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The Impact of Using Digital Cross-Puzzle Learning Media Supported by Eclipse on Students' Learning Outcomes in Science Learning at SMPS Giat Bangun Negeri

Rina Sardiana Sari[1], Sutrisnawati Mehora[2], Riska Novianti[3]
[1,2,3] Department of Physics Education, Universitas Sembilanbelas November Kolaka

Abstract

The study adopted a quantitative, true experimental design using a pretest-posttest control group format. Two sample classes were involved: an experimental class that received the treatment, and a control class that received conventional instruction without any intervention. This design aimed to isolate the independent variable's effect, ensuring any observed changes in learning outcomes could be reliably attributed to the treatment. The study had two objectives: first, to investigate the effect of crossword puzzle media on student learning outcomes, and second, to statistically evaluate the significance of differences between the experimental and control groups' post-test scores. Focusing on sound wave material for Grade VIII students at SMPS Giat Bangun Negeri, the research revealed that the experimental class attained a mean post-test score of 81.96, markedly exceeding the control class's mean of 77.60. This finding indicates that the eclipse-assisted crossword puzzle medium substantially improved student achievement. Furthermore, inferential analysis using a t-test confirmed the statistical significance of these results. The pretest comparison yielded a calculated t-value exceeding the 0.05 significance threshold, confirming no significant initial difference between groups and establishing baseline equivalence. Conversely, the post-test analysis yielded a calculated t-value below 0.05, justifying the rejection of the null hypothesis. It can therefore be confidently concluded that the experimental class performed significantly better than the control class on the post-test, confirming the effectiveness of the instructional treatment.

Keywords: *Digital learning media, Crossword Puzzle (Cross-Puzzle,) eclipse software, media learning outcomes.*

Corresponding Author:
Rina Sardiana Sari
Department of Physics Education, Universitas Sembilanbelas November Kolaka, Indonesia
Jl. Pendidikan No.24, RT.04/RW.04, Kel. Laloeha, Kec. Kolaka, Kab. Kolaka, Sulawesi Tenggara 93511
Email: rinasardian4@gmail.com

1. INTRODUCTION

Education constitutes a fundamentally critical sector for any nation, as it serves as a primary vehicle through which individuals may realize their full potential. This foundational importance is formally recognized within Indonesian legislation. Specifically, Article 1, Paragraph 1 of Law Number 20 of 2003 on the National Education System of the Republic of Indonesia defines education as a deliberate and systematically designed endeavor to foster a conducive learning environment and an active learning process.. Through this deliberate framework, students are empowered to actively develop their inherent capacities. The holistic development envisioned encompasses spiritual religious strength, self-discipline, individual personality, intellectual acuity, noble moral character, and practical skills. These competencies are deemed essential not only for the learners' personal fulfillment but also for their meaningful contribution to society, the nation, and the state. Ultimately, the learning process is designed to facilitate the comprehensive development of all the potential that students possess. (Fitriyani et al., 2018).

The study of natural phenomena belongs to the physics branch of the Natural Sciences (IPA) and holds a vital role within the realms of science and technology. Physicists emphasize hands-on learning to foster understanding and scientific thinking, which is why it is essential for school study. Understanding physics concepts, explaining relationships between concepts, and applying them broadly and accurately to solve problems is one of the objectives of physics learning. The achievement of this goal requires innovation in the learning process, which involves providing learning experiences that involve both mental and physical effort. These learning experiences are realized through student-centered approaches, models, and methods. The direct engagement of students in the learning process is anticipated to cultivate a heightened enthusiasm for learning. Furthermore, such active involvement assists learners in establishing meaningful connections between academic subject matter and real-life experiences. By bridging this gap, students are better positioned to comprehend the deeper significance of learning and to recognize its practical role and application in their everyday lives (Wahab, 2019).

According of the results of researchers' observations in the Bambaea area of Bombana Regency, the Minimum Competency (KKM) value for physics material in several schools varies; some are high and some are low. At SMPN 05 Poleang Timur, the KKM value for physics material is classified as high, namely 75, with an average of 37.57. This condition is inversely proportional to the SMPS Giat Bangun Negeri, where the KKM value for physics material is 65 with an average of 32.68. The elevated Minimum Mastery Criteria (KKM) scores observed at SMPN 05 Poleang Timur can be attributed to the integration of instructional media within the learning process. In contrast, instructional practices at SMPS Giat Bangun Negeri remain predominantly conventional, relying solely on textbooks and student worksheets (LKS). Consequently, an examination of the learning outcome data for Grade VIII A students at SMPS Giat Bangun Negeri reveals that their performance on the topic of sound waves was relatively poor. Consequently, the repeat scores were below the Minimum Completion Criteria (KKM) standard. For example, in class VIII B, 28 students passed the KKM, while 11 students scored >75 and 17 students did not achieve the KKM, with scores <75.

The importance of using learning media at this time can encourage students' interest or motivation in improving learning outcomes in accordance with school curriculum standards and to achieve the Minimum Competency Minimum (KKM). So according to observations in several schools, one of the schools that still needs to implement learning media is SMPS Giat Bangun Negeri. Where is the problem at SMPS Giat Bangun Negeri? So far teachers have only used books as learning media in class. So, the limited media causes students to feel bored while learning. To illustrate, instructors at SMPS Giat Bangun Negeri have thus far relied exclusively on textbooks as their primary instructional resource. However, when textbook usage is complemented by interactive learning media, the learning process becomes more engaging and enjoyable for students. Accordingly, there exists a clear need for interactive, game-based instructional media to optimize the educational tools currently employed by teachers. One such viable alternative is the implementation of digital crossword puzzle learning media assisted by Eclipse.

Through the use of crossword puzzle learning media supported by Eclipse, students are provided with an interactive and engaging tool that can enhance their understanding of complex concepts, it is hoped that students can learn more enthusiastically and without feeling bored because it has a word guessing game in it. Crossword puzzle learning media is learning that is combined with games (Wulan et al., 2019). Through the use of crossword puzzle learning media supported by Eclipse, learners engage in an activity that involves filling blank spaces comprising small boxes with letters to form words based on given questions, categorized into horizontal and vertical orientations. The relaxed and fun characteristics of crossword puzzles are very suitable for use as a learning medium, so it is hoped that students will not get bored in the learning process. This crossword puzzle learning media has never been used at SMPS Giat Bangun Negeri, so researchers want to use this crossword puzzle learning media in physics learning, especially sound wave material.

The sound wave material was chosen because it contains many important concepts and important terms such as frequency, amplitude, wavelength, resonance, echo, reverberation, sound intensity, and the Doppler effect. So this characteristic is very suitable to be integrated into crossword puzzles because students can remember and understand the concept through the introduction of terms and their definitions. and scientific terms that need to be understood and remembered by students (Slavin, R. E., 2018). In addition, this material is often considered difficult because it is abstract. Therefore, the application of crossword puzzle-based learning media (TTS) is expected to increase learning

motivation, strengthen conceptual understanding, and help students master important terms in the sound wave material in a more interesting and interactive way. Crossword puzzles also combine game-based learning elements so that the learning process becomes more enjoyable. It encourages students to actively seek answers, discuss, and connect concepts that have been learned (Suparno, P. 2013). In addition, crossword puzzles can be used as a means of practice, enrichment, and learning evaluation. By filling in keywords, students can repeat the material that has been studied so that learning retention increases (Arsyad, A., 2019).

In this study, researchers used the Eclipse application to create crossword puzzles to make it easier to create these puzzles with the help of Eclipse (Wati et al., 2022). Furthermore, the use of the Eclipse application for creating crossword puzzles remains infrequent. Based on the considerations outlined above, the researchers were motivated to conduct a study titled "The Effect of Using Digital Crossword Puzzle Learning Media Assisted by Eclipse on Student Learning Outcomes in Science Learning at SMPS Giat Bangun Negeri, Focusing on the Topic of Sound Waves." This research specifically focuses on investigating the impact of Eclipse-assisted digital crossword puzzle the influence of media on students' academic achievement within the domain of sound wave material. It is earnestly anticipated that the integration of such interactive media will stimulate student interest and foster active engagement throughout the learning activities. So, this research is expected to be an innovation for teachers for modern and interactive learning. Because according to Auer (2018), the Eclipse Crossword educational game is an active learning strategy rooted in the constructivist learning model.

2. METHODS

This study will employ an experimental research methodology, specifically a true experimental design combined with a quantitative approach. The primary objective is to determine the effect of using Eclipse-assisted digital crossword puzzle learning media on both student motivation and learning outcomes in the context of sound wave instruction. The research is scheduled to be conducted during the even semester of the 2024/2025 academic year at SMPS Giat Bangun Negeri Bambaea, located in Poleang Timur District, Bombana Regency, Southeast Sulawesi Province.

The study adopts a pretest-posttest control group design, which requires the involvement of two sample classes: a control class and an experimental class. The control class serves as the untreated group, receiving conventional instruction without any specific intervention, wherein the teacher delivers the learning material solely through traditional explanatory methods. In contrast, the experimental class functions as the treatment group, receiving instruction through the implementation of Eclipse-assisted digital crossword puzzle learning media.

The study's population consisted of 56 students in class VIII Science at SMPS Giat Bangun Negeri, which was divided into two classes during the even semester of the 2024–2025 school year. Class XIII B Science Methane, which included 28 students as the control group, and class XIII A Science Redox, which included 28 students as the experimental group, served as the study's sample. In this investigation, a random sample strategy was employed. Eclipse-assisted crosswords will be used in a learning process to treat the experimental class. Eclipse-assisted crosswords will not be used in the control class.

In order to evaluate student learning results, this study included pretest and posttest instruments. Ten questions were chosen for usage following validity and reliability testing based on the test findings, which included 15 questions with a 60-minute time allotment for each subject to complete. Descriptive and inferential analysis were the two types of analysis employed in this study. The average (mean) and standard deviation are included in descriptive statistical analysis using the following formula:

a. Calculate the average score for each assessment item using the following formula:

$$\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n} \quad \text{..... (1)}$$

Description:

$\overline{X}$ = Average student learning outcome score

x_i = Score per student

n = Number of students

b. Calculating Standard Deviation

The standard deviation can be calculated using the following formula:

$$S = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{X})^2}{n-1}} \quad \text{..... (2)}$$

Where:
S = Standard deviation
x_i = Score for each student
$\bar{X}$ = Average score for student learning outcomes
n = Number of students

Inferential data analysis was used to determine the degree of similarity between the sample results and the results obtained in the overall population using data normality tests and data homogeneity tests using SPSS 27.

Hypothesis testing was then conducted, consisting of an independent sample t-test. The formula used to implement the unpaired sample t-test is as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}\right)+\frac{1}{n_2}}}$$ (Fitriyani et al., 2018:249)

Note:
$\bar{x}_1$= Average ability of the control class
$\bar{x}_2$= Average ability of the experimental class
n_1= Number of students in the control class
n_2 = Number of students in the experimental class
s_1^2 = Variance of control group data
s_2^2 = Variance of experimental group data

3. RESULT AND DISCUSSION

This research was carried out at SMPS Giat Bangun Negeri, employing a pretest-posttest design that involved two classes: Grade VIII A as the control class and Grade VIII B as the experimental class. The primary objective of this study was to examine the effect of utilizing Eclipse-assisted digital crossword puzzle learning media in enhancing student learning outcomes. Prior to the administration of any treatment, both classes were given pretest questions designed to assess students' initial comprehension of the subject matter. Following the pretest, the researcher delivered instruction on sound wave material over the course of four meetings. The control class, VIII A, received instruction through conventional media, whereas the experimental class, VIII B, was taught using Eclipse-assisted digital crossword puzzle media. Upon completion of the learning process, both classes were administered posttest questions to evaluate their final achievement levels. Subsequently, the collected data were analyzed utilizing Microsoft Excel and SPSS 27 software. Based on the research findings and statistical tests conducted, the results indicated that there were discernible differences in student learning outcomes before and after treatment between the control class and the experimental class. These learning outcomes are presented in Table 1 below.

Table 1 shows the results of the descriptive analysis for the control class and experimental class in grades VIII A and VIII B at SMPS Giat Bangun Negeri.

	Pretest Control Class	Posttest Control Class	Pretest of Experimental	Posttest of Experimental Class
Number of Students	28	28	28	28
Total Value	1.260	2.173	915	2.295
The highest score	80	95	60	83
Nilai Terendah	20	65	25	70
Mean	45,00	77,60	32,67	81,96
Standard Deviation	14,29063	9,382523	15,41777	7,66658

Based on the descriptive analysis findings for both the control and experimental classes, it is clear that the comparison of the mean pretest scores between the two groups shows a substantial difference.

The mean pretest score attained by the control class was higher than that of the experimental class, with the control class achieving an average of 45.00 and the experimental class recording an average of 32.67. At this stage, neither class had received any instructional treatment. The pretest scores of student learning outcomes for the control class are displayed in Table 1. The data indicate that out of 28 students, 20 obtained scores within the range of 0–54, six students achieved scores between 55 and 64, and two students fell within the 65–74 range. In the experimental class, all 28 students attained pretest scores within the 0–54 range. This distribution demonstrates that students' initial understanding of the material was considerably low prior to the administration of treatment, with the majority failing to reach scores above 55. The research findings further revealed that the standard deviation of pretest scores in the control class was 14.29063, whereas in the experimental class it was 15.41777. This statistical discrepancy suggests that the dispersion or range of scores in the control class was more varied than that of the experimental class. Put differently, the pretest scores of students in the control class demonstrated greater heterogeneity, whereas those in the experimental class were relatively more homogeneous in character.

The results of this study showed that the control class obtained a mean post-test score of 77.60, while the experimental class achieved a considerably higher average of 81.96. This difference suggests that, after the treatment was administered, the experimental class exhibited greater learning achievement than the control class, indicating a more pronounced improvement within the experimental group. Furthermore, the results showed that the standard deviation of post-test scores in the control class was 9.382523, while in the experimental class it was 7.66658. This finding suggests that the distribution of scores in the control class was broader, reflecting more widespread variation in learning outcomes. Conversely, the experimental class exhibited a narrower score distribution, indicating that student achievement tended to be more uniform following the treatment. Consequently, this substantiates that the Eclipse-assisted crossword puzzle learning medium implemented in the experimental class proved highly effective in enhancing the overall comprehension of all students collectively, rather than benefiting only a select portion. This effectiveness was particularly evident in the instruction of sound wave material.

Subsequent to computing the mean, maximum and minimum values, and standard deviation, the data were subjected to a normality test utilizing the Kolmogorov-Smirnov method within the SPSS 27 software. The results of this normality assessment are presented in Table 2

Table 2. Results of the Normality Test Using the Kolmogorov-Smirnov Test with the Help of SPSS 27 Software

Tests of Normality

		Kolmogorov-Smirnov[a]		
	Class	*Statistic*	*df*	*Sig.*
Learning outcomes	*Pretest of Experimental*	.212	28	.002
	Posttest of Experimental	.154	28	.088
	Pretest of Control	.139	28	.179
	Posttest of Control	.111	28	.200*

**. This is a lower bound of the true significance.*

a. Lilliefors Significance Correction

Based on the data presented in Table 2, the normality test employing the Kolmogorov-Smirnov method yielded the following results. The experimental class pretest for learning outcomes prior to media implementation produced a significance value of 0.002, which falls below the 0.05 threshold ($0.002 < 0.05$). In contrast, the experimental class posttest after media utilization recorded a significance value of 0.088, exceeding the 0.05 criterion ($0.088 > 0.05$). Regarding the control class, the pretest learning outcomes exhibited a significance value of 0.179, meanwhile, the post-test yielded a significance value of 0.200, which also exceeds 0.05 ($0.200 > 0.05$). Based on the data from both classes, it can be inferred that the data follow a normal distribution. Subsequently, a test of homogeneity of variances, commonly known as Fisher's test, was performed to ascertain whether the two sample groups were drawn from populations with equivalent variances. The homogeneity assessment in this study was carried out utilizing both SPSS 27 software and Microsoft Excel, and the findings confirmed

that the variances of both groups originate from a homogeneous population. The results of the manual computations executed via Microsoft Excel are presented below.

Table 4. Results of Manual Calculation of the Homogeneity Test Using Microsoft Excel

	Pretest of Experimental Class and Control Class	Posttest of Experimental Class and Control Class
F_{hitung}	1,163	1,497
F_{tabel}	3.17	3.17

Drawing upon the research findings obtained through inferential analysis utilizing prerequisite tests, namely, the normality test and the homogeneity test of the data, the following conclusions may be drawn. The normality test, performed using the Kolmogorov-Smirnov method in SPSS software, produced results indicating that the pretest and post-test data for both the experimental and control classes yielded significance values exceeding 0.05. Consequently, it can be confirmed that the data from both classes follow a normal distribution. With regard to the homogeneity test, manual calculations performed using Microsoft Excel led to the conclusion that in the Fisher test, or the two-sample variance test, the F-calculated values for both the pretest and post-test data obtained from the experimental class and the control class were less than the F-table values. This confirms that both samples originated from a homogeneous population. Furthermore, the homogeneity test conducted using SPSS 27 software yielded significance values for both the pretest and posttest of the experimental-control classes that exceeded 0.05, thereby corroborating that the data presented in the table are homogeneous in nature.

The results of the independent sample t-test, performed using SPSS to compare the experimental and control groups, yielded a significance value of 0.144, which is above 0.05. Consequently, H_0 is rejected and H_a is accepted, indicating that a significant difference exists between the pretest results of the experimental and control class students on the topic of sound waves. The mean pretest score attained by the experimental class was 32.67, whereas the mean post-test score for the same class reached 81.96. The difference test was subsequently performed on the post-test values of both the control and experimental classes using a t-test, or independent sample t-test. The analysis revealed that the two-tailed significance value fell below 0.05, thus resulting in the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_a). This finding indicates that the implementation of Eclipse-assisted digital crossword puzzle media produced a statistically significant effect on the learning achievement of Grade VIII students at SMPS Giat Bangun Negeri in the topic of sound waves, as reflected by the marked enhancement in student performance. These outcomes align with earlier research undertaken by Valine Febriansari (2021), titled "The Influence of Crossword Puzzle Media on Student Learning Outcomes in Religious Subjects of Class V at Muhammadiyah 4 Elementary School Bandung," which determined that crossword puzzle instructional media exerted a favorable impact on student learning outcomes, as evidenced through assessments administered to both the experimental and control groups.

Drawing upon the outcomes of the hypothesis test conducted through the independent sample t-test—a statistical procedure employed to compare groups exposed to differing treatments—the subsequent interpretations may be derived. The manual calculation results indicate that in the pretest t-test comparing the control and experimental classes, the obtained t-value exceeded the 0.05 significance threshold. Consequently, it may be inferred that no statistically significant difference was present between the pretest scores of the experimental and control groups prior to the administration of the treatment. In contrast, the post-test t-test yielded a computed t-value below the 0.05 threshold, indicating that the experimental class demonstrated significantly higher post-test achievement compared to the control class. These results are further supported by the SPSS computations, in which the pretest comparison between the experimental and control groups produced a significance value exceeding 0.05, thereby affirming the lack of a significant initial disparity between the two groups. Meanwhile, the post-test comparison yielded a significance value below 0.05, thus validating the superior performance of the experimental class. This outcome aligns with research conducted by Wirahyuni (2017), which asserted that effective learning media are those capable of stimulating enthusiasm and motivation to learn, as evidenced by improved student learning outcomes.

Consequently, the subject matter becomes more comprehensible, particularly the sound wave material taught using Eclipse-assisted crossword puzzle learning media, leading to more satisfactory student achievement. Furthermore, previous research by Wana (2021) indicated a substantial impact of crossword puzzle-based instructional media on student learning outcomes, as indicated by a significance value of 0.879 < 0.05. In summary, the utilization of Eclipse-assisted digital crossword puzzle learning media in science instruction at SMPS Giat Bangun Negeri exerts a substantial influence, as reflected by the higher mean scores attained by experimental class students compared to their control class counterparts. Moreover, this instructional medium not only enhances learning outcomes but also fosters increased learning enthusiasm, improves problem-solving abilities, strengthens memory and conceptual understanding, creates an enjoyable learning atmosphere, trains critical and logical thinking skills, and enriches vocabulary and literacy, particularly in the context of sound wave material.

4. CONCLUSION

The digital crossword puzzle learning media, supported by Eclipse, demonstrated a significant and profound impact on science learning outcomes at SMPS Giat Bangun Negeri, particularly on sound waves. This substantial effect was empirically demonstrated by the superior mean post-test scores achieved by the treatment class in comparison to those of the control class. These findings demonstrate that this interactive digital media serves as a highly effective tool for enhancing student mastery and engagement in science learning, particularly on sound waves.

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BIOGRAPHIES OF AUTHORS

	**Rina Sardiana Sari, S.Pd., M.Sc** She serves as a lecturer in Physics Education at the Faculty of Teacher Training and Education, Sembilanbelas November Kolaka University. Her research concentrates on material physics and physics education. She can be contacted at email: rinasardian4@gmail.com
	**Sutrisnawati Mehora, S. Si., M.PFis** is a lecturer in the Physics Education Study Program, Faculty of Teacher Training and Education, Universitas Sembilanbelas November Kolaka, Indonesia. Her research focus on Earth physics and physics education. She can be contacted at Email: mehora130317@gmail.com
	**Riska Novianti** , is an undergraduate student in the Physics Education Study Program, Faculty of Teacher Training and Education, Universitas Sembilanbelas November Kolaka, Indonesia. Emal: riskanovianty727@gmail.com