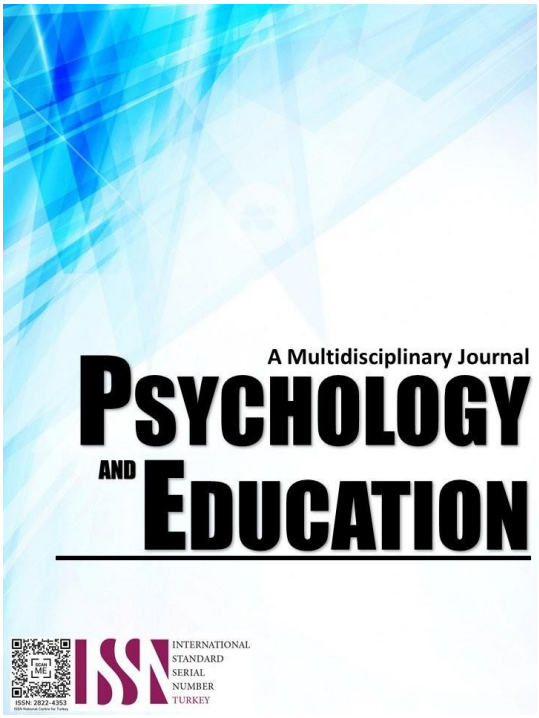
EFFECTIVENESS OF GAME-BASED APPROACH IN TEACHING PROBLEM SOLVING AMONG GRADE 3 PUPILS



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Research Article

Effectiveness of Game-Based Approach in Teaching Problem Solving among Grade 3 Pupils

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Abstract

The experimental research design was used in this study. The findings of this study revealed that using a game-based teaching approach is better than using a traditional teaching approach in improving the performance of the respondents, as demonstrated by higher post-test scores. The game-based approach led to a significant increase in the performance of the respondents. On the other hand, employing a traditional teaching approach demonstrated no significant difference between the post-test scores and the pre-test scores of the respondents. Further, the study also conducted an independent-sample T-test to compare the mean scores of two groups of respondents: one group taught using a game-based approach and the other using a traditional approach. Using an independent-sample T-test, the study further revealed that the mean score of the respondents taught using a game-based approach is significantly higher than the mean score of the respondents taught using a traditional approach. These findings indicate that using a game-based teaching approach is better than a traditional teaching approach to enhance the learning outcomes of the students. Future researchers should conduct longitudinal studies and comparative assessment to assess the effectiveness of game-based approach as a learning intervention across different subject areas and grade levels.

Keywords: *learning difficulties, problem, problem solving, game-based approach*

Introduction

The rapid development of technology has an influence on education area. Some of the new technologies emerged in the recent years have been used in education. One of the examples is mobile learning which allows students learn everywhere and every time using mobile devices such as smartphones and netbooks (Dabbagh et al., 2016).

The mobile learning started to be famous gradually due to the increasing of mobile devices existence and wireless availability. Nowadays, mobile devices provide some facilities such as music, video, game, and other applications that became tangible asset for mathematics educators and developers to create the instructional media. Game is one of the forms of instructional media. The learning process that employed game application in the classroom is called game-based learning (Jin, Tu, Kim, Heffron, & White, 2018). The integration of game and learning content aimed to create the learning circumstance that was interesting without ignoring the materials that must be learned by the students. Since this learning approach gave the positive effects for the leaning outcome (e.g., Balakrishnan, Liew, & Pourgholaminejad, 2015; Prahmana, Zulkardi, & hartono, 2012), it would make sense that the game application could be used as one of the learning facilities. A previous study revealed that children who were about 11 to 14 years old spent their time by playing game in the mobile device (Rideout, Foehr, & Roberts, 2010).

The educational game should be designed with various activities to create the interesting game experiences (Huang, Hew, & Lo, 2018). Furthermore, the game characteristics could include the fantasy elements, challenging activities, rules, choices, competition and goals (Waddell & Peng, 2014). For learning designers, these characteristics could be used in different ways because each characteristic served some opportunities to facilitate the learning activities. This advantage of game could be combined with certain learning method so that the learning activities can be directed, focus and meaningful.

There were some controversial issues from the teachers regarding the use of mobile technologies such as smartphones and netbooks as the learning instruments in the school. On the other words, some of the teachers did not agree with the use of smartphone in the classroom, while the other looked that there were some potential advantages of it (Mohammad, Fayyoumi, & AlShathry, 2015; Sulisworo, 2013).

However, the use of appropriate method would also determine the effectiveness and efficiency of the learning (Schrittesser, Gerhartz-Reiter, & Paseka, 2014). Moreover, in mathematics learning, the learning methods could help students understand the materials easily (Lee, Li, & Shahrill, 2018) in which the final purpose was to increase the students' learning achievement (Ali, Hukamdad, Akhter, & Khan, 2010).

One of the main objectives in mathematics learning is developing students' skills particularly mathematical skills that were used in the daily life (Graumann, 2011). The effectiveness of implementation of mathematics in the daily life not only considers by doing mathematics operation but it also relates to how students use mathematical concepts in solving daily life problems. Therefore, giving contextual problems in the classroom would be very meaningful for students. Indeed, it has been recommended that mathematics should be learned by using a problem-solving method which is identically means using daily life contexts in the teaching and learning process (Ohlsson, 2012).

Considering the importance of problem solving in learning mathematics, there was rarely found the educational game that facilitated this method. Consequently, the students only used the general traditional instruction that was textbook as the media of the problem-

solving learning (Fan, Zhu, & Miao, 2013).

Many research studies argue that applying interesting learning approach gave positive effects in learning mathematics (Abdulwahed, Jaworski, & Crawford, 2012). The internet is a rich source of information, and more and more people make information available online. One day, the knowledge from the internet will be more than teachers alone can provide. Obviously, the traditional teaching and unilateral knowledge acquisition has not attracted the attention of young people, and cannot fulfill the needs of the information society. Because the convenience of network and interactivity results in increasing time and location flexibility, e-learning has become the development trend of education and learning. Due to its prevalence, the network provides quick information technology access to various industries. Information systems improve the effectiveness and save time, becoming an important tool for business management, decision-making, competition and development. Therefore, the system developer, who the business needs, must have some knowledge and skill, understand the concept of the system development. System analysis is the process of effective problem solving, which makes "system analysis" become an important task. But now most learning approaches of system analysis are in accordance with the traditional face-to-face way, and textbooks often seem esoteric with their many steps, theories and case studies, but lack practical exercise. The game-based learning has abundant characteristics, such as Representation, Fun, Play, Goals, Outcomes and feedback, Win states, Competition/Challenge, Problem solving, Task, Story and so on (Felix & Johnson, 1993; Prensky, 2001), to increase the learning motivation of student. Games are used to improve the dull and hard course, where course content corresponds to game levels, making the knowledge and skill of the course teaching available through game-based learning. In summary, People love the digital game-based learning system, that using system analysis course as activity content, lets students through "Learning by Doing" achieve personalized learning, bring the entertainment of game, fun, interactive into education, achieving the purpose of edutainment (Ching-Hsue & Chung-Ho, 2011).

Some of the rules found in the 2013 curriculum included the following: subjects must contribute to the formation of attitudes, skills and knowledge, and the depth of subject materials should be of international standard, must enable students achieve higher results than those obtained in Private International Students Assessment (PISA) 2019. The competency framework of the 21st Century (Nuh, 2013), implies learning should be able to make educators cooperate in their teaching and should enable learners study what is relevant to the society. Therefore, learning should be able to produce learners that are innovative and creative. Nuh (2013) states that the ability to be innovative, creative and intelligent can be obtained by observing, questioning, associating and experimenting.

One of the core competencies of Grade 7 mathematics is understanding knowledge (factual, conceptual and procedural) by being curious about science, technology, art, cultural phenomena, and events relating to the physical world. These competencies demonstrate mathematics's abstract nature, making it a difficult subject, and dreaded by students. Also, interviews done by a mathematics teacher revealed that the abstract nature of mathematics makes it a difficult subject and one that is feared by students of in Junior High School, in Semarang. This is evident from the many students who did not obtain the minimum completeness score (reaches 25%). Yuksel et al. (2008) said the fear of mathematics is a complex combination of affective and cognitive dimensions. Personality, self-concept, self-esteem, learning styles, high demands from parents, negative attitudes to mathematics, avoiding mathematics, teachers' attitudes, ineffective learning styles, negative learning experience and less awards are factors that make students fear mathematics.

Incorporating game-based instruction inside the classroom can greatly affect the way they concentrate on, process, internalize and retain new and difficult academic information. Thus, the researcher would conduct this study to determine the perception of Grade 7 students in game-based approach. This would be designed to verify how the students perform in class implying this approach.

Research Questions

This study aimed to assess the effectiveness of game-based approach in teaching problem solving among Grade 3 pupils in Baler District during the school year 2022-2023. Specifically, the study sought to answer the following questions:

1. What is the mean score performance of Grade 3 pupils in the pre-test in the control group and experimental group before the utilization of the Game-based Approach?
2. What is the post-test mean score performance of the Grade 3 pupils in the control group using the traditional teaching approach in problem-solving lessons?
3. What is the post-test mean score performance of the Grade 3 pupils in the experimental group after the utilization of the game-based Approach?
4. Is there a significant difference between the pre-test and post-test in the control group?
5. Is there a significant difference between the Pre-test and Post-test in the experimental group?
6. Is there a significant difference between the mean scores between those who were taught with the traditional approach and the game-based approach?

Methodology

Research Design

This study made use of experimental research design. David (2005, 13) pointed out that experimental method of research is used to determine the effectiveness of a treatment or an intervention or the "cause and effect" relationship of certain phenomena under

controlled condition. The subjects of the study are randomly assigned to the experimental group and to the control groups and both groups are exposed to similar conditions except for the intervention /treatment. She stressed that among the different research methods, the experimental method yields the most conclusive research findings.

In this study, two groups were involved: the experimental group which utilized Game-based Approach and the control group which used the Traditional Approach in teaching problem solving. Pre-test and post-test were utilized to determine the significant difference on pupil's achievement in Problem Solving. The two classes were taught by the researcher during the period in which they were assigned.

Participants

The subjects of the study were the sixty (60) Grade 3 pupils of Baler District during the school year 2023-2024. Classes were divided into two groups composed of thirty (30) pupils in each group. The selection of the subjects draw- by- lot method was employed. Each student was asked to draw a number from a box which contains the numbers 1 and 2. Students who picked number 1 should stay in the experimental group while those who drew number 2 should stay in the control group. This selection was done before the start of the experiment. The two classes were taught by the researcher herself.

The table below shows the distribution of the number of Grade 6 pupils in Casiguran Central School.

Casiguran Central School		
Section	*Number of Enrolled Learners*	*Actual Number of Students*
1. A	42	30
2. B	40	30
Total no. of Respondents	82	60

Instruments

A 30-item Achievement Test in mathematics covering the lessons in two weeks was prepared by the researcher herself. Fraenkel and Wallen (1993, 139) stressed that validation of an instrument is the process of collecting evidence to support such inferences. Thus, the validity of an instrument refers to the appropriateness, meaningfulness, and usefulness of the inferences a researcher makes.

In this study, the content and face validity of the achievement was done by seeking the approval of the department head in Mathematics and 2 Master teachers in Mathematics teaching Grade 3. After incorporating the suggestions of the validators, the final draft of the Pre Test and Post Test were prepared.

A dry-run of the achievement test was done by administering it to 5 Grade 3 pupils who were not subjects of the study. This was done to determine the reliability of the Achievement test. Reliability, as also pointed out by Fraenkel and Wallen (Ibid) refers to the consistency of the scores of an instrument, Employing Kuder-Richardson Formula 20, the reliability coefficient of the Achievement Test was determined.

Procedure

A letter of request endorsed by the school principal was forwarded to the office of the Schools Division Superintendent for the permission to conduct the study. As soon as the letter of request was approved, the researcher started the experiment by giving the Pretest to the Experimental Group and the Control Group. The test papers from each group will be scored. A special scheduling for each of the groups sought from the office of the principal which was recommended for approval by the Department Head in Mathematics. The two classes were taught consecutively by the researcher herself. During the first week of the experiment, the experimental group was taught first period in the morning and the Control group was taught in the second period. However, to avoid any bias as to the time, the schedule was reversed wherein the Control group was taught first period and the experimental group was done second period. After two weeks of straight teaching, the same Achievement test was administered to both groups and the scores in this test were considered the Post-test. The following game-based activities were employed for the experimental group.

Data Analysis

The mean performance of the Grade 7 students in the Pretest and Posttest were described with the use of descriptive statistics such as: mean, median, mode, standard deviation, skewness and kurtosis.

To establish the effectiveness of the Game-based Approach in teaching problem solving to Grade 7 students, the t-test was employed.

Ethical Considerations

The data collected were used solely for the purpose of the study. The researcher ensured the confidentiality of their responses. All information provided by the respondents were held strictly confidential.

Further, proper citations should be observed as an academic way of acknowledging and giving credit to the contributions of other researchers and writers. Intellectual honesty must be practiced by the researcher at all times.

Results and Discussion

This section presents the details of the analysis and the interpretations of the data in relation to the problems posed in the study.

Table 1. *Respondents' performance during the-pretest*

	Mean	*SD*
Control Group	22.13	9.486
Experimental Group	24.87	8.106

Descriptive Statistics was utilized to determine the mean and standard deviation of the respondents in the control group and experimental group during the pre-test. The results in table 1 demonstrated that the mean score of the respondents in control group during the pre-test is 22.13 and the standard deviation is 9.486. On the other hand, the mean score of the respondents in the experimental group during the pre-test is 24.87 and the standard deviation is 8.106.

Table 2. *Control Group's performance during the post-test*

	Mean	*SD*
Control Group	23.33	8.368

Descriptive Statistics was used to determine the mean and standard deviation of the respondents in the control group during the post-test. The results in table 2 showed that the mean score of the respondents in control group during the post-test is 23.33 and the standard deviation is 8.368.

Table 3. Experimental Group's performance during the post-test

	Mean	SD
Experimental Group	30.10	7.078

Descriptive Statistics was employed to determine the mean and standard deviation of the respondents in the experimental group during the post-test. The results in table 3 showed that the mean score of the respondents in experimental group during the post-test is 30.10 and the standard deviation is 7.078.

Table 4. Control Group's performance during the pre-test and post-test

	Mean	*SD*		
Control Group pre-test	22.13	9.486		
Control Group post-test	23.33	8.368		
		t	*df*	*p*
Control group pre-test and control group post-test		-1.995	29	0.056

Paired sample t-test was computed to determine whether the respondents' mean in the post-test where the teacher used traditional teaching approach significantly differs with the mean pre-test. Results in table 4 show that the mean of the post-test (Mean = 22.13, SD= 9.486) is equal to the mean of the pre-test (Mean = 23.33, SD = 8.368), t(29)= - 1.995, p>.05. Therefore, the null hypothesis is accepted. It implies that the traditional teaching approach have no significant effect on the post-test. The findings corroborate the assertion made by Villasis et. al. 2023 where the respondents under the control group demonstrated only minimal improvement on the post-test.

Table 5. *Experimental Group's performance during the pre-test and post-test*

	Mean	*SD*		
Experimental Group pre-test	24.87	8.106		
Experimental Group post-test	30.10	7.078		
		t	*df*	*p*
Experimental group pre-test and experimental group post-test		-5.871	29	0.000

Paired sample t-test was computed to determine whether the respondents' mean in the post-test where the teacher used game-based teaching approach significantly differs with the mean pre-test. Results in table 5 show that the mean of the post-test (Mean = 30.10, SD= 7.078) is significantly higher than the mean of the pre-test (Mean = 24.87, SD = 8.106), t(29)= - 5.871, p<.001. Therefore, null hypothesis is rejected. It implies that game-based teaching approach have significant effect on the post-test. Similarly, Charlton et. al. 2005 revealed that games increase the students' learning and retention.

Table 6. *Post test of control group and experimental group*

Group	N	Mean	Std. Deviation	Std. Error Mean
1- Post-test (control)	30	23.33	8.368	1.528
2- Post-test (experimental)	30	30.10	7.078	1.292

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
score	Equal variances assumed	2.543	0.116	-3.382	58	0.001	-6.767	2.001	-10.772	-2.761
	Equal variances not assumed			-3.382	56.446	0.001	-6.767	2.001	-10.774	-2.759

The Mean score of Group 1, n=30 (taught using traditional approach) is 23.33 and the Standard Deviation is 8.368, while the Mean score of Group 2, n=30 (taught using game-based approach) is 30.10 and the Standard Deviation is 7.078. The p-value Sig. (2-tailed) is 0.001 which is p<0.005. Since p<0.005, we will reject the null hypothesis saying that there is no significant difference between the post-test mean score of the Grade 3 pupils in the experimental group and the control group. The results of the independent- sample T test showed that 30.10 is statistically higher than 23.33. Hence, the use of game-based approach in teaching significantly improves the performance of the respondents implying that this approach is more effective than traditional approach in teaching. The findings align with the assertion made by Villasis et. al. 2023 stated that that the learning outcomes of the group engaged in game-based activities showed a significant increase compared to those of the control group.

Conclusions

Based on the aforementioned findings of this study, the following conclusions were formulated:

1. Teaching approach plays a vital role in shaping students' learning experiences and outcomes. The findings of this study revealed that using a game-based teaching approach is better than using a traditional teaching approach in improving the performance of the respondents, as demonstrated by higher post-test scores. The game-based approach led to a significant increase in the performance of the respondents. On the other hand, employing a traditional teaching approach demonstrated no significant difference between the post-test scores and the pre-test scores of the respondents.

2. The study conducted an independent-sample T-test to compare the mean scores of two groups of respondents: one group taught using a game-based approach and the other using a traditional approach. Using an independent-sample T-test, the study further revealed that the mean score of the respondents taught using a game-based approach is significantly higher than the mean score of the respondents taught using a traditional approach. These findings indicate that using a game-based teaching approach is better than a traditional teaching approach to enhance the learning outcomes of the students.

On the basis of the findings in this study and the conclusions drawn, the following are hereby recommended:

Educators should consider the use of different teaching approaches such as game-based, especially for subjects where engagement and retention are crucial. They should be provided with professional development opportunities to learn how to effectively implement game-based teaching methods in the classroom. This may include training sessions, workshops, or access to educational resources and tools specifically designed for game-based learning.

Furthermore, educational institutions should allocate resources for the development and integration of different teaching approaches such as game-based in the curriculum. With this, educators can establish a more conducive learning environment for the students.

While the findings of this study offer a valuable insight, it also indicates the need for further exploration regarding this topic. Future researchers should conduct longitudinal studies and comparative assessment to assess the effectiveness of game-based approach as a learning intervention across different subject areas and grade levels.

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