JISE 9 (2) 2020 : 203 – 209

Journal of Innovative Science Education

http://journal.unnes.ac.id/sju/index.php/jise

Remediation of Sound Wave Material Assisted by Sasando to Improve Understanding of Concepts and Analytical Thinking Abilities

Afrianus Gelu ✉, Putut Marwoto, Mahardika Prasetya Aji

Universitas Negeri Semarang, Indonesia

Article Info

Article History :
Received September 2019
Accepted October 2019
Published August 2020

Keywords:
Sasando, Understanding of Concepts, Analytical Thinking

Abstract

Physics learning in sound wave material by utilizing sasando musical instruments is one of the learning experiences that allows students to develop cognitive, affective, and psychomotor abilities. Through sasando, sound material can be learned, for example the concept of factors that affect the frequency, resonance, and intensity of sound. The purpose of this study was to determine the effect of applying PBL learning models assisted by sasando musical instruments to the students understanding of concepts and analytical thinking ability. Data collection techniques are carried out through observation and tests. The results of data analysis showed that PBL learning strategies assisted by sasando musical instruments had an effect on students' both conceptual understanding and analytical thinking ability. The results of the N-Gain pretest and posttest calculations in the experimental class showed an increase in understanding concepts and analytical thinking ability of students. The understanding concept of N-Gain value increases by 51.76% with the medium category, while the value of N-Gain analytical thinking increases by 52.95% with the medium category. In general, the conclusions that can be drawn from this study are PBL learning strategy strategies assisted by sasando musical instruments have a positive effect on understanding concepts and students' analytical thinking skills.

✉ correspondence :
Postgraduate Universitas Negeri Semarang
Jalan Kelud Utara III No.37, Kota Semarang, Indonesia 50237
E-mail: afrigelu20@gmail.com

p-ISSN 2252-6412
e-ISSN 2502-4523

INTRODUCTION

The Association for Educational Communication and Technology (AECT) distinguishes six types of learning resources that can be used in the learning process, namely messages, people, materials, tools, techniques, and settings (Maharani, 2015). The tools and materials used in learning can utilize the local wisdom that is around us. Local wisdom is understood as the ideas of local communities that are full of wisdom, good value, and followed by community members (Sartini, 2004). Sasando is a form of local wisdom in the form of musical instruments originating from Rote Island, East Nusa Tenggara Timur (NTT).

Physics is a science that requires supporting facilities and infrastructure to understand a material. Sound waves are one of the physics topics taught to high school students. There are several studies that have been carried out that are related to sound wave material, for example the development of 3D pageflip physics-based learning media for vibration and sound wave material (Kurniawati et al., 2017); the development of science comics based on Problems Based Learning (PBL) to improve students' thinking skills about sound (Fatimah & Widiyatmoko, 2014); efforts to improve learning outcomes, activities and attitudes in the material of vibration, waves and sounds, through methods of discussion, observation, and experimentation (Purnomowati, 2016); and many other studies. Of all the research that has been done, of course the results obtained cannot represent all the very broad regions such as in Indonesia.

The learning model is also very influential on students' understanding of sound wave material in addition to the media used. The learning model is a pattern or plan that has been planned in such a way and used to compile the curriculum, organize the subject matter, and give instructions to the instructor in his class (Isjoni, 2013: 50). One learning model in education is the Problem Based Learning Model (PBL). PBL is a learning model where learners work on authentic problems with the intention to compile their own knowledge, develop thinking skills to a higher level, develop independence and self-confidence (Arends, 2007).

Science learning not only uses the right media and learning models, but bringing elements of art will create a new atmosphere in the classroom. Learning methods that integrate physics and music have made learning more interesting, fun, memorable, easy to understand, and more memorable (Waluyo et al., 2016). The teacher must bring together two things that look different, such as science education (physics) and art (music) so that the learning process becomes interesting. The use of acoustic guitars, sound phenomena can be explained by direct observation in learning (Kasar et al., 2012; Sobel, 2014). Learning sound physics with music makes the understanding of students' physics concepts better (Ramsey, 2015).

The use of media, models, and appropriate learning methods is very influential on the understanding of concepts and students' thinking skills in the material being taught. Students do not understand the concepts taught because the selection of learning models is not appropriate by the teacher, lack of use of learning media, and class conditions that tend to be teacher-centered (Trianto, 2010).

Poor understanding of the concept is also caused by students having difficulty concentrating, quickly forgetting the material that has been delivered by the teacher, feeling bored with the lessons delivered, material delivery that is not innovative, unpleasant learning atmosphere and students feeling tense during the learning process (Subali at al., 2012). The teacher must hone students' thinking skills, in addition to teaching students to understand concepts well. Thinking habits can help students improve the mastery of physics concepts (Yoesoef, 2015). One example of the ability to think is the ability to think analytically. Analytical thinking is a part of high-level thinking (Ramos, 2013), where students' analytical thinking ability is to answer cognitive types C4 (analyze).

The results of an interview with one of the physics teachers said, "*So far what we know that sasando can only be used in art lessons, we have never used it in physics lessons. If the order can be used in physics lessons, we don't know how to explain it to students.*" Generally three teachers interviewed stated the same thing. Based on the results of interviews with three high school physics teachers

from the city of Kupang, it was concluded that the abstract sound concept raises a variety of different thoughts on students when learning it. Most students have an understanding that is not in accordance with what they really mean, so students have a conception that they design themselves according to their experience. Schools in Kupang city in general have not yet integrated local wisdom in physics learning, for example SMAN 4 Kupang and SMA Kristen Citra Bangsa. The results of observations at the school show there is still a lack of learning media or practical tools that can support physics learning, especially in sound wave material.

Learning physics in sound material by utilizing sasando musical instruments is one of the learning experiences that allows students to develop cognitive, affective, and psychomotor abilities. Through sasando, sound material can be learned, for example the concept of factors that affect the frequency, resonance, and intensity of sound. Frequency can be explained through Sasando which has a large number of strings and different string mass meetings. Factors that affect the intensity and level of intensity can also be studied by varying the size of palm leaves on Sasando (Gelu, 2017). The phenomenon of resonance can be studied also through the structure of palm leaves which functions as a resonator. The benefits of using local wisdom are practical and enjoyable (Abadi et al., 2017).

Based on the above problems, it is necessary to conduct learning remediation activities on sound material by integrating the local wisdom of the Rote community in the form of Sasando musical instruments on sound material. This learning is to find out the ability to understand the concept of sound and the ability of students to think analytically.

METHODS

This type of research is quasi-experimental research with the pretest-posttest control group design technique. Data collection concept understanding and students' analytical thinking ability through pretest and posttest. The learning model used is a Problem Based Learning learning (P)model assisted by a musical instrument. The research design can be seen in Table 1.

Table 1. One-Group Pretest-Posttest Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_1	X_2	O_2

The research was conducted in Kupang City precisely at SMAN 4 Kupang and SMA Kristen Citra Bangsa. The population of this study was students of class XII IPA who had received sound wave material. Sampling is based on the results of the pretest value. Students of SMAN 4 Kupang were declared remidial based on the results of the pretest functioning as experimental class students, while the remidial students of the SMA Kristen Citra Bangsa based on the pretest function as control class students.

The technique of collecting data uses observation and tests. The research instrument consisted of the observation sheet and the pretest-posttest question. Data analysis using t test and gain test. The t test is used to determine the effectiveness in terms of improving the understanding of concepts and the ability to think analytically by students with PBL learning models assisted by Sasando musical instruments, while the gain test is used to determine the increase in understanding of concepts and the ability of students to think analytically.

RESULTS AND DISCUSSION

The pretest data shows that students come from homogeneous and normal populations. Based on the preliminary data analysis also obtained the initial ability of the students in control class and the experimental class was relatively the same. The average initial ability of the control class reaches 44, while the experimental class 47. After being given remidial learning of sound material using conventional methods in the conrol class and PBL learning models assisted by Sasando musical instruments in the experimental class, the posttest results showed that there was a change in conceptual understanding and students' analytical thinking ability in each class.

The normalized gain test results shown in Table 2 show an increase in understanding of concepts after being given remidial learning with a moderate improvement category in both classes.

Changes in understanding students' concepts can also be seen from seven indicators of understanding concepts. Figure 1 and Figure 2 illustrate that there is an increase in each indicator in the control class and experimental class, but the experimental class students have improved understanding of the concept.

Table 2. Gain Test Results Concept Understanding

Group	N-Gain (%)	Criteria
Experiment	33.45	medium
Control	51.76	medium

The results of the analysis presented, show that there are differences in understanding of the concept between the control class and the experimental class. Understanding the concept of students in the experimental class is better than students in the control class. This is caused by the existence of different treatments in both classes. The experimental class uses remedial learning with PBL models assisted by Sasando musical instruments, while in the control class remedial learning is done using conventional methods.

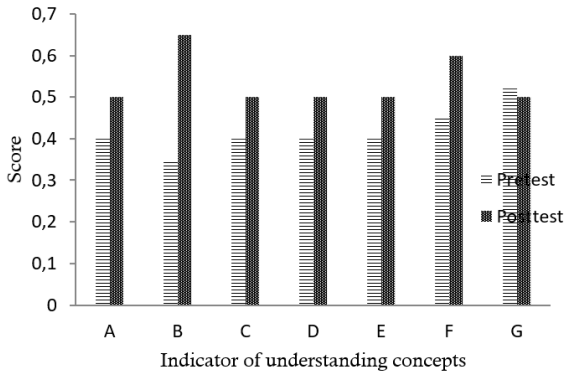


Figure 1. Control Class Concept Understanding Score

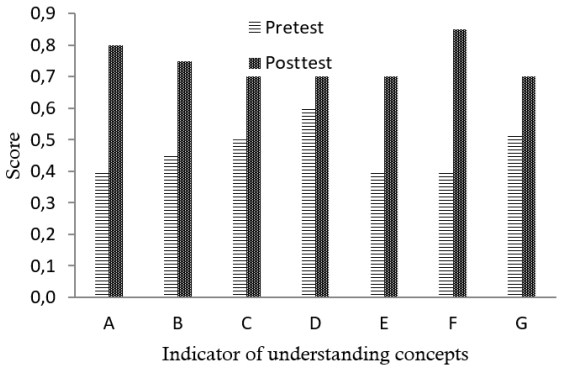


Figure 2. Experimental Class Concepts Understanding Score

Explanation Figure 1 and Figure 2:

A. Interpret
B. Give an example
C. Classify
D. Summarizes
E. Suspect
F. Comparing
G. Explaining

PBL learning model contributes to understanding concepts by knowing the principles of physics (Tasoglu & Bakac, 2014; Shisigu et al., 2018). The effect of remedial learning with the PBL model applied to the experimental class makes students more active in solving problems in sound material. This is because the problem taken comes from the problems that exist around the student environment.

For example, in understanding the characteristics of sound waves, students can learn through Sasando musical instruments that have their own characteristics in emitting sound waves; in understanding resonance events, students can learn through resonators in Sasando musical instruments (palm leaves); and to learn the intensity of sound, students can learn it through Sasando musical instruments by changing the size of the palm leaves as shown in Figure 3. PBL learning design by forming students into several groups can help students understand sound wave material (Wittman, 2003).

Figure 3. Size of Sasando Leaves

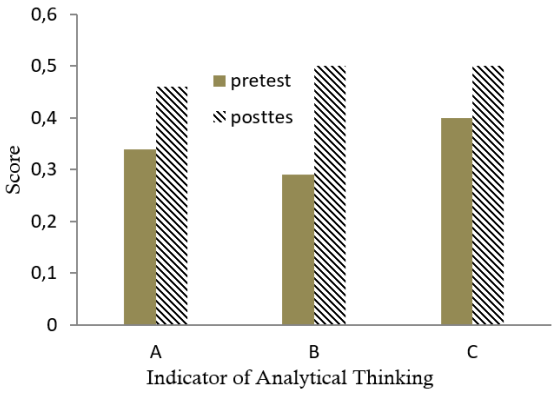
Local culture-based learning models are quite effective in enhancing basic science compost (Suastra & Tika, 2011). Sasando musical instrument which is a traditional musical instrument from NTT Province has an influence on students' understanding of concepts in learning sound wave material. The results of Anwar et al., (2018) shows that with traditional musical instruments can improve the effectiveness of learning physics, which is shown by active questions, positive responses, and improve understanding of the basic concepts of wave vibrations. The use of teaching aids is the main attraction for students because learning becomes varied, not monotonous, and involves the active role of students (Setyowati et al., 2016). The use of Sasando musical instruments has a significant influence on students' understanding of concepts in sound material.

To see the improvement in students' analytical thinking skills in the control and experimental classes, the normalized gain test was used through the results of the pretest and posttest. The gain test results can be seen in Table 3. The scores of students' initial and final analytical thinking abilities of each indicator in the control class and experimental class can be seen in Figure 4 and Figure 5.

Table 3. Gain Test Analytical Thinking Result

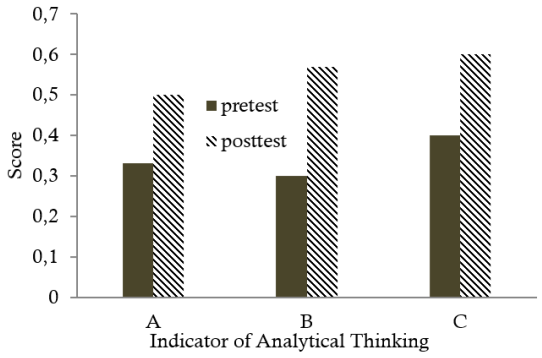
Group	N-Gain (%)	Criteria
Experiment	41.79	medium
Control	52.95	medium

The combination of PBL learning models and Sasando musical instruments can improve students' analytical thinking skills. The ability to think analytically consists of three indicators namely distinguishing, organizing, and attributing (Anderson, 2015). In Figure 4 and Figure 5 shows the ability to think analytically on each of the different indicators both in the control class and the experimental class. Students in the experimental class have improved analytical thinking skills better than students in the control class. That is the use of PBL models and Sasando media on learning used in the experimental class can improve students' analytical thinking skills. This can be indicated by the Gain test results in Table 3.



Explanation: (A) Organizing, (B) Distributing, and (C) Distinguishing

Figure 4. Final Capabilities of Analytical Thinking in Control Class Students



Explanation: (A) Organizing, (B) Distributing, and (C) Distinguishing

Figure 5. Final Capabilities of Analytical Thinking in Experiment Class Students

The PBL teaching model is new for experimental class students. According to the results of the analysis, there is a positive effect of PBL on students' analytical thinking ability scores. PBL students appear to be more proactive in learning, which makes their ability to think analytically to be higher than the control class students. Learning by using Sasando musical instruments requires students to analyze scientific concepts with elements contained in Sasando. Every student has different basic abilities in terms of analyzing this phenomenon. This shows that there is an introduction to the use of Sasando musical instruments to students' analytical thinking abilities. This result is in line with research conducted by Kim & Wolf (2008) which states that learning by linking science, environment, and society will make students' thinking skills better. The results of research by Rusilowati et al., (2010) show that science learning with a vision of Science, Environment, Technology, and Society (SETS) can improve learning outcomes both cognitive, affective, or psychomotor.

CONCLUSION

Conclusions that can be revealed based on analysis and discussion are Sasando musical instruments influencing the learning of sound material, indicated by the existence of:

1. Increased understanding of the concept of sound after remedial learning with PBL models assisted by Sasando musical instruments in students of the experimental class. The gain test results of concept understanding in the experimental class were 51.76% with an increase in the medium category.
2. Increasing the ability of analytical thinking students in the experimental class after remedial learning with PBL models assisted by Sasando musical instruments. The results of the analytical gain test in the experimental class were 52.95% with an increase in the medium category.

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