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Analysis of student problem-solving through science worked examples in the context of Wonosobo local wisdom

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ABSTRAK

This research regarding applying science-worked examples in the context of local wisdom to improve students' problem-solving abilities is motivated by students' low problem-solving abilities, especially in science-physics learning. Students' standard problem-solving abilities are due to the lack of practice in the learning process. Through the application of Science Worked Examples, it is hoped that it will be able to help students in the learning process so that they can grow students' problem-solving abilities. The type of research used in this research is a quantitative method with an experimental approach. The subjects used in this research were class VIII A as a control sample and class VIII B as a testing sample at SMP N 2 Garung. The research results showed an increase of 31.9% in the control sample using conventional teaching materials and a rise of 44.1% in the experimental sample using Science Worked Examples. The effectiveness obtained using the N-Gain test was 1.38, so it was concluded that there was a difference in effective improvement where learning with worked example science teaching materials was stated to be more effective.

Keywords: Local wisdom, problem-solving abilities, science worked example

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INTRODUCTION

Problem-solving abilities and understanding concepts are often understood as two things that educators hope their students will master when studying science, including physics. When a student can answer the questions, it does not mean his conceptual abilities are exemplary. Likewise, if a student has a good grasp of a concept, they will not necessarily be able to use that knowledge in solving the problems given. These two abilities are closely related to each other. Problem-solving skills are one of the two abilities needed in facing current developments. Developing problem-solving skills is an expected goal in education in the 21st century (Gunawan et al., 2020). Cases in the field show that students have not been able to master

problem-solving skills due to the lack of training provided (Saidah & Nurita, 2017; Ermawan & Fauziah, 2023; Rahayu et al., 2021). Without efforts to develop problem-solving skills, it isn't easy to expect the younger generation to compete in the future. Therefore, students must always be given problem-solving skills to be honed continuously.

Education research, primarily cognitive, understands that regular problem-solving training will foster experience in choosing existing solutions (Chu & Macgregor, 2011) as an ability to live daily life and the world of work. So, it can be concluded that students' problem-solving skills in physics lessons can grow if trained regularly. The results of several studies suppose that students who are trained in problem solving regularly will be superior to students who are not trained in their learning outcomes (Gunawab et al., 2020; Riyadi et al., 2021; Renkl, 2014).

Exercises given to students to develop problem-solving abilities can be shown as worked examples. Sweller defines a worked example as a learning strategy that provides questions and answers from an expert (teacher) for students to learn from (Adi, 2023). In line with Sweller, Renkl et al. define worked examples as a learning process combining problem-solving and providing examples of questions and answers (Irwansyah & Retnowati, 2019). Worked examples make it easy for students to give answers to questions by analyzing and following the solution stages offered.

Problem-solving abilities and science learning are closely related to each other, considering that science is a subject that requires detailed problem-solving. Apart from the problem-solving skills needed in science learning, relating science material to the surrounding environment is also necessary to introduce regional local wisdom to the nation's next generation. It is essential to introduce local wisdom to students to develop a spirit of character guided by the local wisdom values of their region in social life in society (Chairul, 2019). The problem in the field is that the values of local wisdom have experienced a shift reflected in the fading of the order agreed upon by the community and practiced collectively (Hidayati, 2016). The change in local wisdom in society needs particular attention, one of which is collaborating with local wisdom in education through the learning process.

Previous research has discussed the application of worked examples in the science learning process, especially in physics subjects. Much of the research that has been carried out only focuses on developing worked examples or applying worked examples in the learning process without linking them to the environment or local regional wisdom. Several studies that discuss the application of worked examples in the physics learning process include Yadiannur and Supahar (2017), who developed Worked Examples for electrical circuits. Adlina and Supahar (2019) set worked examples on kinematics material with the help of an Android application.

Referring to the findings and results of studies that have been carried out, it is necessary to carry out research by applying worked examples in science-physics subjects in collaboration with local wisdom. This research will use science worked examples in the context of Wonosobo local wisdom to determine the problem-solving skills of junior high school students.

RESEARCH METHODS

The type of research used is quantitative, using an experimental approach. The experimental approach design used was a true experimental design, where this design compared the pre-test and post-test scores in two random groups. Then, it looked at the differences between the two test classes (Sugiyono, 2017). The research design is presented in Table 1.

Table 1. Experimental design

Class	*Pre-test*	*Treatment*	*Post-test*
Experiment	A_1	X_1	A_2
Control	B_1	X_2	B_2

A1 is the initial test for the experimental class, A2 is the final test for the experimental class, X1 is the experimental class treatment by applying Science Worked Example teaching materials, B1 is the initial test for the control class, and B2 is the final test for the control class.

The research was conducted at SMP N 2 Garung Wonosobo, and the population used was all class VIII at the school. In contrast, the research sample was class VIII A as the experimental class and VIII B as the control class. This research is based on three stages, including the study's preparation, implementation, and final stages (FITK, 2021). The preparation stage examines appropriate theories as a form of preparing the learning process that will be carried out, analyzing the material that will be used, compiling the right learning tools, compiling the necessary instruments, and analyzing the instruments that have been prepared. The implementation stages contain a pre-test as an initial test for students on test subjects, providing treatment, namely applying worked example science teaching materials to the experimental class. In contrast, the control class uses conventional teaching materials and a post-test to measure students' abilities after treatment. The final stage of research involves processing field data and drawing conclusions based on the data.

The data collection in this research used questionnaires and tests. The questionnaire contains questions or statements related to the research problem, which are in sheet form (Prawiyogi et al., 2021). The questionnaire used contained questions about students' responses to applying science worked examples in the context of Wonosobo local wisdom. Test questions are used to determine the quality of students' problem-solving.

Validity and reliability tests, normality and homogeneity, hypothesis, and gain, are some data analyses used in analyzing research data. Validity is a test that measures whether the instrument prepared is valid or not (Hayati & Lailatussaadah, 2016). Instruments that are declared valid can be used to collect research data. The purpose of the validity test is to find out that the instrument that has been prepared can be used to measure what should be measured (Lestiyanawati & Adi, 2021). Product moment correlation is used in this research to analyze the instrument's validity. The test selection is based on the type of instrument developed, namely essay questions for tests and questionnaires with more than one correct answer (Yusup, 2018). The product-moment correlation equation can be seen in Equation 1 below

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)^2\}}} \quad (1)$$

The instrument is concluded to be valid if r count > r table. The validity coefficient value ranges from -1.00 to +1.00. A coefficient value of -1.00 indicates that individuals in the

instrument test and criteria test have no relationship. In contrast, a coefficient value of +1.00 means that there is a relationship between the instrument test and the requirements (Yusup, 2018).

Reliability testing analyzes whether research instruments can produce similar data or not after repeated use. Reliability testing aims to obtain a research instrument that has reliable value (Budiastuti & Bandur, 2018). The reliability test used in this research is Cronbach's Alpha. The selection of this test is based on the instrument used having more than one correct answer option (Adamson & Prion, 2013). The Cronbach's alpha equation is as follows (Sugiyono, 2017)

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2}\right) \quad (2)$$

The instrument is concluded to be reliable if the calculated alpha coefficient is between 0.71 and 0.90 (Yusup, 2018). If the coefficient calculation value is <0.70, it is recommended to revise reducing items with a low correlation coefficient. On the other hand, if the calculated value is >0.90, it is recommended to eliminate items with the same correlation coefficient (Tavakol & Denick, 2018).

The Normality Test determines whether research data is normally distributed or comes from a normal population. Liliefors analysis was used to assess the normality of research data. This analysis was chosen because the trial subjects were <50 people and were tested in two or comparative trial classes (Usmadi, 2020). Homogeneity functions to analyze differences in populations consisting of 2 or more. Homogeneity determines populations with the same or different values (Usmadi, 2020). Lavene's analysis is used to analyze data homogeneity. The selection of this test is based on the assumption that the population has the same variance.

Hypothesis testing is a test used to prove the research hypothesis raised. The paired t-test was used to analyze the hypotheses in this research. This test was chosen because this research wanted to know the differences between two research subjects (Tarumasely, 2020). The gain test determines the increased value of a research-dependent variable. The dependent variable in this research is students' problem-solving abilities. The equation used to analyze the gain value is shown in Equation 3 below (Kurniawan & Hidayah, 2021).

$$n_{\text{Gain}} = \frac{\text{Postest Score} - \text{Pretest Score}}{\text{Max Score} - \text{Pretest Score}} \text{X } 100 \quad (3)$$

Interpretation of gain values is classified in Table 2 (Ramdhani et al., 2020)

Table 2. N Gain Score Criteria

N-Gain	Criteria
100-71%	High
70-31%	Currently
30-1%	Low

RESULTS AND DISCUSSION

Validity Reliability of Instrument Analysis

An instrument is said to be valid if $r_{count} > r_{table}$. It is concluded that the instrument is declared valid (Arikunto, 2010). It is known that the r_{table} value = 0.468. A recap of the results of instrument validity calculations can be seen in Table 3.

Table 3. The result of the Validity Instrument

Item	r_{count}	r_{table}	Result
1	0,737	0,468	Valid
2	0,654	0,468	Valid
3	0,735	0,468	Valid
4	0,622	0,468	Valid
5	0,625	0,468	Valid
6	0,601	0,468	Valid
7	0,801	0,468	Valid
8	0,875	0,468	Valid
9	0,548	0,468	Valid
10	0,645	0,468	Valid

The data in Table 3 can be concluded that the rcount value for all items is more significant than r_{table} ($r_{count} > r_{table}$), so it can be seen that all assessment items are declared valid (Arikunto, 2010).

This research analyzed reliability using Cronbach's alpha with the SPSS for Windows application. Reliability calculations are presented in Table 4.

Table 4. The result of the Reliability Instrument

Question Items	Reliability Result	Result
10	0,817	High

Based on Table 4 above, it can be concluded that the results of the instrument reliability analysis are 0.817 with high criteria. These results are by Nunnaly, Kaplan, and Succuzo's theory that when the reliability coefficient is 0.7-0.8, it is high enough for basic research.

Hypothesis Analysis

This research aims to analyze differences in test subjects on the dependent variable. They paired t-test functions to determine differences in problem-solving abilities of SMP N 2 Garung students in the application of Science Worked Examples in the context of Wonosobo local wisdom. Paired t-test was analyzed using the SPSS for Windows application to make calculations easier. The research results are declared to have a significant difference when t count > t table with the significance level of 5% and p-value < 0.05. A recap of the hypothesis analysis calculations can be seen in Table 5.

Table 5. The result of Paired t-test

Subject	Average	Calculated Value	Table Value	P
Post-test Experiment Post-test Control	60 44,16	2,805	2,012	0.007

Table 5 shows that the calculated value is 2.805, the table value with degrees of freedom is 24 + 24 – 2 = 46, and the significance used is 5% = 2.012. From the calculation results, it is known that 2.805 > 2.012 and the p-value is 0.007 < 0.05 (Riduwan, 2006), so it is concluded that there is a difference in the problem-solving abilities of students at SMP N 2 Garung in the application of Science Worked Example teaching materials in the Wonosobo local wisdom context with conventional teaching materials.

Gain Test

The gain test is used to analyze the final state of students. Post-test and pre-test values as a basis for analyzing gain increases. This test was diagnosed with the help of SPSS for Windows. A recap of the improvement calculation results is in Table 6.

Table 6. The result of Problem-Solving Increase

Subject	Average before research	Average after research	Gain	Result
Experiment	27,08	60	0,441	Currently
Control	17,91	44,16	0,319	Currently

Based on Table 6, it can be seen that the increase in problem-solving was in the moderate category for the control class, with a score of 0.441. The rise in problem-solving in the moderate category was 44.1% for experiments. The effectiveness of learning is 1.38 > 1, so it can be concluded that there is a difference in effective improvement where learning with worked example science teaching materials is more effective than learning with model teaching materials (Hake, 1999).

This research was conducted to determine the differences and increase students' problem-solving abilities in learning Vibrations, Waves, and Sound at SMP N 2 Garung by applying Science Worked Examples. Problem-solving ability is part of the thinking process used in solving problems. Students' problem-solving abilities can be seen from the achievement of indicators.

The type of research used is quantitative with a True Experimental Design with the Pre-Test and Post-test Control Group Design method. The initial stage of this research was testing the instrument, followed by data collection at SMP N 2 Garung with 2 test samples, namely VIIIA and VIIIB, which were used as control samples and experimental samples, respectively. The two research samples were given different treatments, and the control sample was given ordinary teaching materials, while the experimental sample was given science worked examples teaching materials. The data collected in this research is to prove whether the hypothesis raised is acceptable or not.

Based on the research, the results of hypothesis testing showed that $t_{count} > t_{table}$. From the calculations, it is obtained that $t_{count} = 2.805$, then the calculated value is compared with the table value with a significance level for the table value set at 5% = 2.012. The data provisions are read if the calculated value is greater than the table value. Hypothesis a (Ha) is accepted, and Hypothesis 0 (H0) is rejected. Based on the recap of research data, it was found that the calculated value was more significant than the table value, with the significance level used being 5%, so that hypothesis a (Ha) was accepted. So, it can be concluded that there are differences in students' problem-solving abilities in applying science worked examples in the context of Wonosobo local wisdom.

To increase the accuracy of the data, an improved test was carried out on students' problem-solving abilities with N-Gain for both control and experimental samples. The results obtained for the increase for the two samples were 31.9% for the control and 44.1 for the experiment, both in the medium category. The effectiveness of learning in this study was 1.38, where this value is more than 1, so it can be concluded that there is a difference in effective improvement where learning with worked example science teaching materials is more effective than learning with model teaching materials.

The application of Science Worked Examples in the context of Wonosobo local wisdom is a breakthrough at SMP N 2 Garung so that students are interested in participating in learning because in the teaching materials, there is not only exciting learning material, but there are also interesting Wonosobo local wisdom values.

CONCLUSION

Based on research that has been conducted regarding "Application of Science Worked Examples in the Context of Wonosobo Local Wisdom to Improve the Problem-Solving Abilities of SMP N 2 Garung Students," it can be concluded that the application of Science Worked Examples in the Context of Wonosobo local wisdom for students of SMP N 2 Garung significantly shows its effectiveness in improving students' problem-solving abilities. There are differences in the problem-solving abilities of students at SMP N 2 Garung who use science worked examples teaching materials and conventional teaching materials. This is demonstrated by hypothesis testing with a t_{count} of 2.805. Next, the t table value with degrees of freedom is 46 and a significance of 5% = 2.012. The calculation results show that 2.805 > 2.012, and the p-value is 0.007 < 0.05. The magnitude of the increase in problem-solving ability for the control sample was 0.319 in the medium category, and the experimental sample was 0.441 in the medium category. The effectiveness of applying science worked examples is 1.38 > 1, so it can be concluded that there is an effective difference where learning with science worked examples teaching materials is more effective.

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