The Effect of Using Student Worksheets with A STEM Approach on Vibrations, Waves, and Sound Material on Learning Outcomes of Class VIII Students

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Abstract: *This research aims to determine the effect of using STEM-based student worksheets on Vibrations, Waves and Sound material on learning outcomes of class VIII students. This research was quasi-experimental with a pretest-posttest control group design. This research was carried out from March to April at SMP N 3 Harian. This research uses a test instrument in the form of 20 multiple-choice questions and a non-test in form of a student response questionnaire to STEM-based student worksheets of 15 statements. The sampling technique used in this research was random sampling consisting of 60 students, namely 30 students in class VIII B as experimental class and 30 students in class VIII A as a control class. Hypothesis testing uses the t-test with research results* $t_{count} > t_{table}$*. Based on the research result, it can be concluded that there is an influence on learning outcomes using student worksheets with a STEM approach on vibrations, waves, and Sound material in class VIII.*

INTRODUCTION

The 2013 curriculum for natural sciences subjects at the junior high school level was developed as integration-based subjects, not as scientific discipline education. Science subjects are application-focused; they foster critical thinking, curiosity, and the development of responsible and caring attitudes toward the natural and social environments (Ariyana et al., 2018; Ministry of Education and Culture, 2013). In compliance with Government Regulation 68 of 2013 regarding organizing the junior high school curriculum, it envisaged that science education could be provided holistically through integrated science. Holistic learning is interdisciplinary learning that links various science fields in science learning. Integrated science refers to integrating multiple dimensions, specifically the domains of attitudes, knowledge, and abilities (Ministry of Education and Culture, 2013).

Numerous elements significantly impact how well the learning process achieves educational objectives from a technical and non-technical standpoint. For education to be successful, more than just teachers and students are needed; additional factors must also be in place (Sumar & Razak, 2016). The teaching and learning process is a separate communication

process where teachers and students exchange ideas to develop ideas and understanding. Miscommunication often arises, and deviations occur, so communication is not effective and efficient, partly due to students' unpreparedness, lack of interest, and passion. This form of creativity can be seen through student worksheets (Achdiyat & Andriyani, 2016).

Student worksheets, abbreviated as LKPD, are learning resources containing activities and exercises that help students simplify and improve their understanding of learning material. The contents are designed and developed according to their conditions and situations. In addition, student worksheets create interactive learning when used in teaching and learning activities. Another aspect that educators need to pay attention to in encouraging the success of the learning process is the approach to learning. The learning approach is essential to the learning process (Ayu et al., 2018). Teachers use a learning conceptual framework to help students understand and readily accept learning objectives. One way to make a breakthrough in scientific education is to use the STEM (Science, Technology, Engineering, and Math) approach.

STEM is a popular learning approach worldwide that is effective because it combines four main areas of education: science, technology, engineering, and math (Dewi, 2019). When STEM knowledge and skills are incorporated into the teaching and learning process in an integrated way, they have an important and positive influence on student learning outcomes (Fithri et al., 2021).Using a STEM approach to learning with student worksheets can help students apply what they learn in the classroom to real-world phenomena, which will enhance their learning outcomes (Samal et al., 2021). Student worksheets with a STEM approach can help students understand the concepts of learning material, and students can also relate the information obtained to everyday life (Hadiati et al., 2021).

Learning outcomes include cognitive, skills, and affective. Cognitive learning outcomes relate to knowledge, understanding, and mastery of concepts. Psychomotor learning outcomes involve physical skills and motor abilities. Affective learning outcomes are related to changes in students' values, attitudes, and beliefs.

The results of interviews with school teachers showed that most students could not master the concepts in science learning material, one of which was vibration, wave, and sound. Based on this description, the researcher is interested in conducting research on "The Effect of Using Student Worksheets with a STEM Approach on Vibrations, Waves and Sound Material on the L earning Outcomes of Class VIII Students" at SMP N 3 Harian for the 2023/2024 academic year.

METHOD

This type of research includes experimental research, namely research to determine whether or not something used has effects on students. The study was conducted at SMP Negeri 3 Harian in March – April 2017.The population of this study was all student of the eight grade. Sample were taken trough random sampling technique. This research involved two classes: one experimental class and one control class. The experimental class was treated using student worksheets using a STEM approach, while the second class was treated using a conventional learning model. So, the research design used is a quasi-experimental design. Student learning outcomes from implementing this treatment are obtained by giving students tests consisting of an initial test and a final test. The design used is a pretest-posttest control group design.

The data in this research were in the form of quantitative and qualitative data. Quantitative data was in the form of learning outcomes from pretest-posttest. Qualitative data was in the form of questionnaires toward the learning through the student worksheet with a STEM Approach.

The data analysis technique in this research were normality test, homogeneity test and

hypothesis test. Data normality testing was carried out using the Liliefors Test. If $L_{count} < L_{table}$, the data is usually normal distributed. Testing homogeneity by comparing $F_{count} < F_{table}$ means the data is homogeneous. Furthermore testing a hypothesis to get a conclusion using t-test, namely accepting or rejecting the hypothesis with $t_{count} > t_{table}$ (H_a accepted).

RESULT AND DISCUSSION

Research Result

Data on learning outcomes of experimental class and control class students can be obtained through pretest and posttest. The pretest questions are asked at the beginning of the lesson, and the posttest is conducted at the end of the lesson through a written test. The pretest and posttest questions are multiple-choice with four answer choices: a, b, c, and d, totaling 20 questions.

a. Normality Test

The Liliefors test is carried out to determine whether the data obtained from the population is normally distributed. The normality test criteria are that H0 is rejected if L_{count} is greater than L_{table}, and H_0 is accepted if L_{count} is smaller than L_{table}. Accepting H_0 means the data comes from a population with a normal distribution, whereas if H_0 is rejected, it means the research data comes from a population with an abnormal distribution. The results of the normality test using the Liliefors test are shown in Table 1.

Table 1. Normality test Calculation Result

Data	Class	L_{count}	L_{table}	Category
Pretest	Experiment Class	0.138	0.161	Normal
	Control Class	0.104		
Posttest	Experiment Class	0.148		
	Control Class	0.146		

The results of data analysis in Table 4.4 show that the data normality test in the experimental class pretest obtained an L_{count} of 0.138 < 0.161, the same as the control class obtained an L_{count} of 0.104 < 0.161. The data normality test in the experimental class posttest obtained L_{count} of 0.148 < 0.161, and the control class obtained L_{count} of 0.146 < 0.161. From these data, it can be concluded that both classes' pretest and posttest data are typically distributed.

b. Homogeneity Test

The homogeneity test is carried out using the F-test. The criteria for the homogeneity test are that H_0 is rejected if F_{count} is greater than F_{table}, and H_0 is accepted if F_{count} is smaller than F_{table}. Accepting H_0 means that the data comes from a homogeneous population, whereas if H_0 is rejected, the research data comes from a population that has a non-homogeneous distribution. The results of the homogeneity test using the F-test are shown in Table 2

Table 2. Homogeneity test Calculation Result

Data	Class	Variant	F_{count}	F_{table}	Category
Pretest	Experimental Class	138.76	1.01	1.86	Homogeneous
	Control Class	140.23			
Posttest	Experimental Clas	70.57	1.25		
	Control Class	101.03			

From the results of calculations on the pretest data, it was obtained that F_{count} = 1.01 while

F_{table} = 1.86, so $F_{count} < F_{table}$. From the posttest data, it was obtained that F_{count} = 1.25 and Ftable = 1.86 so that $F_{count} < F_{table}$. So, it can be concluded that the data is homogeneous.

c. Hypothesis Test

Hypothesis testing used the independent t-test with the experimental class using LKPD with a STEM approach. In contrast, the control class did not use LKPD with a STEM approach with a significant improvement test qualification (α) = 0,05. If Sig (2-tailed) > 1/2 α then H_0 rejected, If Sig(2-tailed) < 1/2 α then H_a accepted. The t-test is used to see the effect of using students' worksheets with the STEM approach on vibrations, waves, and sound material in class VIII SMP N 3 Harian. The t-test of the post-test data hypothesis is shown in Table 3.

Table 3. Hypothesis Data Posttest

Class	t_{table}	t_{count}	Explain
Experimental	2.002	2.237	H_0 rejected
Control			

Based on the calculation results, it can be concluded that H0 is rejected because of the count $t_{count} > t_{table}$ (2.237 > 2.002) and significance test value < significance level value (0.023 < 0.05). So, the average posttest score for the experimental class is not the same as the average posttest score for the control class, so it can be noted that there is an influence of using LKPD with a STEM approach on the learning outcomes of class VIII students at SMP N 3 Harian on Vibration, Waves and Sound material.

Discussion

The research results found that in the pretest before being treated with students using LKPD with a STEM approach, the highest score obtained by students was 65, and the lowest was 10. After being treated using LKPD with a STEM approach, the highest posttest score obtained by students was 100, and the lowest score was 50. The percentage increase in student learning outcomes for those who use LKPD with the STEM Approach can be seen in Figure 1.

Figure 1. Average of Experimental and Control Class



Based on Figure 1, it can be seen that the learning outcomes of experimental class students have improved more than those in the control class. The average pretest score for the experimental class was 38.17, and the posttest was 80.33, while in the control class, the average pretest score was 36.67, and the posttest was 74.33. The difference between pretest and posttest scores in the experimental class was 42.16, while in the control class, the difference between pretest and posttest scores was 37.66. Increasing student learning outcomes is indicated by increasing average test scores. Based on the description above, using LKPD with a STEM approach influences student learning outcomes.

CONCLUSION

The conclusions obtained from this research are as follows:

1. There is an influence of using STEM based student worksheets to he learning outcomes of Class VIII students at SMPN 3 Harian on Vibration, Waves and Sound material. The learning outcomes of class using student worksheet
2. Student responses who learning STEM student worksheet obtains a good response from students.

BIBLIOGRAPHY

Achdiyat, M., & Andriyani, F. (2016). Hasil Belajar Matematika Ditinjau dari Model Pembelajaran Teams Assisted Individualization (TAI). *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *6*(3), 246–255. https://doi.org/10.30998/formatif.v6i3.996

Ariyana, Y., Pudjiastuti, A., Bestary, R., & Zamromi, Z. (2018). Buku Pegangan Pembelajaran Keterampilan Berpikir Tingkat Tinggi Berbasis Zonasi. *Direktorat Jendral Guru Dan Tenaga Kependidikan*, 1–87.

Ayu, I. G., Dewi, M., Purnami, N. M., & Sisdyani, E. A. (2018). *Learning Strategy And Academic Achievement Of Student : An Exploratory Study*. *8*(6), 45–57. https://doi.org/10.9790/7388-0806024557

Dewi, AP (2019). Implementation of Student Worksheets (LKPD) Based on Science, Technology, Engineering, and Mathematics (STEM) on Business and Energy Material to Improve Critical Thinking Ability at SMA Muhammadiyah 7 Yogyakarta.

Fithri, S., Pada, A. U. T., Artika, W., Nurmaliah, C., & Hasanuddin. (2021). Implementasi LKPD Berbasis STEM untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik Pendahuluan. *Jurnal Pendidikan Sains Indonesia*, *9*(4), 555–564. https://doi.org/10.24815/jpsi.v9i4.20816

Hadiati, S., Matsun, M., Sari, IN, Angraeni, L., Sukardi, E. & Pramuda, A. (2021). Improving the Capabilities of Physics Teachers in the New Normal Era through Easy and Effective Online Physics Experimentation Training. Surya Abdimas. 5(1).

Kemendikbud. (2013). *MATERI PELATIHAN GURU SMP / MTs*.

Samal, N., Ramlawati & Rusli, MA (2021). Application of STEM-Based LKPD to Improve Learning Outcomes of Class VII Students at SMPN 8 Makassar. In Proceedings Of The National Seminar On Science Education II.

Sumar, WT & Razak, IA (2016). Learning Strategies in Implementing Soft Skills Based Curriculum. Yogyakarta: Deepublish.