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The impact of treasure hunt games on learning outcomes in time measurement

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Abstract

Background: Educational games are increasingly recognized as effective teaching tools, especially in elementary education. This study focuses on the application of a treasure hunt game in teaching mathematics, specifically time measurement concepts, to second-grade students at SD Islam PB Soedirman, Cijantung, East Jakarta.

Aim: The primary aim of this research was to assess the impact of the treasure hunt game on the improvement of mathematical learning outcomes among the students.

Method: This research adopted a quantitative experimental approach with a Post-test Only Control Group design. The sample consisted of 50 second-grade students divided into two groups: an experimental group (2D) and a control group (2G), each with 25 students. The experimental group was taught using the treasure hunt game, while the control group did not receive any special intervention. Data collection was conducted through observation and objective testing with 13 multiple-choice questions that had been validated. Data analysis was performed using SPSS for testing validity and reliability, as well as for prerequisite and hypothesis testing.

Results: The prerequisite test results indicated that the data were homogenous and valid. The hypothesis testing, conducted using a paired t-test, showed a significant value of 0.003 ($p < 0.05$), indicating a significant difference between the experimental and control groups.

Conclusion: Based on the findings, it can be concluded that the treasure hunt game significantly influences the improvement of mathematical learning outcomes in time measurement for second-grade students. This suggests the effectiveness of game-based learning methods in the context of elementary mathematics education.

INTRODUCTION

Mathematics education at the primary level encounters distinctive hurdles, particularly in aligning with Indonesia's 2013 Curriculum, which amalgamates various subjects under specific thematic units, math included. This curriculum's holistic approach is designed to furnish students with contexts that are both pertinent and stimulating (Hasanah, 2019; Nugroho et al., 2021; Wulandari, 2020). However, Hossain & Ariffin (2018) contend that the instruction of mathematics frequently resorts to traditional methodologies that fail to captivate the students' interest. These traditional strategies often do not mirror the learning needs and preferences of today's digital age students, who demand more engaging and interactive educational methods. The difficulty of teaching mathematics is intensified by the students' apprehension and aversion to the subject. Several research findings have highlighted that numerous students experience fear or distaste towards mathematics, which can result in diminished concentration and less than ideal educational achievements (Atoyebi & Atoyebi,

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2022; Attard & Holmes, 2020). Furthermore, these studies suggest that the root of mathematics anxiety and avoidance lies in insufficient engagement and unappealing instructional techniques. Supporting this view, Awofala & Lawani (2020) discovered that repetitive and minimally interactive instructional methods often do not effectively foster student involvement, particularly at the primary education level.

Insights from a private primary school in Cijantung, East Jakarta, present a comparable picture. The instructional techniques used tend to be repetitive and fall short in engaging student interest. This is in agreement with the research of Ojaleye & Awofala (2018), who concluded that conventional teaching strategies often do not establish a learning atmosphere that is both stimulating and interactive, elements vital for student motivation. Moreover, Awofala & Lawani (2020) emphasize the importance of adopting more inventive and imaginative teaching methods to elevate student participation, as well as to overcome the monotony and apprehension associated with math. Such methods not only boost engagement but also help in developing a profound comprehension and achieving sustained progress in math education. Considering these obstacles, it becomes crucial to seek out alternative solutions, like game-based learning, which can alter students' perceptions and methods of engaging with math at the elementary level.

Overcoming obstacles in math education, this investigation suggests employing treasure hunt games as a novel teaching strategy. Influenced by the latest educational innovations, this method draws on a study by Hasanah (2019), which revealed that interactive gaming can boost students' participation and activeness. The investigation posits that treasure hunts, with their exploratory and adventurous nature, can ignite students' enthusiasm and curiosity, rendering the educational journey more captivating and dynamic. This bolsters the theory that engaging and stimulating education enhances comprehension and memory retention. Prior work by Chen et al. (2020) has underlined the effectiveness of game-based education in elevating students' motivation and academic achievements in math. This investigation demonstrates that treasure hunts, tailored and customized for second graders, can offer a lively and pleasurable learning ambiance. It opens avenues for students to immerse themselves in the educational endeavor, fostering conceptual insight and problem-solving prowess. This modality prompts learners to actively delve into, experiment, and cooperate in a nurturing educational setting.

The distinctiveness of treasure hunt games in mathematics education stems from their capacity to blend cognitive, affective, and psychomotor learning facets. Echoing findings from Wachdani (2022), these games present a comprehensive learning strategy that extends beyond sharpening mathematical abilities to include the cultivation of social and emotional skills. This fosters a holistic educational experience, allowing learners to associate math concepts with real-life scenarios, thus enhancing and adding relevance to the educational journey.

The realm of education encompasses a wide array of subjects, with mathematics being a prominent example. Mathematics is not confined to the classroom; it permeates daily life. Educational technology innovations aimed at the early grades of primary education have the capacity to narrow the gap in opportunities and equip students with the skills needed for mathematical success (Thai et al., 2022). Nevertheless, it's commonly held that students harbor an aversion to mathematics (Luttenberger et al., 2018), as it is among the subjects that

instill fear in many learners. Consequently, this situation has given rise to numerous expedited techniques for solving mathematical challenges (Kamarullah, 2017).

The 2013 curriculum for elementary schools features thematic learning for lower grades, requiring students to grasp various subjects within a unified theme. These include Mathematics, Indonesian Language, Natural Sciences, Art and Craft, and Physical Education, integrated into a single sub-theme. The aim is to facilitate learning that is quick, easy, and meaningfully connected to the students' immediate environment. Despite these intentions, the reality is that student participation often does not meet the anticipated results in the detailed descriptions of the time equivalence modules. This discrepancy is likely to influence the educational achievements of the learners (Alifiyah & Bakhtiar, 2022).

Observations at a certain private elementary school in Cijantung, East Jakarta, revealed that when explaining material, teachers mainly use traditional teaching methods, such as lectures, Q&A, group discussions, and exercises from textbooks. This approach often leads to a lack of student concentration and unsatisfactory learning outcomes. Setyowati (2021), as cited by Wachdani & Thohir (2022), suggests that game-based learning approaches are effective in diverse educational settings, particularly suitable for elementary students who are naturally inclined to play. Maulana's research, mentioned by Arisetyawan & Prasekolah (2010), highlights that in mathematics, numerous engaging and enjoyable games significantly boost students' motivation to learn. Various strategies can improve educational results, including integrating play into learning. As students engage in play, they also absorb lessons, suggesting that educational environments should foster a sense of playfulness without overlooking educational goals (Hartono, 2015). These teaching and learning strategies ensure that the focus shifts away from a teacher-centric model. Furthermore, engaging and enjoyable education can draw students' interest, motivating them to engage with learning activities, even beyond the classroom walls (Chen et al., 2020).

A treasure hunt game was employed by the researcher to foster active involvement among students during thematic mathematics lessons. This initiative was sparked by the researcher's observation that instruction was overly focused on the teacher, with students primarily in a passive listening role without engaging actively. The concept for the game emerged while the researcher was participating in the "Kampus Mengajar 4" project, during a Zoom meeting featuring speakers from the "Kampus Merdeka" initiative. Dita Juwita, the Supervisor of Training at "Kampung Mengajar 4," proposed the idea of integrating such games into educational settings. Subsequently, the game was adapted to align with the study participants' abilities. Additionally, as noted Suparyanto and Rosad (2020), treasure hunting is an outdoor activity that appeals to both children and adults, offering a dynamic way to learn and explore.

Considering the context provided, it is imperative to conduct subsequent investigations to evaluate the effect of treasure hunt activities on the mathematics achievement concerning time units in grade two of PB Soedirman Cijantung Islamic primary school. This current study draws upon previous findings, specifically the research by Alifiyah & Bakhtiar (2022) at SD Muhammadiyah 2 GKB, which involved first graders with class 1C serving as the control and class 1A as the experimental group. This study revealed that incorporating treasure hunt games notably enhances the academic performance of students in elementary school.

Other researchers like Sulistyowati (2022) have found that utilizing treasure hunt games to boost listening abilities can lead to innovative discoveries, such as enabling students to self-express and recognize particular objects and symbols. Another investigation by Istiharah (2020) at SDN 7 Cakra Negara with a cohort of 36 fourth-grade students, divided equally between boys and girls, along with two observing teachers, employed Classroom Action Research (CAR) methodology across two cycles, with each cycle including two meetings. The findings from this research demonstrated that treasure hunt games could significantly enhance both student engagement in learning activities and their educational achievements in social science subjects.

Setiawan (2020) emphasized that "play is a form of education for children," suggesting that integrating play into educational settings or schools creates a learning culture among students. Vogt et al. (2018), in their research "Learning through play–pedagogy and learning outcomes in early childhood mathematics," highlight that the practice of integrating play into learning from a young age is widely recognized, yet its efficacy remains modest. In the study "Effects of games on students' emotions of learning science and achievement in chemistry" by Chen et al. (2020), the discussion centers on how cooperative games affect the emotions of students in science learning and their achievements in chemistry, specifically focusing on students' performance in chemistry and their emotional engagement with science education. Meanwhile, research conducted by Thai et al. (2022) reveals that "My Math Academy," with its distinctive characters and varied scenarios, promotes individual learning and ongoing assessment throughout each game level, aiming to facilitate students' understanding and mastery of mathematics. The approach of learning through play, leveraging the innate link between educational processes and everyday life, can inspire learners to form connections between mathematics and science as they experience it. The main objective of this study is to explore the influence of treasure hunt games on the outcomes of mathematics education.

METHODS

This research utilized a True Experimental design, specifically a Posttest Only Control Design, to maximize the effectiveness of the study. This design was chosen because participation in the game by the students was essential for achieving the best possible outcomes. It also facilitated the random selection of samples for the study. The research sample consisted of 50 students from the second grade of an elementary school, divided into two groups: 25 students in class 2D as the experimental group who participated in the treasure hunt game, and 25 students in class 2G as the control group who did not participate in the game.

The methodologies employed included observation, testing, and experimental procedures. The purpose of observation was to uncover the factors contributing to students' poor performance in mathematics, thereby aiding in devising effective strategies to enhance their academic achievements. Testing was implemented to acquire insights into the students' competencies within their studied modules. These tests were given post-intervention to evaluate the enhancement of the students' abilities after receiving the specified treatment.

Data collection was carried out using observation techniques, objective tests, and experimental methods. The tool employed included 13 validated and reliable multiple-choice

questions. The SPSS (Statistical Product and Service Solutions) software was used for data validation testing. Data analysis was performed in two phases: initial prerequisite testing and subsequent hypothesis testing. The prerequisite test outcomes indicated that the study's data were both normal and homogenous (exhibiting equal variances). The analysis for hypothesis testing utilized the paired sample t-test, which resulted in a significant value of 0.003, where $0.003 < 0.05$. Thus, it can be concluded that the null hypothesis (Ho) is rejected in favor of the alternative hypothesis (Ha).

RESULTS AND DISCUSSION

Prior to initiating the study involving the treasure hunt activity, the participants were briefed and understood the game's procedures, as outlined by the investigator. This research aimed to examine the treasure hunt game's effect on the mathematical achievement of the students. Within this investigation, the game was implemented across two learner groups: class 2D served as the Experimental group, whereas class 2G functioned as the Control group.

Experimental Group Learning

At the beginning of the lesson, the teacher reminded students of the previous material on time unit equivalence and then announced that this lesson would be conducted outside using a game-based method. The announcement that the learning would take place outside made the students very enthusiastic and excited. Their enthusiasm grew when they saw various fruits and objects made from origami paper. The teacher ensured that the students understood the game rules previously explained. The teacher emphasized the importance of being sportsmanlike, following the given rules, and cooperating well within their groups. Then, students were given the opportunity to review the material while the teacher quickly hid the treasure that the students would later.

The teacher then took the students to the schoolyard to play the treasure hunt game. The students were divided into 5 equally sized groups, each containing 5 members. After the groups were formed, the students gathered with their respective groups. Then, the teacher provided each group with a clue about the location of their hidden treasure that they needed to find. Each group had to search for the origami shaped according to their group's theme. If group 1 found the treasure belonging to another group, group 1 was not allowed to inform that group of the treasure's location, and the same rule applied to other groups. A sample image of the origami/treasure for each group can be seen in Figure 1.

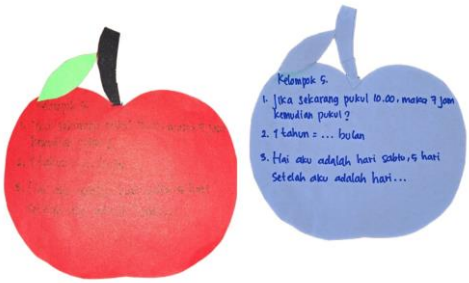

Figure 1. The treasure of each group

The teacher will count from 1 to 3 to start the game, and upon the word "Start," each group will scatter according to the clues given. Students are given 10 minutes to find their treasure. Once a group has found its treasure, members are to regroup with their team. After all groups have completed their mission, the students are instructed to return to the classroom to embark on the next part of their mission. Upon returning to the classroom, students are given an answer sheet to fill out the questions contained in their found treasure. The students are then given another 10 minutes to discuss the contents of their treasure. The atmosphere of this discussion can be seen in Figure 2.

Figure 2. Group discussion

Groups that have completed their task can exchange their work for snacks prepared by the teacher. This is intended to enhance the cooperation among students within their groups as well as their time management skills in completing tasks. Before concluding the lesson, the teacher provides information about the next meeting, which will include a post-test. The teacher then reminds the students to review what they have learned that day so they can perform well on the upcoming test.

Control Group Learning

In the control class, the learning activity was conducted solely through lectures. Unlike the experimental class, which was engaged in a treasure hunt game as a special activity, the control class did not receive this kind of treatment. The session started with the teacher reminding students of the previously covered material. Then, the teacher proceeded to explain advanced topics using a combination of lectures and group discussions, interspersed with icebreakers to stimulate focus and enthusiasm among the students. Following this, the teacher outlined the learning objective, which was to understand the equivalence in units of time used in daily life, such as hours, minutes, seconds, weeks, years, and months.

Subsequently, students were tasked with solving problems related to the topic of time unit equivalence. They worked in groups without a set time limit. This approach aimed to observe differences in accuracy and the time required by students in both the experimental and control classes to complete the tasks. In reality, students in the control class took slightly longer than those in the experimental class. At the end of the lesson, the teacher announced that there would be a post-test in the next session and reminded students to review the newly learned material to enhance their knowledge.

In the subsequent meeting, the teacher conducted a post-test to assess the outcomes achieved by the students in the experimental group after the intervention, as well as those in the control group who received no such intervention. Before administering the post-test, it

was necessary to test the validity of the question instrument that would be given to the students. The purpose of this validity test was to determine which questions were valid or invalid. The validity testing was carried out at SDN Susukan 03 Pagi, involving class 2B with 28 students. From the validity testing of 20 multiple-choice questions, 13 questions were proven to be valid. Following the validity test, a reliability test was conducted for all the question items as a whole. The Cronbach's Alpha coefficient, which was used to test reliability or measure consistency, adopted an acceptance level of 0.70 (Setiawan, 2019).

Table 1. Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
.708	21

Based on Table 1 above, the reliability test results obtained a reliability coefficient (r-value) of 0.708, which is considered reliable as it meets the criteria of r-value > 0.70. Following this, the post-test was carried out at SD Islam PB Soedirman Cijantung, East Jakarta, involving two classes: class 2D as the experimental group and class 2G as the control group. Class 2D received a treatment in the form of a treasure hunt game, while the control group did not receive any specific treatment. Before the study commenced, the first step taken was to develop a Lesson Plan (RPP) that would later be implemented in both classes. The subject chosen was thematic Mathematics with a focus on the Equivalence of Units of Time. The study then analyzed the post-test results from both the experimental and control classes using SPSS, as shown in Table 2 below.

Table 2. Description of Learning Outcome Data

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Experimen	25	65	93	79.44	9.269
Control	25	58	86	72.00	8.083
Valid N (listwise)	25				

From the data presented in the table above, the highest post-test scores were achieved by the experimental class, with a maximum score of 93, a minimum score of 65, and a standard deviation of 9.269, involving 25 students. In contrast, the control class reached a maximum score of 86, a minimum score of 58, and a standard deviation of 8.083, also with 25 students. Therefore, it can be concluded that there is a significant difference in data analysis between the experimental and control classes.

A normality test was conducted using a significance level of 0.005 with an equal number of respondents, namely 25 students in each class. The results processed through SPSS are shown in Table 3 below.

Tabel 3 Uji Normalitas

Tests of Normality							
	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Learning outcomes	postest_exsperimen	.240	25	.001	.892	25	.012
	postest_control	.220	25	.003	.874	25	.005

From the normality test results mentioned, the experimental class obtained a significance (sig.) value of 0.012, and the control class obtained a sig. value of 0.005. It can be concluded that the data is normal because the calculated L-value is less than the L-table value. Therefore, the post-test data for both the experimental and control classes are declared normal.

Following this, a homogeneity test was conducted to determine whether the variances of the results are the same or different. The homogeneity test uses a significance criterion based on a mean > 0.05; hence, the data is considered homogenous because it achieved a sig. value of 0.114, as shown in Table 4 of the Homogeneity Test below.

Tabel 4 Uji Homogenitas

Test of Homogeneity of Variance					
		Levene Statistic	**df1**	**df2**	**Sig.**
Learning outcomes	Based on Mean	2.589	1	48	.114
	Based on Median	2.617	1	48	.112
	Based on Median and with adjusted df	2.617	1	46.650	.112
	Based on trimmed mean	2.558	1	48	.116

The hypothesis testing of the study, conducted through a t-test, was aimed at determining whether there was a difference in the post-test results of students from the experimental and control classes. The conclusion of the t-test is drawn if the significance (sig) value is < 0.05, or if the calculated t-value is greater than the t-table value. In Table 5, the sig. (2-tailed) value is shown to be 0.003, indicating that the treasure hunt game had an effect on the learning outcomes in mathematical equivalence of time units for second-grade students at SD Islam PB Soedirman Cijantung, East Jakarta.

Tabel 5 Uji Hipotesis

Independent Samples Test										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Learning outcomes	Equal variances assumed	2.589	.114	3.098	48	.003	7.560	2.441	2.653	12.467
	Equal variances not assumed			3.098	46.798	.003	7.560	2.441	2.650	12.470

There is a significant body of research on the influence of treasure hunt games on various aspects of learning and development. The use of treasure hunt games has been studied in the context of improving problem-solving abilities (Setyowati, 2018), increasing motivation and knowledge acquisition in various subjects and enhancing social-emotional development (Wina et al., 2019). Furthermore, the application of treasure hunt games has been found to have a significant impact on learning outcomes (Alifiyah & Bakhtiar, 2022), including in thematic learning for elementary school students (Puspita et al., 2023).

This study also opens up opportunities for further research on the use of various types of games in mathematics education or other subjects. Future research could explore the effectiveness of games in different contexts or with different game designs. Exploring how different game designs impact learning. This includes aspects such as difficulty levels, reward mechanisms, storytelling and narrative, as well as interactivity. Such research could provide insights into how to design more effective educational games.

CONCLUSIONS

In the research conducted with second-grade students at SD Islam PB Soedirman Cijantung, focusing on the thematic mathematics topic of Time Unit Equivalence, it can be concluded that the use of a treasure hunt game influences the students' mathematics learning outcomes. This conclusion is drawn from the data analysis results, which show that student learning outcomes improve in correlation with the introduction of the game in the mathematics subject for second-grade students. The presence of the game creates an engaging learning environment, allowing students to be actively involved in the learning process, which in turn makes them enjoy their lessons.

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AUTHOR CONTRIBUTIONS STATEMENT

LA is the principal researcher, responsible for creating the instruments and conceptualizing the study. NA, the supervising lecturer, has contributed extensively from the onset of the research by providing ideas, guiding the direction of the study, offering feedback on the research's strengths and weaknesses, reviewing various instruments presented, and offering encouragement and support to LA as the author.

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