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Utilization of 'Quizizz' a Game-based Assessment: An Instructional Strategy in Secondary Education Science 10

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Abstract: The primary goal of this study was to explore the effectiveness of Quizizz in enhancing students' motivation, interest, and achievement in physics. This study was conducted at the Nueva Ecija University of Science and Technology (NEUST) – Gabaldon campus during the second semester of the academic year 2021-2022. This study used both a descriptive and a quasi-experimental one-group pretest-posttest design. The descriptive design was used to describe the student's motivation and interest in learning waves and optics before and after the intervention of Quizizz. The quasi-experimental one-group pretest-posttest design was used to determine the effectiveness of Quizizz in increasing students' motivation, interest, and achievement in physics. The study included 20 students pursuing a bachelor's degree in secondary education with a major in science. According to the findings, before the intervention of Quizizz, students agreed that they are motivated and interested in learning physics, and their performance was average. Following the intervention, students unanimously agreed that they are more motivated and interested in learning physics, and their scores in a specific unit increased. According to the t-test, the intervention of Quizizz significantly increases student motivation, interest, and achievement in physics. It demonstrates that using Quizizz in physics instruction improved students' motivation, interest, and achievement in physics.

Keywords: *Achievement in physics, game-based assessment, interest, motivation, Quizizz.*

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Introduction

The sudden closure of schools, colleges, and universities during the pandemic forces the adaption of new teaching and learning methods. Most colleges and universities in the Philippines utilize online learning systems. The Nueva Ecija University of Science and Technology uses online platforms for teaching college students. The university's professors and instructors primarily use Facebook Messenger, Google Classroom, Google Drive, Google Forms, Google Site, Schoology, Zoom meeting, Google meet and similar tools to deliver lessons and assess students' performance (Nueva Ecija University of Science and Technology [NEUST], 2020). This learning platform serves as a bridge between students and teachers, as well as a motivator for students to continue their education. Nonetheless, despite technological progress and the use of various learning modes by Philippine Higher Education Institutions (HEIs), there are still problems and challenges to address (Joaquin et al., 2020). Furthermore, the COVID-19 pandemic had the biggest impact on the quality of learning experiences and students' mental health in the Philippines (Barrot et al., 2021).

Students' motivation in studying, on the other hand, drives them to strive harder in their studies. Wieking (2016) demonstrates that using technology in the classroom boosts students' motivation and enjoyment of learning. As a result, using motivational technologies in the classroom is essential. Similarly, in an online setting, simply discussing the topic is insufficient; stimulating software, such as online games, must be included. Students that obtained satisfaction through online gamification passed their courses (Llerena-Izquierdo & Atiaja-Balseca, 2020). Furthermore, even amid a crisis, online gamified learning and formative assessment increase student involvement in learning (Zainuddin et al., 2021). Similarly, Nieto-Escamez and Roldán-Tapia (2021) demonstrate that gamification was an innovative, engaging, and efficient technique for delivering curricula material; also, it was considered a fun activity by the students. As a result, interactive learning is essential in online learning to increase student satisfaction and perseverance (Croxton, 2014).

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Online learning platforms, on the other hand, have several detrimental effects on course persistence and grade, contradicting the concept that there is no significant difference between online and face-to-face learning (Xu & Jaggars, 2013). According to Bird et al. (2022), there is a 6.7 percent decline in course completion, which is being driven by increases in course withdrawal and failure. Furthermore, the number of time students spend in front of laptops, computers, and devices may have a negative impact on their health and body (Yousof et al., 2021). Hence, Purnama et al. (2021) argue that to mitigate the detrimental effects of online learning, digital literacy and parental participation must improve.

Several teachers used internet games to teach and assess their students. Yıldırım and Baran (2021) used digital and physical activity games to teach physics and discovered that it improved student achievement. Azizah et al. (2021) used Teams-Games-Tournament employing monopoly media and discovered that it helps students focus and grasp the information thoroughly, and it trains them to think systematically and analytically. In addition, Zeng et al. (2020) showed in their study that the game-based learning group fared the best, followed by the educational video group, and the traditional group scored the worst. Furthermore, Rehman et al. (2021) use interactive computer simulation on student physics concepts; their data reveal a significant difference in the student's pre-test and post-test with a very significant effect size of 0.97. Similarly, after controlling for gender, video game experience, pretest knowledge, and game enjoyment, game-based assessment persistence predicted the acquisition of qualitative physics (Ventura & Shute, 2013). However, Deta et al. (2021) state that some educational physics games do not contribute to improved student learning results.

Among the interactive online tools used by educators include Kahoot, Quizalize, Quizlet, and Quizizz. Students can use these apps to answer online quizzes and view the results of their tests (Curto Prieto et al., 2019). According to Asa'd and Gunn (2018), the inclusion of Kahoot in assessment motivates students to practice more physics problems and to be more prepared in class. Similarly, Darmawan et al. (2020) showed that, despite the students' low mean quiz score, their response to the usage of Quizizz in learning science during the epidemic was positive. Furthermore, students taught using Zoom Cloud Meeting and Quizizz media were shown to be more motivated than those taught using Whatsapp (Vitarani et al., 2021). Additionally, Nirwana et al. (2021) have shown that the use of Quizizz in learning physics improves students' learning outcomes. On the other hand, according to Göksün and Gürsoy (2019), the beneficial impact of gamified activities utilizing the Quizizz application was lower than the beneficial impact of the control group's instruction style in terms of academic success.

Based on the aforementioned literature, the researcher used game-based assessment, specifically the Quizizz. A Quizizz is an interactive game show-style quiz, similar to Kahoot, Quizalize, and Quizlet (Bindel, 2018). In addition, the researcher formulated the following questions: 1.) How may the motivation and interest of the students in learning waves and optics be described before and after the utilization of Quizizz?; 2.) How may the pre-test and post-test scores of the students in waves and optics be described?; 3.) Is there a significant difference in the motivation and interest of the students in learning waves and optics before and after the utilization of Quizizz?; and 4.) Is there a significant difference in the pre-test and post-test scores of the students in waves and optics?

Null Hypotheses: 1.) There is no significant difference in the motivation and interest of the students in learning waves and optics before and after the utilization of Quizizz ; 2.) There is no significant difference in the pre-test and post-test scores of the students in waves and optics.

Methodology

Research Design

This study used both a descriptive and a quasi-experimental one-group pretest-posttest design. A descriptive research design seeks to characterize phenomena, situations, or populations by answering the what, when, where, and how questions about the study problem (Child Care and Early Education [CCEE], 2020). A one-group pretest-posttest design is a sort of quasi-experimental design. In a one-group pretest-posttest design, just one group of participants is measured on a dependent variable of interest, pre-tested, exposed to an intervention, and measured again to see if there are significant differences between the pre-test and post-test (American Psychological Association [APA], 2020).

The descriptive method was used to describe students' motivation, interest, and achievement in physics, specifically waves and optics, before and after the integration of Quizizz. The quasi-experimental method was used to determine the effect of Quizizz on students' motivation, interest, and achievement in Physics.

Sampling Technique

Purposive sampling was used by the researcher to select the participants because there are only 20 students enrolled in a bachelor of secondary education major in science. Purposive sampling, also known as judgmental sampling, is a sampling approach in which a researcher chooses study participants based on their judgment (Business Research Mythology [BRM], 2021).

The Participants

The study included 20 second-year bachelor of secondary education major in science students from Nueva Ecija University of Science and Technology, Gabaldon campus. Participants were 7 (35%) male students and 13 (65%) female students.

Experimental Procedure

The researcher employed a group of 20 education students for the one-group pre-test-post-test design. The researcher assessed the students' motivation and interest in learning physics (waves and optics) by administering a questionnaire at the start of class and then giving them the subject's pre-test.

Within a week, there are six-hour class meetings, with discussions covering the first four hours. During this period, the topic was taught through online meetings (Google Meet), e-modules, and messenger. The fifth hour is for practice and review of the concepts presented in the previous four hours of discussions and class experimentation, in which students are allowed to discuss and exchange thoughts about the topics covered. The final hour is devoted to their quiz game, which is powered by Quizizz. Students compete against one another in this quiz game by collecting digital scores. The student with the highest digital score is named the week's most valuable player (MVP). There are also first, second, and third place winners.

The researcher re-administered the questionnaire to the students after sixteen weeks of employing "Quizizz" to assess their motivation and interest in learning physics. The researcher also administered the subject's post-test. After collecting all data, the t-test for dependent variables was used to identify the differences in motivation, interest, and performance of the students in physics before and after applying the Quiz-game (Quizziz).

Materials and Instruments

Questionnaires

The researcher devised the questionnaire for determining motivation and interest in learning physics. It was used to describe the student's motivation and interest in learning physics before and after the intervention of "Quizizz". The responses are as follows: 4 – Strongly Agree, 3 – Agree, 2 – Disagree, 1 – Strongly Disagree.

The researcher also designed the pre-test and post-test, which were based on the topics of waves and optics.

Questionnaires and Test Questions Validity

The researcher used the Lawshe technique to validate the questionnaires for motivation and interest in learning physics (waves and optics), as well as the items used in the pre-test and post-test. The researcher sought the assistance of 15 faculty members who taught physics at Nueva Ecija University of Science and Technology's four campuses. They classified each item as essential, useful but not essential, and non-essential. The content validity index was calculated using the formula: $CVI = \sum [(2n_e - N)/N] / TNI$, where n_e is the number of panelists who rated the items essential, N is the total number of panelists and TNI is the total number of items per questionnaire.

Table 1. Shows the Content Validity Index of each Questionnaire.

Questionnaire	Content Validity Index (CVI)	Critical Value (15 Raters)	Interpretation
Motivation	0.84	0.49	Valid
Interest	0.87	0.49	Valid
Test Questions	0.81	0.49	Valid

Test Questions Item Difficulty Index and Discriminating Power

The difficulty and discriminating coefficient of each item are shown in Table 2. There are 50 items in the test questions. Each item has an average difficulty index and a high discriminating power, indicating that these items are adequate for assessing students' knowledge of waves and optics.

Table 2. Shows the Difficulty Index and Discriminating Power of each Item

Items	Difficulty Index	Interpretation	Discriminating Power	Interpretation
1	0.50	Average	0.38	Very Good Item
2	0.43	Average	0.38	Very Good Item
3	0.53	Average	0.50	Very Good Item
4	0.43	Average	0.38	Very Good Item
5	0.50	Average	0.38	Very Good Item
6	0.47	Average	0.50	Very Good Item
7	0.43	Average	0.63	Very Good Item
8	0.47	Average	0.50	Very Good Item
9	0.67	Average	0.50	Very Good Item
10	0.63	Average	0.38	Very Good Item
11	0.43	Average	0.38	Very Good Item
12	0.47	Average	0.50	Very Good Item
13	0.47	Average	0.50	Very Good Item
14	0.50	Average	0.63	Very Good Item
15	0.50	Average	0.63	Very Good Item
16	0.57	Average	0.63	Very Good Item
17	0.60	Average	0.50	Very Good Item
18	0.67	Average	0.50	Very Good Item
19	0.67	Average	0.50	Very Good Item
20	0.43	Average	0.38	Very Good Item
21	0.47	Average	0.50	Very Good Item
22	0.43	Average	0.38	Very Good Item
23	0.50	Average	0.38	Very Good Item
24	0.37	Average	0.38	Very Good Item
25	0.57	Average	0.38	Very Good Item
26	0.53	Average	0.50	Very Good Item
27	0.63	Average	0.38	Very Good Item
28	0.50	Average	0.38	Very Good Item
29	0.47	Average	0.50	Very Good Item
30	0.43	Average	0.63	Very Good Item
31	0.40	Average	0.50	Very Good Item
32	0.43	Average	0.38	Very Good Item
33	0.43	Average	0.38	Very Good Item
34	0.37	Average	0.38	Very Good Item
35	0.37	Average	0.38	Very Good Item
36	0.37	Average	0.38	Very Good Item
37	0.57	Average	0.38	Very Good Item
38	0.53	Average	0.50	Very Good Item
39	0.60	Average	0.50	Very Good Item
40	0.60	Average	0.50	Very Good Item
41	0.63	Average	0.63	Very Good Item
42	0.50	Average	0.38	Very Good Item
43	0.43	Average	0.38	Very Good Item
44	0.43	Average	0.38	Very Good Item
45	0.50	Average	0.38	Very Good Item
46	0.43	Average	0.38	Very Good Item
47	0.50	Average	0.38	Very Good Item
48	0.43	Average	0.38	Very Good Item
49	0.60	Average	0.50	Very Good Item
50	0.50	Average	0.38	Very Good Item

Questionnaires and Test Questions Reliability

The questionnaires and test questions were pre-tested with 30 students from the other campus who are studying physics, specifically waves and optics. These students are not part of the study. The questionnaire for motivation and interest has a reliability coefficient of 0.89 and 0.91 respectively. While the test questions have a reliability coefficient of 0.92. The reliability coefficient was determined using the SPSS-Cronbach's alpha.

Data Collection

The researcher requests permission from the area head of the college of education and the campus director of Nueva Ecija University of Science and Technology, Gabaldon campus. Google Forms were used to collect data. During the first meeting, the questionnaire was employed to assess motivation and interest in learning physics, and then the test questions (pre-test) were administered. After sixteen weeks, the identical questionnaire and test questions (post-test) were delivered again.

Data Analysis

IBM-SPSS was employed to analyze the data. Means and standard deviations were used to describe the student's motivation and interest to learn physics and to describe the students' performance before and after the intervention of "Quizizz". A dependent t-test was used to determine the differences in the student's motivation, interest and performance before and after the intervention of quiz-game (Quizizz).

The normality test for each variable is shown in table 3. Motivation before, *w(20) = 0.955, p>0.05*, motivation after, *w(20) = 0.941, p>0.05*, interest before, *w(20) = 0.946, p>0.05*, interest after, *w(20) = 0.915, p>0.05*, pre-test, *w(20) = 0.979, p>0.05*, and post-test, *w(20) = 0.844, p>0.05,* are normally distributed.

Table 3. Test of Normality

		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
Motivation	Before	.955	20	.444
	After	.941	20	.254
Interest	Before	.946	20	.316
	After	.915	20	.080
Achievement	Pre-test	.979	20	.925
	Post-test	.844	20	.055

Findings / Results

Student's Motivation to Learn Physics, Before and After the Intervention of "Quizizz"

Table 4 shows that before the intervention of "Quizizz", strongly agree that physics is a fascinating subject, particularly waves and optics *(m = 3.30)*, that their interest is piqued by their curiosity about light waves and optics *(m = 3.45)*, they want to learn about waves and optics because it will help them understand the world better *(m = 3.25)*, that learning about waves and optics will broaden their physics knowledge *(m = 3.4),* they are going to work harder to learn more about waves and optics. *(m = 3.35),* and they intend to devote more time to studying waves and optics *(m = 3.40).* Students also agree that they believe they can earn a grade of 1.25 or higher in physics *(m = 2.85),* their current goal is to achieve a high score in waves and optics *(m = 2.95),* which experiments and research involving waves and optics excite them greatly *(m = 3.10),* and they will be very proficient in learning about waves and optics *(m = 2.80).* Overall, students are agreeing that they are motivated to learn physics *(twm = 3.185).*

All of the items relevant to motivation are assessed as strongly agreed by the students following the intervention of "Quizizz." They substantially agree that they are more motivated to learn physics *(twm = 3.53).* In addition, as indicated in table 3, all of the item mean scores increased after the intervention.

Table 4. Student's Motivation to Learn Physics, Before and After the Intervention of "Quizizz"

Motivation	**Before**		**After**	
	Mean	**Interpretation**	**Mean**	**Interpretation**
Physics is a fascinating subject, particularly waves and optics.	3.30	Strongly Agree	3.60	Strongly Agree
My interest is piqued by my curiosity about light waves and optics.	3.45	Strongly Agree	3.55	Strongly Agree
I want to learn about waves and optics because it will help me understand the world better.	3.25	Strongly Agree	3.45	Strongly Agree
Learning about waves and optics will broaden my physics knowledge.	3.40	Strongly Agree	3.45	Strongly Agree
I'm going to work harder to learn more about waves and optics.	3.35	Strongly Agree	3.40	Strongly Agree
I intend to devote more time to studying waves and optics.	3.40	Strongly Agree	3.45	Strongly Agree
I believe I can get a 1.25 or higher in waves and optics.	2.85	Agree	3.85	Strongly Agree
My current goal is to achieve a high score in waves and optics.	2.95	Agree	3.60	Strongly Agree
Experiments and research involving waves and optics excite me greatly.	3.10	Agree	3.40	Strongly Agree
I'll be very proficient in learning about waves and optics.	2.80	Agree	3.55	Strongly Agree
Total Weighted Mean (TWM)	3.185	Agree	3.53	Strongly Agree

Student's Interest to Learn Physics, Before and After the Intervention of "Quizizz"

Table 5 shows the interest of the students in learning physics before the intervention of Quizizz. Students strongly agree that they are interested to learn more about waves and optics *(m = 3.60),* they love to acquire new knowledge in physics *(wm = 3.60)*, they like to constantly attend physics subjects, specifically waves and optics *(m = 3.25),* they like to do experiments regarding waves and optics *(m = 3.25),* and that studying lights and waves are very interesting topics *(m = 3.30).* On the other hand, students agree that they like to talk to their classmates and their professor regarding waves and optics *(m = 3.20),* they love solving problems regarding waves and optics *(m = 2.95),* they intend to continue learning about waves and optics, even they finished the course *(m = 2.90),* they love to do more activities in physics *(m = 3.15),* and they are willing to make a report about waves in optics and presented on the class *(m = 2.80).* Overall, students are agreeing that they are interested in learning physics *(twm = 3.20).*

Students' interest in learning physics increases as a result of the intervention. With a cumulative weighted mean of 3.56, students strongly agree on all items about physics interest.

Table 5. Student's Interest to Learn Physics, Before and After the Intervention of "Quizizz"

Interest	Before		After	
	Mean	**Interpretation**	**Mean**	**Interpretation**
I am interested to learn more about waves and optics.	3.60	Strongly Agree	3.70	Strongly Agree
I love to acquire new knowledge in physics.	3.60	Strongly Agree	3.60	Strongly Agree
I like to constantly attend physics subjects, specifically waves and optics.	3.25	Strongly Agree	3.50	Strongly Agree
I like to do experiments regarding waves and optics.	3.25	Strongly Agree	3.50	Strongly Agree
I like to talk to my classmates and my professor regarding waves and optics.	3.20	Agree	3.50	Strongly Agree
I love solving problems regarding waves and optics.	2.95	Agree	3.35	Strongly Agree
Studying lights and waves are a very interesting topic.	3.30	Strongly Agree	3.50	Strongly Agree
I intend to continue learning about waves and optics, even after I finished this course.	2.90	Agree	3.35	Strongly Agree
I love to do more activities in physics.	3.15	Agree	3.95	Strongly Agree
I am willing to make a report about waves in optics and present to the class.	2.80	Agree	3.65	Strongly Agree
Total Weighted Mean (TWM)	3.20	Agree	3.56	Strongly Agree

Pre-test and Post-test

Table 6 shows that the post-test mean *(M = 41.20, SD = 4.82)* was greater than the mean of the pre-test *(M = 30.75, SD = 6.07)* result. The mean difference between the post-test and pre-test results is 10.45, demonstrating that students gain knowledge after incorporating Quizizz into class instruction.

Table 6. Pre-test and Post-test Results

	Mean	**N**	**Std. Deviation**
Pre-test	30.7500	20	6.07735
Post-test	41.2000	20	4.81882

Student's Achievement in Waves and Optics Before and After the Intervention of Quizizz

Table 7 reveals that there is a significant difference in physics students' motivation, *t(19) = 3.139, p<0.01,* interest, *t(19) = 3.350, p<0.01*, and achievement, *t(19) = 8.452, p<0.01,* before and after the intervention of Quizizz. Motivation *(Cohen's d = 0.702)* and interest *(Cohen's d = 0.75),* both have a medium effect size, whereas achievement *(Cohen's d = 1.89)* has a large effect size.

Table 7. Student's Achievement in Waves and Optics Before and After the Intervention of Quizizz

	Paired Differences			Effect	
	t	**df**	**Sig. (2-tailed)**	**Cohen's d**	**Effect size**
Motivation	-3.139	19	.005	0.702	Medium
Interest	-3.350	19	.003	0.75	Medium
Achievement (Before and After)	-8.452	19	.000	1.89	Large

Discussion

According to preliminary findings, after the intervention of Quizizz, students' motivation to learn physics, specifically waves and optics, increased by a certain unit. Students are more confident and believe they can achieve a higher physics score. Furthermore, they are more eager to participate in physics tests and laboratory activities. The Quizizz exercise encourages students to strive for more and to excel. It could imply that Quizizz can considerably boost students' motivation to learn physics. According to Lestari (2019), when Quizizz was used instead of Kahoot, 90% of students displayed more motivated performance. Furthermore, students found Quizizz to be more engaging, challenging, and inspirational. Similarly, Junior (2020) demonstrates that a well-planned quiz-type application such as Quizizz can drive pupils to learn better.

The data show that following the intervention, students' interest in learning physics increased in a specific unit. It demonstrates that learning physics through Quizizz increases students' interest in the subject. Students are very interested in physics, particularly waves and optics. Students are eager to learn, attend class meetings, and discuss it with their classmates and professors. Students are likewise eager to write a report on waves and optics. According to Mohamad et al. (2020), Quizizz is capable of providing an online platform that may reinforce learning, provide rapid feedback, and motivate users.

According to the data, there is an increase in student achievement in physics. It demonstrates that students gain knowledge while learning physics. Furthermore, the standard deviation of the pre-test is greater than the standard deviation of the post-test, implying that the student's scores before the intervention of Quizizz were much more dispersed than after the intervention. It means that the instructor's instructions, which are delivered through Quizizz, are tailored to each student's unique needs. Jiemsak and Jiemsak (2020) demonstrate that after four weeks of incorporating Quizizz into instruction, student academic performance improves. Furthermore, students' attitudes toward online self-assessment via Quizizz were positive.

Table 7 demonstrates that after the intervention of Quizizz, students are significantly more motivated to learn waves and optics. Students are excited about participating in all activities on the Quizizz platforms. Furthermore, students put in a lot of time and effort to get good grades in physics. Quizizz, according to Dwinta and Sapriya (2021), has the power to motivate students and engage them in learning by making studying more fun and challenging. Razali et al. (2020) also demonstrate that gamification with Quizizz increases students' intrinsic and extrinsic motivation.

The t-test table (table 7) also reveals that students' interest in studying waves and optics has greatly increased. Students are more willing to learn, more active in physics class, and keen to complete the course. They are also eager to engage in class discussions by preparing a report to be given to the class. According to Harefa et al. (2020), students' perception of media grew in a specific unit, as did students' motivation in learning through the media Quizizz. Furthermore, Yunus et al. (2021) concluded that using Quizizz for game-based learning increased students' interest in learning English.

According to the t-test, Quizizz considerably improves students' performance in waves and optics. Furthermore, using Quizizz as a platform encourages students to participate in the quizzes provided for each topic. Students are motivated to achieve a high digital score on Quizizz, so they review the content more thoroughly. Setiyani et al. (2020) stated that Quizizz-aided class has significantly improved students' problem-solving skills. Likewise, according to Nurani et al. (2021) applying Quizizz in the learning evaluation process significantly improve students' performance, because students are attracted to this innovative learning evaluation.

Conclusion

Students agree that they are motivated to learn about waves and optics before the intervention of Quizziz. Students rated their motivation as higher after Quizizz's intervention. Students unanimously agree that they are more eager to learn physics. The t-test revealed significant results, implying that student motivation before and after is significantly different. It implies that after incorporating Quizizz into wave and optics instruction, students became more motivated to learn. This demonstrates that Quizizz effectively increases student motivation. Students agree that they are interested in learning physics before the intervention of Quizizz. Following the intervention, students' interest in a particular unit increased. The t-test revealed a significant difference in student interest before and after the intervention of Quizizz. It demonstrates that incorporating Quizizz into instruction increases students' interest in learning physics significantly. The data also shows that students' physics achievement improves in a specific unit. Furthermore, students' scores after the intervention were more concentrated than before the Quizizz intervention. Furthermore, the t-test revealed that there is a significant increase in student achievement following Quizizz intervention. Overall, incorporating Quizizz into instruction increases students' motivation, interest, and performance in physics (waves and optics).

Recommendations

Quizizz and other e-learning platforms may be used by teachers and educators to increase students' motivation and interest in learning. Teachers and educators may participate in a variety of training related to e-learning and other game-

based learning platforms. The institution may also create e-learning computer programs, such as game-based learning platforms. More research on these game-based assessment platforms may be conducted in the future.

Limitation

The study's goal is to identify new learning platforms that will improve students' behavior and learning performance during distance learning. However, the study outcomes may alter in different situations, such as face-to-face classes. Furthermore, the small number of respondents limits the study's ability to use a non-equivalent control group design, which would be more powerful than a one-group pretest-posttest design.

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