 0.01 level (1-tailed)			

According to Table 5, the correlation between the reading comprehension test and students’ opinions questionnaire is 0.517 and having the number of significant at 0.01 indicated that the correlation between the reading comprehension test and the students’ opinions questionnaire is significantly related.

Discussion

1.The effect of the gamification within BBL instruction on improving reading ability.

The analysis of reading comprehension pre-test and post-test results demonstrated that the mean scores of reading comprehension increased from 11.17 before the intervention to 23.38 after the intervention. Additionally, the results also show that 33 % of the students had a high progression on develop their reading ability, whilst 66.67% of students make moderate progression on developing their reading ability. According to all these results, it is obvious that gamification and BBL activities were effective ways to develop their reading comprehension because the researcher designed the activities

based on the principle of BBL. At the beginning of each lesson, the students did brain gyms activities including singing a song and do the gestures. Throughout the brain gym activities, the students were eager to learn. These results are in accordance with Chrision (2002) and Garner (1999) mentioned that movement is an essential key to create higher energy level, maintains students' attention, and encourages the brain to work actively.

The consequently increased score results are consistent with the results by Kohar (2019) who implemented a pre-experimental research to compare the effectiveness of reading comprehension using the BBL model. The result of this study revealed that the difference of two mean scores between pre-test and post-test of reading comprehension was significant, indicating that BBL is effective in improving reading comprehension. Similarly, Khanthap and Bhiasiri, (2012), investigated the reading comprehension ability after using BBL, found that 75% of students passed the test with an average scores of 76% indicating that BBL was able to improve the students' reading comprehension.

Besides the BBL, gamification applications including Kahoot, and Class 123 are major keys in improving the students' reading ability. The results of the posttest and the questionnaire proved that Kahoot and Class 123 were effective gamification applications. Students improved their reading because the students retained their knowledge when they repeatedly read the story to answer the questions in the game. This view corresponded to the study of Ling (2018), who studied the effect of gamification in motivating students to learn. It was found that gamification enhances students to process themselves into a situation that enhances their performance to understand the information The students engaged in learning through repetition and extended practices. Furthermore, the findings also showed that Kahoot and Class 123 increased the student's engagement and motivation to learn. The students more actively participated in reading activities to complete the game stages. Several researchers (Wang & Tahir, 2020; Marsa et al, 2021; Göksün& Gürsoy, 2019; Kaensige & Yohansa, 2018) also supported this finding. For example, Wangs and Tahir (2020), who did documentary research, found that the results of 93 studies confirmed that Kahoot has a positive effect on learning performance. Like Marsa et al (2021), who used an explanatory sequential mixed method design with students of the English Education Program. The findings also revealed that the effect of Kahoot in teaching reading comprehension achievement has a very high impact on

engagement, perception, motivation, and positive attitude. It influenced students' reading comprehension achievement. All these results about the effect of Kahoot in improving the academic achievement which mentions above concur with the results by Göksün and Gürsoy (2019), who investigate the reflections of Kahoot activities that are used as a formative assessment tool based on academic achievement and student engagement in learning, stated that the gamified with Kahoot application had a more positive impact on academic achievement and student engagement when compared to the other groups. Furthermore, Kaensige and Yohansa (2018) implemented the Class Action Research model to investigate the effectiveness of Class 123 on increasing student engagement. The result also reveals that Class 123 can create motivation and increase students' behavioral engagement which affects the students' achievement.

In conclusion, the students develop their reading comprehension because the BBL activates their brain functions to work actively as well as gamification is a promising tool to create the students' engagement and motivation.

2. The students' opinions toward gamification within BBL instruction

The benefits of gamification within BBL instruction

1) Student's vocabulary knowledge improvement

the participants believed that this intervention could enhance their vocabulary. For example, participant 6 mentioned that the gamification within BBL instruction helped them learn new vocabulary and identify the meaning of new vocabulary. The result of the questionnaire also supports this view as the students agreed that gamification and BBL activities promotes them to improve their vocabulary knowledge. All these results align with some researchers (e.g., Castro & Kimhachandra, 2019; Salem, 2017; Lago & Seepho, 2012) who employed gamification or BBL in their teaching. It was found that BBL and gamification can enhance their vocabulary. For example, Castro and Kimhachandra (2019) investigated the impact of gamification on vocabulary learning. The findings indicated that gamification enhances vocabulary learning. On the other hand, Lago and Seepho (2012), who using BBL in retaining their vocabulary knowledge, urged that BBL can also improve and retain their vocabulary. This view is supported by Salem, (2017), who investigated the effectiveness of BBL in retaining vocabulary, also confirmed that BBL is an effective way to consolidate vocabulary recall and retention.

2) Student's reading comprehension ability improvement

Regarding the interview results, several participants mentioned that gamification within BBL instruction can develop their reading comprehension ability because the participants need to practice their reading through various activities and read the text several times to complete the activities as well as this intervention can activate their whole brain functions to work actively. Similarly, the questionnaire result shows that the students agreed that gamification within BBL instruction promotes students to improve their reading skills as the average opinion scores toward the usefulness of the course were 3.42. All these results of this study were consistent with previous studies (e.g., Khieosawat et al., 2021; Chanthalat et al., 2020; Eladl & Saad, 2019), which reported that BBL can improve the student's reading ability. The BBL and gamification can improve their academic achievements by providing them with a relaxing learning environment, enhancing students' ability to process themselves into a situation that enhances their performance to understand the information, and engaging learning through repetition and extended practices. (Hileman, 2006)

3) Students' engagement

The semi-structured interview indicated that participants had a positive attitude toward the gamification within BBL instruction. The gamification within BBL instruction provides a relax learning environment. Interviewees enjoyed with the class activities including singing songs, making a gesture, Kahoot games, and Class 123. Similarly, the questionnaire results reveal that the highest students' opinion scores given by the majority of the students were on course activities. When students feel relaxed, they tend to participate in reading activities. Corresponding to the terms of using BBL instruction, students participate in the lesson under the relax atmosphere because the brain works actively under low pressure (Caine et al., 2009; Christison, 2002; Hileman, 2006).

In addition, the results of this study show that gamification is one of the tools that engage students to learn reading. The students focused on texts to answer questions correctly and get points in the game. These views are supported by Prensky, (2001) who mentioned that the student was motivated by exposure to gaming, visually rich, dynamic

interfaces designed for multitasking, when they played the game. Furthermore, many researchers (e.g., Learspornkulrat, 2021; Sawaengkit et al., 2020; Tragoonkasemsook, 2016) also studied the effect of gamification on motivation and students' behavior. The result showed that gamification could activate good behavior, create motivation, and engage students in learning. When the students play the game, they engage in learning through repetition and practice, which is encouraged by keeping the stage low and minimizing failure (Ling, 2018).

Challenges of the gamification within BBL instruction.

1) Barriers to team collaboration

Regarding the interview results, participants narrated that sometimes their group members intentionally did not participate in group work or discussion. To prevent this limitation, the teacher should ensure that all students participate in group activities. This view is supported by Bruffe (1993) who mentioned that the teacher's ability was to delegate authority and the students' ability to empower authority to one another for their own learning processes.

2) Poor and slow internet connection

The data gathered from semi-structured interviews reveals that internet access is one of the major problems in using gamification. Few interviewees stated that they could not log in to the applications due to an unstable internet signal. This limitation aligns with Phueakphud (2019, cited in Kim et al., 2018), who mentioned that technology and students' level are considerations before using gamification. However, this limitation is less effect on the research results as only a few students could not log in to the application.

3 The correlation between the reading comprehension scores, and the students' opinions scores

The correlation between the reading comprehension scores and the students' opinions scores is 0.517, and having the number of significant at 0.001 indicated that the correlation is significantly related. Meanwhile, the students who have high performance on reading comprehension tend to have positive attitudes toward this intervention,

because when the students have positive attitudes, they tend to participate in activities. Thus, their reading comprehension ability was improved.

Conclusion

This study employed BBL instruction which is ground from Leftwicha's (2012). The researcher uses her approach as the basic framework for all lesson plans which cover five steps including warm up, presentation, practice, evaluation and wrap-up. Gamification is the processes of applying game in non a game context (Kapp,2012). For this study, gamification is served as a tool to engage students to learn reading comprehension. The following is the conclusion of this study.

Based on the results of this study, there was a dramatic difference between reading comprehension ability before and after using this instruction. Subsequently, this instruction is an effective way to improve student's reading ability because of its features while employing gamification within BBL instruction. At the beginning of each lesson, students were assigned to do various activities such as sing a song and make a gesture to activate their whole brain functions to work actively. In addition, students read the text several times to find specific information and the main idea of text throughout the group activities. BBL also provides relax environment that enhance students learn English. These features were strong enough to lead student's reading comprehension ability and their vocabulary knowledge to be improve. Furthermore, this instruction also provided gamification which aids students to be engage to the texts, and class activities.

Regarding questionnaire results show that students have positive opinions toward course content, course materials, course activities, and the usefulness of this course. In addition, the interview results reveal that this instruction is an effective approach in terms of more engaging students to read and do class activities, and improving reading comprehension ability, and vocabulary knowledge. However, the data also shows that the group collaboration barrier and the poor internet connection were challenges of using this instruction. Students get bored when they cannot log in to the games and their friends don't participate in a group activity. Therefore, the effective way to use

gamification within BBL instruction, the teacher must ensure that all students participate in games and group assignments.

Suggestions to use the results of this research.

- 1) The teacher should provide a variety of materials, such as flashcards, PowerPoint, and worksheets. The materials should be colorful, and interesting.
- 2) The devices and internet access should be available for all students.

Recommendations for Future Studies

- 1) For future studies, this instruction should be employed to improve other field subjects or levels to investigate the learning outcome of this intervention.
- 2) For future research should be focused on the comparative study of using gamification with alternative activities including group activities, and individual activities.
- 3) For future research should be conducted using gamification within BBL in different learning environments to investigate the students' achievement.

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