

Practicality and Effectiveness of Student' Worksheets Based on Ethno science to Improve Conceptual Understanding in Rigid Body

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Abstract— Generally, the learning process in classes still used worksheets that does not link the matter and instructional topics with local knowledge of local area. Though it is able to increase the students' conceptual understanding of the specific physics topics. This study aimed to analyze the practicality and effectiveness student' worksheet based on Ethno science in improving student understanding of rigid body' concept. The study used a quasi-experimental with pretest-post test control group design. The sample was students' senior high school in Lampung' province, Indonesia. The sampling technique used simple random sampling technique. Data were obtain through the questionnaire, responses of teachers and students, and test of learning outcome in multiple choice questions reasoned type. Data were analyzed by percentage, N-gain, and effect size. The results showed that student worksheet based on Ethno science was practically using in learning and effective in improving conceptual understanding which is indicated by the differences in test results between the control and the experimental class.

Keywords—Effectiveness, Ethno science, Conceptual Understanding, Practicality, Student Worksheet.

I. INTRODUCTION

Education has a strategic role in improving the quality of human resources that can meet the development of the curriculum. The 2013 curriculum is curricula for primary and secondary education, the curriculum requires that learning must be responsive to the development of science, culture, technology, and art so as to build curiosity and the ability of the student (Kemendikbud, 2014). Teachers must have the ability to develop teaching materials were varied so that learning will be applied not monotonous and tend to be boring for students. The purpose of science teaching is to enable students not only to develop knowledge, understanding, positive attitude, and skill, but also interest to learn objects in environment

(Permendikbud, 2006). Generally, the success of students in the learning is determined by the ability of teachers to teach (Sumarni et al., 2017). Therefore, as educators must be creative in making the innovation of teaching materials in order to achieve these demands.

Based on observations in high school showed that the teaching materials in the form of student worksheet still contain practice questions and short course materials, and generally, the learning was using teacher center. This case gave the significant problems in conceptual understanding as well as student's mind set is not to be creative. Meanwhile, the results of needs analysis data showed that 73% of students felt difficult to understand the equilibrium of rigid body concept, and 85% of students stated that they required student worksheet oriented local wisdom in order to develop their conceptual understanding in physics.

The equilibrium of rigid body concept is difficult enough to students in secondary school. This is in accordance with the opinion of Sahala et al (2013) stated that although the learning was done about rotational dynamics and equilibrium of rigid body in school, but in fact many students who have difficulty to understand and apply the concept of rotational dynamics and rigid body's equilibrium. To learn about equilibrium of rigid body concept will be many obstacles and difficulties when administered directly without starting from the events in the environment in the form of art and culture (Mujadi, 2015). Culture can be used as a means for linking indigenous science with the learning process in school (Berkes et al., 2000).

Science integrated learning in activities that begin by using a variety of learning resources to explain a phenomenon (Novi et al., 2012). Ethno science was an activity to transform the original science (knowledge developed in the community) into scientific science (Rahayu et al., 2015; Sardjiyo, 2005). Local knowledge is a system in the order of the social, political, cultural,

economic, and environmental life in the midst of the local community (Misnah, 2015). Ethno science was a learning approach that relates to the local culture, indigenous science and science theory that has been developed in Brazil (Battiste, 2002) and Canada (Ward, 2010), and Tanzania (Ruheza et al., 2013). In addition, Ethno science also closely related to the environment, where the environment has become the center of attention of various scholars, intellectuals, scientists, politics and government (Dhanya, 2017). Learning based Ethno science approach digs initial views on culture or habits of a person that are used in everyday life, and then it was translated into scientific knowledge (Sudarmin et al., 2017; Rist et al., 2006). Ethno science is important for the level of local wisdom and knowledge in the science curriculum that aims to promote the spirit of nationalism students (Kidman et al., 2013). In addition, environment-based learning helpful in preserving the environment, students play an important role in raising public awareness and protecting the environment (Talens, 2016).

The role of local knowledge-based learning is important in understanding the concept of students' ability to generate. Understanding is the mental or thought process for observing phenomena or events, and ideas that can be delivered either orally or in writing, visually or symbolically. Cognitive processes included in the category of understanding of interpreting, exemplifying, classifying, summarizing, in summing up, compare, and explain (Knuth et al., 2002; Canon et al., 2005; Anderson et al., 2001). Based on Afrianawati et al (2016) also showed that learning by applying the Ethno science model can increase students' cognitive abilities. Other studies have shown that the use Ethno science approach in learning has a high potential in exploring the ability of students' conceptual understanding (Parmin et al., 2017).

The purpose of this study was to apply learning with student worksheets based on Ethno science to analyze an improved physics conceptual understanding in terms of practicality and effectiveness of students worksheets in learning equilibrium of rigid body concept. Based on these objectives, then formulation of the problem in this study, as follows:

- 1) How practicality student worksheet based on Ethno science in equilibrium of rigid body learning?
- 2) How effectiveness student worksheet based on Ethno science in equilibrium of rigid body learning?

II. RESEARCH METHODS

2.1 Research Design

This research used quasi-experimental with pretest-post test control group design. The assessment of practicality test showed by feasibility student worksheet and the response of teachers and students towards learning using

student worksheets based on Ethno science in qualitative data. While, the assessment of effectiveness demonstrated by the results of conceptual understanding test in quantitative data. This study was conducted in two classes, the one was experimental class that taught by using student worksheet based on Ethno science and the other one was control class that taught by using conventional student worksheet.

2.2 Research sample

The sample collecting technique was purposive sampling, the samples were selected based on consideration of the researcher. Samples of this study involved three physics teachers and 50 students of high school in Lampung province, Indonesia, where 25 students were in the experimental class that taught by using student worksheet based on Ethno science. Meanwhile, 25 other students were in control class were taught by conventional worksheet.

2.3 Research Instruments

Research instruments used to practicality test consists of two instruments namely feasibility observation sheets and sheets of teachers and students response. Feasibility observation sheet used to determine the level of adherence to learning using student worksheet based on Ethno science consisting of 35 items consisted of a questionnaire that require respondents to choose answers, excellent, good, fair, or poor. While, the sheets student responses to student worksheet used to know the teachers and students response after learning using student worksheet based on Ethno science which consisting of 20 items. Furthermore, the effectiveness of the conceptual understanding test consists of 10 multiple choice questions reasoned. Prior to use all instruments were validated by the experts and has been declared valid.

2.4 Data Analysis

Data analysis results practicality student worksheet were determined by calculating the average score of every aspect. The result of the acquisition of scores form of quantitative data which is then converted into qualitative data. The determination of the conversion of the score is taken from Arikunto (2006) which can be seen in Table 1.

Table.1: Conversion Score Quantitative Data
Into Qualitative Data

| Accomplishment' Level | Qualification |
|-----------------------|-------------------|
| 81-100% | Excellent |
| 61-80% | Good |
| 41-60% | Sufficient |
| 21-40 % | Insufficient |
| 0-20% | Very Insufficient |

Analysis of the data to determine the students' increased conceptual understanding in using student worksheet

based on Ethno science consist of average score of *N-Gain* and effect size. Analysis of *N-Gain* is used to determine whether there is an increased conceptual understanding between pre test and post test. Interpretation criteria *N-gain* proposed by Hake (2002) as shown in Table 2. Effect size is used to determine the influence of student worksheet based on Ethno science in learning to the student conceptual understanding. To calculate the magnitude of the effect size was using *Cohen's*, then interpreted based on the criteria according to Cohen that can be seen by Becker (2000) in Table 3.

Table.2: Criteria Interpretation of gain

| N-Gain | Interpretation |
|--------------------|----------------|
| $g > 0.7$ | High |
| $0.3 < g \leq 0.7$ | Medium |
| $g \leq 0.3$ | Low |

Table 3: Interpretation of Effect Size

| Effect Size | Interpretation |
|----------------------|----------------|
| $d \geq 0.80$ | Large |
| $0.50 < d \leq 0.80$ | Medium |
| $d \geq 0.50$ | Small |

III. RESULT AND DISCUSSION

The main results of this study conducted the high school in the province of Lampung, Indonesia was an analysis about the practicality and effectiveness of student worksheet based on Ethno science that has been developed. Learning was done by using worksheets based Ethno science consisting of three meetings which therein were preliminary, content, and cover. Student worksheet equipped with various phenomena Ethno science, exercises, practical guidance, and the task independently. As for some of the phenomena that exist Ethno science on student worksheets used in this study as shown in Figure 1. The teacher had taught the student by using the student worksheet based on Ethno science and obtained data of practicality and effectiveness.

The assessment of practicality student worksheet based on Ethno science in learning measured through feasibility student worksheet and response of teachers and students to student worksheet in implementation. The results of the student worksheets feasibility observation illustrated by the diagram shown in Table 4.

Table 4 shows the results of observation feasibility student worksheet overall with an average score of 92% was included in the very high category. This means that the student worksheet based Ethno science used has a step of learning activities, social system, the principle of reaction, support system, and a very good instructional impact. Learning activities using student worksheets

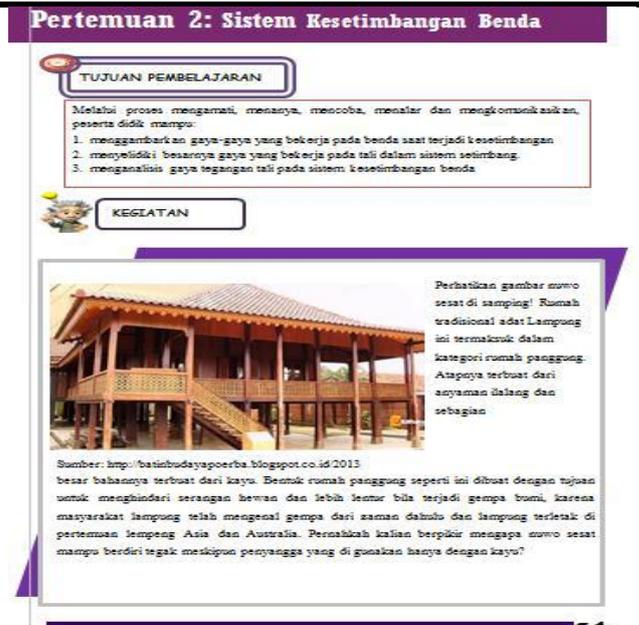


Fig.1: Student's Worksheet On Second Meeting

Table.4: Observations Feasibility of Student Worksheet Based On Ethno science

| N | | Percentage | Criteria |
|----|---|------------|-----------|
| 0. | | | |
| 1 | Introduction Activities | 94% | Very High |
| 2 | Core Activities | 89% | Very High |
| 3 | Closing Activities | 87 % | Very High |
| 4 | Time Management | 92% | Very High |
| 5 | Observed Aspect | | |
| 5 | Observations | 94% | Very High |
| 6 | Circumstances Class | | |
| 6 | Systems Social | 92% | Very High |
| 7 | Principle of Reaction | 88% | Very High |
| 8 | Support Systems | 87% | Very High |
| 9 | Impact of Instructional and Accompaniment | 80% | High |
| | Average Score of Feasibility in Student Worksheet | 92% | Very High |

based Ethno science facilitated students understanding and recognize the equilibrium of a rigid body concept then it connected with the culture or customs in their neighborhood.

Feasibility in learning activities aspects such as preliminary activities, core, and the cover obtain a very high score, it indicated that the student worksheet-based

Ethno science in learning was very good. Activity was a preliminary stage of activities to re-announcements about the learning objectives and explain to students about the use of worksheets based Ethno science. At the core activities of the students were divided into five groups, and each student is required to listen to the explanation of teachers and students were asked to observe the phenomenon Ethno science that exist in the worksheet, the phenomenon Ethno science observed equilibrium concept in Lampung's dancers, the concept of tradisional house building in Lampung, Indonesia, then the equilibrium on teeter totter and ladders are used to facilitate the work. Without realizing the process of making the art of dance and the traditional house is not off to do with the concept of physics, in particular the concept of equilibrium objects. This sort of thing can be used by teacher to relate the physics concepts to the culture in a learning process. Studying about equilibrium of rigid body will be many obstacles and difficulties when administered directly without starting from the phenomenons in the environment in the form of art and culture (Mujadi, 2015).

Feasibility of social system in the learning visible from the interaction between teachers and students when the teacher guides the students in group discussions to resolve the existing problems in students worksheet based Ethno science, while the interaction between students and his group demonstrated when they conducted an experiment to prove their hypothesis that they created, then they presented the results of an experiment in front of the class. Teacher as facilitator to guide them in the presentation, as well as providing reinforcement as a scaffolding on their findings. In line with this results Abdurrahman et al (2018) revealed that through scaffolding activities, students tend to be more active and enthusiastic in interacting with teachers, other students, and learning resources. This is done to assist students in solving the problems that exist in the worksheet. According to Nurulsari et al (2017) a positive interaction between students, teachers, and learning resources, the effect on the implementation of the social systems that obtain very high percentage.

Adherence to the principle of the implementation of the learning percentages reaction is very high at 88%. This happens because the role of teacher as facilitator is able to create a pleasant atmosphere. Based on the observation of the observer, the students looked enthusiastic in working with the program material physics bendar strong equilibrium, in terms of the completion of the core activities of teachers not so involved in the learning process so that students can be trained independence.

Feasibility support system obtained percentage is very high, reaching 87%. Analysis of support system conducted through conformity assessment by the observer is learning the implementation of appropriate lesson plans have been made, as well as learning resources in the form of worksheets based Ethno science in accordance with the ongoing learning materials. Therefore, the enforceability of the test vote on aspects of the support system is very high.

Assessment of the impact of instructional aspect and companion reached a score of 88%, which shows that its implementation is very high. Student worksheet implementation Ethno science based learning instructional impacts for students is to improve understanding of scientific concepts and attitudes. In addition to the instructional impact, student worksheet Bridesmaids result of the development impact that fosters creativity, a sense of caring for the culture and the environment, careful, thorough, and the responsibility to conduct a study.

Furthermore, the student response seen from the clarity of the language used in the student worksheet, suitability appearance, ease of use, and the level of student satisfaction in using worksheets result of the development. Student response was positive in every aspect. The results of students 'response to student worksheet result of development reached 87%, this means students' response to the use of very high student worksheet. The students' responses also supported by positive comments when they were asked at the end of the lesson. According to the students, they said that learning to use this worksheet is new and exciting, because the student worksheets with pictures, the phenomenon of the surrounding culture, and content material that is easy to understand. Response teachers were having observed and used worksheets result of the development which is the average teacher found student worksheet developed in accordance with Core Competencies (CC) and Basic Competencies(BC) were already standard.

Teachers argue that by using student worksheet based on Ethno science, students are able to discover new things in the understanding of physics concepts. Student worksheet result of the development is able to enhance students' understanding in solving problems in physics particularly equilibrium of rigid body. There are so many phenomena Ethno science shown in student worksheet, so it allows students to hone their ability in problem solving and group discussion. In addition, the questionnaire responses have filled teacher can be seen in Table 5

Table 5: Results of Response Teachers to Use Worksheet Student Based Ethno science

| N | Result of Response in Physics Teacher | Percent age (%) | Criteria |
|---|---------------------------------------|-----------------|----------|
| 1 | Physics Teacher 1 | 91.7 | Very |
| 2 | Physics Teacher 2 | 86.5 | Good |
| 3 | physics teacher 3 | 90.8 | |
| | average Percentage | 89.6 | |

based on the responses of teachers to use student worksheets based Ethno science, it is known that the physics teacher had a positive response to the use of worksheets, the average physics teacher responds by 89.6%, or very good. These results indicate that work-based Ethno science acceptable to facilitate teacher in physics. Teachers assume that Ethno science based learning can make students were able to relate their real science with theory, more creative, and easy to accept learning. The same thing was stated in the research Sudarmin et al (2017) that learning can dig Ethno science original view about the culture and habits of students in the learning community. Additionally, Rist et al (2006) suggested that Ethno science help to improve students' assumptions about culture in the society with regard to the natural sciences.

Based on the results of enforceability of the product and the response of teachers and students gain a very high category, it can be concluded that based student worksheet Ethno science practical development results to be used in high school physics teaching material particularly rigid body equilibrium. The practical teaching materials can be interesting, as well as to motivate learning (Uno, 2006).

The results of the effectiveness of student worksheets based Ethno science in learning is measured through student conceptual understanding test results on an experimental class and control class. The test results effect size using a calculator *Cohen's* (Figure 2) showed that the effect of the used student worksheet based on Ethno science was large enough to generate students conceptual understanding. Effect-size was calculated and

showed the value r 0.7493158 or in medium category. That was, the effect of using student worksheet based on Ethno science for generating the student conceptual understanding was in the medium size. Meanwhile, based on the analysis of N-gain in the experimental class and control class can be seen in Table 6.

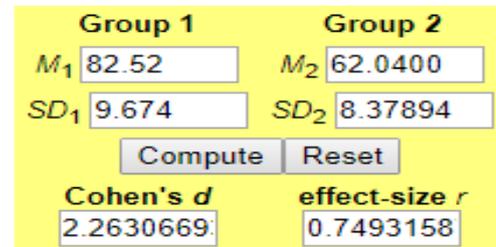


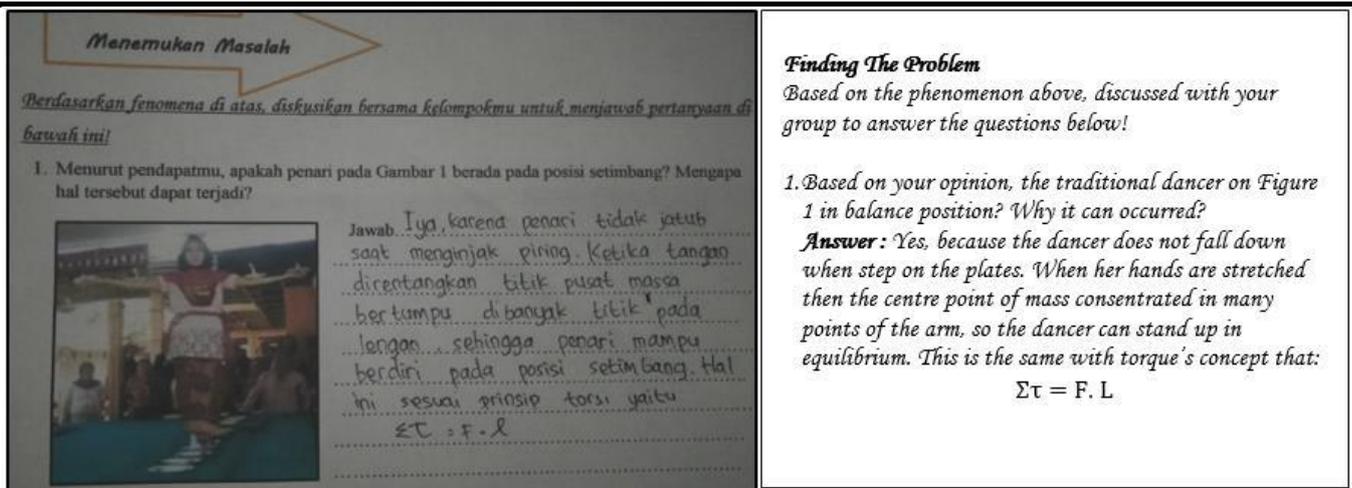
Figure 2: Effect size on conceptual understanding

Table 6: Average yield N-gain and Concept Training Effect size Student

| Class | Pret est | Post test | Std. dev | N-gain | Category |
|------------|----------|-----------|----------|--------|----------|
| Experiment | 46.96 | 82.52 | 9.67 | 0.66 | Medium |
| Control 1 | 62.04 | 41.44 | 8.37 | 0.34 | Low |

Based on Table 6, the experimental class that used student worksheet based Ethno science got an increased gain of conceptual understanding that was higher than the control class that used a conventional student worksheet. The experiment class got N-gain score 0.60 or in the category of moderate improvement, while the control class got N-gain score 0.34 or lower improvement. Learning that using learning resource of student worksheet based Ethno science provide experience for students to relate phenomena in the surrounding areas with the existing physical theories. Posttest results of the students after learning Ethno science increased, it was consistent with a research (Sudarmin et al, 2017; Afrianawati, 2016; Kartimi, 2014).

Student's answer in student worksheet based on Ethno science was effective in improving students' conceptual understanding that can be seen in Figure 3.



Menemukan Masalah
(Berdasarkan fenomena di atas, diskusikan bersama kelompokmu untuk menjawab pertanyaan di bawah ini!)

1. Menurut pendapatmu, apakah penari pada Gambar 1 berada pada posisi setimbang? Mengapa hal tersebut dapat terjadi?

Jawab. Iya karena penari tidak jatuh saat menginjak piring. Ketika tangan direntangkan titik pusat massa bertumpu di banyak titik pada lengan sehingga penari mampu berdiri pada posisi setimbang. Hal ini sesuai prinsip torsi yaitu $\Sigma \tau = F \cdot l$

Finding The Problem
Based on the phenomenon above, discussed with your group to answer the questions below!

1. Based on your opinion, the traditional dancer on Figure 1 in balance position? Why it can occurred?

Answer: Yes, because the dancer does not fall down when step on the plates. When her hands are stretched then the centre point of mass concentrated in many points of the arm, so the dancer can stand up in equilibrium. This is the same with torque's concept that:

$$\Sigma \tau = F \cdot L$$

Fig.3: The student's answer on Ethno science' worksheet

Based on student worksheet question based on Ethno science in Figure 3, the worksheet showed that the phenomenon Ethno science occurred in traditional Indonesian dancers that dance dishes. Dancers plate capable of holding a candle in her arms as she stepped on the plate. Seen in the figure that the plates were not broken, it is then analyzed by the students why it happens. Through the analysis process, teacher would guide students to relate the equilibrium of rigid body concept in this Ethno science phenomenon. It turned out learning by using student worksheet based on Ethno science guided students to apply the concept of rigid body equilibrium, look at the students' answers in Figure 3 students were able to decipher the reasons for the existing problems and were associated with the concept of style moment. The steps began by observing the phenomenon, and then analyzed the phenomenon, answered questions, and then conducted an experiment to prove the answer to the problem of the phenomenon. Through these activities the ability of conceptual understanding began to grow, conceptual understanding was very important in learning physics (Suryaniet al., 2018). Natural science was better when taught through the cultural approach, customs, and traditional methods, this was in line with research Gasat et al (2017). The process of learning using student worksheet based on Ethno science will open their views of nature and culture, basically a physics concept that originated from nature.

IV. CONCLUSION

Based on the description in the discussion can be concluded that student worksheet based Ethno science, 1) practically viewed from the results feasibility of student worksheet in learning, teachers' response were very good and positive students' responses against student worksheet. 2) effectively viewed from differences in test results between the students' conceptual understanding of

experimental class and control class. Students' conceptual understanding in experimental class are taught using student worksheet based Ethno science higher than the control class. Learning physics used student worksheet based Ethno science has several advantages consist of attractive design, hone the idea of student creativity, curious, accompanied by figures of the phenomenon realistic, step coherent learning, and guided to find the concept to be learned.

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