Full paper

Sains Humanika

Student's Engagement, Motivation and Achievement using Gamified Assessment (GA) in learning Mathematics

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Article history: Received: 31 January 2022 Received in revised form:30 June 2022 Accepted: 31 August 2022 Published online: 25 December 2022

Abstract

The new teaching reform has ushered in new learning strategies, especially online teaching during the epidemic. The new educational concept virtually encourages teachers to use various innovative assessments such as gamified assessments to guide and attract students to learn independently to achieve teaching objectives. This allows Web 2.0 applications to provide an opportunity for students to integrate into this innovative learning environment. However, no concrete research has been conducted to investigate the impacts of gamified assessment (GA) on the engagement, motivation, and achievement of primary school students. This study uses a quantitative research design, a pre-experimental study of a one-group pre and post-test method to investigate students' engagement, motivation, and achievement using gamified assessment in learning Mathematics. The data collection process took about 4 weeks and a total of 30 students were selected as the sample of this research. The sample of this study consisted of Year 3 students at one of the Chinese vernacular schools in the northern district of Johor. The students were selected through the purposive sampling technique. Data were obtained through several instruments such as questionnaires and pre and post-test. Data were analyzed using descriptive analysis and inferential analysis which are Pearson Correlation and paired sample t-test using the SPSS software. The result of this study shows that 83% of students agreed that the use of Quizizz as GA tool in Mathematics learning can improve their engagement and achievement in learning. The result also shows that, 83% of students believe that using Quizizz can inspire and stimulate their motivation in learning. Furthermore, study shows that there is a moderately positive correlation between motivation and achievement ($r = .328$, $n = 30$, $p = .077$). Finally, the study also demonstrates that there was a significant difference in the effect of gamified assessment on primary students' engagement, motivation, and achievement in learning Mathematics. ($t=-13.001$, $df =29$, $p<0.05$). Overall, this study found that the use of gamified assessment (GA) can affect students' engagement, motivation, and achievement in learning mathematics.

Keywords: Engagement, Motivation, Achievement, Gamified Assessment, Mathematics

1.0 INTRODUCTION

The spread of COVID-19 has led the challenge to educational institutions worldwide. The outbreak of the epidemic has increased the difficulty of teaching and delayed the progress of students' learning. Especially when it comes to learning mathematics, because learning mathematics requires constant practice, deduction, and application, teachers must ensure that students have a good learning environment, habits, and attitude to learn to improve their ability to learn mathematics (Simpson, 2016). Changes in various learning systems such as distance education or online learning, e-learning, distance education, correspondence education, off-campus learning, flexible learning, and massive online open courses (MOOCs) have forced schools to follow the pace of technology to change education methods (Rasmitadila et al., 2020). Due to this pandemic, technology is one of the most critical tools to support distance learning. As recent studies have shown (Mohalik & Sahoo, 2020), online learning is the only option left out in the hands of academicians to carry out academic activities, which is in line with the precautionary measures of COVID-19.

The Malaysian Ministry of Education has drawn up the latest "Education Blueprint" (2013-2025), focusing on technology-based teaching, such as information, communication and technology (ICT) in education into the daily teaching and learning process. Teachers use gamified teaching tools and gamified assessments to replace rigid traditional teaching, which first stimulates students' motivation and then continue to conduct gamified assessments to maintain students' academic performance, continuous learning performance, and freshness. Gamified assessment can continuously improve students' attention, desire for knowledge, desire for learning, and desire for self-breakthrough performance (Shuai, 2020). From another perspective, using technology can enhance the fun of learning, which can also virtually reduce the pressure and anxiety of learners on various tests or assessments (Pitoyo et al., 2020).

Among all online platforms, Quizizz will be the focus of this study. It is believed to be a highly effective tool to support students' self-assessment, particularly when learning Mathematics. Formative assessment plays an essential role in the continuous development of the learning to develop its competencies and skills and continue supporting them in this growth process.

Student engagement is a problem facing education. Recent studies on student classroom engagement define it as a multi-dimensional structure related to school success (Barghaus et al., 2017). In the opinion of most students, mathematics is one of the most challenging subjects because students must memorize mathematical formulas, answer according to examples and equations, and provide uninteresting

course content (Udjaja et al., 2018). Gamification is a significant potential in effectively increasing learners' engagement (Marx et al., 2016; Raju et al., 2021), improving academic achievement and promoting cognitive ability development. Interactive games can effectively attract learners' attention and influence their emotions and behaviors.

This research is based on the theoretical framework shown in Figure 1. This theoretical framework guided the research to determine the theories involved in the online implementation of the research. Ryan & Deci (2017) defined Self-Determination Theory (SDT), which is a method that uses traditional empirical methods to study human motivation and personality while adopting an organic theory. This theory emphasizes the importance of the internal resources of human evolution for the development and development of personality and self-discipline of behavior.

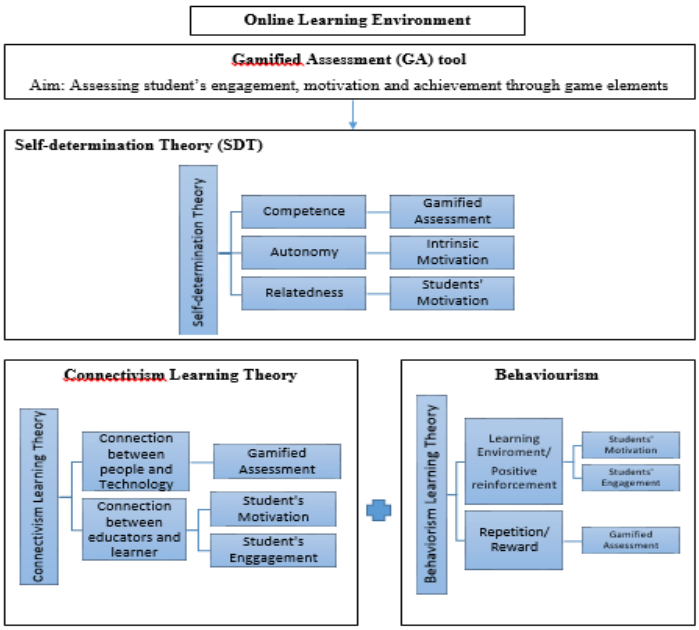

Figure 1 Theoretical Framework

2.0 LITERATURE REVIEW

According to Darmawan et al., (2020) Quizizz is the most suitable digital application for e- assessment and practice. The use of the e-assessment application can encourage students and teachers to be sensitive to technology. Zhao (2019) also mentions that Quizizz is a game-based educational application that supports multiplayer activities that makes the classroom more engaging.

In addition to ensuring complete teaching, teachers must also use technological tools that keep pace with the times, such as gamification tools, to eliminate students' anxiety about learning mathematics and to input mathematical concepts and knowledge applications. Whether in online learning or classroom learning, researchs have shown that gamified assessment can effectively improve student participation, learning motivation (Alsawaier, 2018; Alshammari, 2020; Antonaci et al., 2019; Legaki et al., 2020; Lestari, 2019; Lopes et al., 2019; Morillas Barrio et al., 2016; Papp, 2017; Raju et al., 2021; Razali et al., 2020; Rohaila & Fariza, 2017; Setiyani et al., 2020; Watson-Huggins, 2018; Zuhriyah & Pratolo, 2020). Interestingly, researchers agreed that gamified assessment efficiently improves mathematics performance (Watson-Huggins, 2018). For example, gamification tools such as Quizizz, Kahoot, Duoligo, EngageBay and AgileCRM are suitable methods for creating gamified assessments to enhance student engagement (Darmawan et al., 2020; Hamzah et al., 2019; Handoko et al., 2021; Hawari et al., 2020; Meng et al., 2019; Norzimah & Norhanisha, 2019; Smiderle et al., 2020; Türkmen & Soybaş, 2019), enhance learning motivation (Akhtar et al., 2019; Amalia, 2020; Hamzah et al., 2019; Khalid, 2020; Mason et al., 2020; Norzimah & Norhanisha, 2019; Permana & Permatawati, 2020; Razali et al., 2020) and improve academic performance (Darmawan et al., 2020; Norzimah & Norhanisha, 2019; Rahayu & Purnawarman, 2019; Setiyani et al., 2020; Sin et al., 2020; Türkmen & Soybaş, 2019).

The COVID-19 pandemic led educators to online education readiness (Lapada et al., 2020). In particular, gamified teaching brings freshness to boring teaching and stimulates students to learn spontaneously. Darmawan et al., (2020) said that Quizizz should be used as an evaluation tool, especially during the epidemic, as it has formed a significant effect. They stated that Quizizz is an excellent and practical software application provided during this epidemic.

Furthermore, Junior (2020) stated that teacher playing an important role to integrate more up-to-date strategies in the classroom, to give a more practical approach to the content taught, and to shift the individuals' minds from being merely information consumers to become content producers, instead. According to Zabala, (2018), gamification is more effective in achieving optimal learning compared to using traditional curriculum or teaching learning process methods. Hamzah et al., (2019) revealed that Interactive game teaching has a positive impact on students' interest in learning mathematics. They can also explore basic concepts of mathematics in the game.

Research on gamification requires strong theoretical connections to bridge the gap between theory and practice. The Self-Determination Theory (SDT) (Ryan & Deci, 2017), Connectivism Learning Theory (Keller, 2019) and Behaviourism (Antonaci et al., 2019) was used to guide in this research. The researchers investigated the studied of engagement, motivation and achievement in mathematics education. The theory of self-determination (SDT) states that people are motivated by three innate and universal

psychological needs for growth and change. This theory suggests that people can become self-determined when their needs for competence, connection, and autonomy are fulfilled. Connectivism is a learning theory created by George Siemens in 2004. It can also be understood as an educational theory or viewpoint or a global strategy. Behaviorism, cognitivism, and constructivism are the three broad learning theories most used in the creation of teaching environments. Gamification has a strong connection with human psychology, specifically behaviorism. Behaviorists believe that learning is the link between stimulus and response. Behaviorists basically believe that behavior is a learner's response to environmental stimuli that the environment is a stimulus, and the accompanying motivational behavior is a response, and all behaviors can be learned.

■3.0 METHODOLOGY

In this research, the researcher used a quantitative research design, a one group pre-experimental, pre and post-test design. The sample of this study consisted of Year 3 students at one of the Chinese vernacular schools in northern district of Johor. The students were selected through purposive sample technique. Figure 2 shows a research design that was conducted in this study.

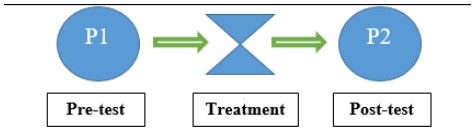

Figure 2 Pre-experimental one group research design

Table 1 shows data collection and analysis technique according to the research objectives. The questionnaire consists of 8 questions. This questionnaire is bilingual (Chinese and English language). While the pre and post-test assessments consists of 20 questions.

Table 1 Data collection and analysis technique

Research Objectives	Instruments	Data Analysis
To identify student's engagement in learning Mathematics after undergoing gamified assessment (GA) through Quizziz.	Questionnaire (Part B: Engagement Survey)	Descriptive analysis Mean, Percentage and Standard Deviation
To identify student's motivation in learning Mathematics after undergoing gamified assessment (GA) through Quizziz.	Questionnaire (Part C: Motivation Survey)	Descriptive analysis Mean, Percentage and Standard Deviation
To identify the relationship between student's motivation and student's achievement after undergoing gamified assessment (GA) through Quizziz.	Motivation Survey (adapted from Rouse, 2013; Watson-Huggins, 2018; Wen, 2018) Post-Test Assessment	Pearson Correlation
To investigate the effect of gamified assessment (GA) on primary student's achievement in Mathematics.	Pre and Post-Test Assessment (Gamified Assessment)	Normality test Paired sample t-test

Figure 3 show the research framework guidelines for students in using gamified assessment (GA) tool (Quizizz): the effect of GA on Grade 3 student's engagement, motivation and achievement in learning Mathematics. A pre and post-performance test will be carried out to compare the students' level of achievement before and after the study. Besides, each time after the pre-test and post-test of Mathematics, researcher will give a set of questionnaire form to investigate students' motivational level and their perception of the tests.

<table>
<tr><td>Week 1
Development of Instruments</td><td>Instrument selection
Preliminary investigations
Pilot study
Establish pre-test and post-test, 2 set of questionnaires</td></tr>
<tr><td>Week 2-5
Treatment</td><td>
<table>
<tr><td colspan="3">Using Quizizz for a treatment Group, N= 30 students.</td></tr>
<tr><td>Time</td><td>Title of learning</td><td>Number of questions</td></tr>
<tr><td>Week 2</td><td>Number up to 10 000</td><td>10 questions</td></tr>
<tr><td>Week 3</td><td>Number up to 10 000</td><td>10 questions</td></tr>
<tr><td>Week 4</td><td>Addition and Subtraction</td><td>10 questions</td></tr>
<tr><td>Week 5</td><td>Multiplication and Division</td><td>10 questions</td></tr>
</table>
</td></tr>
<tr><td>Week 6
Data collection
Data analysis</td><td>Quantitative data collection
Descriptive statistics
Inferential statistics (Pearson correlation and Paired sample t-test)</td></tr>
</table>

Figure 3 Research procedure

This pilot study conducted in another third grade of SJK (C) in Segamat district, not in the same class as the subjects. A total of 30 third-grade students were involved in this pilot study. The test of the pilot study is taken from the pre-test and post-test evaluations, and it contains 20 math questions. At the same time, relatively pilot studies will be conducted to ensure the applicability and appropriateness of the instruments used.

The questionnaire, pre-test and post-test are to strengthen the validity of the study. The validity form was created by the researcher and validated by the year three mathematics teacher. In addition, the researcher also requires the lecturer to verify the engagement and motivation questionnaire for actual research objects to ensure that the questions in the questionnaire are consistent with the goals of this research. To test the reliability of this research, randomly select 30 third-grade students from a nearby Chinese elementary school in the research school for pre-test and post-test. The analysis of this instrument showed high consistency which is the alpha of Cronbach's 0.84. According to "The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education", the alpha value of 0.84-0.90 is reliable (Taber, 2018).

■4.0 RESULTS

Student's Engagement Following the Use of Gamified Assessment (GA) in Mathematics Learning

The questionnaire is divided into three sections: Part A, which contains demographic information, Part B, which contains items that assess student engagement, and Part C, which contains items that assess student's motivation. The outcomes acquired from the data analysis are presented below.

Part A: Demographic Information

Table 2 displays the data on the demographic background of the students.

Table 2 The data of demographic background of the students

		Number of Sample	Percentage (%)
Gender	Male	15	50
	Female	15	50
Total		30	100
Race	Bumiputera	1	3.33
	Chinese	27	90
	Indian	1	3.33
	Others	1	3.33
Total		30	100

Based on the demographic information provided above, the participants in the study included 15 males (50%) and 15 females (50%) who were all Year 3 students at one of the Chinese vernacular schools in northern district of Johor. Chinese students accounted for a maximum of 27, or 90 percent of the total number of students in the study, while Bumiputera, Indians, and other races each accounted for one for each race.

Part B: Questionnaire Analysis of Student Engagement in the Use of GA Using Quizizz in Mathematics Learning

The purpose of Part B (refer to Appendix A) is to determine students' engagement in learning Mathematics after undergoing gamified assessment (GA) via Quizziz. The teacher explains beforehand to ensure that students understand the questions in the questionnaire, and 8 bilingual items are used to assess students' engagement. Students respond to this questionnaire by selecting "Yes" or "No." In the table 3 below, the results of the data analysis were sorted by percentage.

Table 3 The outcome of a questionnaire relating to student engagement in the use of GA using Quizizz in mathematics learning.

No	Items	Yes	No
1	I enjoyed doing Maths activities using Quizizz.	30 (100%)	0 (0%)
2	The activities in Quizizz do help me to achieve something, which gives me a sense of accomplishment.	25 (83.33%)	5 (16.67%)
3	The activities in Quizizz challenging me to learn.	26 (86.67%)	4 (13.33%)
4	The activities I do in Quizizz reflect my understanding of Maths.	25 (83.33%)	5 (16.67%)
5	I tried my best to answer all Maths questions in Quizizz.	30 (100%)	0 (0%)
6	I look forward to learning mathematics with my classmates using Quizizz.	28 (93.33%)	2 (6.67%)
7	I like the game element in Quizizz.	30 (100%)	0 (0%)
8	Question in Quizizz makes me more enthusiastic about participating in math courses.	27 (90%)	3 (10%)

According to the results of table 3, 30 students responded to the questionnaire regarding student engagement in the use of GA using Quizizz in learning mathematics. For the first question, it is necessary to investigate students' use of Quizizz to enjoy relevant mathematical activities. One hundred percent of students, or thirty students, stated that they enjoyed doing math questions on Quizizz.

The second question is to determine whether the Quizizz activities assisted students in achieving some goals, thereby increasing their engagement in mathematics learning. 83.33 percent of students, or 25 students, stated that using Quizizz as an assessment gave them a sense of accomplishment.

In response to the third question, 86.67 percent of students, or 26 students, believed that Quizizz activities challenged their learning, while 13.33 percent, or 4 students, denied that Quizizz activities enabled them to actively learn. The fourth question is to investigate the Quizizz activities that can demonstrate students' understanding of mathematics and answer questions. According to the data, 83.33 percent of students, or 25 students, believe that Quizizz's assessment can help students answer questions about their mathematical understanding, while 16.67 percent, or 5 students, disagree.

In the fifth question, all the students said that they tried their best to answer all Maths questions in Quizizz. Compared with the sixth question in the engagement questionnaire, 93.33% of students or 28 students chose to look forward to meeting their classmates to use Quizizz together for maths assessment. However, 6.67 percent of students, or 2 students, disagreed with using Quizizz to learn mathematics with their classmates.

Furthermore, in the seventh question, 100% of the students, or 30 students, stated that they like the elements in Quizizz while using it as a gamified assessment tool. Finally, 90% of students (27 students) agreed that the Quizizz question makes them more enthusiastic about engaging in math courses, while 10% of students (3 students) disagreed.

In summary, this engagement questionnaire proves that more than 83 percent% of students or 25 out of 30 students said agreed that using Quizizz as GA an assessment tool in math learning can improve their engagement in mathematics learning.

Student Motivation Following the Use of Gamified Assessment (GA) in Mathematics Learning

Part C: Questionnaire Analysis on Student Motivation to Use GA Using Quizizz in Mathematics Learning

Part C contain 8 bilingual questions in the questionnaire. Students answer this questionnaire by selecting "Yes" and "No". The result data analysis is sorted by percentage as shown in the table 4 below.

Table 4 The results of a questionnaire on student motivation to use GA using Quizizz in mathematics learning.

No	Items	Yes	No
1	I felt confidence to do Maths questions using Quizizz.	26 (86.67%)	4 (13.33%)
2	Even though the assessment in Quizizz cannot guarantee a good grade, it does improve my math grades.	25 (83.33%)	5 (16.67%)
3	I prefer to use this Quizizz while studying maths.	28 (93.33%)	2 (6.67%)
4	I can get better results in this Mathematics assessments using Quizizz.	27 (90%)	3 (10%)
5	The design of the Mathematics assessment in Quizizz make me felt satisfied.	30 (100%)	0 (0%)
6	I feel interested when doing Mathematics assessment using Quizizz.	30 (100%)	0 (0%)
7	I feel motivated when using Quizizz to solve math problems on my own.	27 (90%)	3 (10%)
8	I have confidence when using Quizizz to solve math problems.	28 (93.33%)	2 (6.67%)

30 students responded to the questionnaire related to student motivation in the use of GA using Quizizz in learning mathematics. According to the findings of question 1, 86.67 percent of students (26 students) felt confident in doing Maths questions with Quizizz, while 13.33 percent of students (4 students) were unsure.

The second question is to investigate whether students agree that although the mathematics assessment produced by Quizizz does not guarantee a good result, it does improve students' math grades. 83.33% of students or 25 students agreed with this point of view, only a small number of 16.67% of students (5 students) disagreed with this point of view. For third question, 93.33% of students (28 students) claimed that Quizizz gave them a motivation and they prefer to use this Quizizz while studying maths. However, 6.67% of students (2 students) disagree with this point of view.

The fourth question is to investigate whether students can achieve better results after passing Quizizz's gamified assessment of mathematics. 27% of students (27 students) indicated that their math scores have improved, and 10% (3 students) of students disagree with this view. Refer to the data of fifth question, students were 100% agreed that the design of the Mathematics assessment in Quizizz make them felt satisfied. On the other hand, the data of sixth question shows that 100% of students (30 students) also feel interested when doing Mathematics assessment using Quizizz.

The seventh question survey is about whether students feel motivated when solving math problems by themselves. Up to 90% of students or 27 students believe that they use Quizizz to conduct mathematics gamification assessments to generate motivation for learning mathematics mean while 10% of students or 3 students denied this point of view. Lastly, 93.33% of students or 28 students claimed that they have confidence to solve math problems in the use of gamified assessment using Quizizz. Only 2 students were not confidence to solve math problem through the process of using Quizizz. In summary, this motivation questionnaire demonstrates that more than 83% of students or 25 students believe that using Quizizz as GA in mathematics learning can inspire and stimulate their motivation and achievement in math learning.

The Relationship between Student's Motivation and Student's Achievement after Undergoing Gamified Assessment (GA) through Quizizz

To understand the relationship between student's motivation and student's achievement after undergoing GA through Quizizz, the researcher had conducted Pearson Correlation analysis. The data involved are student's motivation score and post-test score.

Table 5 Analysis of relationship between student's motivation and student's achievement after undergoing GA through Quizizz

		Achievement
Motivation	Pearson Correlation	.328
	Sig. (2-tailed)	.077
	N	30

correlation is significant at the 0.01 level (2-tailed)**

Based on table 5, there was a moderate, positive correlation between motivation and achievement, but since the p-value is bigger than a significance level (0.01), the study fails to reject the null hypothesis. Hence, there is not a significant moderately positive correlation between motivation and achievement ($r = .328$, $n = 30$, $p = .077$).

The Effect of Gamified Assessment (GA) on Primary Student's Achievement in Learning Mathematics

This part is to compare the scores of students before and after treatment to report the results. The pre-test is conducted in the traditional handwriting method and the post test is to use Quizizz to test mathematics as a gamified assessment online. Each assessment contains 20 questions, and the assessment include the four basic arithmetic questions in the third-grade math subject (Table 6).

The pre-test and post-test in this section are used to test and validate the fourth objective of this research, which is to investigate the effect of gamified assessment (GA) on primary students' achievement in learning Mathematics.

The pre-test was conducted before the treatment of using Quizizz as gamified assessment and the post-test was conducted after the 4 weeks of treatment of using Quizizz as gamified assessment. According to the procedure of collecting data analysis for pre and post-test, the result of pre and post-test were collected, and the inferential statistic of normality test and paired sample t-test was used to investigate if there any significant difference in student's achievement performance when using the GA among primary students.

Table 6 Students performances, pre and post test scores and scores differences

Student	**Pre-Test Score**	**Post-Test Score**	**Differences of result between pre and post test**
1	100	100	0
2	75	100	25
3	80	95	15
4	70	85	15
5	65	95	30
6	75	100	25
7	60	90	30
8	65	85	20
9	65	80	15
10	55	80	25
11	55	75	20
12	40	70	30
13	35	70	35
14	40	80	40
15	35	70	35
16	40	75	35
17	30	75	45
18	25	60	35
19	15	70	55
20	15	65	50
21	10	65	55
22	5	55	50
23	5	55	50
24	5	60	55
25	5	50	45
26	5	60	55
27	5	65	60
28	5	50	45
29	5	55	50
30	5	55	50

The researcher had also addressed the minimum and maximum scores, the mean and standard deviation gained by the students in pre and post-test. The results are displayed in Table 7.

Table 7 Descriptive analysis of student's maximum and minimum scores, means and standard deviation in pre-test and post-test

	N	Mean	Standard Deviation	Minimum	Maximum
Pre-Test	30	7.30	5.808	1	20
Post-Test	30	14.6	3.403	10	20

The researcher had used the result from Shapiro-Wilk test to measure the normality of the data. Table 8 demonstrates the normality test result for pre and post-test. The significance value of Shapiro-Wilk normality test for pre-test is 0.005. The value is lower than alpha level, which is 0.05, thus the null hypothesis is rejected means the data for pre-test scores are not normally distributed. However, the value

of Shapiro-Wilk normality test for post-test is 0.94. The value is higher than alpha level, which is 0.05, thus it fails to reject the null hypothesis and it means that the data for post-test scores are normally distributed.

Table 8 The normality test of pre-test and post-test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.170	30	.026	.890	30	.005
Post-test	.110	30	.200*	.941	30	.094

Since the data on the pre-test is not normally distributed, the researcher once again calculated the normality test based on the score's differences. Therefore, the result is presented in Table 9.

Table 9 The normality test of score difference

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Score Difference	.143	30	.118	.947	30	.142

Table 8 demonstrates the normality test result for score differences. The significance value of Shapiro-Wilk normality test for score difference is 0.142. The value is higher than alpha level, which is 0.05, thus fails to reject null hypothesis and it means the data for scores differences are normally distributed. Hence, the paired sample T-test will be used to analyze the pre-test and post-test score as presented in Table 10.

Table 10 Descriptive analysis of pre-test and post-test scores

Paired Samples Statistics				
	Mean	N	Std. Deviation	Std. Error Mean
Pre_Test	36.50	30	29.041	5.302
Post_Test	73.00	30	15.514	2.832

Based on Table 10, the mean value of pre-test is 36.50, the standard deviation is 2.041 and the standard error mean is 5.302. Meanwhile, the mean value of post-test is 73.00, undoubtedly higher than the mean value for pre-test. Table 11 shows the result of paired sample t-test for pre and post-test assessment. The results revealed that the Sig. (p-value) is .000, which is less than 0.05. This shows that there was a statistically significant difference between the mean of student's pre and post-test scores. As a conclusion, the result showed that GA using Quizziz does have effect on primary student's achievement in learning Mathematics.

Table 11 The paired samples test of pre and post-test

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2tailed)
Pair1	PreTest Post Test	-36.500	15.377	2.808	-42.242	-30.758	-13.001	29	.000

■5.0 DISCUSSION

The main purpose of this research is to explore whether the use of gamification tools as an assessment can improve students' engagement and motivation in learning mathematics, thereby affecting students' mathematics achievement. In this study, a questionnaire was used to investigate the engagement and motivation of students in using gamified assessment (GA) which is Quizziz. There are 30 students participating in this research. Furthermore, this study also investigates the relationship between students' motivation and their achievement in learning Mathematics. Finally, the results of pre-test and post-test were analyzed to prove the impact of GA on students' mathematics learning achievement.

From the traditional classroom teaching method to the current online teaching mode, student engagement and motivation have always been an important factor in the teaching process. Recently, more and more classes have been transferred to the Internet, which makes student participation more difficult than before (Raju et al., 2021). However, there is a significant change on students' engagement in learning mathematics after the use of gamified assessment tools.

Engaging students in learning is an important part of the classroom teaching process (Meng et al., 2019). Based on Table 2 in terms of student's engagement, most of the students enjoyed doing Maths activities using Quizizz. The result is consistent with the previous study conducted by Permana & Permatawati (2020), where students showed positive opinions and attitudes about using Quizizz application in the classroom.

Based on table 4.2, about 83 % of students believed that Quizizz did help them to strive and succeed in learning Mathematics, which gives them a sense of accomplishment. A possible explanation for this might be that students have interest in learning Mathematics via

Quizziz due to its features that promote student's interest in learning. The result corroborates the findings in previous study by Suo Yan & Adam (2018) who reported that courses based on digital games can effectively promote students' attention, interest, creativity, and social relationships.

Additionally, the data from Table 2 shown that, one hundred percent of students, or thirty students, stated that they have tried and do their best to answer all Maths questions provided in Quizizz. In accordance with the present result, previous study has demonstrated that most students are doing their best to complete the task while using Quizizz as the GA (Permana & Permatawati, 2020). Interestingly, result has shown that, the existence of game elements such as leaderboard, timing, interface and graphics are contributing factor that excite students to use Quizziz. The result is in agreement with Norzimah & Norhanisha (2019) which showed that student is interested in game elements found in Quizizz such as learderboard, timing, music, colour, animation, and graphics.

Literature review shows that multiple gamification technologies such as points, badges, leader board, levels, rewards, progress bars, challenges, feedback, and avatars can be used to gamify the learning experience of different university courses (Alomari et al., 2019). The results show the potential of using gamification technology to promote learners' motivation, engagement, and achievement, mainly through the establishment of a comparative learning environment that affects students' learning styles, not necessarily the environment itself (Alomari et al., 2019). This includes creating an interesting statement among students, encouraging them to participate more in the learning task, thereby increasing their interest and motivation (Alomari et al., 2019). Furthermore, students are looking forward to learning mathematics with their classmates using Quizizz. 90% or 27 students are so enthusiastic about using Quizizz as a GA. The attractive and interactive display of application give encouragement to learning mathematics. 93.33% or 28 of them also looking forward to learning mathematics with their classmates using Quizizz. Therefore, it can be concluded that, student engagement is affected by the game elements, the challenge of the activity, and the measure of learning pleasure.

Motivation is a key factor affecting the success of gamification. Before gamification learning environment can be developed, knowledge of human motivation must be addressed (Razali et al., 2020). Overall, the result of student motivation to use GA using Quizizz in mathematics learning can be seen in table 3. In this research, there are positive effects found in the gamification approach towards motivation. According to the result of table 3, 86.67% (26/30 students) of students felt confidence to do Maths questions using Quizizz. The students agreed that Quizizz was more interesting, motivated and fun. This finding is consistent with Basuki & Hidayati (2019) who agreed Quizizz makes students more confident and active in learning and it allows students to complete the test more independently. It is also in line with Setiyani et al. (2020)'s research, that is, using Quizizz makes students more confident in mathematics learning, engagement actively in the classroom, and learning is more student-centered and therefore more effective.

The ranking or comparison of Quizizzs' test reports drives students more motivated to use Quizizz to learn mathematics (Handoko et al., 2021). The test report provides students with information about their test. Students can reflect on their learning progress by analyzing the test report. Students have a hypothesis that the test report is useful for them to understand the weaknesses they need to treat (Pitoyo et al., 2020). Basuki & Hidayati (2019) pointed out that most students like the competitiveness in Quizizz. In this research, 83.33% or 25 students stated that even though the assessment in Quizizz cannot guarantee a good grade, it does improve their math grades. This may result in students learning more competitively.

Therefore, the use of gamification elements and an interactive reaction system in learning fully and effectively influences students to use Quizizz for mathematical evaluation rather than traditional evaluation methods. Students think that these elements help them answer as quickly as possible, and the result is that when they answer wrong and the opposite, they feel annoying and funny memes (Pitoyo et al., 2019). The results of the study indicate that students are satisfied in interested in using Quizziz for Maths assessments. This could be due to the more interesting way of presenting questions in gamified assessments than traditional assessments, the changing forms of questions, and the quality design pictures that can attract the attention of students. The result support data from previous research who found that a meaningful gamification design can make users feel satisfied when using it. Quizizz has game features such as avatars, themed environments, memes and music to bring fun to the learning process (Junior, 2020). In addition, it also allows students to compare their grades with each other by motivating them to study. Another possible explanation for this result may be due to the fact that gamification elements motivate students' learning interests, changing the way they learn, becoming interested in mathematics and having confidence in completing mathematics assessment questions.

Furthermore, student motivation plays an important role in the process of internal conceptual change. This relates to emotional components, critical thinking, learning strategies, and academic performance. When students determine their achievement goals, they will be internally motivated (Cahyani, 2016). Therefore, 97% of students said they felt motivated when they were confident in solving math problems. From the finding of research, students have a clear and positive response to the motivation to use Quizizz for assessment. Especially in the design of Quizizz, it attracts students' attention and increases their frequent use of Quizizz for evaluation. It is also hoped that through this GA, math scores can be improved. Hence, the motivation of students is affected by factors such as game element design, healthy competition, satisfactory usefulness, and student performance. Finally, the results of this research shown that learning motivation is mainly to guide students to change their thinking, behavior, and curiosity to learn. As Ly et al. (2016) stated, motivation is a force or a complex situation, a preparation for a person to move towards a specific goal. Motivation can affect the learning process and learning results. If the learning process is effective, interesting, and useful, and can integrate students' interests, it will increase students' participation in the learning process.

The analyses of relationship between student's motivation and student's achievement can be seen through the result of table 4. This research shows that there is a positive correlation between motivation and achievement. According to the data, the result satisfies the hypothesis, where $r \neq 0$, it showed that there is positive relationship between motivation and student's achievement.

Motivation has been widely accepted by teachers and researchers as one of the key factors affecting the success of learning (Li & Pan, 2009). A lot of research has explored the relationship between the components of student motivation and their achievement, and the analysis shows that there is a relationship between positive (but usually moderate) motivation (measured in different ways, using different theoretical frameworks) and achievement between students (Lee & Stankov, 2018). This shows that the results of this research coincide with other finding about motivations and achievement (Amrai et al., 2011; Faber et al., 2017). In other word, motivation is significantly positively correlated with student achievement (Ly et al., 2016).

Achievement is seen as the result of motivation. A multi-level analysis of Faber et al. (2017)'s research literature reveals a positive impact on student performance and motivation. The student's intensity of use measures supports the impact on student performance and

motivation. In addition, students with excellent grades have a higher achievement effect. At the same time, Garon-Carrier et al. (2016) found that higher achievement in mathematics leads to higher intrinsic motivation in mathematics, which is consistent with SDT and can have multiple explanations. The simplest explanation for this predictive association is that mathematical achievement is self-reinforcing, which leads to an increase in intrinsic motivation.

In short, there is a moderate positive correlation between student's motivation and achievement in learning Mathematics. However, only few research that assessing relation between student's motivation and achievement specifically in Mathematics learning through Quizziz. In addition, student's motivation, and student's achievement after undergoing gamified assessment (GA) through Quizziz is a test with very few related studies in the literature. There can be related research in the future, and it is not limited to using Quizizz or other GA software.

■6.0 CONCLUSION

The results of this research show that gamified assessment tools can have a positive impact on third-grade students' engagement in learning, learning motivation, and achievement in learning mathematics. -This finding is consistent with previous research (De Witte et al., 2015; Faber et al., 2017). Overall, the current research results confirm that Quizizz can have a positive impact on student participation, motivation and achievement. An important contribution of the research is that the results of the study show that Quizizz can also contribute to the achievement of students who are average or excellent regardless of poor achievement. In addition, the results of the research show that more teachers can use Quizizz's feedback to teach students appropriate to their performance. The same applies to students using Quizizz: more intensive use is accompanied by higher levels of mathematical achievement and mathematical motivation and density of engagement in learning. In addition, the study also found that there is more intensive use of Quizizz space. Very likely, if it can promote the use of Quizizz by teachers (for example, through teacher professionalization), then the impact on student achievement will be greater.

Gamified assessment can have a positive impact on students' learning from all angles, especially their achievement, engagement, and motivation in learning activities (Abdul Rahman et al., 2018). Gamified assessment is not considered a panacea. Possible it can be merged without technology and expensive software investment. In this research, it is considered as an effective tool to improve motivation, participation and learning (Papp, 2017).

In summary, this research shows that using Quizizz as a gamified assessment can affect students' engagement in learning, learning motivation and learning achievement. The influence of gamification evaluation is also in line with the current pace of technological learning, especially in the current epidemic situation, it is appropriate to become a learning tool for pre- and post-class evaluation. The convenience of GA can also encourage students to meet the novel learning methods, and teachers can also be good at using teaching materials to assess students' learning abilities and select suitable learning materials. This research has brought a new perspective in the field of education for the use of Quizizz, especially the use of gamified assessment by teachers to enhance students' participation in learning, attract students to study and improve students' mathematics achievement. Teachers and students have a positive attitude towards using Quizizz in the classroom, especially in online teaching.

Through this research, we have noticed that internet connection and learning are beneficial to learners, and that technology is an important part of our lives. Education through the Internet is a necessity especially during the epidemic control period. Various gamified assessment software gradually plays a role in replacing certain parts of traditional teaching, such as presenting classroom questions in interesting and different formats, encouraging students to learn to use gamified learning to reduce learning pressure and consolidate the joy of learning. In addition, gamified assessment also encourages students to have the ability to compete to demonstrate their knowledge and ability in the rankings. In short, the research result is to test whether the assessment of gamification can help teachers solve students' learning problems and allow students to activate their learning through gamification software and keep pace with time, so as not to be marginalized by new technology teaching. This study has three primary limitations. First, this study used a pre-experimental one-group research design. To study the effect of certain intervention it is best to conduct experimental study that has a control group. Thus, it is recommended that future research should conduct the study by using experimental research design. Secondly, the sample size is limited. Only 30 students from primary school students in one of the districts in northern Johor involved in this study. Therefore, the findings cannot be generalized to other group of respondents. It is suggested that future research focus on larger sample size. Finally, the variables examined in this study were limited to engagement, motivation, and performance. Even though research on gamified assessment is expanding, it is suggested that future researchers investigate the types of game elements that students prefer for assessment in learning.

Acknowledgement

Penulis ingin mengucapkan ribuan terima kasih kepada Universiti Teknologi Malaysia (UTM) dan Kementerian Pengajian Tinggi (KPT) atas sokongan dalam penghasilan manuskrip ini. Kajian ini juga berjaya dihasilkan atas sokongan dari Sekolah Pendidikan, Fakulti Sains Sosial dan Kemanusiaan, UTM.

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