Game-Based Learning Model with Baamboozle Media Based on Artificial Intelligence Increases Student Engagement and Learning Outcomes

Mega Ega Wardani[1*], Siti Maryatul Kiptiyah[2] iD

[1,2] Pendidikan Guru Sekolah Dasar, Universitas Negeri Semarang, Semarang, Indonesia
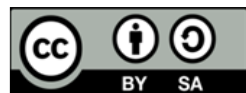
ABSTRAK

Maraknya siswa yang memiliki hasil belajar dan student engagement yang rendah. Rendahnya hasil belajar matematika disebabkan oleh model ataupun media pembelajaran yang tidak sesuai digunakan dalam pembelajaran. Penelitian ini bertujuan untuk menguji keefektifan penggunaan model pembelajaran Game Based Learning dengan berbantuan media Baamboozle terhadap Student Engagement dan hasil belajar siswa. Metode penelitian yang digunakan dalam penelitian ini adalah ekperimen semu dengan desain One Group Pretest Posttest. Total sampel penelitian ini yaitu 27 siswa Kelas III SD. Metode pengumpulan data dalam penelitian ini adalah observasi, angket, dan tes. Instrumen yang digunakan dalam mengumpulkan data yaitu soal tes. Teknik analisis data menggunakan statistik inferensial. Hasil penelitian yaitu hasil posttest menunjukkan bahwa seluruh siswa tuntas KKM. Hasil Uji t didapatkan bahwa terdapat perbedaan Pretest dan Posttest setelah menggunakan model pembelajaran Game Based Learning dengan media Baamboozle. Hasil angket dan observasi yang dilakukan oleh guru menunjukkan bahwa Student Engagement meningkat. Disimpulkan bahwa model pembelajaran Game Based Learning dengan media Baamboozle efektif untuk meningkatkan hasil belajar dan Student Engagement pada muatan matematika.

ABSTRACT

The rise of students who have low learning outcomes and student engagement. Low mathematics learning outcomes are caused by models or learning media that are unsuitable for use in learning. This research aims to test the effectiveness of using the Game-Based Learning learning model with the assistance of Baamboozle media on Student Engagement and student learning outcomes. The research method used in this research is a quasi-experiment with a one-group pre-test and post-test design. The total sample for this research was 27 third-grade elementary school students. Data collection methods in this research are observation, questionnaires, and tests. The instrument used to collect data is test questions. Data analysis techniques use inferential statistics. The research results, namely the post-test results, show that all students completed the KKM. The t-test results showed differences in the pre-test and post-test after using the Game-Based Learning learning model with Baamboozle media. The results of questionnaires and teacher observations show that Student Engagement has increased. It was concluded that the Game-Based Learning learning model using Baamboozle media effectively improved learning outcomes and Student Engagement in mathematics content.

1. INTRODUCTION

Learning outcomes are about students' abilities after learning about the material they are studying. Learning outcomes are influenced by several factors, one of which is the selection of learning strategies and models appropriate to students' needs in the Industrial Revolution era (Inde et al., 2020; Irawan & Sutadji, 2017; Nurhasanah & Sobandi, 2016). Teachers can utilize technology development in the industrial era 4.0 well to improve students' understanding of learning. Educators must be able to provide technology-based and fun learning to improve student learning outcomes (Humida et al., 2022; Koderi et al., 2019; Wulandari et al., 2020). Teachers are expected to be able to utilize information and communication technology in learning so that students can learn easily (Bailey et al., 2022; Lin & Wu, 2016; Panigrahi et al., 2018). In addition, it can be a solution to determining variations in learning strategies and learning evaluations.

Corresponding author
*E-mail addresses: megaa.wardanii@students.unnes.ac.id (Mega Ega Wardani)

Interesting learning activities not only impact increasing learning outcomes but can also increase student engagement in students.

Student engagement can be interpreted as students involved or interested in learning. Student engagement is the time and effort given to learning activities based on the desired results of the school to participate in these activities actively (Stroud, 2014; Susanti, 2020). Student Engagement dimensions are agentic, behavioral, emotional, and cognitive (Bokiev et al., 2018)(Lidiawati & Helsa., 2021; Stroud, 2014; Susanti, 2020). Agentic engagement is a student's contribution to the direction or task they receive in learning. Behavioral engagement is an effort made by students to pay attention to learning activities and diligently complete assignments. Emotional engagement can be described as students' positive emotions in teaching and learning activities with interest and enthusiasm so that they are far from emotions of annoyance and boredom (Afzal & Crawford, 2022; Maroco et al., 2016). Cognitive engagement is the desire to exert effort to understand complex ideas and master difficult skills. However, the current problem is that many students still need higher learning outcomes and student engagement. Previous research findings also confirmed that low mathematics learning outcomes are caused by the inappropriate learning model used in mathematics learning (Amelia Pertiwi Pasaribu & Simatupang, 2020; Hurianti & Tastra, 2018; Kencanawati et al., 2020). Other research also confirms that the need for more innovative learning media impacts low mathematics learning outcomes (Ambarwati, 2019; Asih & Ujianti, 2021; Rasvani & Wulandari, 2021). The low influence of student engagement on student learning outcomes in mathematics subjects occurs due to interest, talent, learning motivation, and mathematical and logical intelligence. In addition, the thing that causes low student learning outcomes is teacher-centered learning activities (Ariana et al., 2018; Suprianingsih & Wulandari, 2020). Suppose teachers continue implementing learning centered on the teacher rather than the students. In that case, it will reduce students' interest and ability to think critically and actively participate in each learning activity (Ni Pt Risma & Abadi, 2020; Widiani et al., 2017).

The observations conducted at SDN Sekaran 01 also found problems in mathematics learning. The results of daily student tests with Minimum Completion Criteria in third grade Mathematics, out of 54 students, 22 (40.74%) completed the Minimum Completion Criteria. In comparison, 32 students (59.26%) still needed to complete the Minimum Completion Criteria. Therefore, the learning outcomes of third-grade Mathematics at SDN Sekaran 01 still need to be higher. Other problems are, first, the learning activities carried out by teachers in class still need to be more varied, and the learning model is conventional and does not use technology. Second, student involvement in learning still needs to be improved in the learning process, so it only focuses on teachers with a dominant role. Third, teachers cannot determine learning media when teaching and can only focus on textbooks and student worksheets. In addition, teachers are accustomed to using media that already exists in schools, so they need help developing or innovating learning media. To overcome these problems, choose the right learning model and media for students. One variation of the learning model that can be used in applying the Game-Based Learning learning model. Games have fun characteristics so that learning will be more popular with students (Harjanta & Herlambang, 2018; Wardani et al., 2017). Previous research findings also stated that games could teach several skills that can be used as alternative media in education (Andari, 2020; Christian, 2021; Helfianti et al., 2021; Hutson et al., 2022). Game-based learning is a model that can build student participation during the learning process (All et al., 2021; Sakdah et al., 2021). Another meaning of game-based learning is that it is a learning model that uses existing applications or web games and is created to help maximize the learning process (Del Moral Pérez et al., 2018; Wardani et al., 2017). In addition, game-based learning can also be interpreted as a game-based learning model that utilizes unique game applications (All et al., 2021; Rahayu & Rukmana, 2022; Sakdah et al., 2021). Game-based learning allows teachers to break away from lecture-based learning and spend more time on exploration and independent thinking (Tokac et al., 2019). In this game-based learning process, a digital game delivers learning material to increase students' knowledge and absorption, especially in learning mathematics (Del Moral Pérez et al., 2018; Widiana, 2022). One of them is Baamboozle. Bamboozle is an edugame model similar to a quiz competition but is online-based, and students do not need to create an account. The advantages of the Baamboozle website include being practical, being used even without creating an account, being flexible because it can be used for online and offline learning, and inviting students to learn and play simultaneously so they do not get bored in learning mathematics (Anggraini et al., 2021; Rahayu & Rukmana, 2022). Edugames Baamboozle is a fun digital game processing quiz. On this platform, various forms of games can influence the learning atmosphere of students.

Previous research findings state that game learning can stimulate students' intellect and improve their understanding (Ibam et al., 2018; Widyatmojo & Muhtadi, 2017). Other research findings also state that by implementing Game-Based Learning in learning, students can increase their interest in learning and understanding elementary school students' concepts (Qohar et al., 2021; Widiana, 2022; Zou et al., 2019). The game-based learning model can influence learning knowledge, multiplication skills of arithmetic operations, and the development of students' interest in mathematics. Using digital game-based learning

models in elementary education is especially useful (Anggraini et al., 2021; Rahayu & Rukmana, 2022). Other research findings state that learning assisted by Baamboozle edugames can improve critical thinking skills and student learning outcomes (Rohman et al., 2023; Setyawan & Panduwinata, 2023).

This study's novelty lies in using Baamboozle as a Game-Based Learning (GBL) platform in mathematics learning for third-grade students, which has yet to be widely studied. In addition to examining learning outcomes, this study also examines the impact of GBL on various dimensions of student engagement, providing a more comprehensive insight into the influence of technology on learning. With the adaptation of technology in the industrial era 4.0, this study offers concrete solutions for teachers to improve the quality of learning through interactive and fun digital media and reduce dependence on conventional methods. This contributes significantly to overcoming the problem of low learning outcomes and student engagement in mathematics learning in elementary schools. This makes the Game-Based Learning learning model assisted by Baamboozle an interesting learning solution. In addition, no research has been conducted on the Game-Based Learning model assisted by Baamboozle. The advantage of using the Game-Based Learning learning model assisted by Baamboozle is that teachers can prepare students to face the demands of the abilities that must be possessed in the era of the Industrial Revolution 4.0. Based on this, this research aims to analyze the Game-Based Learning learning model assisted by Baamboozle and its impact on student engagement and mathematics learning outcomes, especially on the material on whole numbers of operations in everyday life for third-grade students at SDN Sekaran 01.

2. METHOD

The type of research used is quantitative research. The research design chosen is experimental. Experiments aim to identify the impact of certain variables on other variables by controlling conditions strictly (Abraham & Supriyati, 2022; Prof.Dr.Sugiyono, 2015). The experimental design used in this study was a quasi-experiment with a One Group Pre-test Post-test design. This study did not involve a comparison group; a pre-test was conducted beforehand. The initial and final tests measure whether participants have significant differences after receiving different treatments. A response questionnaire was used to assess differences in student engagement, which students must fill out and then strengthened by the results of observations made by the class teacher. The population of this study consisted of class IIIA students at SDN Sekaran 01, with a total sample of 27 students. The data collection methods in this study were observation, interviews, and tests. The observation method was used to discover the problems in the field regarding learning. The interview method was used to obtain information from teachers and students regarding the problems experienced by teachers and students regarding learning. The test was used to determine the improvement in learning outcomes, and the questionnaire and teacher observation were used to see the improvement in student engagement. The instrument used in collecting data was test questions. The test grid is presented in Table 1.

Table 1. Research Questionnaire Grid

No.	Aspect	Statement
1	Agentic Engagement (student contribution to learning direction)	I pay close attention to the teacher's explanation. I ask the teacher if I need help understanding the explanation of the learning directions given. I pay close attention to the assignments given by the teacher.
2	Behavioral Engagement (the effort students put into understanding)	I do the assignment according to the teacher's instructions. I do my teacher's assignments seriously.
3	Emotional Engagement (students' positive emotions in learning)	The learning delivered by the teacher makes me excited to learn. The learning carried out by the teacher with game media is fun. I feel energized during the learning process.
4	Cognitive Engagement	The questions presented during learning make me want to do them correctly. The learning done by the teacher through games motivates me to collect more marks.

The data analysis techniques used include prerequisite tests, including normality and homogeneity tests, which aim to determine the type of statistical test to be used, and hypothesis testing by the normality test results, namely by using the t Paired Samples Test. Questionnaires and teacher observation sheets are arranged based on the main dimensions of Student Engagement, which include Agentic Engagement

(students' contribution to learning direction), Behavioral Engagement (students' efforts to understand), Emotional Engagement (students' positive emotions in learning), and Cognitive Engagement.

3. RESULT AND DISCUSSION

Result

This study assesses the effect of implementing the Game-Based Learning model with Baamboozle media based on Artificial Intelligence on elementary school students' engagement and learning outcomes. This study will involve 27 students of SDN Sekaran 01. The data collection techniques used are tests to see improvements in learning outcomes, questionnaires, and observations to see improvements in Student Engagement. A research assessment can be considered a valid data collector if it can accurately reveal data from the variables studied. The test instrument testing in this study used the Correlation Product Moment method. The results of the validity test showed that all questions were declared valid. The results of this validity test explain that the questions given to respondents related to the material to be tested on the sample are said to be able to be used as a measuring tool desired by the respondents. After the questions have been tested for validity, we also need to test their reliability. A measurement technique called the Cronbach Alpha coefficient is used to predict stress reliability. The reliability test results are the Cronbach alpha value of 0.755 so that they get reliable criteria. The learning outcome data was obtained, and then a normality test was carried out using the IBM SPSS 25 Application. The results of the normality test are presented in Table 2.

Table 2. Results of Normality Test (One-Sample Kolmogorov-Smirnov Test)

Statistics		Pre-test Score	Post-test Score
N		27	27
Normal Parameters	Mean	48.22	85.44
	Std. Deviation	23.598	6.936
Most Extreme Differences	Absolute	0.186	0.218
	Positive	0.186	0.154
	Negative	-0.133	-0.218
Test Statistic		0.186	0.218
Asymp. Sig. (2-tailed)		0.17	0.12

The results of the probability test analysis on SPSS are seen in the Asymp. Sig. (2 tailed) the value is 0.17i > 0.05, meaning the data is normally distributed. Further testing can be carried out (Ghozali, 2018). Next, a paired samples t-test was conducted. The results of the paired samples t-test are presented in Table 3.

Table 3. Paired Samples t-Test Results

Paired Group	Group	Mean	Std.Deviation	Std. Error Mean	95% Confidence interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre-test Post-test	-37.222	22.883	4.404	-46.275	-28.170	-8.452	27	0.000

Based on the test results, the Sig value (2-tailed) is 0.000, meaning the sig value <0.05 means there is a difference in value after and before treatment. It is concluded that the Game-based learning model with Baamboozle media based on artificial intelligence can improve student learning outcomes. In the graph of the development of the values of 27 students, the researcher coded the student's name using the following letters:
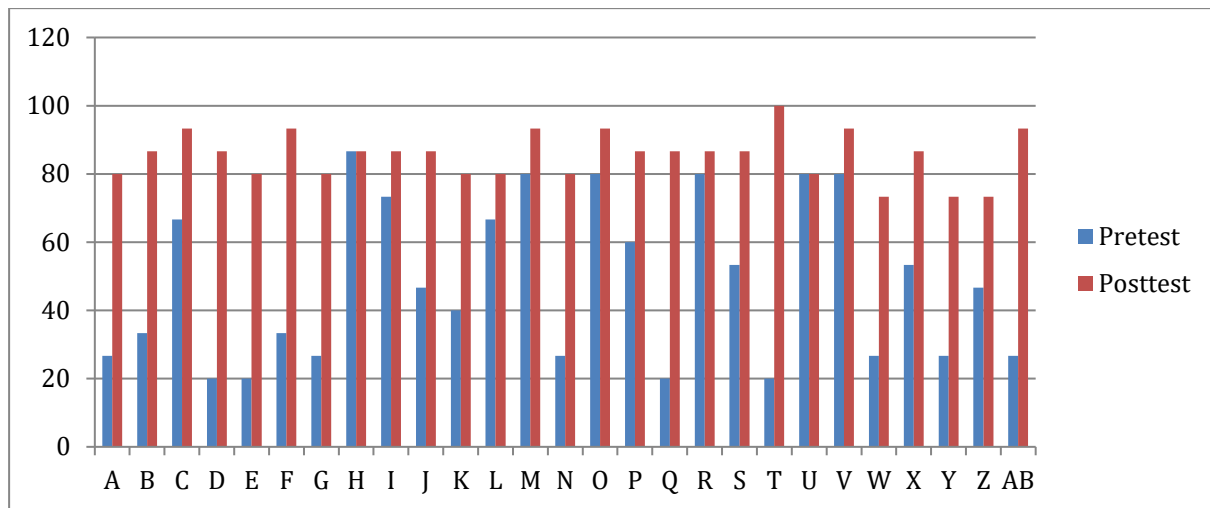
Figure 1. Improving Student Learning Outcomes

The data collection technique used is a test to see the increase in Student Engagement by observation. This questionnaire consisted of 10 questions, which 27 students then filled out. The results of this questionnaire show that all students are quite interested in the learning model applied. The following Table 4 is the result of the student response questionnaire:

Table 4. Table of Student Response Questionnaire Results

No	Statement	Score (the number of students)				
		1	2	3	4	5
	Agentic Engagement (student contribution to learning direction)					
1.	I pay close attention to the teacher's explanation.				7	20
2.	I ask the teacher if I need help understanding the explanation of the learning directions given.				7	20
3.	I pay close attention to the assignments given by the teacher.				1	26
	Behavioral Engagement (the effort students put into understanding)					
4.	I do the assignment according to the teacher's instructions.				4	23
5.	I do my teacher's assignments seriously.				3	24
	Emotional engagement (students' positive emotions in learning)					
6.	The lessons delivered by the teacher made me enthusiastic about learning.				2	25
7.	Learning carried out by teachers using fun game media.					27
8.	I did not feel bored during the learning process.				2	25
	Cognitive Engagement					
9.	The questions presented during learning made me want to do them correctly.				7	20
10.	The learning that the teacher did through games motivated me to collect more marks.				2	25

Researchers carefully record information about behavior, events, or directly observed characteristics in the observation process without manipulating the Student Engagement variable. A class III B teacher assisted in this observation process at SDN Sekaran I. 4 dimensions are the focus of observation of the Student Engagement variable. The results of the observation are as follows: first, Agentic engagement. The observation results show that using the Game-Based Learning learning model with Baamboozle media based on Artificial Intelligence is very complex because it involves 22 out of 27 students competing with each other with the rules designed in the learning media. Second, Behavioral engagement. The observation results show that the group scores encouraged 85% of students to put in all their efforts in doing the assignments and questions presented by the teacher and the games in learning seriously and by the teacher's directions. Third, Emotional engagement. Based on the observation, results show that from the beginning to the end of learning, 25 out of 27 students are enthusiastic and do not feel bored because of the many challenges from the games presented in learning. Fourth, Cognitive engagement. Based on the results of observations show that when receiving Game Learning with Baamboozle media based on Artificial

Intelligence, it shows how students work on questions more skillfully, interactions between students encourage other students to find ways to work on questions related to the material being taught, and have the willingness to try harder.

Discussion

The data analysis results showed an average difference between the pre-test and post-test learning outcomes, which means that using the game-based learning model with Baamboozle media based on artificial intelligence is influenced. First, the Game-based learning model with Baamboozle media based on Artificial Intelligence can improve student learning outcomes. The study results showed how students worked on questions more skillfully, and interactions between students encouraged other students to find ways to work on questions related to the material being taught and be willing to try harder. This can certainly improve student learning outcomes. Artificial intelligence (AI) media is often used in learning because it is easier to use, and students also find it easier to apply at school or home (Ingkavara et al., 2022; Spector & Ma, 2019). Learning media is a tool that students can use to make it easier to understand the material (Gogahu & Prasetyo, 2020; Herliana & Anugraheni, 2020). Previous research also stated that using learning media can improve student learning outcomes (Azzahra & Pramudiani, 2022; Khairunnisa & Ilmi, 2020; Ula et al., 2020). This is the reason why teachers must master technology to create learning that is based on the development of the times. Media has a role as a tool to help teachers in the learning process because it can organize information verbally and visually, making it easier for students to learn and impacting student learning outcomes (Hanifah et al., 2019; Pangestu et al., 2019).

Second, the Game-based learning model with Baamboozle media based on artificial intelligence can increase student engagement. Student Engagement results from student interaction that can encourage students to find effective solutions (Afzal & Crawford, 2022; Bokiev et al., 2018). The impact is, of course, that students can improve their learning outcomes as well. This is also true of the research results that show that game-based learning can improve student learning outcomes (Attard & Holmes, 2020; Maroco et al., 2016; Ully & Dewi, 2022). The results of filling out the observation implementation questionnaire during the research conducted by the teacher regarding student engagement based on four dimensions, including the first regarding agentic engagement from the results of the questionnaire and observation showed that 22 out of 27 students were actively involved in observing the directions and steps explained by the teacher. In addition, students tried to do assignments and questions seriously. These results are based on research showing that game-based learning can improve student engagement and learning outcomes (Amerstorfer & Freiin von Münster-Kistner, 2021; Rahmawati et al., 2023).

Third, the Game-based learning model with Baamboozle media based on artificial intelligence can create a fun learning atmosphere. Technological advances in the Industrial 4.0 era force education to have the ability to create a comfortable and optimal learning experience (Hudayati et al., 2021; Lestari et al., 2021; Widiyono & Millati, 2021). Therefore, with the changing times, increasingly sophisticated technological devices can be a solution for students and teachers to access learning resources without being limited by time and situation (Gazali & Pransisca, 2021; Latip, 2020). One form of utilization of these conditions is the existence of Game-Based Learning with Artificial Intelligence-based media. Many Artificial Intelligence-based media products can support learning and can be accessed for free by everyone. In addition, this application is designed like a game, so it is interesting to its users. Game-based learning is always interesting (Andari, 2020; Dewantara et al., 2019; Islamiyah, 2017). Apart from increasing students' motivation to learn, games in learning will increase student interaction (Khoerniawan et al., 2018; Miluningtias & Shofiyah, 2021). Student interaction will help teachers improve Student Engagement during teaching and learning. The research results show that game-based learning has a significant effect and can improve student engagement in the learning process (Hidayati & Aslam, 2021; Rahmawati et al., 2023).

Previous research findings also confirmed that technology-based media-assisted learning can arouse students' interest and enthusiasm (Herfandi et al., 2020; Humaida & Suyadi, 2021). Other research says that using learning media makes the learning atmosphere more varied, and students can receive the material well (Fithri & Setiawan, 2017; Rahman & Tresnawati, 2016; Sokibi & Adnyana, 2018). The game-learning approach can stimulate students to learn and improve their understanding (Ibam et al., 2018; Widyatmojo & Muhtadi, 2017).

This study has several significant advantages, including applying the Game-Based Learning (GBL) learning model with Baamboozle media based on Artificial Intelligence (AI), which is very effective in helping students learn. This media can increase students' enthusiasm for learning with the practicality of using the Baamboozle site, which does not require account creation, is flexible for online and offline learning, and is interesting because it combines elements of learning and playing. These advantages make the Baamboozle media suitable for the GBL learning model, effectively combining game elements with learning and making students more motivated and actively involved in the learning process. However, this

study also has several limitations. First, this study only measures student engagement and learning outcomes at the elementary school level, so the results may need to be more generalizable to other levels of education. In addition, this study has yet to explore other aspects of the learning process, such as the long-term effects of using the GBL learning model with Baamboozle media or how external factors such as parental support and the learning environment play a role in the success of this method. The implications of this study are quite broad, especially in the context of education in the digital era. The GBL learning model with AI-based Baamboozle media can make learning easier for students, especially in mathematics. This certainly helps teachers in achieving optimal learning goals. Increasing motivation, student involvement, and interaction between students can encourage the creation of a fun and interactive learning atmosphere. Therefore, it is recommended that educators apply this GBL learning model in the classroom to increase motivation, critical thinking skills, and student involvement, both in online and offline learning. This model is also expected to be a reference for creating active, student-centered learning and maximizing the use of technology in education. It is recommended that the Game-based learning model be applied in the classroom to increase motivation and critical thinking and provide a fun and interactive learning atmosphere through technology. The Game-Based Learning learning model is expected to help the online and offline teaching and learning process. The Game Based Learning learning model can be a reference for increasing Student Engagement, active learning, and student-centered learning so that the teaching and learning process becomes fun, communicative, and collaborative, and can maximize the use of technology for learning, which also has an impact on student learning outcomes.

4. CONCLUSION

This study concludes that the Game-Based Learning (GBL) learning model with Baamboozle media based on Artificial Intelligence (AI) significantly improves student learning outcomes and engagement in mathematics learning in grade III of SDN Sekaran 01. Data analysis shows a significant increase between the pre-test and post-test results, indicating that using GBL with Baamboozle effectively improves student understanding. In addition, this model also improves various dimensions of student engagement, creates a fun and interactive learning atmosphere, and motivates students to be more active in learning. The practicality and flexibility of Baamboozle media make it a very suitable tool for online and offline learning. Therefore, it is recommended that educators adopt this GBL learning model to improve student motivation, engagement, and learning outcomes, as well as create more active and student-centered learning by utilizing existing technology.

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