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PHY-01019

The Characteristics Mastery Test Development of Earth and Space Concepts for Teachers Prospective

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Article info	Abstract
<p>Keywords:</p> <hr/> <p>Corresponding Author: ^{a)}taufik_lab.ipba@upi.edu ^{b)}liliasari@upi.edu</p>	<p>This study was aimed to analyze the characteristics of the development of tests mastery of the concept of earth and space according to classical test theory and item response theory. The test is based on the basic concepts and essential principles of the earth and space science. The research method using mixed methods with design embedded experimental models. The analysis in this study is based on 41 responses student teachers who have taken courses ESS at the Physics education department at one of the educational and educators institutions in Bandung city. By comparing the classical test theory and item response theory, the overall conclusion of this evaluation is that the model of 3PL is better to use when evaluating the test.</p>

INTRODUCTION

Earth and Space Science (ESS) is a part of the Physics, which specifically examines about natural phenomena on Earth and celestial bodies as part of the solar system and the universe as a whole. Some theories and laws of physics can be used to explain more in depth the state of the earth and the universe as a whole. As the mathematical tools used in physics and engineering, also contribute to further study of the universe. Some concepts or principles of physics and some natural phenomena can be studied with the help of mathematics. BA is our home and roof. We rely on both to the existence and survival. Resources give us groceries for life. A simple change in the system of Earth and Space have a major influence on society and on the journey of human civilization. Understanding Earth and Space systems and how we interact with it, it is very important for survival.

The phenomenon of ESS everyday including storms, tsunamis, extreme weather, floods, volcanic eruptions, landslides, so familiar with the community, therefore some studies highlight the need to improve the mastery of concepts BA at school or college, through learning associated with inquiry and direct experience¹. In addition, the inquiry can foster critical thinking skills, which is the basis for developing other high-level skills².

In the last 15 years, research on science education BA increased relatively more sharply compared to other science education research, this is in line with the issues which often arise and be the talk as well as the needs of the people in America, even in the world³. Student misconceptions in ESS as well as the textbooks are still often found⁴. One of the most fundamental challenges in creating a society which berliterasi BA is to instill the basic concepts and understanding of age-appropriate BA learners, and this can be built through the learning experience⁵.

ESS literacy is very important in the formation of history. Many of the challenges facing humanity (the depletion of energy and mineral resources, climate change, water shortage, natural disasters) are directly related to ESS. There are tough decisions to be



taken by the government (local and central) associated with these problems, and the survival of the people of the twenty-first century will depend on the success of this decision. Human history is a record of creativity and ingenuity of people in solving problems. Solutions relating to the issue of BA and with the current challenges, will also come from human creativity, both as individuals and society. We need society and government ESS literate.

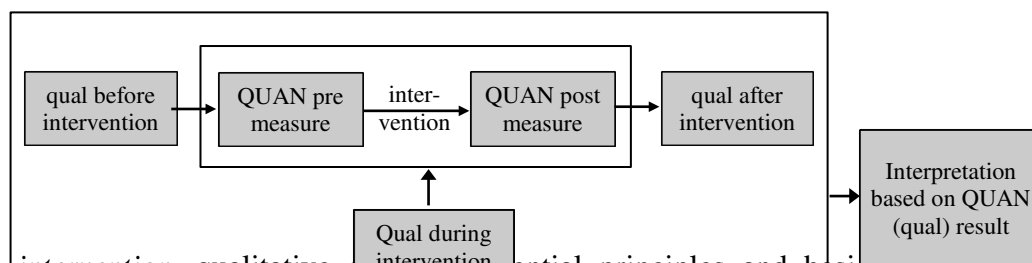
To create a society that ESS literacy, influenced by the quality of education including educational aspects of science teacher candidates in it, which is believed to play an important role for science education reform. Prospective teachers must be prepared so as to understand, control, and foster ESS literacy for everyday life of their students.

Evaluation of learning outcomes in FPMIPA UPI (mid and last semester), using a form of test descriptions and / or multiple-choice test. Construct a multiple choice test, but must pay attention to distinguishing features and level of difficulty, also should pay attention to detractors option. To determine the quality of the test items required analysis of the characteristics of test items, so that the strength or weakness of the test can be known.

This study aimed to analyze the characteristics of the test mastery of ESS concepts base on classical test theory (CTT) and item response theory (IRT). Analysis with CTT that determines the standard deviation, reliability, distinguishing features and level of difficulty. IRT analysis through item characteristic curve and function information.

RESEARCH METHODOLOGY

Based on the type of data, the model used in this research is with approach Embedded Mixed Methods Experimental Model. This model has inherent qualitative data in experimental design. Embedded design procedure is to combine (mix) a set of different data in a single level design. Priority quantitative model, with qualitative data attached to this methodology⁶. This research method is shown in Figure 1:



In the *qual before intervention*, qualitative data is obtained from the field study, the study of literature, as well as analysis and synthesis of the journal. At this stage produced a syllabus and lesson plan, as well as the concept of mastery test instrument ESS. Tests consists of 40 questions multiple choice form with four option. Grating tests listed in appendix table 1. The device learning and test devices examined by two expert people, and the results of judgment becomes the input for the revision. Aspects examined by the expert covers material and construction tests.

In the *QUAN pre measure*, explore initial information ESS concept mastery students through tests that have been compiled. *Intervention* in the form of the form of activity review and revision based test that's been made, he explored the essential principles and basic concepts ESS (*Qual during intervention*).

After the intervention, test mastery of ESS concepts re-evaluated in *QUAN post measure*, with the classical item theory and response item theory. Results of analysis for intervention becomes the input to increase quality tests mastery of concepts ESS (*qual after intervention*). After a whole series of stages completed, then analyzed and interpreted (*Interpretation based on QUAN (qual) result*).

Test was given to 41 students who have taken the ESS course. CTT analysis is to determine the standard deviation, the Kuder Richardson (KR-20) reliability, discrimination index by point biserial correlation coefficient (r_{pbis}), level of difficulty (p) by an average of correct answers, and the standard error of measurement.

IRT analysis is to determine the parameters of the test item; distinguishing (a), the level of difficulty (b), and factor guesses / guessing (c); by the maximum likelihood method. Then the characteristic curve analysis tests based on test items. Item characteristic curve is a mathematical function that connects the probability of correctly answering an item tests the ability of the participants. The types of item response theory depends on the parameters used are⁷:

1. One-Parameter Logistic Model (1PL), emphasizes the difficulty level parameter item (b). The equation are:

$$P_i(\theta) = \frac{e^{a(\theta-b_i)}}{1+e^{(\theta-b_i)}} \quad \dots (1)$$

where,

$P_i(\theta)$: probability that the test participants have the θ ability randomly selected to answer the i -item correctly. θ : the level of ability of the subject (as independent variables). a : discrimination index each item. b_i : difficulty level of item. i : The subscript i indicates the item; 1, 2, 3 ... n : number of items in the test.

2. Two-Parameter Logistic Model (2PL), involves two parameters namely the level of difficulty of items (b) and discrimination index item (a).

$$P_i(\theta) = \frac{e^{Da_i(\theta-b_i)}}{1+e^{Da_i(\theta-b_i)}} \quad \dots (2)$$

where, a_i :
discrimination index
item. D : scaling factor
which value is 1.7

3. Three-Parameter Logistic Model (3PL), involves three parameters namely the level of difficulty of items (b) and distinguishing items (a) and the guesses factor (c). The equation is

$$P_i(\theta) = c_i + (1 - c_i) \frac{e^{Da_i(\theta-b_i)}}{1+e^{Da_i(\theta-b_i)}} \quad \dots (3)$$

where c_i : guess factor item.

From equation (1), (2), and (3), it appears that the 2PL model is a special case 3PL model when factors guesses $c_i = 0$. And the 1PL model is a special case of 2PL models when distinguishing $a_i = a$. Each parameter in 1PL, 2PL and 3PL calculated using *irt software* version 1.3.0. Software have been relatively easy to use and compatible with MS Excel.

Information of each model are described by function information or information function (IF). IF is a function of the extent to which the chosen 1PL, 2PL, or 3PL model, is able to provide information on the estimated ability. The higher the peak of the IF, the more informative also chosen model is able to explain traits-level test participants. Mathematically, a function information item (IF) is expressed by the equation:

$$IF_i(\theta) = \frac{1}{P_i(\theta) \{1-P_i(\theta)\}} \left\{ \frac{\partial P_i(\theta)}{\partial \theta} \right\}^2 \quad \dots (4)$$

Derivative $\partial P_i(\theta)/\partial \theta$ shows the gradient of the curve characteristics of the item. The maximum coefficient of direction occur at the steepest part. This happens on the difficulty level parameter value (b) on the model 1PL and 2PL, and slightly larger than the difficulty



level parameters (b) the model 3 PL. In the model 2PL and 3PL, IF will increase if parameter distinguishing (a) increases⁸. IF the 3PL models will increase if the guess factor parameter (c) is getting smaller. Accumulation of the overall function of the items of information will be obtained information function tests or test information (TI), which is a mathematical formula is:

$$TI(\theta) = \sum IF_i(\theta) \quad \dots (5)$$

RESULTS AND DISCUSSIONS

As already mentioned before that CTT is performed on each of the tests is to determine the standard deviation, reliability, power differentiator (r_{pbis}), and the level of difficulty (p). The standard deviation of 9.313 and KR-20 reliability tests is 0.920. Discrimination index test items ranged from 0.088 to 0.706, and the level of difficulty ranges from 0.780 to 0.146. Distribution chart level of difficulty (p) for discrimination index (r_{pbis}) is shown in Figure 3.

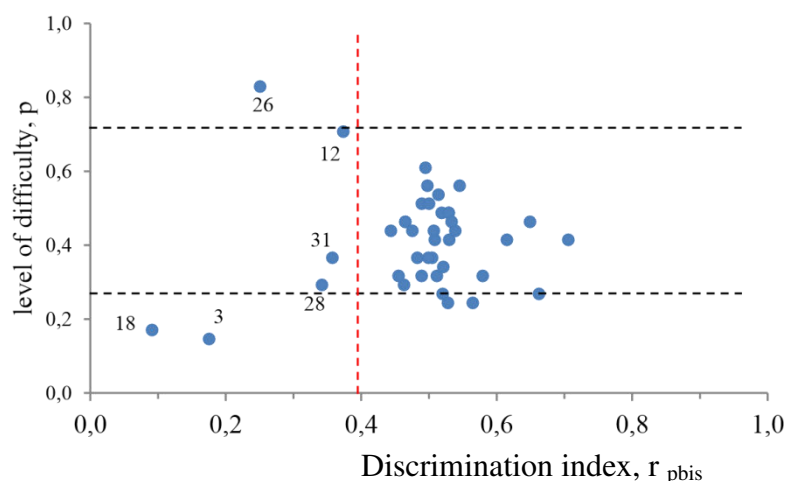


FIGURE 3. The distribution of the level of difficulty vs. discrimination index

Level of difficulty (p) are grouped into difficult ($p \leq 0,3$), moderate ($0,3 > p > 0,7$), and easy ($p > 0,7$)⁸. By referring to that good test item has discrimination index $r_{pbis} \geq 0,4$, figure 3 is shown that the six items have discrimination index low (number item 18, 3, 28, 31, 12, and 26). By using *eirt software* version 1.3.0, obtained IRT parameter: (a) distinguishing features, (b) the level of difficulty (b), and (c) guess factor, for each model of logistics. Then graphed information function based on the equation (4) as shown in Figure 4.

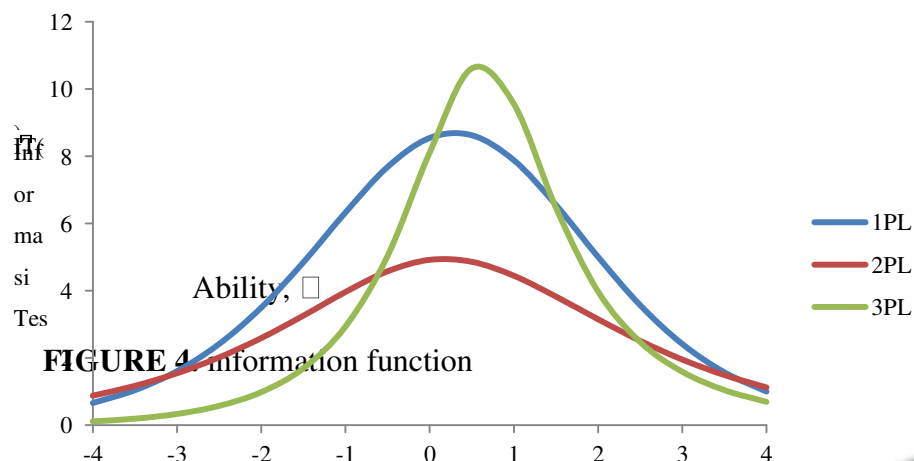


FIGURE 4. Information function

From figure 4 it appears that IF on 3PL model have highest peak. This means that the 3PL model can provide better information about the relationship between the response of the participants of the test pattern with the overall characteristics of each item. It also has implications for the ability of the participants estimate the precision of the test, the IF higher then the precision of a model in estimating the ability of the participants.

CONCLUSION AND RECOMMENDATION

ESS concept mastery test can distinguish groups of low and high groups, and detractors functioning properly. From the analysis of the acquired IRT models the most rational parameter logistic 3PL is a model, it is shown on the information function test and standard error of measurement. From the characteristic curve of each item, obtained by distinguishing, level of difficulty, and the guess factor.

The procedure in this study makes it possible to construct a test that will meet the specifications of the desired test. So we can build a test that has a good discrimination the particular capabilities. That is, the ability of the group of participants, the test item can be chosen so as to maximize the test information on the capabilities of the participants. Of course, this test item selection option will make a major contribution to the balanced capabilities expected precision.

If we want to know the increase or change in control of ESS with a test concept that refers to specific criteria, generally we will observe the test results on the pretest lower than the posttest. Therefore, it is suggested should select items that are easy relatively to pretest and relatively more difficult to posttest. Then, because items in both tests measure the same ability, and estimates the capability does not depend on the choice of specific test items, we can measure change by reducing the ability of estimate pretest posttest estimation capabilities

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PHY-01044

Developing Research-based Physics Learning Models with Guided Inquiry Approach for Students of SMAN 1 Padang

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Article info

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Abstract

Learning models which was expected in 2013 curriculum is an active student learning with a scientific approach. One of the active student learning model is research-based learning with guided inquiry approach. The results of the preliminary survey of the implementation of physics learning in Secondary High School (SMAN) 1 Padang showed that teachers have not been implementing research-based learning with guided inquiry approach. Physics learning implemented through experiment that were verified theory. There are still many students who have not been thoroughly studied physics. Physics laboratory and the equipment already available as support facilities, but has not been used optimally. Research-based learning is a learning model that can improve scientific skills and student learning outcomes. To be able to carry out research-based learning, required lesson plan, student worksheets, and handout. This research aims to develop research-based physics learning model that valid, practical, and effective for students of SMAN 1 Padang. Research and development using the 4D model of Thiagarajan. The research instrument was an interview guide, observation sheet, sheet validation, practicality questionnaire, affective assessment sheet, skills assessment sheet and achievement test. The results showed that the learning model has included the category of valid, practical and effective in improving student competence. Validity of learning model based on expert judgement. Practicality of learning model based on the observation, teachers and students responses. The effectiveness of the learning model based on student learning outcomes in the domain of cognitive, scientific skills, and affective. Suggested to high school physics teacher in order to implement research-based learning with guided inquiry approach.

INTRODUCTION

Physics is one branch of science, and a science that was developed through the steps of observation, problem formulation, formulation of hypotheses, testing of hypotheses through experimentation, conclusions, as well as the discovery of theories and concepts. Depdiknas (2006) explains that the subjects of physics learning activities carried out through process skills activities that include exploration (to obtain information, facts), experimentation, and problem solving (to strengthen the mastery of concepts). Exploration activities aim to provide opportunities for students to obtain information, stories, and facts which related to knowledge to achieve basic competence. The experiments activities carried out in the laboratory with the aim to strengthen the concepts in accordance with the basic competencies in the syllabus. Subjects of physics cannot be separated from the experiments activities so that students are required to think scientifically based on the scientific method. Therefore in physics learning, teachers must conduct exploration

activities and experiments to realize the goal of physics learning. Physics learning has a very important role in order to establish a scientific attitude, analytical thinking, and foster the creativity of students.

Physics is considered important to be studied as a separate subject with some consideration. First, in addition to providing supplies to students of science, physics was intended as a vehicle to foster thinking skills that are useful for solving problems in everyday life. Second, to provide the knowledge of students, understanding, and capabilities that is required in higher education and development of science and technology. To achieve these objectives requires a systematic process, integrated, effective, and sustained through quality learning activities.

One factor that affects the quality of learning is teaching material availability. Teaching material is a form of planning the learning process. Teachers are required to make a teaching material that consists of a syllabus, lesson plans, teaching materials, instructional media, and assessment instruments that included the domain of knowledge, attitude, and skills along with answer keys and rubrics (Depdiknas, 2008). Selecting and using the appropriate teaching material in the learning process is a very important factor in guiding students to acquire learning experience. The good teaching material can facilitate the realization of interactive learning, inspirational, fun, challenging, and motivating students to actively participate and provide enough space for innovation, creativity, and independence in accordance with their talents, interests and physical and psychological development of students (Depdiknas, 2007). Through the good teaching material, students are expected to become more active and the learning process become more meaningful for students.

Observations showed that the teaching material used in SMAN 1 Padang has not included a good teaching material. SMAN 1 Padang is one of the excellent schools in Padang. SMAN 1 Padang has a good grades of National Examination, full infrastructure, teachers that are competent in their field, and good administration. The excellence of the SMAN 1 Padang should have an impact on the learning process. However, reality shows that most of the learning outcomes of students of SMAN 1 Padang has not reached the minimal target of competency. It can be seen from the physics class X academic year 2014/2015. From seven classes, the highest passing grade is 40.6%. The average value of the highest grade is 78.5 while the minimal target of competency is 80. To determine the cause of low outcome of the student, given a questionnaire to students of class X MIA in SMAN 1 Padang about the learning process and the teaching material used. The survey showed that in the learning activities of students rarely conducted the experiments in the laboratory. Activities in laboratory experiments are useful to foster the spirit of researching for students to acquire knowledge based on experimental results.

To solve the problems that have been describe, the variety of teaching material needs to be improved so that the learning process can be conducted well, can foster students' independence, so it will improve the skills of critical thinking in solving problems. One model of learning in accordance with the 2013 curriculum is research-based learning model with guided inquiry approach. Wardoyo (2013) explains that the research-based learning is learning based on research approach in the learning process. The learning process combine the research and meaningful learning. Students are required to connect the learning experience at school with real life. In the learning process, students need to try the acquire knowledge through research and correlate the learning material with real life.

According to Lockwood (Poonpan, 2001) research-based learning is an instruction system which use an authentic learning, problem solving, cooperative learning, hands-on, and inquiry discovery approach, guided by a constructivism philosophy. Its usefulness had been recognized for many decades of research in the classroom but had not been adopted

as a teaching method. Research-based learning is based on the philosophy of constructivism which includes four aspects: learning to build student understanding, learning to develop the prior knowledge, learning as process of social interaction, and meaningful learning is achieved through real experience. Research-based learning is a learning method that uses authentic learning, problem solving, cooperative learning, contextual (hands-on and minds-on), and the inquiry approach (Widayati, 2010). Arifin (2010) suggest steps that research-based learning model, "A curriculum integration in three stages sophistication of research involvement (Exposure, Experience, and Capstone) that will enhance student competencies". Jenkin (Yahya 2010) explains the advantages of the research-based learning models give students the chance to practice the searching, formulating hypotheses, collecting and analyzing data, and concluding the result.

To carry out research based learning, teaching material must be developed. Teaching material include lesson plan, handouts, student worksheets, and assessments. The teaching material is designed based on the analysis of learning needs of students and attention to the characteristics of the subject matter. Teaching materials are made in a systematic, clear and specific, presenting illustrations, schemes, examples of which can be interesting to learn, and easy to learn. In the student worksheet, there are questions that can guide students in developing creative and innovative thinking ability.

Problems in this research are: How to develop research-based learning model in physics learning for high school students that valid, practical, and effective? The aim of research is to produce research-based learning model in physics learning for high school students that valid, practical, and effective.

METHOD

The research design used methods of research and development which refers to the four D models. According to Thiagarajan (Trianto 2009) four D models stage is define, design, develop, and disseminate. The research was conducted to physics teaching for high school students. Subjects were physics learning model for high school students. Respondents were students and physics teachers at SMAN 1 Padang. Data collection instruments are validation sheets, observation sheets, questionnaires, and achievement test. Based on the type of data collected the data was analyzed qualitatively and quantitatively. Validation data of teaching material, observation, questionnaires, and test results were analyzed descriptively and compared with the criteria of validity, practicality, and effectiveness of the teaching material. Implementation data of learning models were analyzed qualitatively by revising readability. Revisions were made based on the records of researchers, the results of observations by the observer on the implementation of learning model, the opinion of experts and teacher.

RESULTS AND DISCUSSION

Research Based Learning Models with Guided Inquiry Approach

The research has produced a research-based learning models with guided inquiry approach. Research-based learning is a learning model that uses research in the learning process. Research-based learning is based on the philosophy of constructivism which includes four aspects, namely learning that build student understanding, learning to develop prior knowledge, learning is a process of social interaction, and meaningful learning is achieved through real experience. Research is an important means to improve the quality of learning. Research component consists of the background, procedures, implementation, research results, discussion, and publication of research results (Puskur, 2010). The research-based learning models consists of six stages: (1) exposure stage, (2)

lecturing of core knowledge, (3) experience stage, (4) internal report for feedback, (5) presentation, and (6) final report (Arifin, 2010). Research-based learning model implemented with guided inquiry approach. According to Eggen and Kauchak (Trianto, 2010) guided inquiry learning stages are: (1) Formulate a problem. Teachers guide students to identify problems. (2) Formulate hypotheses. Teachers provide students with opportunities to brainstorm in formulating hypotheses. Teachers guide students in formulating hypotheses and prioritize which hypothesis is a investigation priority. (3) Design the experiment. Teachers provide students with opportunities to determine the steps of the experiment in accordance with the hypothesis. Teachers guide students to sort the steps of the experiment. (4) Conduct the experiment. Teachers guide students to get information through the experiment. (5) Collect and analyze data. Teachers provide an opportunity for each group to present the results of data analysis. (6) Make conclusions. Teachers guide students in making conclusions. Stages of research-based learning with guided inquiry approach can be seen in Table 1.

Table 1. Stages of Research-based Learning with Guided Inquiry Approach

Stages	Teachers activity	Students activity
Exposure Stage	Teachers guide students to prepare themselves and pray Teachers explain the learning objectives and motivate students by giving phenomena in everyday life.	Students listen and observe phenomena that are presented by the teacher Students record the teacher's explanation about the learning objectives
Lecturing of core knowledge	Teachers present a problem about the interesting phenomenon regarding the concepts presented with the aim to train students to observe a phenomenon. Teacher asks students to describe observations Teachers provide references related to the concepts that have been presented Teachers ask the students to search for information about the problem based on references Teachers lead students to ask questions to identify problems	Students ask questions about the phenomena presented teachers Students read references Students identify the problems based on questions of teachers
Experience stage	Teachers divide the group of students Teachers guide students to formulate a problem Teachers guide students to formulate a hypotheses and predict the answer based on the problems Teachers guide students to design an experiment, collecting data, conducting experiments Teachers guide students to test the hypothesis	Formulate a problem Formulate a hypotheses and predict the answers based on problems Design the experiment and collect data Test the hypothesis
Intern report for feedback	Teachers guide students in the group to work and learn Teachers tell students to look for information or answers to obstacles in the experiment process through discussion	Students discuss the results of the hypothesis of the experiment has been done Students seek information through reading and discuss to answer the problems in the experiment
Presentation	Teachers ask the students to present the answer to the problem in the class systematically Teachers ask the students to compare answers are presented with answers that have been obtained through readings and discussion Teachers provide an opportunity for other students to provide feedback on the results of his presentation	Students present the answers that they have acquired in class Other students observe and provide feedback to the answers of the group presentation



Stages	Teachers activity	Students activity
Final report	Teachers guide the students to formulate conclusions Teachers confirm the conclusions and provide detailed information about the concept being studied Teachers ask the students to give a final report based on experiments that have been carried out	Students are formulate conclusions about the solution the problem in a thorough study of the first to the last stage in the form of a final report with guided of teachers.

Validity of Learning Model

Learning models, lesson plan, student worksheets, and assessments that compiled based on learning model were validated by three experts judgement. Aspects assessed by experts judgement is the contents feasibility, construction feasibility, and language feasibility. Results of the validation of learning model and teaching material can be seen in Table 2.

Table 2. Results of the Validation of Learning Model and Teaching Material

No	Assessment Component	Experts Judgement				Average Score	Category
		FY	RL	ZS	EZ		
1	Contents feasibility	79	76	73	79	76.8	Valid
2	Construction feasibility	77	72	79	75	75.8	Valid
3	Language feasibility	70	71	80	80	75.3	Valid

Results of the validation of learning model and teaching material showed that the learning model and the teaching material includes a valid category.

Practicality of Learning Model

Field testing of learning model is the practicality of the learning model and teaching materials. Field testing of research based learning model with guided inquiry approach conducted the four meeting. During the field testing, researcher helped by physics teachers SMAN 1 Padang as an observer. The task of observer is observing the implementation of learning model and student activities. Practicality of learning model based on the learning feasibility and student response. The results of observations indicate that the learning model can be implemented by teachers and students. The response of students to the implementation of learning model shows that learning model easily implemented by students. Thus it can be stated that the research-based learning model with guided inquiry approach included the practical category.

Effectiveness of Learning Model

Student learning outcomes can be seen in Table 3. Student learning outcomes in the cognitive domain showed good progress. The average value of student learning outcomes in the cognitive domain is 81.54 and mastery learning percentage is 93.75%. The average value of student learning outcomes in psychomotor domain is 80.19 and mastery learning percentage percentage is 86.50%. Student learning outcomes in the affective domain including the excellent category for all students with an average of 81.48. More than 85% of students have met the mastery learning criteria. Thus it can be stated that the research-based learning model with guided inquiry approach is effective in improving the students competence on physics subject.

Table 3. Student Learning Outcomes

No	Domain of Learning	Face to Face	Average	Category
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Outcomes	1	2	3	4	Score	
1 Cognitive	75.03	80.21	80.78	90.14	81.54	Very good
2 Psychomotor	74.40	75.15	85.12	86.10	80.19	Good
3 Affective	79.81	80.54	81.45	84.12	81.48	Very good

DISCUSSION

The integration of guided inquiry approach to research-based learning process conducted by the adjustment of stage learning. Research-based learning model with guided inquiry approach generated in this research is valid, practical, and effective to improve the competence high school students in physics. Results of this research was supported by Zubaedah (2013), Rokhimi (2013), and Bella (2013) in his research concluded that the application of research-based learning can improve the activity, process skills, and learning outcomes the fifth grade students of Elementary School in science lessons.

Research-based learning model with guided inquiry approach was conducted in the laboratory. The importance of laboratory activities to understand the concepts of physics for students presented by Ivins and Raghbir. According to Ivins (McComas, 2005) laboratory activities is more effective in helping students learn the concepts of physics. Raghbir (McComas, 2005) found that students showed a high level of cognitive ability when they actually acquire knowledge through laboratory activities. Inquiry experiment activities that are more challenging students in finding the physics concept than the verification activities. Results of Cox's research (2002) stated that laboratory activities inquiry can improve the performance of students in doing practical work. Wahyudin's research (2010) states that the application of the method of guided inquiry with multimedia can increase of interest and understand of high school students.

Research-based physics learning with guided inquiry approach can improve to students competencies of physics as a whole, not just reach the minimum competency and skills but also a scientific attitude and internalize behavior in life, thus becoming their characters. Prayitno (2010) states that the association the character education with instructional materials containing five aspects of I: faith and piety, initiative, industrius, individuals, and interaction. Faith and piety include rules divinity and religious life. Initiative means spirit, willingness to try, unyielding to achieve something useful. Industrious means working earnestly, diligent, disciplined, productive, value-added considerations, honest, entrepreneurial spirit. Individuals include potential quality, diversity and independence. Interaction implies individual relationship with other individual.

The process of attitudes formation assessed from start invisibility the students attitude indicator. This process can be seen that an increase in the number of students who show started sightings attitude indicator. Attitude formation process essentially requires a long time, as stated by Nugroho (2011) that attitude formation occurs with some steps to change personal attitudes which started from dissatisfaction, followed by having a logical and rational vision, risk-taking, and responsible to arrive at consistent stage. At this stage of consistently been able to say for a change in attitude in a person. It is certainly not easy given the challenges the students every day. Therefore, in a number of meetings in learning, students' attitudes is difficult to know the level of consistency.

CONCLUSION

Research has produced a research-based learning model with guided inquiry approach. Research-based learning is a learning model that uses research in the learning process.

There are six steps of research based learning, namely: exposure stage, lecture of core knowledge, experience stage, the internal report for feedback, presentation, final report, which is integrated with guided inquiry approach which consists of six steps: formulating the problem, formulating hypotheses, designing experiments, conduct experiments, collect and analyze data, and concluded.

Research-based learning model with guided inquiry approach is valid, practical, and effective to improve the competence students in physics. The cognitive of students is in the very good category. The psychomotor of students also in good category. The affective of the students is in the very good category. Mastery learning of students on cognitive and psychomotor domain more than 85% complete. It is recommended to teachers of physics to apply this learning model. For further researchs to develop a material of learning model that has not been done in this learning model.

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PHY-01064

The Relationship Between Students's Self-Efficacy and Physics Academic Achievement With Peer Instruction

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Abstract

Peer instruction (PI), which formerly introduced by Eric Mazur, is a teaching method that revolutionize students' learning experiences in class by optimizing students engagement in class discussion. The key feature of PI is *ConcepTest* to help resolve student misconceptions about subject matter in order to build great foundation about conceptual understanding. where student has two answering oppurtunies in each question: once after a round of individual reflection and once again after have discussion with peers. To distinguish between the student whom know the correct answers by learning process and the student whom influenced by neighbors answer that they perceive more knowledgeable, we need to use an isomorphic question as additional *ConcepTest*. This study has been conducted to investigate the improvement of correlation between students' self-efficacy and physics academic achievement with peer instruction teaching method. This study used quasi experiment research method with the matching pretest-posttest control group design. The results shown that implementation of peer instruction teaching method increased positive correlation between students' self-efficacy and their physics academic achievement. Such interventions in group discussion around a pair of *ConcepTest* could helping students builds a sense of mastery, providing mastery experiences, social persuasion about their capabilities to success.

INTRODUCTION

Based on preliminary studies that have been conducted by author about students' academic self-efficacy, it is found that student's biggest difficulty in physics is they do not know what to do to handle it. Not only did they display this attitude towards test, but they also had the same feelings towards physics class activities and assignments. This is not the first time author seen students' negative perpective on physics. After did some further investigation, it is found that they actually did know what to do, but simply believes that they did not. This is great representative of students who has little self-efficacy in physics. This sample case about students with low self-efficacy is one of the most commonly phenomenon faced by teacher. Perceived self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave [1].

There are many research has shown that there is positive correlation between students' self-efficacy and academic achievement [2-4]. Self-regulation is considered as key role in students learning processes and attainments by setting challenging goals for themselves. Self-regulated students exhibit a high sense of efficacy in their capabilities, which is influences their sense knowledge and skill goals they set for themselves and their

commitment to fulfill these challenges. This conception not only encompasses the cognitive skills emphasized metacognitive theorist, but also extends beyond to include the self regulation of motivation, the learning environment, and social support for self-directedness [5].

Peer instruction (PI), which formerly introduced by Eric Mazur [6] is a teaching method that revolutionize students' learning experiences in class by optimizing students engagement in class discussion. The key feature of PI is *ConcepTest* to help resolve student misconceptions about subject matter in order to build great fondation about conceptual understanding where student has two answering oppurtunies in each question: once after a round of individual reflection and once again after have discussion with peers. To distinguish between the student whom know the correct answers by learning process and the student whom influenced by neighbors answer that they perceive more knowledgeable, instructor need to use an isomorphic question as additional *ConcepTest*. *ConcepTest* is widely known as central feature of peer instruction (PI) teaching method. *ConcepTest*, which is abbreviation of *Conceptual Test*, is presented in PI as brief lecture-style presentation on key points of physics to help resolve student misconceptions about subject matter [7-9]. Students are asked to choose their own answers and then convince their peers of the correctness of their answer as a process to forces student to think and argue through discussion [6, 10]. The basis for this teaching method is conseptual understanding which is actively constructed by learner, who has much impact on their understanding as instructor.

Based on previous exposure, this study aimed to investigate the improvement of correlation between self-efficacy and physics academic achievement as impact of peer instruction teaching method, and see students' switching response profile on *ConcepTest*.

RESEARCH METHODOLOGY

This study used quasi experimental research method with the matching pretest-posttest control group design. The sample consisted of 66 tenth-grade students (N experimental class = 34; N control class = 32). Sample was determined by random selection after population fulfilled the normality and homogeneity prerequisite. Independent variabel in this study are conventional teaching model integrated peer instruction (x_1) and conventional teaching model (x_2). Conventional teaching model used in this research is guided inquiry. Dependent variable in this study are students' self-efficacy (O_1) and physics academic achievement (O_2).

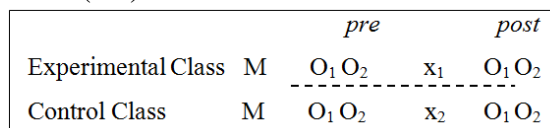


FIGURE 1. The matching pretest-posttest control group design

Two *ConcepTest* were posed during. Student answered each *ConcepTest* in two rounds of questioning by posing their response via Flashcard. Fig. 2 illustrate the diagram of implementation of peer instruction teaching method with two *ConcepTest*. The first round of the first *ConcepTest* (CT_1) is in the beginning of class, the second round of the first *ConcepTest* (CT_{1ad}), first round of the second *ConcepTest* (CT_2), and the second round of the second *ConcepTest* (CT_{2ad}) is in the end of class. Subscript of 'ad' refers to after discussion activity with peers.

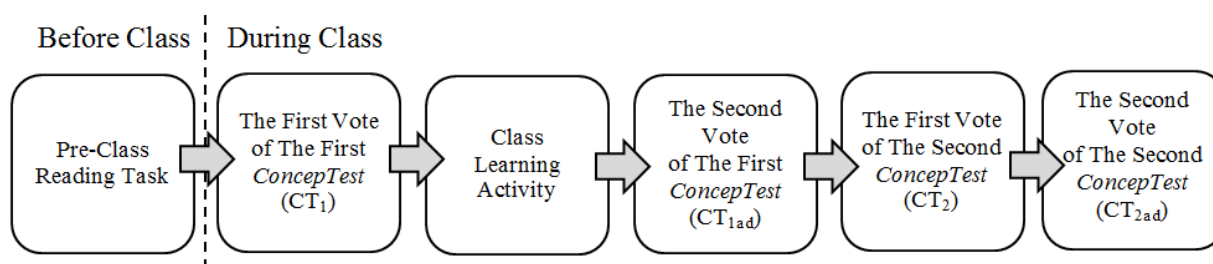


FIGURE 2.. Diagram of peer instruction teaching method with two *ConcepTest*

The class were met once a week for 90 minutes over a heat and temperature topic, were in place for three weeks (not included pretest and posttest). The instrument that used to measure students' self-efficacy is the Self-Efficacy Instrument for Nonmajors [11]. Concept Acquisition Test instrument for heat and temperature topic is developed by writer to measures students' physics academic achievement.

Correlational analysis of self-efficacy survey and physics academic achievement test used Pearson Product Moment. Table 1 shows coefficient interpretation of correlation [12].

TABLE 1. Correlation coefficient interpretation

Correlation Coefficient	$r \leq 0,20$	$0,20 < r \leq 0,40$	$0,40 < r \leq 0,60$	$0,60 < r \leq 0,80$	$0,80 < r \leq 1,00$
Interpretation	Very weak	Weak	Moderate	Strong	Very strong

RESULTS AND DISCUSSION

TABLE 2. The mean results from the pre and post data of students' self efficacy survey and physics academic test

Subject	N	Pre-Survey Mean	Post-Survey Mean	Sig. (2-tailed)	Pre-Test Mean	Post-Test Mean	Sig. (2-tailed)
Experimental Class	34	3.85	6.92	.000	18.2	61.9	.000
Control Class	32	4.23	5.37	.000	17.8	44.5	.000

Table 2 shows the mean of pre and post data of students' self-efficacy survey and physics academic test. Both class's data were compared to answer the research question regarding to investigate the improvement of correlation between self-efficacy and physics academic as impact of peer instruction teaching method. The t-test resulted in all significance (Sig.) values being less than .05 (Sig. < 0.05). which means the difference between the pre and post data were significant. Meaning the difference could have been done due to impact of given treatment. Then we calculated correlation coefficient (r) using SPSS 20.0 software.

Correlational analysis of self-efficacy survey and physics academic achievement test, used Pearson Product Moment, shows that there are different significant result before and after treatment for both class. Table 3 shows The pre-survey data correlated to the pre-test data and the post-survey data correlated to the post-test data. Before treatment, there are no significant positive correlations between self-efficacy and physics academic achievement (Sig. > .05), and after treatment there are significant positive correlations between two dependent variables (Sig. < .05). Before treatment, experimental and control class had a very weak correlation between self-efficacy and physics academic achievement

($r_{\text{experimental class}} = .142$ and $r_{\text{control class}} = .138$). Discrepant things was found after treatment, correlational analysis showed that experimental class attained higher correlation value that control class ($r_{\text{experimental class}} = .801$ and $r_{\text{control class}} = .590$).

TABLE 3. The pre-survey data correlated to the pre-test data and the post-survey data correlated to the post-test data

Data	Experimental Class	Control Class
Pre-Survey and Pre-Test Correlation	.142	.138
Pre-Survey and Pre-Test Correlation Significance (2-tailed)	.424	.450
Post-Survey and Post-Test Correlation	.801	.590
Post-Survey and Post-Test Correlation Significance (2-tailed)	.000	.000

We found that increased positive correlation of experimental class was higher than control had. The increased positive correlation simply strengthen the fact when students perceive they have competence in their knowledge, beliefs and feelings about their capabilities plus their expectation of success [13] they will show improvement in their performance in physics. Students are facilitated by *ConcepTest* in PI to understands basic concepts as an effort to reach the higher level of cognitive domain, that is aplying, analyzing, evaluating, untill creating. During answering *ConcepTest*, students beliefs to solve challenge task are improved. In summary, the key element is the beliefs the students have of themselves will lead to confdence and competence in doing the task. Numerous studies have shown that students with a high sense of academic self-efficacy display greater persistence, effort, and intrinsic interest in their academic learning and performance [2, 14]. The same result emphasized in at college level, Chemers, Hu, and Garcia [15] found academic self-efficacy strongly related to performance and adjustment to college student. Self-efficacy has been shown to be an accurate predictor of succes in academic performance and Pajares [16] even found that twenty five percent of a student’s academic succes is based solely on their self-efficacy [17]. Academic self-efficacy influences the academic persistence and this is necessasry to mantain high academic achievement [18].

TABLE 4. Distribution of students response on physics *ConcepTest*

Cours e	<i>ConcepTest</i> (CT)	Distribution of students response				Answer key
		A	B	C	D	
1	CT ₁	44%	21%	12%	23%	D
	CT _{1ad}	18%	32%	3%	47%	
	CT ₂	12%	9%	12%	67%	D
	CT _{2ad}	0%	3%	0%	97%	
2	CT ₁	6%	30%	49%	15%	B
	CT _{1ad}	0%	97%	3%	0%	
	CT ₂	0%	18%	79%	3%	B
	CT _{2ad}	0%	46%	39%	15%	
3	CT ₁	49%	24%	15%	12%	B
	CT _{1ad}	0%	100%	0%	0%	
	CT ₂	33%	49%	9%	9%	A
	CT _{2ad}	88%	9%	3%	0%	

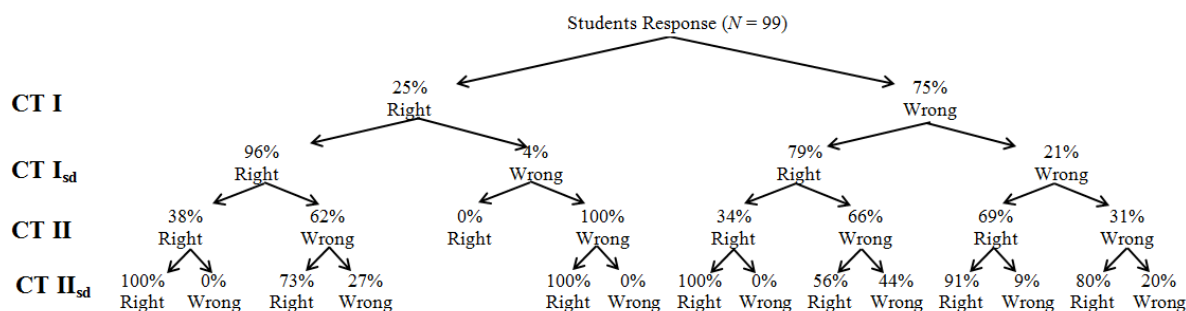


FIGURE 3. The brekdown of students response on physics *ConceptTest*

Tables 4 and Fig. 3 shows the distribution and breakdown of students response on *ConceptTest*. This result indicate that peer discussion enhances students' conceptual understanding. Of the three pairs *ConceptTest*, they are all had four answer choice. This study support the substantial value of student discussion in PI as an effective way to create meaningful learning experience in class. The impact of PI have maintained the "transmissionist" view that during discussion suggest a more constructivist explanation: that these students are arrives at conceptual understanding on their own, through the process of group discussion [8]. Additionally fact, we found that student with low self-efficacy are more likely to switch their responses into negative direction (from right to wrong and from wrong to a different wrong) than student with high self-efficacy. Otherwise, student with high self-efficacy are much more likely to switch from wrong to right than student with low self-efficacy. This facts indicated that the instructors may need to ensuring effective pairing so that students get greater support for reveal and overcome their conceptual understanding by discussion activity. Such interventions in group discussion around a pair of *ConceptTest* could helping students build a sense of mastery, providing mastery experiences, social persuasion about their capabilities to succeed, and reducing stressful provoking situations.

CONCLUSIONS

Research has shown that the implementation of peer instruction teaching method can improve the correlation between students' self-efficacy and their physics academic achievement. Student with high self-efficacy often display greater performance than the low one. Additionally fact, we found that student with low self-efficacy are more likely to switch their responses into negative direction. So the instructor may need to consider an effective pairing in order to give student a meaningful learning experience by qualified discourses in discussion.

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The Effect of Metacognitive Strategy on Students Problem Solving Ability

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Problem Solving Ability

Abstract

This study has investigated the effect of metacognitive strategy on student's problem solving ability in physics. The design for this study was a quasi experimental with non-equivalent post-test only control group design. Two groups of senior high school students (n=84) participated in this study. During 4 weeks study, one group received the metacognitive strategy while the other group acted as control. Data of the study were collected by problem solving ability test. Finding of the study indicate that strategy instruction was effective on physics problem solving ability ($F=93,790$; $p<0,05$). Students which are taught with metacognitive strategy showed a better problem solving ability. The researcher recommend that metacognitive strategy be infused in classroom so it can help students to learn learning material more efficiently, give them a better understanding toward the learning material, and retain information longer.

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INTRODUCTION

The main target of modern education are helping learner to enhance their problem solving ability in order to be a good problem solver (Trianto, 2008). Schoenfeld (1992) said that problems are hold an essential role in science learning (physics) and helps them to construct their problem solving ability. This ability can be used not only in solving mathematical problem, but also solving socioscientific problems or any other problems related to issues or phenomenon around them. Those problems are solved by applying physics concepts they have understood. So, student with a good problem solving ability will showed a better performance in applying their knowledge to solving problems. Polya (on Schunk, 2009) said that, there are four stages in solving problem, which are; understand the problem, devising a plan, carrying out, looking back.

Using the right learning strategies can helps students to developing their problem solving ability, metacognitive strategy are one of the learning strategy that can be used. Byrnes (2008) said, metacognition is a form of cognition which involved activity to controled one's own cognition processes. Metacognition is an appreciation of what one already knows, together with a correct apprehension of the learning task and what knowledge and skills it requires, combined with the ability to make correct inferences about how to apply one's strategic knowledge to a particular situation, and to do so efficiently and reliably (Peirce, 2003). In other words, metacognition is a mental process related with one's ability in comprehending their own thinking process or high order cognition.

According to Pintrich (on Wernke et al., 2011), there are four steps in metacognitive strategy, which are ; planning, monitoring, regulation, dan evaluation. Planning involved problem analyzing, finding relevant informations and also choosing the right strategies.

Monitoring were executed to know their learning progress and to know how efficient the strategy that have been used. Regulation were used to find out if there's any problem in their learning process, so that students can reviewing their strategy or learning activity. Evaluation were used to know if they already met the learning objectives in this steps students can make an inference and also interpreting their learning processes

METHOD

A quasi-experimental design, with non-equivalent post-test only control group design was employed. The dependent variable was problem solving ability as measured by problem solving ability test. There were one control and one experimental group, where only experimental group received metacognitive startegy instruction. Both groups were tested after the treatment are given in each group. The participants of the study consist of eleventh-grade students studying in one of the public high schools in Gianyar, Bali, 42 of students were in experimental group, and 42 of them in control group.

RESULT AND DISCUSSION

Based on problem solving ability test result, known that student's physics problem solving ability score on experimental group lie within 124-172, with maximum score 200. Meanwhile student's physics problem solving ability score on controll group lie within 120-154, with maximum score 200.

Table 1. Mean score and standard deviation each group

Group	Mean	Standard Deviation
Experimental	154,98	8,84
control	136,74	8,42

Based on the main score data, experimental group have a higher mean score compared to control group That's mean that, students in experimental group possessed better problem solving ability compared with students in experimental group.

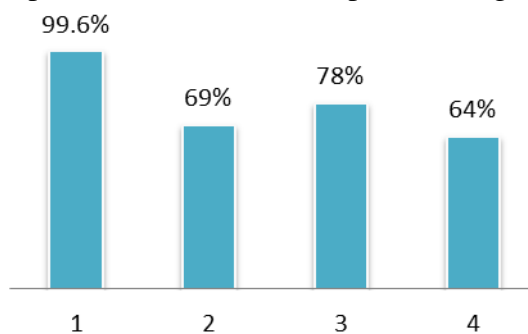


Figure 1. chart of students problem solving ability aspects on experimental group

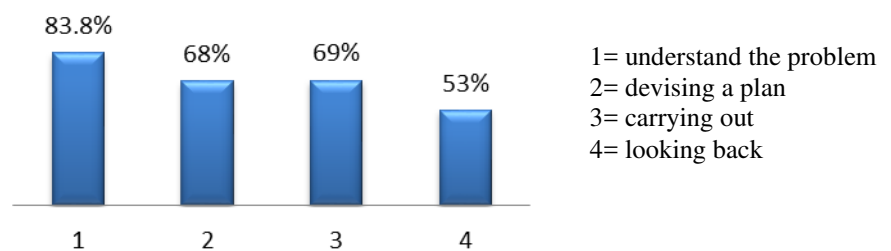


Figure 2. chart of students problem solving ability aspects on control group

Figure 1. and Figure 2. Showed the percentage of students achievement of each aspects of problem solving ability in experimental and control group. There are four aspects on students' problem solving ability, which are; (1) understand the problem, (2) devising a plan, (3) carrying out, (4) looking back. Based on the figures, known that percentage of all problem solving ability aspect of students on experimental group is different than the control group. The percentage of most of problem solving ability aspects (understand the problem, carrying out, and looking back) on experimental group are 10 point higher than control group. Although on aspect devising a plan there's only a slight different between experimental group and control group, but still experimental group has a bigger percentage. So from that description, we can conclude that in all aspects of problem solving ability, students in experimental group showed a better performance compare to the students in control group.

The hypothesis for this study are tested using one way ANOVA (Table 2.).

Table 2. ANOVA result for problem solving ability test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Strategi	6985,190 ^a	1	6985,190	93,790	0,000
Intercept	1787041,714	1	1787041,714	23994,619	0,000
LS	6985,190	1	6985,190	93,790	0,000
Error	6107,095	82	74,477		
Total	1800134,000	84			
Corrected Total	13092,286	83			

Based on the source effect of variable (learning strategies) on dependent variable (problem solving ability, the obtained $F=93,790$ with sig. 0,000. Because $p < 0,05$, the F obtained falls beyond the critical value, the hypothesis that all differences among the population means are equal is rejected ($H_0; \mu_1 = \mu_2$) in favor of the alternative hypothesis that the population means differ in some way ($H_A; \mu_1 \neq \mu_2$). That is, it concludes that there are real different among the treatment conditions with regard to their effect on students' problem solving ability.

Goos et al, (2002) said that problem solving process requires analyzing the given information about the problem, organizing the possessed information, preparing an action plan and assessing all the operations carried out. These operations of problem solving process require one to arrange each level and step and make decisions at the same time. And all these operations performed during the process are skills which constitute the character of metacognition. For that reason, metacognition is a necessary skill for being successful in problem solving. d Hollingworth and McLoughlin (2001), stated that studies on problem solving have suggested that problem solving operations such as definition of problem, practice, and controlling the outcome are not enough for learning. It is not sufficient to know what to do, knowing when to apply similar strategies it is necessary also. So, metacognition have an important role in problem solving process, mainly in helping students to understand the problem and planning a strategies to solved them. Students that have controled their metacognition are aware of their own thinking processes. Therefore, they will know their own weakness and strength in learning, and make any decision or a better method to learn regarding the knowledge about their weakness and strength.

The result of this study are align with previous study concerning metacognitive strategy by Ibe on 2009. The study showed that metacognition are the strong predictor of learning achievement and problem solving ability. Students that can distinguished information that have been given before and the information that they need to know effectively are easier in reviewing and learning a new information. Metacognitive strategy are learning strategy that can help student to increase their motivation in learning and also give them the oportunity to learn how to understand and recognize informations during learning process. The same result is found by Fauche and Lamport on 2011. They found that metacognitive strategy can help students in solving problem. Students can make their learning fruitful and meaningful and also can transfer their knowledge in soling a problem. Make them conscious of their metacognitive processes which never been recognized before, it helps them to recognizing what they actually do in their learning and it makes them really know what to choose and why they choose certain strategies to help them solved the problem.

CONCLUSION

There is significat different of problem solving ability between the experimental group who taught with metacognitive strategy and the control group who taught with conventional strategy. Where, students who taught with metacognitive strategy showed better problem solving ability than the students in control group. Although metacognitive strategy can help students in enhance their problem solving ability, but not all aspects of problem solving ability can improved optimally. The aspects of problem solving ability that has a slight improvement are devising a plan and looking back, both of those aspects are lower than 75%. These things maybe occur because several factors, which are;

First, students not yet accustomed to this strategy, they need time to adjust with the new learning strategy (metacognitive strategy) were used. Student still have a hard times exploring their own knowledge by themselves without teacher assistance and also lack of self efficacy in stating their mind because they are affraid of making mistakes. This things lead to the lack of self-reliant in problem solving process.

Second, students are not familiar working with the new student' worksheet that had given along with the metacognitive strategy. The student's worksheet that usually given to them are just consist of the problems they need to sloved, so it makes them memorized then used the mathematical formula to solve the problem without actually understand the formula throughly. They need a good amout of time to adjust themselves to really involved in their learning process ultimately in planning what to do or how to apply their knowledge, monitoring their problem solving process as well as evaluate it, so they can come up with a good solution in order to solve the given problems.

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Effect of Contextual Laboratory Method on Science Process Skills

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Article info

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Method,
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Abstract

The aim of the study was to investigate effect of Contextual Laboratory method on science-process skills. The sample of the research is consisted of 2 class who studies in one of the high schools in the city of Bandung. In this study quasi experimental design which was randomized pre-test/post-test control group was implemented. While experimental group (30 students) was taught Contextual Laboratory method, control group (30 students) was taught traditional laboratory methods in this study. Science process skills test were administered to both groups before and after the instruction as a pre and post test. Results of study reveal that there is significant difference between experimental and control groups students science process skills test scores. Another result of study displays that experimental group students have higher mean scores than control group students in post science process skills test.

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INTRODUCTION

Basically, the process of learning or learning and teaching process is the interaction between student learning activities and teachers' teaching activities that happened simultaneously. It inspires educators to be able to design and to implement learning and teaching activities more focused on understanding scientific concepts, which can be useful in daily activities in the community. The underlying concept of science is summarized in Physics which is a branch of Natural Sciences (IPA) that relating to natural occurrences in everyday life, so that learners are able to understand the physics extensively.

To understand the physics extensively, the learners must begin with the capability of understanding the basic concepts that exist in physics. One way is to perform the learning activities in which students gain more concrete understanding of the concept and purpose, it can be realized by implementing learning activities through practical methods. In addition to student conduct direct instructional activities, students are also given the opportunity to arrange their own concepts in cognitive structure which can be applied in everyday life.

To get an ability to understand physics more concretely can be done by providing a supportive learning method based on the scientific method. Piaget states that the problems in the teaching of science is based on the scientific method which this can be accounted for based on the steps to obtain a scientific concept. The scientific method begins with scientific events that are experienced by students in everyday life (in Supriadi, 2010: 55).

Practicum conducted for many days tends to be oriented as a means of proof of concept, or principle of law which had previously been informed in a face to face learning in the classroom. The design was practical verification, it is reflected from the observation when practical verification of progress and review of experimental module or student worksheet were prepared and used for this, which in detail contains the practical steps that



must be followed by the students during execution practicum, students only act as a handyman measure should obediently follow step by step and provisions for the sake of the provisions contained in the guide practical and should not differ at all, so that aspect of science process skills such as applying hypotheses, predict, plan experiments are not trained in conventional lab. Such lab is not much science students develop processes appearance, only training some aspect of observing, interpretation and involve few intellectual of students.

This is contrary to the function and purpose of physics at the high school level stating that physics is a means (MONE, 2006: 443-444):

1) Develop an experience to be able to formulate the problem, propose and hypotheses test through experiments, designing and assembling the instrument experiments, collect, process, and interpret data, and communicate the results of the experiment orally and in writing, 2) Develop the ability to reason in thinking analysis of inductive and deductive using the concepts and principles of physics to explain natural events and solve problems both qualitatively and quantitatively, 3) Mastering the concepts and principles of physics, and have the skills to develop the knowledge and attitude of confidence as a preparation for continuing education at higher level and develop science knowledge and technology.

From the description of the purpose of physics level, high school seems that the implementation of physics in high school is intended as a means to train and develop the skills of students to propose hypotheses, planning experiments, interpret experimental data and communicate so that students can master the concepts and principles of physics and develop knowledge. These skills include the science process skills.

Science process skills have a very important position in understanding science knowledge. According to Hill in Mahmuddin (2003), suggested that the formation of knowledge in science is done through a scientific process. From the above explanation in mind that with trained science process skills, the higher the understanding of the concept will be owned by the students.

From the above problems, the need for efforts to improve the learning process so that students more engaged in learning so that students' skills can be further improved. The learning process should be more giving experience to students to put forward the hypothesis of the problems observed daily, to design and conduct an investigation through experiment to obtain data that can be interpreted, processed and analyzed by students and provide experiences for students to communicate its findings.

Noting this, the need for learning practical activities that can help students achieve the function and purpose as mentioned above, such as by using a Contextual lab or Contextual Laboratory. In line with a study done by Kistiono (2014) Practical Methods Contextual that can improve understanding of the concept of Basic Physics with moderate improvement category. Basic Physics practical application in more effective than conventional lab application that is verification.

Kistiono (2014) also suggested that Contextual Laboratory is an instructional model that involves students in practical activities in which the learning process begins with physical phenomena that is often encountered in everyday life (real word problem) as a means of growing motivation, then proceed with the construction of knowledge and skills by the students themselves through activities inquiry lab where implementation is done in cooperative groups.

Based on these descriptions, the researchers are interested in doing research on the application of contextual-based practical method (Contextual Laboratory). Therefore, the basic purpose of this study is to investigate the application of the method Contextual Laboratory in teaching physics to improve the ability to understand and process skills of science students.

METHOD

Research design

The purpose of this study is to determine the picture comparison enhancement science process skills among students who get Laboratory Contextual learning methods with students who get teaching using conventional lab methods, types of research used in this research is quasi experiment.

Participants is consisted of 60 students (30 students experimental group and a control group of 30 students), all of the group receives the same time to the experimental group and the control group.

In this study takes two classes with one class functioned as an experimental class and the other class functioned as the control class. Therefore, the research design that can be used in the study were randomized *pretest-posttest* control group design, as shown in the figure below (Sukmadinata, NS, 2009: 204).

Table 1. *Randomized Pre-test-Posttest Control Group Design*

Groups	<i>Pretest</i>	Treatment	Posttest
Experiment	Science process skills	Contextual Laboratory methods	Science process skills
Control	Science process skills	Conventional lab methods	Science process skills

Samples and Population

The population in this study were all students of class X on one high school in West Bandung regency, while the sample in this study consisted of two classes were chosen at random by using randomized cluster sampling of five classes: one class of experiments implemented by the method of Contextual Laboratory and a grade control applied to conventional lab methods

Instrument

In this study, the instruments used are as follows:

1. Tests science process skills: science process skills test consisting of 13 multiple choice questions, scoring using the scoring rules for multiple-choice test that is 1 or 0. Score 1 if the is right, and 0 score if the answer is wrong. Ideal maximum score is equal to the amount of a given problem.
2. Observation of current practical activities and results of student worksheet : This observation is made to describe and analyze the feasibility process lab activities with emphasis on the elaboration of indicators of science process skills are trained. The instruments used in this observation is performance assessment rubric.

Data analysis

Data obtained from the *pretest* and *posttest* are used to find the value of the gain normalized (*N-gain*). *N-gain* function to determine how much the increase in a variable, in this case the science process skills. SPSS used for statistical analysis of the data in this research. Independent sample test was used to compare the data obtained from the study. To prove the uniformity of each group, the dependent variable is the result of this study compared the results *N-gain* between the experimental class and control class. As for the significance level used in this study was 0.05. Because the data is normalized average gain is homogeneous then the hypothesis test used is *t test*.



RESULTS AND DISCUSSION

The findings obtained from the analysis of data based on average data *pretest* and *posttest* determined science process skills capacity building through calculating the average score of *N-gain*.

Table 2. science process skills result *N-gain*

Groups	<i>Pretest</i>	<i>Posttest</i>	<i>N-gain</i>
Experiment	0,24	0,67	0,56
Control	0,30	0,54	0,33

Table 3. independent sample *t-test* result of *N-gain* science process skills

df = 58	t	p	Significant level
$\alpha = 0,05$	5,706	0,000	$P < 0.05$, Significant

As seen in Table 3, there is a significant difference between total result *N-gain* of the experimental and control groups after the application according to the significance level of $\alpha = 0.05$. Looking at the averages to determine what the difference is, it is seen that there was experimental group significantly improve students' science process skills compared with conventional lab methods approach.

Based on data from the average *pretest* and *posttest* determined science process skills capacity building through calculating the average score of *N-gain*. Data processing on average *pretest*, *posttest*, and the average *N-gain* for the second class, shown in Figure 1.

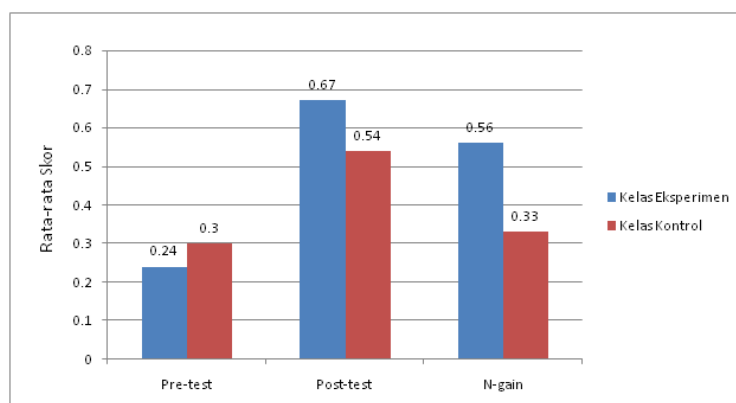


Figure. 1. Science process skills result *N-gain*

Based on Figure 1 above, it can be seen that the average *pretest* for both classes have an average that is not much different, only has a difference of 0.06. While the average score for the *posttest*, the experimental class had an average of 0.13 out of class by a margin of control. For the average *N-gain*, the experimental class has an average large enough with a difference of 0.23. Category increase in Science Process Skills students are in the same category, which is located in the middle category. While the statistical results showed that the application of the method Contextual Laboratory, can significantly improve Science Process Skills students compared with the application of conventional lab methods.

Based whereas the average *N-gain* Science Process Skills, there are differences between the experimental class control class, where the experimental class is superior compared with the control class. That is an increase in the overall Science Process Skills better in the experimental class that implements the method Contextual Laboratory. More significant increase in Science Process Skills in the experimental class also reinforced by the results of the statistical test research hypotheses with significance value of 0.000,

which is smaller than the significance level used (0.05). This is in accordance with the disclosed Mergendoller (2005) that if the average yield of *N-gain* of a learning higher than the average yield of *N-gain* from other learning, then it is said that learning is more effective in improving a competence than other study.

Someone will have a skill if someone is trained through the activity. Similarly, the Science Process Skills on students who will increase if he has the experience to conduct or the skill trained (Wenning, 2006). If we look at the general approach Contextual Laboratory method more often melatihkan Science Process Skills compared with conventional lab methods approach so it is natural that the general increase in Science Process Skills in the experimental class is more significant than the control class.

During the learning process is also carried out an assessment of the student's performance with regard to aspects of Science Process Skills. Stiggins (1994) which states that the assessment of the performance of an assessment involving learners in activities that demonstrate certain skills and or creating specific products. In this study conducted to assess the performance assessment of Science Process Skills aspects. Performance assessment is done to meet the demands of Curriculum 2013 that assessment not only through test but also assessment tests that can assess all competencies of students during the learning process. And in this study the performance assessment results are used as supporting information for analyzing the test results of Science Process Skills.

The study also saw an increase of every aspect of Science Process Skills them, observing aspects, interpretations, proposed a hypothesis, application of concepts, planning experiments, predict. Category improvement of every aspect of the PPP is based on confirmation of the average *N-gain* against Hake criteria, can be seen in Table 5.

Tabel 5. Category improvement of every aspect of the Science Process Skills

SPS	Experiment Group		Control group	
	N-gain	Category	N-gain	Category
Observing	0.51	Normal	0.32	Normal
Interpretations	0.41	Normal	0.36	Normal
Hypothesis	0.37	Normal	0.26	Low
Application of Concepts	0.85	High	0.73	High
Planning Experiments	0.56	Normal	0.29	Low
Predict	0.67	Normal	0.32	Normal

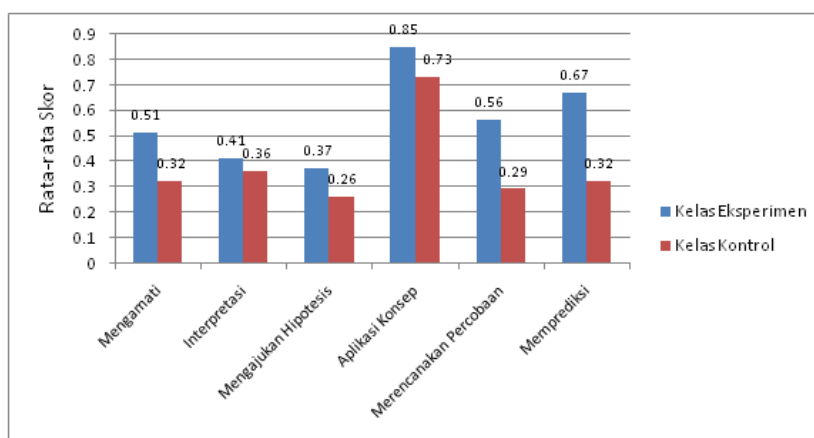


Figure 2. Bar chart improvement of every aspect of the science process skills



Based on the bar chart in Figure 4.4 above, it can be seen that the average *N-gain* in every aspect of the Science Process Skills in the experimental class are generally superior to the control class. In the experimental group, the average *N-highest* gain contained in the application aspect of the concept, while the average gain of *N-lowest* for the aspects put forward the hypothesis. In the control group, the average *N-highest* gain contained in the application aspect of the concept, while the average gain of *N-lowest* for the aspects put forward the hypothesis.

Aspects of the application concept is the highest aspect of the experimental class and control class, aspects related to the application of the concept of student skills, implementing concepts that can be learned in a new situation, using concepts to new experiences sedag to explain what happened. Aspects of the application of this concept also includes aspects of the ability of the highest in the experimental class and the control class. It happened because the experimental class and control class this aspect trained when at the end of learning, where students are required to mention the implementing of the material that has been studied previously, in addition to the later students were able to use the concept or new knowledge has been acquired to explain about what is happening in everyday life.

At the first meeting of teaching materials on the hydrostatic pressure in the experimental class students are asked to explain why the design of the dam under increasingly thick increasingly associated with the concept of hydrostatic pressure. As one example of the students responded that "the higher the dept, the pressure greater " other answer students' increasingly greater pressure inside the dam, so the dam wall is made thicker ". It showed at the first meeting there were several groups of students who simply rewrite the concept that they find, without hooking with the problems presented. But there are groups of students who are able menjelaskan with good linkage concept hydrostatic pressure to shape the design of the dam. The existence of groups of students who mampu describes the application of the concept properly will help in classroom discussions. Group who answered correctly can be an example for other groups. And for the second meeting students' skills in applying the concept of getting better. Previously mentioned that during the learning process there are still some students who have problems, but this does not make students err in applying the concept because the concept of the students wake up is the correct concept.

Aspect proposed a hypothesis is the lowest aspect of the experimental class and control class, put forward the hypothesis aspects related to the skills students express the relationship between two variables, submitted estimates cause of something. This aspect is trained in the process of learning physics by applying the method of Contextual Laboratory, when carried out stages of filing a hypothesis, in which students are required to submit an initial hypothesis based formulation of the problem presented, so that in the end the initial hypothesis proposed students tested when students completed the lab work, whether results practicum according to the initial hypothesis or not. Aspects filed this hypothesis includes the capability of the lowest in the experimental class and the control class. The results in strengthened by the results of the performance assessment worksheets, which at an average grade control aspects put forward the hypothesis of students is 70, while the experimental class of 67.5.

It can occur because when the learning process of students in the experimental class and the control class found it difficult to put forward a hypothesis, it looks at the first meeting of the students still feel confused when I have put forward the hypothesis of the issues raised, there was one student who believes when the process of filing hypotheses about the law of Archimedes, "the density of objects on average is greater than the density of water", it shows that students still find it difficult to megajukan hypothesis, students still

can not connect between variables, due to the rarity of these aspects are trained in school. At the second meeting of the students are already getting used to put forward the hypothesis, it is seen that gradually students are getting used by itself when it should megajukan hypothesis, although not completely perfect, as one example of the hydrostatic pressure, "Pressure depends on the density of the fluid, gravity, depth".

CONCLUSION

- a. Learning approach Contextual Laboratory methods significantly improve students' science process skills compared with conventional lab methods approach.
- b. Teachers stated that the application of the method Contextual Laboratory helped students to improve the ability to understand and process skills of science students.
- c. Most of the students stated that application of the method Contextual Laboratory helped students to improve the ability to understand and process skills of science students.

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PHY-01128

The Effectiveness of Using Interactive Multimedia to Increase Students Mastery of Concept on Topic of Fluid Dynamics on Senior High School in South Halmahera Regency

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Article info

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Abstract

This article is a part of research about developing multimedia of physics learning based on competence of students on senior high school in North Moluccas. This research was done to investigate the effectiveness of using interactive multimedia to increasing student mastery of concept in ability on national examination of physics particularly on concepts of Fluid Dynamics. This research was an experimental research with randomized control group pretest-posttest design which had involved the students of 11th grade at the one of senior high school in Kayoa archipelago at South Halmahera Regency. Data were collected through test which is contains national examination questions for physics lesson. The result of data analyze shown that the average N-gain for experiment group is 0.45 and control group is 0.28. The analyze of t-test shown that the scores $t_{count} = 2.529$ which is higher than the $t_{critic} = 2.0231$. Based on the calculation the effect size obtained the magnitude of effect size = 1.1 (high). Based on analyze of data, it was concluded that the use of interactive multimedia in learning of physics as significantly more effective to increase students mastery of concept in ability on national examination of physics specially on concept of fluid dynamics than conventional learning.

INTRODUCTION

South Halmahera is one of the districts in North Moluccas Province with an area of 8148.90 km². In the north of the district is bordered by Tidore archipelago and Ternate city, while in the south bordered by Seram sea. For the east of the district is bordered by the Halmahera sea, while in the west bordered by Maluku sea. ¹

South Halmahera regency is one of the districts that held a national examination at the senior high school level. National Examination (UN) is an activity for measuring the certain competencies which is achieved by learners in order to assess the achievement of national education standards were implemented nationally ². Physics is one of the subjects which were tested in the national examination for senior high school especially for natural sciences program.

The results of the national examamination specially for physics on senior high school in South Halmahera regency which is identified from the results of national examinations in 2007/2008 until 2011/2012 show that the students mastery concept are still needs to be improved.



Table 1. Average Score of the Physics National Exam

Regency/ City	Average Score of the Physics National Exam				
	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
South Halmahera Regency	6.25	6.00	5.22	6.35	7.12
North Moluccas Province	6.19	5.57	5.43	6.48	7.37

National Examination Report^{3,4,5,6,7}

One of the causes of the students weakness in mastering concept on the competences which is tested in the physics national examination is the lack of availability of multimedia based on Information technology (IT) and media tutorials for trying out of national examination.^{8, 9, 10, 11, 12, 13, 14, 15}

The use of interactive multimedia is expected to be an alternative solution to support the students' mastery of concepts. Haffos defines multimedia as a computer system that consists of hardware and software that makes it easy to combine various components such as images, video, graphics, animation, sounds, text, and data which is controlled by a computer program¹⁶. As well as with these definition, Vaughn explains that multimedia is a combination of text, graphics, sound, animation and video delivered and controlled by computer¹⁷. Along with the rapid advancement of technology, Thomson defines multimedia as a system that combines pictures, video, animation, and sounds interactively¹⁶.

From these above definitions, it seems there are similarities that multimedia technologies includes a variety of media in an interactive learning software. Multimedia can be defined as technology that optimizes your computer's role as a medium that display text, sound, graphics, video, animation in an integrated and interacted¹⁶.

RESEARCH METHOD

This research used experimental method with randomized control group pretest-posttest design.

Table 2. Research Design

Group	Pretest	Treatment	Posttest
Exp. Group (R)	T ₁	Learning with using Interactive Multimedia	T ₂
Control Group (R)	T ₁	Learning with conventional model	T ₂

In this research, the populations are all students on senior high school in South Halmahera regency. While the sample were selected by using cluster random sampling technique who are the students of 11th grade at the one of senior high school in Kayoa archipelago who are spreads into two classes then were selected randomly again to be an experimental class and control class.

Data were collected through test of student competency which were tested on physics national examination especially on concept of Fluid Dynamics. While the data were analyzed using parametric statistical analysis by means of SPSS software version 16.0.

RESULTS AND DISCUSSION

Description of Student Mastery of Concept on the Topic of Fluid Dynamics

The effectiveness of using interactive multimedia to increase students mastery of concept on topic of fluid dynamics on senior high school in South Halmahera Regency are shown in table 3.

Table 3. Effect Size of using interactive multimedia to increase students mastery of concept on topic of fluid dynamics

	Control Group		Exp. Group	
	Pretest	Posttest	Pretest	Posttest
Mean	16.00	41.00	20.00	58.00
Std. Deviation	9.77	15.69	11.37	14.47
One-Sample Kolmogorov-Smirnov Test (Sig.)	0.298	0.202	0.597	0.246
Test of Homogeneity of Variances (Sig.)	0.345		0.615	
Independent Samples Test	t_count = 1.198		t_count = 3.592	
Effect Size	1.1 (high)			

The result of data analyze on table 3 show that using interactive multimedia in physics learning was empirically effective to increasing students mastery of concept on topic of fluid dynamics. The effect size coefficient for the increase students mastery of concept was in the high criterion ($d = 1.1$) based on Cohen's interpretation.

The percentage of the average scores pretest, posttest and N-gain for students mastery of concept on the topic of fluid dynamics are shown in Figure 1.

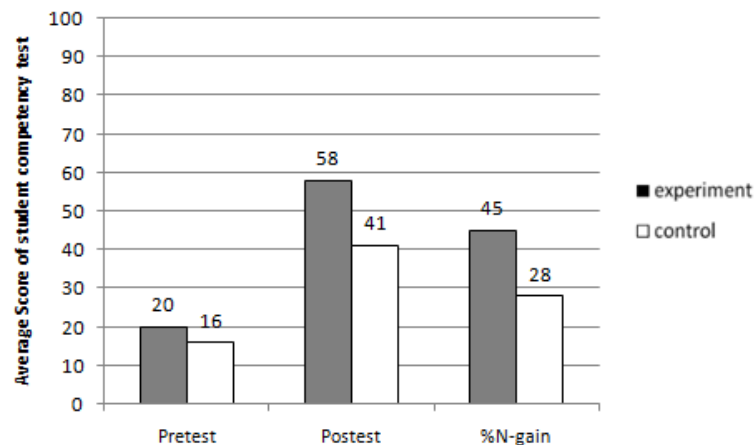


FIGURE 1. Profile of Students Competency Test

The average of N-gain for experimental class is 0.45 (medium) and for control class is 0.28 (low). The results of the two independent samples t -test using SPSS 16.0 with $\alpha = 0.05$ show that the score of $t_{\text{count}} = 2.529$ higher than $t_{\text{critic}} = 2.0231$. Because the t_{count} is higher than t_{critic} . So, H_0 is rejected and H_a is accepted. It means that there are any different student mastery of concept on topic of fluid dynamics between students who learned by using interactive multimedia and conventional learning are significant.

Discussion

Fluid Dynamics is one topic of physics that is on the curriculum on senior high school especially on physics curriculum for students of 11th grade. Interactive multimedia which



have developed on concept of fluid dynamics can be classified on tutorial models. Tutorials are learning guidance in the form of referrals, support, guidance and motivation for the students to learn effectively and efficiently¹⁸.

Interactive multimedia can help students to learn the subject matter. The subject matter in this multimedia presented in the form of text and pictures are equipped with sound, video and animation. With the combination of a variety of multimedia objects is expected to visualize the abstract concept of fluid dynamics so that students can be easier to be understood. In addition, students had been provided the button of label concept, so they can learn the material in accordance with their wishes. The material can be studied repeatedly in mastering concepts thoroughly.

Interactive multimedia has equipped with menu button "Instructions for Use". It is intended to provide information about how to learn if the students learn by using interactive multimedia so that they can learn more effectively and efficiently. When the students are using interactive multimedia, at first they are directed to explore the subject matter through animation and interactive simulations that had equipped with the questions, then learn the subject matter and exercises and terminated by following the evaluation. Evaluation is designed to provide feedback for students automatically when they did not mastery the concepts.

Generally the increasing of students' mastery of concepts on topic of fluid dynamics for the experimental class is better than the control class. Multimedia is media that involves multiple senses in a learning process. One of the advantages of interactive multimedia as learning media is interaction. When students apply this program, they are encouraged to obtain involved in auditory, visual and kinetic, so this involvement is made possible the information or message is easier to be understood¹⁹.

Furht states that multimedia is a combination among a variety of media; text, graphics, animation, pictures and videos¹⁶. The use of interactive multimedia can help visualize the abstract concepts such as the concept of equation of continuity for fluids, Bernoulli's Equation and its applications. The existence of this visualization, the student is expected to be easier to understand the concept.

The combination of various media on multimedia, the senses are involved when learning will become more so as the memory of students will be increased. This is consistent with the results of research Jacobs and Schade, who is stating that the memory of people who only read only gives the lowest percentage is 1%. This memory can be increased up to 25% to 30% with the help of other media such as television. Memory will increase with the use of 3-dimensional media such as multimedia up to 60% .¹⁶

CONCLUSIONS

Based on analyze of data, it was concluded that the use of interactive multimedia in learning of physics as significantly more effective to increase students mastery of concept in ability on national examination of physics specially on concept of fluid dynamics than conventional learning.

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PHY-01130

Model Problem Solving Laboratory To Improve Comprehension The Concept Of Students

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Abstract

This study is aimed to improve students' comprehension concept through implementation model problem solving laboratory of school physics laboratory course and know to respond student by the implementation of model problem solving laboratory on school physics laboratory course. This research uses quasi-experimental and descriptive methods. Instruments that are used concept comprehension test and Guttman scale questionnaire. The research subject is the fourth semester students from the department of physics education academic year 2013/2014 and a sample of 40 people randomly selected from two classes. The result shows comprehension improvement on students used learning model problem solving laboratory. N-gain average of comprehension concept of the student is 0.63. Students give positive response with average 94,3.0% of the uses model problem solving laboratory on school physics laboratory course. It can be concluded that use model problem solving laboratory significantly comprehension concept is improving students on school physics laboratory course and students give positive response of the uses modelproblem solving laboratory on school physics laboratory course.

INTRODUCTION

Laboratory is one of the means of education that can be used as a place to practice, students can make contact with the object to be studied directly either through observation, or by doing experiments, from the laboratory that will always flow of new scientific information derived from the results the discovery of the researchers in the laboratory. Laboratory is an important and a major part in the educational process, meaning that the students individually or in groups with the guidance of educators learn to practice actively using all five senses, brain and energy solving their own problems of from library books or student worksheet, and discuss the results in the laboratory to acquire knowledge.

Practicum is a practice in the laboratory activities including demonstrations, computer simulations complement experimental work on hand, offering to students a rich learning experience, gain a conceptual comprehension of disciplines and develop practical skills (Byers, 2002; Kirschner and Meester, 1988). Contributions in instructional science lab activities should be able to cultivate the ability in the development of conceptual thinking, evokes the imagination, stimulate the desire and methodological sharpness honed as part of the experimental experience.

The main objective of the physics lab itself is to increase the knowledge of physics; develop practical skills; generate and maintain interest, satisfaction attitude and open-mindedness in physics; develop creative thinking and problem solving skills; improve scientific thinking and provide training in experimental methods (Deacon and Hajek, 2010). Practicum is seen to have an important role in school science. In particular many



have claimed that the lab has an important role in determining the students' attitudes toward school science and science outside the classroom (Sharpe, 2012). It is also reinforced by the statement Zezekwa (2011) the development of a positive attitude is one of the basic determinants of performance in every discipline of study. In addition, the practicum can melatihkan and develop both skills are soft skills and hard skills.

The fact that encountered in a preliminary study on one LPTK in West Java is not as expected. Results of the analysis of the syllabus and SAP lecturer of the school of physics laboratory course, explicitly students are required to apply the concept to be able to overcome problems in daily life. Practicum school physics laboratory encountered in the field, to increase students' comprehension need to be trained and developed further. This is marked by the students do not yet have the confidence to do the lab work independently, especially in terms of assembling tools. Students are relying on a lab assistant for help in doing practical work.

One model that makes the problem as the basis for practical activities so that it can apply the concept is Problem Solving Laboratory (PSL). Problem solving laboratory is a model of learning which gives problems in the classroom, and the problem-solving techniques performed by laboratory activities. Once the issue is resolved through laboratory activities, students perform in class discussion to convey concepts that have been found (Ellianawati & B. Subali, 2010). PSL learning model used is based on a model developed by the Department of Physics University of Minnesota, USA (Heller, P & Heller, K, 1999). The measures applied learning model PSL elaborated from Bound & Ton in (Ellianawati & B. Subali, 2010) which consists of: 1). Students can solve the problem according to the stages chosen, using brainstorming and problem investigation techniques, 2). Build a science that has been owned and acquire new knowledge through case studies, 3). Can operate laboratory equipment related to a given theory, 4). Students can use existing media and can perform analysis techniques, 5). Students can analyze and describe and discuss the results of the data lab by making written reports, posters, and oral presentations, 6). Students can work in groups with each group organizing.

Comprehension the concept means that a proper comprehension of the design or an abstract idea. It is shown by the ability of students to understand an idea contained in the communication and information sharing activities in the form of oral or written as well as verbal or symbolic independently by the students to use their own language. Students can be said to understand if they can operate the meaning of the messages of learning, either orally, in writing, or graphics delivered through teaching, book or computer screen (Anderson, 2010).

Based on the results of previous studies showing that according to Malik, Handayani, and Nuraini (2015) the application of problem solving laboratory can improve laboratory science process skills of students. Also according to Azizah and Edie (2014) approach problem solving laboratory can enhance the creativity and student learning outcomes. Also according to Ellianawati and B. Subali (2010) the application of practical model problem solving laboratory can improve the quality of basic physics lab. Research results Putri and Sutarno (2012) concluded there was an increase of science process skills on learning of optical waves with laboratory-based models of problem solving activities. Then, according to research results Mustafit (2009) the implementation of problem solving laboratory inquiry-based laboratory activities can improve comprehension of concepts of student.

RESEARCH METHODOLOGY

Subjects were students of fourth semester academic year of the 2013/2014 taking the school of physics laboratory course which consists of two classes totaling 80 people.

Selection of the sample using random sampling techniques and selected a one class of 40 people.

The method used in this study is a quasi experimental and descriptive methods. To get a description of the student used an improved comprehension of the concept of quasi-experimental method pretest posttest design with one group (Fraenkel and Wallen, 2007). Descriptive method to describe the responses of students to use model problem solving laboratory at the school of physics laboratory course.

The research instrument used consisted test comprehension of concepts of student and questionnaire responses of students to the application of model problem solving laboratory. Giving a pretest to see the ability of students before they receive treatment model of problem solving laboratory while posttest to see the outcomes of students after getting treatment. Course materials laboratory school physics is limited to the material of the resistor. Student comprehension of concepts related descriptions shaped resistor material. Test questions cover aspects of the comprehension of the cognitive domain Bloom revised include: (1) interpret; (2) exemplifies; (3) classifies; (4) summarizes; (5) concluded; (6) comparing (7) explains. The questionnaire aims to reveal the students' perceptions about the application of model problem solving laboratory, implementation, its role in increasing comprehension of the concept, its advantages, and reveal the motivation of the students after receiving the learning model. Student attitude measurement scale used is the Guttman scale, the scale of which is used for a clear and consistent answers to a problem that is asked. Each student was asked to answer a statement with a choice of yes or no answer. If the answer a statement to answer yes, then scored one and if the answer is not, then the score is zero.

RESULTS AND DISCUSSION

Percentage achieved an average score of pretest, posttest, and n-gain comprehension of the concept of students can be seen in figure 1.

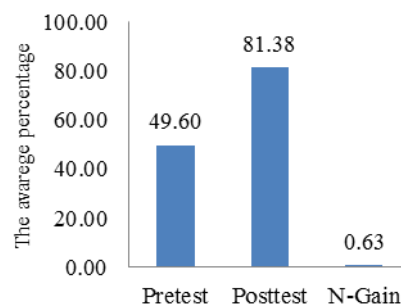


Figure 1 The average score pretest, posttest, and n-gain comprehension of the concept of student

Based on figure 1 shows the average percentage of 50.78% pretest scores. Furthermore, after application of the model of problem solving laboratory data obtained an average score of posttest amounted to 80.48% and the average percentage score of N-gain of 63% (0.63).

Results normality test score of pretest and posttest increased comprehension of the concept of students using the Kolmogorov-Smirnov test. The results indicate the probability value (significance) pretest student conceptual comprehension of 0941 and posttest for 0083. Therefore, the probability value pretest and posttest student comprehension of the concept of greater than 0.05 then the conclusion of data pretest and posttest normal distribution. Data pretest and posttest comprehension of the concept of student normal distribution, then testing the difference of two average and testing



hypotheses about the comprehension of concepts is done with parametric statistical tests (t-test with $\alpha = 0.05$) using paired samples test.

T-test results average pretest and posttest comprehension of the concept of students showed that $t_{\text{arithmetic}}$ pretest to posttest was 23.953 with a significance value of 0.000. Because of the significant value pretest posttest comprehension of concept of student of 0.000 is smaller than the real level of 0.05 then H_0 rejected H_1 accepted the consequences. It can be concluded that there is an comprehension increased of the concept of the student as applied a model of problem solving laboratory at the school of physics laboratory course.

Model problem solving laboratory applied involves the ability of students to be trained in formulating hypotheses through experiments and direct observations that became the basis of the power of science. In addition, students are trained through indirect experience to interpret the resulting data to make conclusions in order to prove the hypothesis made. Based on this indirect experience will guide students to learn to think hypothesis deductive (Liliasari, 2005), so that after going through this learning students can understand the concepts is learned.

Indicators of comprehension concepts examined in this study refers to comprehension aspects of the revised Bloom taxonomy. Comprehension of students for each of these indicators can be seen in figure 2.

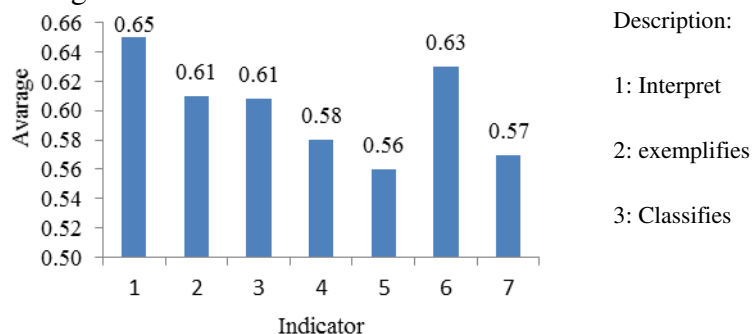


Figure 2 Average n-gain comprehension of each indicator

Based on figure 2 gained an average N-gain is the lowest in concludes indicator of 0.56 with the medium category and highest in interpretation indicator of 0.63 with the medium category.

Acquisition of an average score of N-gain category was due to model problem solving laboratory developed or adopted from model problem-based learning that has the characteristics such as student centered, teacher as a facilitator, collaborative systems and processes of construction of knowledge by students. This model begins with problems in daily life and ends by analyzing and solving them. This model provides an opportunity for students to be more flexible in independent learning, increase the sense of curiosity about something, find yourself a concept through experiments, improve the ability to solve problems, and provide a higher motivation.

Improved comprehension of the concept of students in interpreting indicators including the highest category. This is because the students have been accustomed indicators for studying and interpreting various natural phenomena that occur that are found in everyday life. The increase in this indicator include medium category. The lowest increase in the indicators concluded. This is because on this indicator the students find it difficult to deduce the important concepts used to solve problems.

Results of student responses to the application of the model of problem solving laboratory at the school of physics laboratory course can be seen in table 1.

Table3. Student response to the application of modelproblem solving laboratory

No	Indicator	Percentage of answer (%)	
		Ya	Tidak
1	Help improve the comprehension of the concept	97,5	2,5
2	Help prepare their own knowledge	95,0	5,0
3	Increase motivation to learn	95,0	5,0
4	Improve problem-solving skills	95,0	5,0
5	Improving the ability to apply concepts	95,0	5,0
6	Develop independence and confidence	92,5	7,5
7	Improving the ability to interpret	95,0	5,0
8	Changing perceptions of physics course	92,5	7,5
9	Develop an attitude of scientific thinking	92,5	7,5
10	Improve the ability to analyze the occurrence of a problem	95,0	5,0
11	Improve the ability to make a summary and conclusions	90,0	10,0
12	Guiding find answers to the problems faced	95,0	5,0
13	Improving the ability exemplifies and classify	95,0	5,0
14	Improve the ability to explain	95,0	5,0
15	Improve the ability to compare	95,0	5,0
Avarege		94,3	5,7

Based on the distribution of a questionnaire given to the students, it is known that most of the students stated yes (approval) on any statement contained in the questionnaire. Students give a positive response to the greatest indicator of the application of the model of problem solving can help improve comprehension of the concept and the lowest on indicators can improve the ability to make a summary and conclusions.

Good responses put forward by the students in accordance with what is expressed by Arends (1997, in Trianto, 2007), problem-based learning is a learning approach where students work on authentic problems with a view to construct their own knowledge, develop inquiry and thinking skills level high, develop independence and confidence. This is reinforced by the statement Feranie et. al. (2005) practicum PSL can provide a means for students and aims to: 1) confront them with the initial concept of how nature works, 2) training problem-solving skills, 3) learn to use the tool, 4) learn to design experiments, 5) observe an event which requires explanation is not easy so that they realize that the necessary knowledge to answer, 6) appreciated the difficulty and excitement while doing experiments, 7) experiences like the original scientists, 8) had the pleasure of conducting more active than sitting and listening.

CONCLUSIONS

Results of the analysis data pretest and posttest showed increase comprehension of concept of student as applied to a model of problem solving laboratory on physics laboratory school course with an average N-gain 0.63 including medium category. Students generally stated yes (approval) on any statement contained in the questionnaire on the application of model problem solving laboratory with an average of 94.3%.

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PHY-01191

Graphical Representation Profile of Prospective Teachers of Physics on Thermodynamics Course

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Abstract

Preliminary research on students' graphical representation ability profile of prospective teacher of physics has been conducted in LPTK in East Kalimantan Province. This research used descriptive method. This research were the prospective teachers of physics that enrolled in thermodynamics with 46 students at fourth year undergraduate level as research subjects. To find out the students' graphical representation ability through written test are multiple choice limited to thermodynamics subject matter covers three topics respectively: the energy, the first law of thermodynamics, and the second law of thermodynamics. The result showed an increase in normalized gain $\langle g \rangle$ at the graphical representation students' ability low category in the energy (0,2), the first law of thermodynamics (0,2), and the second law of thermodynamics (0,1). It can be concluded that graphical representation ability of prospective teachers of physics that focused on three topics namely the energy, the first law of thermodynamics, and the second law of thermodynamics still relatively low. Low mastery of graphical representation that students' might have achieved something to do with the applied learning strategies teacher less accommodating student need. Based on these finding it is advisable to conduct further research on the application of more innovation learning strategies and direct participatory student-centered learning.

INTRODUCTION

Thermodynamics is one part of physics majors which taught physics, physics education, and engineering throughout of Indonesia. Knowledge, understanding and mastery of the thermodynamics concept became a base for students to develop the ability as well as the basic for the development and advancement of technology in the future. Thermodynamics has become one of the pillars in the technological progress of a nation. Various applications and thermodynamics methods play an important role in human life. The engineer uses the principle of thermodynamics in their studies to design variety of energy system as required human needs, such as power generation, air conditioner system, jet and automobile engines. The engineers also working to improve of design and enhance the performance that can be measured by variety of factors such as the increase in output of desired product, a reduction in the consumption of natural resources are dwindling, total cost reduction, or a negative impact on the environment. At the global situation, where the acceleration changes occurs in all sectors, then one of the most urgent resources must be prepared to face the world of work is the human resources e.i. teachers. For this reason it should be developed to organize a good learning process that will produce quality graduates.

One of the ability that must be owned of prospective teacher was to understand of

thermodynamics concepts. To understand the concepts, it will effectively facilitate students in problems that related to everyday life. Therefore, understanding the thermodynamics concepts were very important to be trained and owned by prospective teachers in the learning process and after learning. However, to have an understanding of thermodynamics concepts better, student are expected to have an ability to present what they have learned not only in the form of mathematical, verbal, but also in the form of graphical representation. Therefore, graphical representation ability was very important to train and owned by students.

Given the thermodynamics theory that contains of many process require the graphical representation ability to understand all the processes that occur in the system. Then the learning process thermodynamics must be constructed through the learning process that generates these competencies actually happened in the process. Starting from these conditions this research gave a preliminary study about the graphical representation ability of prospective teachers of physics on thermodynamics course they enrolled. Therefore, in this research can be formulated an issue that was how graphical representation profile of prospective teachers of physics on thermodynamics course? Urgently of this research was conducted as base-line for further research.

METHOD

Research method used a descriptive method as preliminary research for dissertation research. The aims of this research was to know the students' graphical profile ability and to find out the student's graphical representation profile using written test. The test were in multiple choice to limited student who enrolled in the thermodynamics course. To collect the data of graphical representation of prospective teachers of physics used thermodynamics subject matter in the energy topic, the first law of thermodynamics and the second law of thermodynamics. The research involved 46 students of physics education class of the year 2013/2014 in a teacher education programme (LPTK) in East Kalimantan.

RESULTS

In this research, the graphical representation ability measured on energy topics, the first law of thermodynamics and the second law of thermodynamics. Here was a comparison diagram of the average of N-gain score $\langle g \rangle$ on each topics.

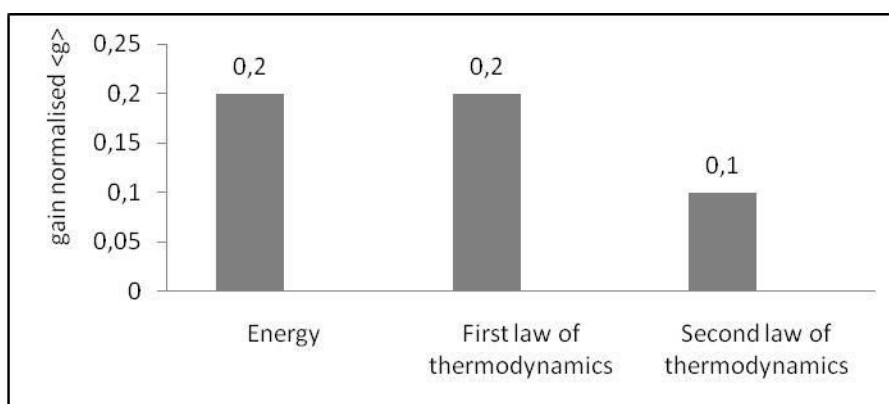


Figure 1 . The average of gain score which normalized $\langle g \rangle$ on each topics

DISCUSSIONS

In the research showed that students' graphical representation ability of prospective teachers of physics on thermodynamics course in the energy topic, the first law of thermodynamics and the second law of thermodynamics still comprehensively in low criteria. The fact that based on the average of gain score which normalized $\langle g \rangle$ students achieved on each topic represented none of medium category. The average still low achievement obtained by students in this research suspected nothing to do with the characteristics of thermodynamics that represent of students the method used by lecturer in the learning process. Some result of the research showed that thermodynamics theory is mathematical, states processes, and abstract, therefore the students have difficulty in leaning thermodynamics. According Huan and Gramol⁸ many theories in thermodynamics were abstract and difficult to visualize. Many student have difficulty in understanding of thermodynamics concept.^{2,3,9,10} Meltzer⁷ found that only 20% of the 653 students who can be apply the first law of thermodynamics after learned. The student difficult to understand the heat concept and work, entropy, and thermodynamics process.¹³ Beside that the students also have difficulty to understanding of PV diagram on sub topic work and energy.^{1,6,7}

Based on the result of research the students' difficulties experiences apparently in according to their learning processes. From the close interview result with some of students about learning process of thermodynamics revealed that the lecturer has been less direct of student center learning and more mathematical in its delivery, never carry out practical activities, questions gave more emphasis on the application of mathematically formula.

Related with the fact that described above, it can be concluded that during the learning process of thermodynamics still tend to be conventional and less involving the students in constructing the concepts, so that result in the lack of understanding of concept and graphical representation ability. This is according to statement of John Dewey in Heuvelen⁴ that science education was tended to fail because so often served merely as a ready-made knowledge and informative. According Chaturvedi et al.⁴ learning with conventional approach were not effective in the 21st century. Students also have difficulty in retention when convention methods used in teaching.^{2,8,12} Therefore, there should be efforts to improve the learning process that involves students actively construct their own knowledge and understanding in order to improve the understanding of the concept and graphical representation ability. This is in line with the result of adult research recommend to science study to put more emphasis on understanding concepts.^{5,11}

CONCLUSIONS AND SUGGESTION

Based on the result of the discussions it can be concluded that prospective teachers of physics in one of LPTK in East Kalimantan showed low graphical representation ability in thermodynamics theory. It's based on the average of the normalized gain score $\langle g \rangle$ the achievement of the students in graphical representation ability was not over 0,2. On each subject being achieved from the third subject of the lowest levels of the achievement showed in the second law of thermodynamics theory. Starting from the result of this preliminary research reminded the importance of the graphical representation ability for prospective teachers of physics. It is very relevant to further research on the factors affecting the law of graphical representation ability of prospective teachers and research on the application of innovation learning strategies and direct participatory students more actively to improve graphical representation ability

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PHY-01216

Cooperative Learning Jigsaw Type to Increase Mastery Concept of Physics Students in Electric Field Topics

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Abstract

Lectures of magnetic electricity is generally carried out by the method of one-way delivery of information from lecturer to students. This leads to the involvement of students in learning is very less which results in less optimize student potential, as seen from the unsatisfactory learning achievement and student responses tend to be negative. This research aims to increase student mastery of concepts, especially on the topic of electric field and to determine the response of students to the process of cooperative learning type jigsaw. One group pretest-posttest design used to determine student mastery of concepts change as many as 41 people who became class sample. The results showed an increase student mastery of electricity concepts with normalized gain value (n-gain) at 0.59 (Medium category) and very positive feedback from students on cooperative learning type jigsaw. Questionnaires result that students are motivated to participate actively in the learning activities and are encouraged to think critically to solve the problems associated electric field generated in learning.

INTRODUCTION

The main activity in the process of education in institutions of formal education is the teaching and learning process¹. Success or failure of education goals is very dependent on the teaching and learning experienced by learners and educators².

In the course of magnetic electricity, based on the observation that has been done obtained information, the learning process is dominated by a one-way lecture method so that students are less involved in the learning process, is reinforced by stuffing the student questionnaire which gave negative responses to the learning process. This is of course an impact on student achievement, as seen from the results of the test are still much below the minimum completeness criteria. To overcome these problems, agreed learning will be done by applying the Jigsaw cooperative learning model. This learning model has advantages over other types of cooperative models, including any liability learners are required to master a particular material as a team of experts, and then convey the material each to his friends who get a different material, so that each other are complementary knowledge. Jigsaw cooperative learning model is one type of cooperative learning that encourages active learners and mutual help in mastering the subject matter to achieve maximum performance³, to help learners develop thinking skills and problem solving, enriching experience in solving the problems which must be in group, become autonomous and independent learners⁴, and can improve learning achievement and practice critical thinking skills of students^{4,5}.



RESEARCH METHODOLOGY

Jigsaw cooperative learning is one type of cooperative learning that encourages active learners and help each other in mastering teaching materials to achieve maximum performance. Steps in the process of cooperative learning jigsaw that is the formation of study groups (prior group and expert group). Grouping students (sample studies) in the Jigsaw learning model described in **Figure 1**.

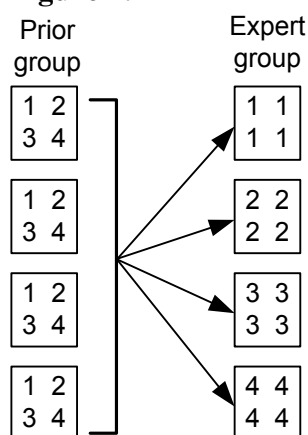


FIGURE 1. Grouping students in the learning of Jigsaw

Subjects in this study were students majoring in Physical education courses as many as 42 students, with the one group pretest – posttest research design.

TABLE 1. The study design one group pretest – posttest

Pretest	Treatment	Posttest
T	X	T

Mastery of concepts students about electric field obtained from the results of tests using essay test instrument that has been validated. Effectiveness Jigsaw cooperative learning model to improve the mastery of concepts obtained through the analysis of normalized gain of pretest and posttest scores using the following equation:

$$\langle g \rangle = \frac{T_f - T_i}{SI - T_i}$$

with $\langle g \rangle$ shows the change scores were normalized, T_f shows posttest scores, T_i showed the pretest scores, and SI is an ideal score/maximum score that can be achieved.

The response of students to the learning process is obtained through questionnaires and questionnaires.

RESULTS AND DISCUSSION

Based on the research that has been done, the data acquired mastery of concepts students before and after a given treatment as well as increased mastery of a concept as shown in **Figure2**.

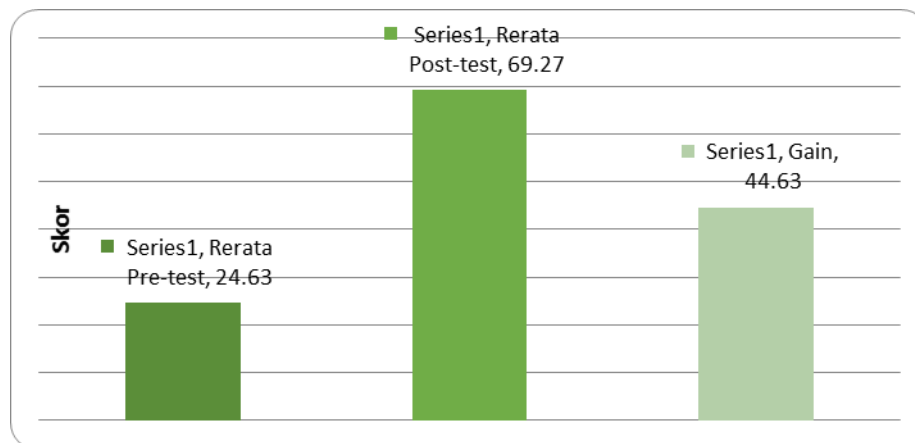


FIGURE 2. Results of tests mastery of concepts

Based on Figure 2, the average student's mastery of the concept of electric field material increase in the amount of 44.63. Category increase can be observed from the normalized gain scores in Table 2 below.

TABLE 2. n-gain test mastery of concepts

Pretest mean	Posttest mean	n-Gain
24,63	69,27	0.59

Normalized gain value for the second cycle is equal to 0.59 and is based on the categorization of Robert Hake (1998), this value includes the medium category. So it can be said that the cooperative learning jigsaw good enough to increasing student mastery of the concept of electric field.

Judging from the scores after learning concept mastery, mastery of the concept of student achievement scores are at 69.27. This result already passed the completeness minimum value specified classes cannot be said to be satisfactory though. This is predicted to occur because students are not familiar with the type of cooperative learning jigsaw, so that should be similar to learning other teaching materials. Nevertheless, judging from the questionnaire and the questionnaire responses of students to the learning process, all students expressed enjoys jigsaw cooperative learning, as shown in Table 3.

TABLE3. Percentage of studentstowards learningquestionnaireresponses

No.	Statement	Yes (%)	No (%)
1	I enjoy learning with cooperative jigsaw	100	0
2	I'm happy if the learning begins with problems in everyday life that demands to be solved	100	0
3	Learning that do provide encouragement to me to learn and think critically	96	4
4	This new learning makes me dizzy and stress	20	80
5	This new teaching gave me the opportunity to find their own concepts being studied	96	4
6	I love to work and discuss in groups	100	0
7	Discussion group of experts to help me understand the concepts being studied	100	0
8	Discussion groups origin make knowledge, understanding and mastery of concepts I grow	100	0



Based on **Table 3** above, the statement remains dominated by the positive response, but if there are some negative responses observed that arise, such as the statement number 1, 4, 5, 7 and 8, although with a small percentage. Search of the reasons that revealed the student that need better time management again. This happens because of a delay start lecturing so impressed the learning process in a hurry. Although aspects that get negative responses increased but an outline of the students still have responded very positively as described in Table3. Questionnaire responses from the students of the attitudes of educators (lecturers) during learning can be seen in **Table4**.

TABLE 4. Results of student assessment questionnaire for teachers (lecturers) and learning

No.	Aspects assessed	Ratings (1-9)
1	Approaches and teaching methods	7.8
2	Media and learning tools	7.6
3	Learning resources (textbooks, reference, environment, society, mass media, etc.).	6.3
4	Management / Classroom Management	7.4
5	Enthusiasm and motivation to teach	8.1
6	The creation of a learning	7.5
7	Student character development (attitudes and behavior)	7.7
8	Ability to Communicate	7.8
Average		7.5

The average student assessment based on table 4 is 7.5 of a range of values from 1 to 9. This indicates a positive response not only to the student learning process but also in the activities and the activities of educators (faculty) for learning, as seen in the numbers 4, 5, 6, 7, and 8. Assessment found in most aspects No. 5 is the enthusiasm and motivation to teach, which means that the teachers (lecturers) felt comfortable teaching by using the cooperative model of jigsaw. Assessment smallest number 3 contained on aspects that learning resources are used, this occurs because during the course of learning resources is limited to books used in the lecture plus some handouts, so that future need greater access, such as Internet access or a variety of relevant e-book.

CONCLUSIONS

Jigsaw cooperative learning model is effective to increase student mastery of concepts in the subject electric field the normalized gain value by 0.57. In addition, the learning process has been done to get a response and a very positive assessment of students, visible from all of the students stated enjoys jigsaw cooperative learning.

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PHY-01225

Influence of the Nature of Science Perception to Teaching-Learning Ability and School Physics Concept Acquisition at Prospective Physics Teachers

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Abstract

This study aimed to analyze perceptions of the nature of science and its implication on the ability to understand and teach school physics concept at prospective physics teachers. This study used an embedded experimental design. This study has been conducted at 42 prospective physics teachers who following Physics Learning Strategies Course at Physics Department, Universitas Negeri Malang in 2014/2015. Data was collected by implementing active learning for 8 weeks with a test, observation, and interviews. Data analysis was conducted qualitatively and quantitatively. The results showed that prospective physics teachers can understand the nature of science and physics learning by experiencing and analyzing of physics learning. These result implicated to teaching-learning ability and acquisition of school physics concept. The study concluded that the perception of the nature of science and learning experiences affect to implement the teaching-learning and acquisition of school physics concept. Results of this study give a recommendation for further research to explore the competence of prospective teachers during teaching practice in school.

INTRODUCTION

The nature of science (NoS) is a multifaceted concept that defies simple definition. The complexity of the concept of the NoS led to various views on scientific knowledge in science. According to the NoS, science is scientific knowledge is tentative; may rely on observation, experimentation, and rational argument "hesitations"; is universal; may be legal, theory, or other rules that apply scientifically; influence each other; and influenced by the environment [1]. The NoS also stated that scientific knowledge is tentative, empirical study. It is subjective because it is the result of human effort through investigation within the framework of a particular theory. And NoS can be inference, imagination, and creativity, affected by factors contextual outside the scientific community, and was developed from a combination of observation and inference [2].

NoS includes aspects of history, sociology, and philosophy of science, and has been defined variously as science epistemology, the characteristics of scientific knowledge, and science as a way of knowing [1][3]. NoS have three domains of science. They are body of knowledge, scientific method and process, and a way of knowing [3]. NOS as body of knowledge includes the scientific facts, concepts, theories, and laws typically presented in science textbooks. NoS as scientific method and process includes observing, predicting, classifying, inferring, etc. This method can be collected by scientific experiments and data analysis [4]. Based on the definition of NoS, the domains of NoS can make the students understand whole of science. It means the prospective teachers who will learn science must have the understanding of NoS.

Some research on NoS in the learning has been done. Understanding of the NoS contributes to the development of scientific literacy [5]. Perceptions of student teachers to NOS will have an impact on learning in the classroom. If a teacher understand how learning experienced by students, then the teacher will find it easier to design a learning process [6]. Although, there is a finding from previous research that there is no link between the perception of NoS student teachers with the ability to practice learning in the classroom [7]. However, if the domains contained in NOS are seen again, NoS able to practice how to study whole of science.

NoS perception affects to the ability of learning and physics concept acquisition for prospective teacher. The ability of learning relates to pedagogical knowledge of prospective physics teachers. Pedagogical knowledge is in line with research [8] that showed teacher candidates should be given a real picture of the class. Knowledge of how physics learning in the classroom is an important thing that will also affect the learning process that occurs in students [9][10]. Pedagogical abilities reflect the depth of a teacher on the learning method [11][12]. In addition to implementation the learning ability, physics concept acquisition also affects to understand and construct new knowledge for students [13][14]. Thus, three domains must be owned by prospective physics teachers that NoS, pedagogical knowledge, and physics concept acquisition integrated into pedagogical content knowledge (PCK) [15]. PCK can be developed by the perception of NoS [16].

. Various attempts to learn NoS that can be implemented with the learning approach explicit-reflective [17], implementation models for Achieving NoS literacy [18] and teaching with and about NoS [15]. Implementation model for the achievement of the NoS are intended to help prospective teachers understand the scientific literacy so that they can learn Physics in accordance with NoS. This model consists of six stages. They are providing information about NoS, the discussion through case studies that how the events in science, inquiry lessons as a model, inquiry lab that reflects the NoS, the study of history that involves NoS, and the assessment emphasizes the importance of NoS. The model is presented in Figure 1 (a).

Learning with and about NoS is intended to help teachers and prospective teachers reach domains of knowledge about NoS. The domain includes understanding science materials, skills and understanding of pedagogical knowledge, and an understanding NoS. The three domains' NoS integrated form pedagogical content knowledge (PCK) as domains that need to be owned by prospective teachers. PCK include (1) scientific knowledge, (2) the science curriculum, (3) how to convey scientific knowledge, (4) the difficulty of learners about the scientific realm, and (5) learning strategies [19][20]. Domain knowledge of teachers and prospective teachers are shown in Figure 1 (b).

Efforts to achieve the domain can be done with the knowledge of teachers and active learning physics-based on NoS. The students-prospective physics teachers are trained on an ongoing basis since the students have a status as prospective physics teacher. Many teachers and prospective teachers of physics have difficulty implementing the nature of science in physics learning. This is due to NoS is often given in a different context and discussed in different subjects [17]. Based on the explanation before, the aim of this study is to analyze perceptions of the nature of science and its implication on the ability to understand and teach school physics concept at prospective physics teachers.

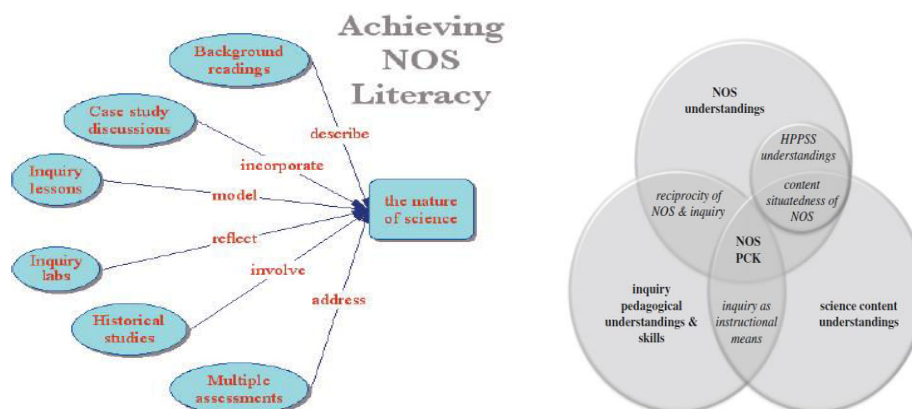


FIGURE 1. (a)Implementation models to reach NoS literacy [18]. (b) The teachers' knowledge domain for teaching with and about nature of science [15]

RESEARCH METHODOLOGY

The study was conducted at 42 prospective physics teachers who following Physics Learning Strategies Course at Physics Department, Universitas Negeri Malang in 2014/2015. This course aims to make students able to hold and practice the nature of science, the nature of physics, methods-approach-model learning and its implications in physics learning. The study was focused on the nature of science, the nature of physics, the nature of learning physics topics and physics teaching implementation

The study used an experimental design embedded in the two groups. Each group obtained an active learning that combined with demonstrations, experiments and discussions methods. The study was conducted for 8 weeks. At each learning, students experience learning according to the topics. For example, during the course topics on problem based learning models, students carry out learning with problem based learning models. In this case, the lecturer becomes a teacher learning model for students. Thus, students learn through learning by doing.

Data collected by a posttest, observation, interviews and journal. A posttest was conducted after the study activities to determine students' perceptions about the nature of science and School of Physics Concept Acquisition. The instrument used an essay test about science learning, physics learning, and the physics concept of school. Observations were conducted during the active learning to determine the students' learning activities. The instrument used the observation sheet activities of physics teaching and learning. Interviews were conducted on student representatives to find out the students' perceptions of beliefs about the nature of science and its relation to physics learning. Journal was made as one form of self-learning and self assessment of procedural learning.

The data were analyzed qualitatively and quantitatively. Qualitative analysis was conducted on the perception of the students about the nature of science and the observation of the learning that is supported by interviews data. Qualitative analysis was conducted with the coding and triangulation. Quantitative analysis was conducted used a simple statistical description which is equipped cross tabulation analysis between school physics concept test with the perception of the nature of science

RESULTS AND DISCUSSION

The study focused on the perceptions of prospective physics teachers toward NoS, physics learning, and the implementation of teaching by peer-teaching. Based on tests and

interviews, the perception of Physics student teachers about NoS arises from the conceptual understanding.

Students' perceptions about NoS can be obtained from the student learning experience as a student at school and learning in pedagogical course. The course is Physics Learning Strategies. Perception of science as scientific products derived from scientific investigation of natural phenomena into one domain achievement of student knowledge about the NoS.

Achievement of domain knowledge of student teachers of physics is supported by knowledge of NoS, learning materials and understanding of inquiry pedagogical [15], perceptions of students about science not only as a product of science (such as concepts, theories, and laws) and demonstrated understanding of the scientific process in accordance with NoS [21]. Students' perceptions about NoS included in the category of scientific knowledge based on facts, scientific model that explains natural phenomena, and how to acquire knowledge [22], empirical, using logic and experimental results [1][2].

Statement of students on learning shows that prospective physics teachers have a good perception about learning physics. The students' perceptions differ from perceptions before taking the course. Learning on the course that integrated theory and practice of NoS has changed the perception of students about learning physics. It is hoped that the students no longer have difficulty in implementing learning physics [17].

Research findings showed that learning involves students and teachers activity. This finding was supported by theory and previous findings. Learning physics will involve hands-on and minds-on activities[23]. Physical activities were not enough for learning of physics. The students must have the experience through the habit of mind in physics learning.

The learning implementation of prospective physics teachers were measured from peer teaching activities. At the time of the teaching practice, student taught school physics concept by active learning. The most of students practiced active learning by inquiry based learning (18%), problem based learning (32%), the 5E learning cycle (23%), discovery learning (19%) and others (8%). Students chose learning model based on NoS' perception, learning theory, and learning models.

Choosing of active learning in teaching practice showed that modeling of active learning in the course affect perception and competence of students. Active learning could develop communication and problem solving skills [24] as well as higher order thinking [25]. In addition, the provision of learning with a variety of learning models could give a chance to do a scientific process [16][26].

The ability of students to implement active learning was influenced by their understanding of school physics concept, teaching models, and students' perceptions of NoS. Students who had a good perception of NoS can demonstrate to teach school physics concept. Although, not all the students showed a positive relationship between the perception of NoS with the ability to teach school physics concept, the findings of this study indicated that the perception of NoS could develop the capabilities of students in pedagogical content knowledge [26]. Student perception refers to the ability of students to apply who understands NoS. Therefore, prospective physics teachers had a good perception of NoS and physics learning in order to practice at school. Thus, NoS literacy and learning capabilities of prospective physics teachers will be achieved.

The results of conceptual acquisition test were grouped into low, medium, and high levels. The results showed that there was a positive correlation between conceptual acquisition and pedagogical knowledge. The conceptual acquisition and pedagogical knowledge of prospective physics teachers were presented in Figure 2.

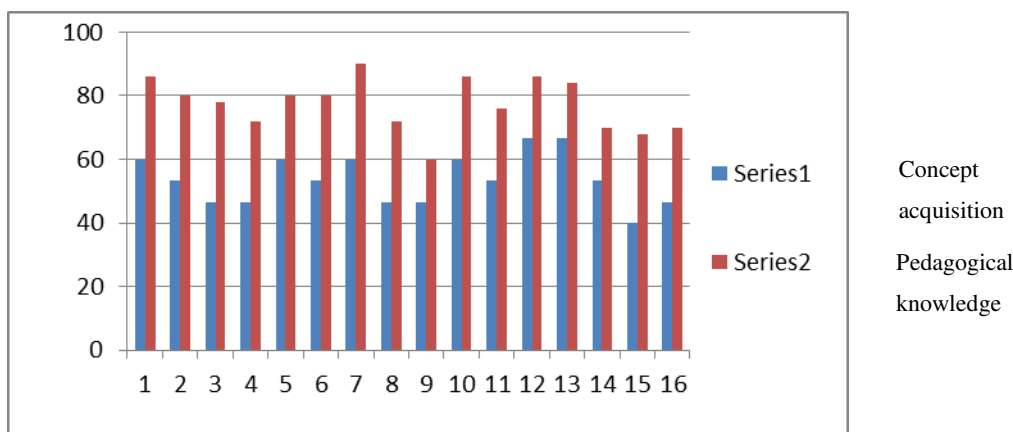


FIGURE 2. The conceptual acquisition and pedagogical knowledge of prospective physics teachers

The result of this study indicated that there was a positive correlation between conceptual acquisition and pedagogical knowledge of prospective physics teachers. This was supported by the others research[27]. The difficulty of teachers will affect to understanding of students [28]. In addition, the results of this study are also consistent with the research that conceptual acquisition had a positive influence on pedagogical knowledge of prospective physics teachers [29]. Thus, it can be stated that NoS, the conceptual acquisition, and pedagogical knowledge are important components that must be mastered by prospective physics teachers.

CONCLUSIONS

There was a positive correlation between NoS, conceptual acquisition and pedagogical knowledge of prospective physics teachers. The perception of NoS and learning experiences affect to implement the teaching-learning and acquisition of school physics concept. The perception of prospective physics teachers related NoS, conceptual acquisition and pedagogical knowledge can be trained by active learning. This method can develop higher order thinking skills to solve the problem in classroom. The prospective physics teachers can use variety of teaching models to teach school physics concept. So, the prospective physics teachers become a professional teacher. Results of this study give a recommendation for further research to explore the competence of prospective teachers during teaching practice in school.

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PHY-01226

The Development of Android-Based Application to Improve the Accuracy, Efficiency, and Effectiveness of Micro Teaching and Internship Assessment

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Abstract

Microteaching and internship program are performance-based courses, which are evaluated using observation technique. Therefore, it is needed to develop an android-based assessment application of microteaching and internship program that is easy to use, practical, efficient, and accurate. This study was aimed at developing of android-based assessment application of microteaching and internship program and to test its feasibility. Its development model used 4D model of Thiagarajan. Its development steps included: 1) conducting literature review and observation of microteaching and internship program; 2) designing the instrument; 3) developing the design and the application; 4) conducting experts validation; 5) improving the application; 6) conducting feasibility test. Based on the result of the expert validation, the application was 97% complete and its feasibility level was 90.9% so that the application was categorized as very feasible. Based on the result of try-out of the application by some lecturers, the aspects of effectivity, efficiency, reliability, and usability of the application were categorized as very feasible. Furthermore, the aspects of compability and design were categorized as feasible. In conclusion, the application was feasible to assess microteaching and internship programs, was accurate, was time effective, economical, and supported on-going process assesment. As a result, this application could be developed to other performance assessments and could be completed with other facilities so that the assessment result could be exported to Ms Excel or Pdf form.

INTRODUCTION

Micro teaching and internship programs are evaluated through performance. Performance assessments is typically conducted through observation in an on-going process (Sugiyanto&Chusnan, 2010) based on Likert scale. The general purposes of microteaching among other are to enable students understand and master concepts, principles, and components of Basic Teaching Skills (BTS) and to be able to apply them (Team PPL, 2008). BTS covers several skills such as 1) skill to open and close classroom instruction; 2) skill to explain the materials; 3) skill to improvise; 4) skill to manage class; 5) skill to ask; 6) skill to offer reinforcement; 7) skill to develop small and individual teaching; and 8) skill to lead small group discussion (Team PPL, 2008).

A tool of practicum evaluation has been developed previously using a processor (Heriyanto, 2010). The problem is that all the assesment indicators must be digitalized first so that the answers must be "Yes" or "No". For this reason, it is needed to developed an application to evaluate micro teaching and internship using mobile phone utilizing Flashlite program (Huda, 2012). The drawback of this application is that it can be used only for *conventional* mobile phones with Symbian operating system and it is not yet able to save the result of an assesment.

The utilization of smartphone as learning evaluation device has not been widely used. With its capabilities, rapid development, open source operating system (Humala, 2013; Ichwan&Hakiky, 2011),



touch screen, and large memory, smartphone is very possible to be used as a learning evaluation tool which is reliable, on-going process and paperless.

Assessment for microteaching and internship programs is fundamentally a performance assessment (Sulthon, 2009), which is supposed to be on-going process. The assessment is usually conducted through a relatively difficult observation (Heriyanto, 2010) and therefore less efficient. For this reason, an Android-based application of assessment is needed. Compared to other systems, Android has more advantages (Prabowo, et al., 2013) such as easy to use, practical, efficient, accurate, fast, on-going process, paperless, and accountable.

RESEARCH METHODOLOGY

This research is a developmental study which includes three stages: 1) preliminary study, 2) development and improvement, and 3) testing device. The application was developed based on the internship program evaluation indicators at the University of Kanjuruhan Malang. Its accuracy was measured through comparison between the results given by the application and the results gained through manual calculation. Meanwhile, the effectiveness and efficiency of the application was measured using several indicators.

The respondents of the research consist of microteaching lecturers at the University of Kanjuruhan Malang, tutors of the internship program, and in-service teachers. There were 33 respondents altogether. The data were collected using checklist and questionnaire. The data were analyzed using descriptive method, namely the percentage of maximum score.

RESULTS AND DISCUSSION

The application was tested using five different smartphone brands and specifications. The results indicate that the application run successfully on Android-based smartphones but not on Windows-based and Blackberry-based smartphones. This is unsurprising because the application has been designed for Android smartphones. The results of validation by three validators shows that the application was complete (97 %) and appropriate (91.7 %). Based on the results of the test conducted by the respondents, the application was complete (98 %). Meanwhile, the appropriateness of the application is described in Table 1 below.

TABLE 1. The appropriateness of the application according to the respondents

No	Aspect	Appropriateness (%)
1	Effectiveness	93,6
2	Efficiency	94,7
3	Reliability	90,9
4	Usability	89,4
5	Compatibility	84,0
6	Design	85,5

The effectiveness, efficiency, and reliability of the application were considered 'very appropriate' by the respondents with a score above 90 %. Surprisingly, the level of efficiency of the application was scored 100 percent by the validators, because the process was faster and also paperless. The assessment process is very practical as the assessment can be done anywhere and anytime, and the results also can be accessed directly. More importantly, the evaluation or assessment process is on-going process and thus is more accurate and accountable.

The usability of the application is high because it is easy to use (touch screen), practical and simple. The compatibility of the application, according to the validator, was 83.3% and 84 % according to the respondents because the application has been designed for Android only. According to design experts and respondents, the design of the application can be categorized .

CONCLUSIONS

The Android-based microteaching and internship assessment application was assessed as 'very complete' and 'very appropriate' by the validator and respondents. The evaluation process became on-going process so that assessment became more effective, accurate, and accountable.

What still needs to be developed is that the compatibility of the application so that it can operate on different operating systems of smartphone and the assessment results could be sent through the internet, bluetooth, or other practical ways.

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PHY-01242

The Effects of Scaffoldings in Cooperative Learning on Physics Achievement Among Senior High School Students

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Abstract

The purposes of this study were to explore the effects of scaffoldings in cooperative learning on physics achievement among senior high school students and to explore the effects of prior knowledge on their physics achievement. This study implemented the 3 x 2 factorial design. Participants included 412 eleventh-grade students from 12 classes in four senior high schools in Malang. Data were collected from two data sources: (a) Prior Knowledge Test to identify students' prior knowledge in physics, and (b) Physics Achievement Test to assess students' physics achievement. Findings revealed that there were significant differences among the three strategies of teaching with regard to physics achievement but no significant difference between high and low prior knowledge with regard to physics achievement. The conceptual scaffolding in cooperative learning generated highest students' physics achievement. Even though students of both high and low prior knowledge tended to have similar physics achievement, there was the effect of interaction between strategies of teaching and prior knowledge on students' physics achievement.

INTRODUCTION

Many students got difficulties in solving physics problems. Saul and coworkers reported that many students who took fundamental physics which was taught by lecturing and traditional laboratory activities, experienced several difficulties [1]. Two major difficulties were weak understanding of concepts in fundamental physics and inability to apply what they knew in a new situation.

The problem solving skills in physics needed critical and logical thinking skills. Learning critical and logical thinking skills were tough, so that many students tried to memorize concepts and formulas of physics. Hammer reported that many students learned physics by memorizing because they had naive physics concepts. Formulas and equations were important in physics because physical quantities had to be solved by applying them. However, if students can not understand physical meaning behind the formulas, they will not be able to solve physics problems [2].

Physics achievement is reflecting the learner's comprehension in implementing physics concepts. Physics achievement of senior high school students in Malang was low. Result of national examination in physics of senior high school students was the lowest in East Java, i.e. rank 36 of 38 districts in East Java [3].

Students who got low physics achievement occurred because there was a discrepancy between student's prior knowledge and level of complexity the learning materials. This showed that it was important to teacher to understand student's prior knowledge. Teacher needed to know student's prior knowledge and experiences and their response to learning materials [4].

In order to reduce student's difficulty in physics, it is clear that students who learn physics need help to bridge the difficulties by scaffolding. Scaffolding will help students to



use many scaffolds for ascertaining that learning has occurred. Scaffolding will help students to prevent them from failure by various scaffolds that focus on student's successes[5]. Scaffolding will bridge between student's prior knowledge and physics achievement, reduce task difficulties by gradual supports.

Scaffolding will improve the quality of physics learning processes and in the long run it will improve physics achievement. Result of the study showed that the quality of learning processes significantly affected students' physics achievement [6]. Furthermore, other research found that the growth of physics achievement was caused by student's active involvement, not by increasing of time period of learning [7]. Student's active involvement can be appeared by implementing cooperative learning.

Study on scaffolding has been done in several ways. Conceptual scaffolding was implemented to solve synthesis problem [8] and visual scaffolding inserted in tutorial to improve retention [9]. Therefore, it was needed to study empirically whether conceptual scaffolding or visual scaffolding in cooperative learning can improve students' physics achievement.

RESEARCH METHOD

Design and procedure

Design of this quasi experiment was the 3x2 factorial design. Three different treatments were implemented into three different groups, i.e. conceptual scaffolding in cooperative learning, visual scaffolding in cooperative learning, and cooperative learning. Each group was categorized into two subgroups based on their prior knowledge, i.e. high and low prior knowledge. The effects of the treatments were measured by the test of physics achievement.

Student sample

Subjects of this research were 412 eleventh-grade students in 12 classrooms of 4 senior high schools in Malang. Experimental groups consisted of 135 students in four classrooms who learned via conceptual scaffolding in cooperative learning and 137 students in four classrooms who learned via visual scaffolding in cooperative learning, while control group consisted of 140 students in four classrooms learned via cooperative learning.

Data collection and analysis

Data of prior knowledge and physics achievement were collected by tests. Data of prior knowledge were collected before treatments. On the other hand, data of physics achievement were collected after treatments. The test of prior knowledge was a multiple choice test consisted of 25 items and had reliability coefficient 0.75. The test of physics achievement was an essay test consisted of 10 items and had reliability coefficient 0.80.

Data were analyzed by two-way anova. This technique was used to analyze the difference of physics achievement among three groups.

RESULTS AND DISCUSSION

Table 1 describes means and standard deviations of physics achievement for three groups in two levels of prior knowledge. The group of students who learns by conceptual scaffolding in cooperative learning acquires highest physics achievement score 70.2 and students with high prior knowledge get higher physics achievement than students with low prior knowledge. However, groups of students who learns by visual scaffolding or without scaffolding show tendency that students with low prior knowledge acquire higher physics

achievement than that with high prior knowledge. Entirely, there is slightly difference in physics achievement between high and low prior knowledge students.

TABLE 1. Physics achievement of three groups in two level of prior knowledge

Group	Prior knowledge	Mean	Std. Dev	N
Conceptual scaffolding in cooperative learning	High prior knowledge	78.6	11.8	65
	Low prior knowledge	62.4	17.1	70
	Total	70.2	16.8	135
Visual scaffolding in cooperative learning	High prior knowledge	60.7	18.0	63
	Low prior knowledge	65.2	16.6	74
	Total	63.2	17.3	137
Cooperative learning	High prior knowledge	53.3	10.7	64
	Low prior knowledge	58.3	22.6	76
	Total	56.0	18.2	140
Total	High prior knowledge	64.3	17.4	192
	Low prior knowledge	61.9	19.2	220
	Total	63.0	18.4	412

Result of two-way anova on physics achievement among three groups based on high and low prior knowledge is shown in Table 2. There is difference on physics achievement among three groups of students that learn physics in different ways ($p < 0.05$). However, there is no difference on physics achievement between high and low prior knowledge ($p > 0.05$). Furthermore, there is interaction between the strategies of teaching and prior knowledge on physics achievement ($p < 0.05$).

TABLE 2. Summary of two-way anova on physics achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	24112.568 ^a	5	4822.514	17.034	.000
Intercept	1631374.192	1	1631374.192	5.762E3	.000
Group (G)	14762.867	2	7381.433	26.072	.000
Prior knowledge (P)	512.005	1	512.005	1.808	.179
G * P	9823.595	2	4911.798	17.349	.000
Error	114945.886	406	283.118		
Total	1776177.000	412			
Corrected Total	139058.454	411			

a. R Squared = .173 (Adjusted R Squared = .163)

Table 3 shows the post hoc test among three groups of students. The test shows that three strategies of teaching affect significantly on student's physics achievement. The strategy of conceptual scaffolding in cooperative learning generates the highest physics achievement and the strategy of cooperative learning without scaffolding results the lowest physics achievement.

TABLE 3. Summary of post hoc test on physics achievement

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig. ^a
CS in cooperative	VS in cooperative learning	7.511*	2.045	.000



learning	Cooperative learning	14.688*	2.034	.000
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*. The mean difference is significant at the .05 level.

Result of this research is in line with several studies. Liang compared the learning strategy of using written scaffold to the strategy of conventional learning in reading for junior high school [10]. The study showed that the use of written scaffold was more effective in improving student's achievement than the strategy of conventional learning. Similar result was acquired by Wu and coworkers that cognitive apprenticeship improved student's achievement [11].

Result of this study can be explained from the creation of learning community. Learning community in the form of group work that is supported by peer scaffolding will improve intensity and quality of learning. By peer scaffolding, the meaning construction in cognitive development occurs in ZPD [12]. The meaning construction by peer scaffolding is in line with students' need to create learning community coherently in order to achieve mastery in physics concepts.

By group work and peer scaffolding, dialogue interactions facilitate students to construct common knowledge. The meaning construction does not occur spontaneously and need a certain structure to facilitate and maximize potency of these processes. Therefore, dialogue interactions are put in the framework of cooperative learning complemented with written scaffold to facilitate peer scaffolding. This peer learning stands on the process of mutually supports among students in the classroom.

Strategies of conceptual scaffolding and visual scaffolding in cooperative learning positively affect on student's physics achievement. The strategies encourage dialogue interactions to support each others successfully in solving physics problems. This high involvement in learning obviously supports the improvement of student's physics achievement. This cooperation in solving tasks gives students opportunity to achieve high level of new knowledge that will not be attained if they work individually [13].

Although prior knowledge does not affect physics achievement, interaction between prior knowledge and the strategies affects on physics achievement. The strategies have significant effects on physics achievement for low prior knowledge because dialogue interactions in the strategies give more support in solving physics problems for low prior knowledge. It means that improvement in physics achievement occurs significantly for low prior knowledge students.

CONCLUSIONS

Conceptual scaffolding in cooperative learning has improved physics achievement higher than visual scaffolding in cooperative learning for eleventh-grade students of senior high school. The difference of student's prior knowledge did not affect student's physics achievement significantly. However, interaction between strategies of teaching and student's prior knowledge affected physics achievement and the strategies of teaching were appropriate to students that had low prior knowledge.

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PHY-01244

The Development of Virtual Simulation Media for Conceptual Change Oriented Physics Instruction on Heat Transfer

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Abstract

A study was conducted to develop virtual simulation media for conceptual change oriented physics instruction on heat transfer concept. Research method was a Research and Development (R&D). The virtual simulation was developed by using animation program and judged good by the experts of physics and educational media. The results showed that the characteristic of simulation virtual media that has been developed was conceptual change oriented and specify to microscopic model of heat transfer concept.

INTRODUCTION

Every student certainly have a prior knowledge that comes from their previous experience which is not necessarily right when they have not gotten classroom teaching [1]. This prior knowledge called as a conception. If the conception is different from the scientific conception commonly known as misconceptions [2]. Misconception is an important issue which will certainly hamper the learning process if it is not handled properly.

Particularly in Physics, misconception occurs in the various topics, such as mechanics, heat and thermodynamics, optics, sound waves, electricity and magnetism, and modern physics. Previous studies specifically on heat transfer topic, successfully reveal that students still have many misconceptions on this concept [3-7]. Nailul [8] found that misconceptions that occur in the concept of heat transfer due to students experienced difficulties in understanding abstract concepts. Further, Nailul [8] explained that students did not understand "what" actually flows between the two substances and the mechanism of heat transfer (conduction, convection and radiation). Students simply memorize the definition only, not to apply and understand the phenomena related with the heat transfer.

The concept of heat is one of the key concepts that are used to understand other scientific concepts. This concept is very important to understand by the students beforehand in order to explain the laws of thermodynamics. In the concept of electric circuits, temperature and heat must also be understood by the students to be able to determine the materials used in an electronic circuit. Heat concept in quantum physics is also one important concept in understanding thermal black body radiation. Considering the importance of understanding the concept of heat as a basis for learning the other physics concepts, it is necessary to give an appropriate treatment to remediate student's misconceptions. The process of changing misconceptions into the scientific conceptions known as conceptual change [9].

According to Posner, *et al.* [9] the process of conceptual change occurs when the



student feels that its conception was not in accordance with the phenomenon or newly learned concepts. Then, it rise to cognitive conflict in the student's minds. The presence of new information that encourages cognitive conflict allows students to rethink their ideas previously that seen to be inconsistent and try to accept the truth of the new information. Therefore, the key of conceptual change is cognitive conflict in the student's minds.

Cognitive conflict in the student's minds can be raised by confronting student's prior conceptions with the actual facts or phenomena. By looking at the actual facts or phenomena, the confidence of students to their prior conceptions will be faded so that they tried to revise their prior conception. This process became the beginning of the conceptual change.

An attempt to present the actual facts or phenomena to confront students' conceptions can be done by direct observation or with the help of a variety of instructional media. On the macroscopic concept of physics that can be observed by the senses, attempt to confrontation can be done by direct observation or using props real learning. However, for the microscopic concept of physics which can not be observed by the senses, such as the concept of heat transfer, it can not be done by direct observation, but with the help of virtual learning media.

Virtual simulation has significant potential as a media in conceptual change learning based on the integration of technology and appropriate learning strategies [10]. The use of virtual simulation media make teaching materials become easier to be understood [11], and give constructive feedback to remediate student's misconceptions [12]. Suhandi, *etal.* [13] also stated that the behavior of microscopicvisualization of a phenomenon can help students in constructing the concept, so that students will be avoided from misconceptions. Therefore, the use of virtual simulation is essential in constructing the concept and changing conceptions of students into scientific conceptions, especially on the abstract and microscopic phenomena as in the concept of heat transfer.

The availability of virtual simulation media on heat transfer concept is still very limited. During this time, the virtual simulation media which are widely used in teaching physics comes from Physics Education Technology (PhET), but simulations of heat transfer is not yet available in the PhET. Meanwhile, heat transfer simulations that comes from other sources mostly does not show the microscopic picture how heat transfers occur, so it may still be able to cause misconceptions in students. On the other hand, most of the physics teacher had difficulty in developing a computer-assisted interactive learning media which user friendly and effectively used as a conceptual change strategy to remove student's misconceptions [14]. Based on such explanations, so, it is necessary to conduct a study on the development of virtual simulation media that oriented on conceptual change to learn heat transfer concept.

METHOD

This study was a research and development that was designed with the stages presented in Fig. 1.

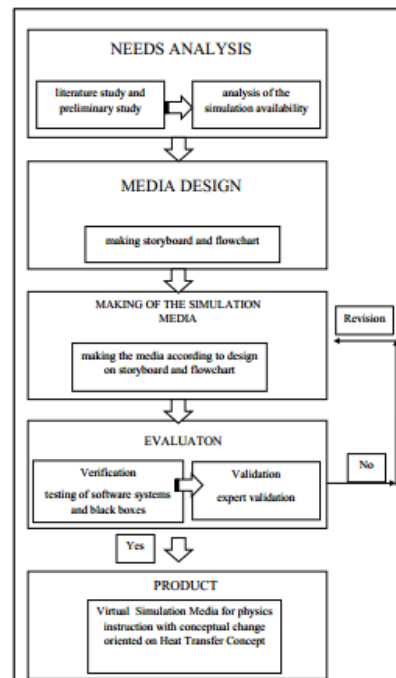


FIGURE 1. Flow diagram of the process

Data collection techniques in this study used a validation sheet and documentation. Validation sheet was used to collect data on the feasibility of simulation media (product) which has been developed based on the judgement of experts in physics and educational media. The data were obtained from the expert's judgement, analyzed by scoring, then described qualitatively to determine the judgement categories, which presented in Tabel 1.

TABLE 1. Categories judgement score

The Average Score	Category
4,08 – 5,00	Very Good
3,36 – 4,08	Good
2,64 – 3,36	Sufficient
1,92 – 3,36	Less
< 1,92	Very Less

RESULTS AND DISCUSSION

Product which has been developed was a virtual simulation media that oriented on conceptual change to learn heat transfer concept. Product was developed by using Adobe Flash CS6 applications operated on the Windows 2008 Operating System. The result of the development in the form of a computer program, which can display the visual effects of microscopic processes of heat transfer on the computer screen. The microscopic process of heat transfer that was presented includes the process of conduction, convection, and radiation.

The design of media display which has been developed contains multiple displays, namely (1) the initial display, (2) the menu bar display, and (3) the settings menu display. The initial display of the media was the main display when the simulation application is opened. When the user opens the simulation, the initial display that appears is the simulation of heat transfer by conduction.

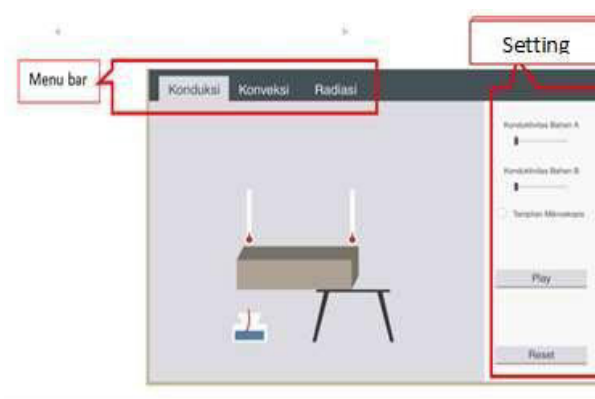


FIGURE 2. The initial display of conduction simulation

On the conduction simulation display, there is a rod objects placed on a table, wherein at each end of the rod is placed a thermometer to see macroscopic changes when the heat transfer occurs. At the bottom of one end of the rod is placed bunsen as a source of heat. Simulations that can be performed on this screen are the simulation of heat transfer by conduction at one end of the rod which is heated using a bunsen and between two rod objects.

Meanwhile, on each display simulation of heat transfer process, there is a menu bar at the top which shows the simulation of heat transfer process that is active and the other menu buttons direct the user to the desired heat transfer simulation. In addition, on the right side of each simulation, there are settings menu that contains several setting options that are suited to the needs of users. There are settings option of "microscopic view" on each setting display to show the microscopic view of the ongoing process. Microscopic view on each simulation process has become characteristic of the media which was developed.

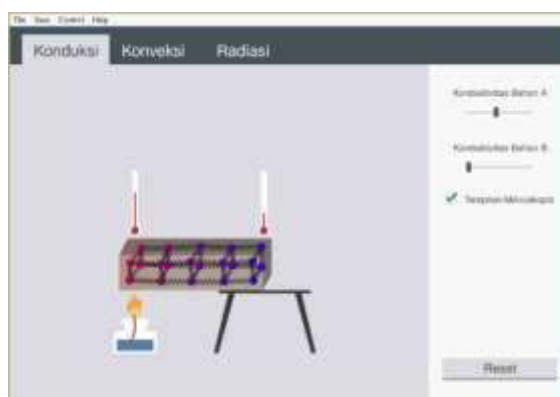


FIGURE 3. Conduction simulation on a single rod

When the user clicks the convection button on the menu bar, then the user will be directed to enter the simulation of convection. At the beginning of convection simulation, there is a water container placed on the furnace. On the right side of the container, there is a thermometer to see macroscopic changes as a result of the process of heat transfer by convection.

Simulation that can be performed on this screen is simulation of convection when boiling water. Simulations on this screen is used to show the process of heat transfer by convection during the boiling water process. In addition, this simulation can also show variations of boiling point due to the influence of outside air pressure.

When the user clicks the radiation button on the menu bar, then the user will be

directed to enter the screen of radiation simulation. In the initial display of simulation of radiation is contained two identical objects that have different colors, namely black and white. In the middle of the screen is placed a radiation source that can emit thermal radiation to both the object. At each end of the rod is placed thermometer to see macroscopic changes as a result of the heat transfer process by radiation. Simulation that can be performed on this screen is simulation of thermal radiation by radiation transmitter at two objects that have different color in a vacuum. This simulation serves to show the differences in absorption and transmit power between two objects that have different colors.

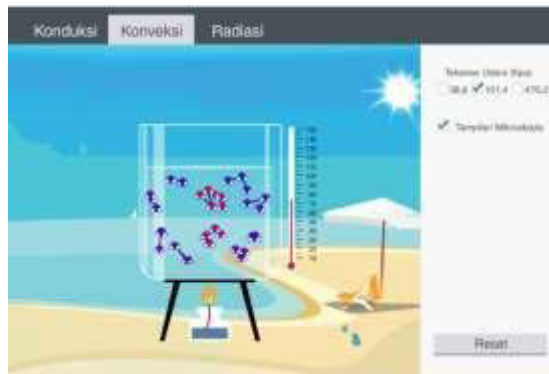


FIGURE 4. Simulation of convection when boiling water

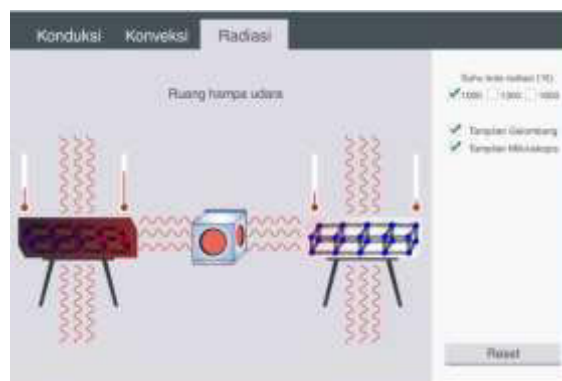


FIGURE 5. Simulation of thermal radiation by radiation transmitter at two objects that have different colors in a vacuum

Meanwhile, validation was conducted by the experts of physics and educational media. The experts of physics judge the virtual simulation from the suitability of the simulation content that was developed with the learning objectives of heat transfer, the suitability of the simulation content with basic competence, suitability of the simulation presentation, the broadness of material in explaining heat transfer concept, the depth of the material in explaining heat transfer concept, the selection of the examples that shown in explaining heat transfer concept, and the suitability of the simulation with heat transfer concept. Generally, the material presented in this virtual simulation has a good quality, it is known through the value was given by experts with an average score of 4.83. the virtual simulation on the heat transfer concept, from the content side declared eligible to be used as a learning media and can potentially change the student's misconceptions on heat transfer concept.

The experts of educational media judge the simulation from the ease aspects of program and the visual communication aspect. Validation was conducted to look at the ease of opening and closing programs, selecting menu, organizing of the material, the legibility of text, color composition and shape modeling, suitability of layout, simulation

image quality, conformity of image with the matter, and consistency of images presentation and text. In general, the virtual simulation that was developed has very good quality, it is known through the value given by the experts with an average score of 4.3. Therefore, the virtual simulation on the heat transfer concept, from the technical side also declared eligible to be used as a learning media.

CONCLUSION

Based on the results of the development of media and data analysis, it can be concluded that this study succeeded in developing virtual simulation media for conceptual change oriented physics instruction on heat transfer concept with the following characteristics: can display the physical process of heat transfer by microscopic or macroscopic, accommodate and counter students misconceptions on heat transfer concept, provide learning activities, such as manipulation of the model, and provide expansion in learning, in order to strengthen the concept construction.

ACKNOWLEDGMENTS

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Identification on Pre-Service Teachers misconception on Electrostatic Concept with Three-Tier Test Diagnostic Instrument

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Abstract

The purpose of this research is to identify misconception of pre-service physics teacher on electrostatic concept 2014/2015 year in one of Semarang University. This research method is descriptive method. This research samples consist of 37 students. The research data was collected by using three-tier test that was developed previously with reliability 0,68 and validity 0,51. The misconception analysis of research showed that 52% students have misconception on charge sub-concept, 36% on electric force sub-concept, 31% on electric fields sub-concept, 38% on potential and electric potential energy sub-concept, and 38% on capacitor sub-concept. The result of research showed that diagnostic instrument of three-tier test was effective to measure misconception of pre-service physics teacher and might be used as alternative of multiple choice for assessment and alternative of student achievement for evaluation.

INTRODUCTION

Learning physics has not been optimal and there are students who have misconceptions. Sstudents who come to class carrying misconceptions. The misconception is the interpretation of students to a phenomenon that is not in accordance with the concept of an expert. Students explain the phenomenon does not correspond to a scientific explanation (Treagust,2006). (Peşman,2010) misconceptions that students explain natural phenomena are not in accordance with the scientific concept or the rules of science and certain of the answer.

Causes of misconceptions (Kaltakci, 2007), namely: students have difficulty understanding the nature of different concepts, teaching methods and teaching materials, textbooks, and the language used. Misconceptions can survive strong in the cognitive structure of students and affect the understanding in the explanation of natural phenomena. Hence, misconceptions should be addressed by educators, because it can hinder students' understanding of scientific explanation.

From the previous explanation, it is necessary to identify misconceptions test instrument. Identification of students who have misconceptions with multiple choice test has been developed by Tamir. Halloun & Hestenes, 1985 mentions that multiple choices can be held to the large sample size, however, does not provide an analysis of multiple choice in the students' answers. Treagust (1988) has developed a two-tier test to identify student misconceptions and first tier in the form of multiple-choice regular/classic as well as the second tier in the form of reason. Erylmaz and Sumel have developed three-tier misconceptions tests on the material temperature and heat. In this test, the researchers added a third tier in the form of the tier of confidence in the response tier one and two. If the student answers incorrectly at tiers one and two, the students had misconceptions.



RESEARCH METHOD

This sampling technique was conducted by purpose sampling technique (Sugiono, 2011). The purpose of this study was to get the identification students' misconception on electrostatic. A tool for identification misconception used by three-tier test instrument. The first tier of a three-tier test is a typical multiple-choice question. The second tier forces students to select a reason for the first tier response. The third tier certainty of response students for the first and second tiers. A misconception and lack of knowledge can be distinguished by three-tier test. Three-tier test are also novel diagnostic instrument, because only two three-tier test could be encountered in the scope of this study's literature review.

RESULT AND ANALYSIS

The results are discussed by focusing on description of students' misconception on electrostatic. It's result from identification misconception by three-tier test instrument. Table 1 shows the details of response student's eighth three-tier test. In this study students' correct response with unscientific explanation is considered as a misconception, in addition to correct response with unscientific explanation and sure for answer first second tiers.

Table 1. The category of identification misconception from response students.

Categories	Response Types	Certainty of response index
Scientific knowledge	Correct response+ scientific explanation	Sure
Lack of knowledge	Correct response+ scientific explanation	Not sure
	Incorrect response+ scientific explanation	
	Correct response + unscientific explanation	
	Incorrect response + unscientific explanation	
Error	Incorrect response + scientific explanation	Sure
Misconception	Correct response + unscientific explanation	Sure
	Incorrect response + unscientific explanation	

The picture 1 shows identification students' misconception on electrostatic. The results not only misconception, but also its can measurement scientific knowledge or concept understanding, lack of knowledge, and error. Electrostatic consist of sub-concept: charge, electric force, electric fields, potential, energy potential, and capacitor.

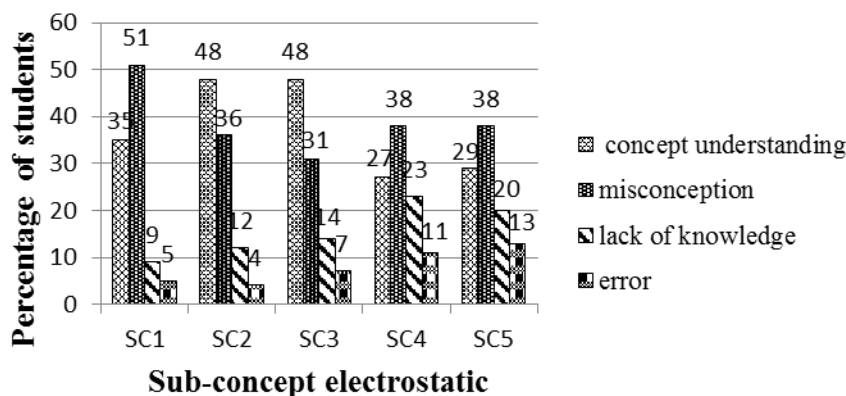


Figure 2. conception each sub concept on electrostatic concept

Ket: SC = Sub-concept

SC1= charge; SC2= electric force; SC3= electric fields; SC4= potential dan electric energy potential; SC5= capasitor

Figure 4.10 shows the SC1 electric charge. The biggest misconceptions when students determine the overall state of the electroscope after bonding with electrically charged objects A negative. Students 51% answered that the electroscope electrically charged negative / positive.

At SC2 electric force, there are still misconceptions. Students 36% had misconceptions determine the electric force. A cause of misconceptions that students are less able to apply the concept of electric force, when given problem varies. Such as determining the electrical force in charge q_2 , which lies between the charge q_2 , q_1 and q_3 with a distance r . In addition, students fooled by the value of different charges $q_1 > q_2$. Students assume that the electric force experienced by each charge is not the same.

At SC3 electric field, the students still think that when positive and negative electrical charges are in the area of electric field, the direction of the force and direction of the electric field. The ability of the students describes the electric field vector at a point most can't. But the ability of the students has been able to describe the basic vector.

At SC4 potential and electric potential energy, the student is not easy to remember the concept of potential and electric potential energy. The cause is that the students thought that the electric potential is a vector quantity and a lot of potential energy formulas related to capacitance and electrical potential. In addition, the electric potential and the potential energy are not commonly known by the students.

At SC5 capacitors, students have been able to determine the capacitance replacement, only when students connect capacitance replacement with electric potential energy cannot. This is because students forget the formula and its relationship with the potential energy of electrical capacitance. In addition, there are some students who cannot distinguish a series or parallel capacitor circuit.

Correct conception of the highest (48%) is shown in the two sub-concepts that force and the electric field. Misconceptions highest (51%) are shown in the sub-concepts of electric charge. Do not know the concept of the highest (23%) is shown in the sub-concepts of potential and electric potential energy. One concept (error) the highest (13%) are shown in the sub-concept capacitors.

The misconception is the understanding of the concept that was built by students in one and different from scientifically accepted concept or concept is different with experts (Köse, 2008). Bingölbali and Özmantar argued that misconception is a tangible form of delusion that a wrong understanding, a common mistake or cognitive chaos students. Delusions are a form of presumption that the right was wrong. Meanwhile, Eryilmaz and Surmeli explained that students who have misconceptions can justify the answer although one and convinced of the truth of the answer. Smith, et al mention misconceptions usually followed by the presumption, an alternative understanding, an understanding that is not mature, and the theory of imperfect (Suat Bal,2011).

CONCLUSION

Although the sample is not large enough. Therefore the identification of misconceptions with three-tier tests may be more successful than one and two tier tests. Apart from identification of misconceptions, three tier tests may be useful in identification of lack of knowledge and errors in students' response. Not only identification about misconception, but also identification another conceptions (lack of knowledge, error). They are also important for required instructional designs.



Whether in transmitter or facilitator role, teachers have effect on students' knowledge. For this reason the identification of lack knowledge, error, and misconception separately become crucial in teacher education process.

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Design of Mr.Fluid Instructional Media for Fostering Students' Creative Thinking

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Abstract

Physics lessons can foster thinking skills that used to solve problems in daily life. Based on the needs assessment analysis, known that a media to carry out experiments about static fluid and fostering creative thinking skill was needed. The purpose of this research is to produce a design of instructional media about static fluid subject for fostering students' creative thinking skill. Method of this study is research and development using instructional development model Four-D (Define, Design, Develop and Disseminate), but in this study only until develop stage. Based on the results of this study, concluded that the design of instructional media named Mr. Fluid for fostering students' creative thinking skill had produce. This study recommended to other researchers to make another instructional media to develop students' high order thinking skills in another physics subject.

INTRODUCTION

Physics study about regularly natural phenomena and it use mathematical approach. Natural phenomena that occurring was observed, and then experiments conducted to derive a conclusion. Physics can't be separated the products with the processes [1]. The process may include experiments on something based on the natural phenomenon that occurs. It will require materials for experiment activities in school.

Physics subject can fostering thinking skill that useful for solving problem in daily life. Physics course in senior high school will give student knowledge, life skill, and understanding about nature. So, they can develop science and technology. Physics related with a way to how to understand the natural phenomena with systematic, using scientific approach, and then to make the result of analysis easier to understand and describe the nature phenomena usually using multiple representation [2].

Students regard physics as a difficult subject because students didn't know how to master it [3]. Humans use their five senses to receive knowledge. Teaching aid allows person to use the senses as much as possible towards an object being studied that will make it easier for someone to know about it [4]. Physics phenomena require an observation using the senses. Observe a physics object and get information from the object, then conducted an analysis of the physics phenomena.

Creativity is a skill of someone to make something new. It can be a new idea, it can be a new product, or it combined with something there are been to make something new that different than before. Creative thinking skill was needed to make an innovation. Of course student must be habitually to solve problems with creative solution.



Creative person will able to solve the problem with unusual way, and sometime more efficient and effective than usual way. Creativity is a skill to meet the challenge [5]. Creativity is any act, idea, or product that changes an existing domain or that transforms an existing domain into a new one. And then, creative person is someone whose thoughts or actions change a domain, or establish a new domain. However, a domain cannot be changed without the explicit or implicit consent of a field responsible for it [6]. Creative thinking can make someone see with different perspectives about an event, suggesting many solutions to problems. Fluency, flexibility, novelty and elaboration are the dimension of creative thinking [7].

Teacher need to be creative in teaching. For physics teacher, he/she need to be creative in developing experiment course activities for fostering students' creative thinking [8]. Teacher has the key position for developing students' creative thinking skill, of course with a particular procedure for fostering creative thinking. Students can be creative if teacher teach student with creative teaching method and creative teaching approach [9].

Creative thinking skill can be fostering with many activities i.e. free questioning, mind map, multiple examples, multiple experimental methods, open discovery, brainstorming, making guess, problem finding, designing model, creative writing, creative drama, invention, open inquiry, creative problem-solving, system design, making analogy, and many more which can foster creative thinking [10]. After that, these activities need to be analyzed to find the suitable activities in physics experiment course.

Lack of materials for experiment in laboratory was being a problem when teacher will conduct physics experiment in school. Some teacher not optimal and less skilled in making practical guide and organize the physics experiment [11][12]. This restrictiveness should be a challenge for teacher to be creative in planning physics experiment with using materials that students can find in around them and easy to be used.

Based on the needs analysis that had made, it known that many students got low score on the daily test in static fluid topic chapter because the students had difficulties in understanding the concept of static fluid. Then, based on the analysis of the basic competencies of the static fluid, students need an instructional media to conduct experiments on fluid static and for students can applied the concept of a static fluid in daily life. So, students need a static fluid instructional media to foster creative thinking skill for the students can applied the concept of static fluid in daily life.

The aim of this study was to produce instructional media design about static fluid for fostering students' creative thinking skill.

METHOD

Method in this research was research and development with use the instructional development model Four-D [13] comprise define, design, develop, and disseminate, but in this study only until develop stage. Define stage start with front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. And then, design stage with media selection, and initial design. The last, develop stage with expert appraisal.

Front-end analysis had done with teacher interview and observation of the condition of the school. Analysis of students conducted with distributing questionnaires to 20 students of 10-grade students. The concept and task analysis performed with literature review.

RESULTS

The main results of this study was the design of instructional media about static fluid consist of teaching aid and materials to carry out the experiments activities in creative

problem solving named "Mr. Fluid." This media can be used to applied about concept of hydrostatic pressure, Archimedes law, and capillarity. Activities conducted with experiments to solve the problems that facilitated by teacher.

Define stages conducted with front-end analysis, learner analysis, concept analysis, task analysis, and specifying instructional objective. Front-end analysis conducted with interviews with a physics teacher in senior high school YP Unila Bandar Lampung. Based on interview, obtained information that students were needed an instructional media for static fluid material. It caused based on the results of students daily tests known that many students who got low score on the static fluid chapter. In addition, static fluid required the student to understand the concepts that difficult for students.

The next step was learner analysis step. This step conducted by distributes questionnaires to 20 students. Based on the questionnaire, it had known that learning media for static fluid material was required. Task analysis had done with the literature review and found that the static fluid material required experiment and students also needed to apply the concept of a static fluid in daily life.

Concept analysis step had done with the literature review on the matter and the basic competence of the static fluid that applied the laws in a static fluid in daily life, and to plan and conduct experiments that using fluid principle to make work easier. Based on the literature review and basic competence about static fluid, it was needed an instructional media to help students applied the static fluid principle in daily life as well as helping students to carry out experiments about static fluid.

Based on the analysis steps that had done, it specified the instructional objective. The instructional objective was the students able to carry out experiment about static fluid and capable to apply the static fluid concept in daily life trough instructional media.

Design stage had done by choose which media to be used and made the media design. Instructional media that was chosen is a real media that consists of teaching aid and materials that were around them and user guidelines to make students capable to carry out problem solving experiment about static fluids.

In addition, there are several indicators of creative thinking. This creative thinking indicators need to be suited with the activities that also support creative thinking skill for the learning objectives can be achieved. And then, the indicators are included in instructional media. This instructional media include several indicators of creative thinking sourced from [14], the indicators are building the knowledge from learner's prior knowledge, stimulating curiosity and desire to know, find the cause, encourage manipulation of ideas, and predict an occurrence based on information.

After that, this step did with made the design of instructional media named Mr. Fluid comprise with hydrostatic pressure teaching aid to show hydrostatic pressure between two liquid that had different density in U pipe with hose. And then, this instructional media equipped with materials to do problem solving activities for fostering students' creative thinking through several activities:

1. Chose the straight line

This experiment used water, hose, ruler, prepared paper with several lines, and students can use anything around them to carry out this experiment. The problem is how to know which one is the straight line. Students should check all line in the paper and choose which one is the straight line.

2. Moving water

This activity uses two vessel, hose, water, syringe, and small plastic glass. Students must transfer the water from one vessel to another vessel as shown in figure 1.(a). The problem is how to transfer the water from one vessel to another vessel where in lower position without moving the vessel. After that students need to solve another problem,

the second problem is how to transfer the water from one vessel to another vessel where in higher position without moving the vessel.

3. Floating a sink object

Vessel or plastic glass, water, salt, coffee, and students can use anything around them to do this experiment. How to make a sink object to float is the problem of this experiment.

4. Cleaning the water

This experiment used bottle, dirty water, tatter, titrate, hose, and allow students to use anything that they think it can be used. The material as shown in figure 1.(b). The problem in this experiment is how to clean the water using daily life material.



(a)



(b)

FIGURE 1. Materials (a) moving water experiment (b) cleaning the water experiment.

Develop stage conducted with expert appraisal by a teacher who had experienced in making instructional media. Learning media that developed was possible to be used in physics course in creative problem solving activities to foster students' creative thinking skills. Phenomena and objects were already using concrete objects. Instructional media had in conformity with intellectual development of students. Conformity with competencies had also grown accordingly, easy to use and safety for students.

Some suggestions were given by the expert. It needs to be added the millimeter block paper on teaching aid U pipe in order to make easy for students in determining the height of liquid. Some phenomena in experiments need to be improved to more fit with the concept of static fluid. Need to be designed rubric skills assessment based on suitability step that chosen by students with concepts that have been taught. Students need to explain reasons why they chose this step to resolve the problems which posed in learning activities. This media need to adjust with the learning time. Paper with straight line in first experiment should be change with some wall picture or photograph of assembled brick in home construction, and then student should choose which picture that straight and not. Experiment about Archimedes's principle should be replaced with experiment about making submarine using a pipette and a bottle water-filled. Experiment to clean water will take a long time and need to be considered again, it should be enough to show video experiment and students are asked to suggest choice which tools will be used, and then they will see which the right choice. This instructional media need to be supported with worksheet and give students an opportunity to explain the concepts and experiment steps in detail, and then make an evaluation of the step that had done.

DISCUSSION

Development of instructional media named Mr. Fluid is intended as an instructional media in additional experiments activities for students and to foster creative thinking

abilities of students. Students need to implement static fluid material that they have learned. Students do problem-solving activities using instructional media from material which easy to find out.

There are many studies about to creative thinking skills [15][16][17]. These studies on the using of media that influence on students' creative thinking skill. Although these studies using ICT media or using computer software, but there are possibilities for fostering creative thinking skills through real media based on activities that support the creative thinking.

Other studies had developed fluid static instructional media that made from daily material and easy to use for students [18][19]. It used to carry out experiment course. Experiment can be conducted well and the media can be used to measure the variable with good accuracy. Moreover, experiment can be conducted in school only, but also students can do it again in their home by their self or with their friends. In this study this developed instructional media can't be used to measure the variable with good accuracy. This instructional media used as reinforcement the static fluid concept.

These activities didn't measure the data and calculate or analyze the data. Because these activities using this instructional media only for reinforcement the concept of static fluid. Student should apply what they had learned about static fluid concept. Additionally, the experiments were open ended activities. Students after the scheduled course over, they can repeat the experiments again in home with group if required.



(a)



(b)

FIGURE 2. Activities (a) moving water experiment (b) floating a sink object experiment.

Instructional media which developed comprise hydrostatic teaching aid and the materials to be arranged by students to solve problems that foster creative thinking skill. This media will help students to learn in groups, making a project, and solve problems.

CONCLUSION

The need assessment indicate that the static fluid instructional media for fostering students' creative thinking skill was needed and this study produced the design of instructional media named Mr. Fluid for fostering students' creative thinking skill. And then, based on expert appraisal known that instructional media which developed was possible to foster students' creative thinking. This study recommended to other researchers to make another instructional media or kit to develop students' high order thinking skills in another physics subject.



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PHY-01311

The Implementation of Problem Based Learning Model Through Scientific Approach to Improve Student's Conceptual Understanding on Simple Harmonic Motion

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Abstract

The aim of this research is to improve high school student's physics conceptual understanding on simple harmonic motion through the implementation of problem based learning model with the scientific approach. The syntax of problem based learning model applied to the learning phase consists of five phases: (1) student orientation on the problem; (2) organizing the students to learn; (3) guide the investigation group; (4) presents the results of the investigation (5) analyze and evaluate the process of problem solving. The pre-experiment method with the design of one group pretest and posttest was used in this research. The conceptual understanding multiple choice test was used as the research instruments. The investigation involved 32 students at one senior high school in the city of Bandung grade 11th, which determined by cluster random sampling techniques. The results showed the high category in normalized gains scale improvement of student's physics conceptual understanding on simple harmonic motion after the implementation of problem based learning model. In conclusion, the problem based learning model was increase the student's conceptual understanding.

INTRODUCTION

At the high school level, physics is considered essential to be taught as a separate subject with some consideration. First, in addition to the provision of knowledge to students, as well as a way to foster thinking skills that are useful for solving problems in everyday life. Second, the physics subjects should be taught for a more specific purpose is to equip learners' knowledge, understanding and a number of capabilities required to enter higher education and develop science and technology. Therefore physics learning scientific inquiry should be carried out to foster the ability to think, work and scientific attitude and communicate as one of the important aspects of life skills (Kemendikbud, 2014).

The learning process of physics at the high school level curriculum in 2013 carried out by using a scientific approach and includes three domains, i.e. the attitudes, knowledge, and skills. Scientific approach is a learning process that is designed so that learners are actively constructing the concept, law or principle through the stages of observing, questioning, experimenting, associating and communicating. The scientific approach is believed to be the golden bridge and the development of attitudes, skills, and knowledge of learners (Kemendikbud, 2013). In a scientific approach learners are invited to play an active role in every step of learning. Learners are asked to observe the various phenomena associated with contextual material that will be discussed in observing step. The phenomena observed raise the curiosity of learners. Then the students are welcome to ask



any question that any learners want to know of the phenomena observed in questioning step, but the teacher did not directly answer these questions. The questions that arise in questioning step was given back to students and teachers asked students to answer these questions after conducting experiments to try such activities or literature. Then the information obtained from experimenting step analyzed in associating step. Once students get the answer of the question, and then asked to communicate what is obtained in communicating step.

Learning model that takes precedence in the implementation of Curriculum 2013 using the scientific approach are Inquiry Based Learning, Discovery Learning, Project Based Learning, and a model of problem-based learning Problem Based Learning. Problem based learning model as a model of learning that emphasize the implementation of the curriculum in 2013 aimed at stimulating students to learn through a variety of real problems in daily life associated with the knowledge that has been or will be studied learners. Problem-based learning is an instructional model that presents real problems in the daily lives of learners (contextual) that stimulates learners to learn. Problem based learning challenging students to "learn how to learn", work in groups to find solutions to real-world problems. Given issue is used to bind the learners in curiosity at the intended learning. The problem is given to the students before the students learn concepts or materials relating to the problem to be solved.

The implementation of Problem Based Learning (Arends, 2008) using the scientific approach includes five phases: (1) orientation of students to the problem, (2) organizing the learners, (3) guide the investigation of individuals and groups, (4) developing and presents the work, and (5) analyze and evaluate the problem-solving process. Orientation phase to focus the problem of learners is to observe the problem which is the object of learning. Organizing phase did by directed activities of learners so that learners submit various questions to study the problem. Guiding phase the investigation of individual and group is guiding learners to experiment to obtain data in order to answer or solve the problem. Develop and present the work phase is to encourage learners associate the data found from experiments with various other data from various sources. While the analyzing and evaluating phase is the problem solving process to focus learners to analyze and evaluate after obtaining an answer to the problems that exist.

The learning process of physics with problem-based learning model through a scientific approach as the demands of the curriculum would be difficult to achieve if the learning is less precise. Implementation in practice of scientific approach in the learning process of physics are still many obstacles, such as physics developed the learning process in the classroom has not used the scientific approach completely. In the learning process students tend to be passive so that no gain learning experience that can foster of the conceptual understanding. The results shows that the retention of information from the teacher for more than 90 percent after two days and gain of the conceptual understanding of 50-70 percent (Kemendikbud, 2013). In addition, other studies have shown that learning with problem-based learning model can improve the conceptual understanding of students in the thermodynamics subject (Aziz et al, 2014). Based on the background above, the aims of the study is to determine the conceptual understanding of high school students on simple harmonic motion of matter after the implementation of problem-based learning model through a scientific approach.

RESEARCH METHODOLOGY

The method that used in this study are pre-experimental research with one group pretest-posttest design. In this study, the students are given the treatment for two times of

learning. Learners are given a pretest to determine the initial capability of the conceptual understanding of the simple harmonic motion matter. Furthermore, the students were treated using problem-based learning model through a scientific approach. After the treatment, the students are given the posttest to see increased the conceptual understanding. The experiment was conducted at one of the high schools in the city of Bandung, the sample is students of class XI-2 as many as 32 people. The sampling technique used in this study is a cluster random sampling. The collection of data captured through research instruments using multiple choice test to measure learners' conceptual understanding. Tests of the conceptual understanding consists of four aspects, i.e. interpreting, inferring, comparing and explaining (Anderson et al, 2001).

Data of increase conceptual understanding of learners was processed using a normalized gain mean score (Hake, 1998) by equation (1).

$$\langle g \rangle = \frac{\langle G \rangle}{\langle G \rangle_{maks}} = \frac{\langle S_f \rangle - \langle S_i \rangle}{100 - \langle S_i \rangle} \dots\dots\dots (1)$$

Description :

- $\langle g \rangle$ = normalized gain mean score
- $\langle G \rangle$ = actual gain mean score
- $\langle G_{max} \rangle$ = maximum gain mean score
- $\langle S_f \rangle$ = post-test mean score
- $\langle S_i \rangle$ = pre-test mean score

The normalized gain mean score ($\langle g \rangle$) calculated as a reference to determine an improved the conceptual understanding after problem-based learning model implemented using a scientific approach.

RESULTS AND DISCUSSION

Data from pretest, posttest and normalized gain mean score ($\langle g \rangle$) of students' understanding concept in simple harmonic motion of matter are presented in Table 1.

TABLE 1. Improvement of student's conceptual understanding on simple harmonic motion

Conceptual Understanding	Pretest	Posttest	$\langle g \rangle$	Category
	Mean score	Mean score		
Pendulum swing	62,92	91,15	0,76	Medium
Vibration of a spring	69,83	94,25	0,81	High
Simple Harmonic Motion	66,38	92,70	0,78	High

Based on Table 1, the conceptual understanding of learners has increased with the normalized gain of 0.78 after a problem-based learning model implemented using a scientific approach. This shows that the model of applied learning can improve the conceptual understanding. These findings reinforce the results Aziz et al (2014) which show that physics teaching with problem-based learning model can improve the conceptual understanding of learners. Tang et al (2008) stated that when problem-based learning

model applied in the classroom will be effective in increasing the conceptual understanding. Model of problem-based learning centered on learners, develop the skills to think critically, to encourage cooperation in completing a task, involving learners in the investigation of the problems choices which enable them to interpret and explain real-world phenomena and build comprehension of the phenomenon (Ates & Eryilmaz 2011; Cheong, 2008).

The recapitulation of normalized gain mean score ($\langle g \rangle$) for each aspect of conceptual understanding of students in simple harmonic motion matter is presented in Figure 1.

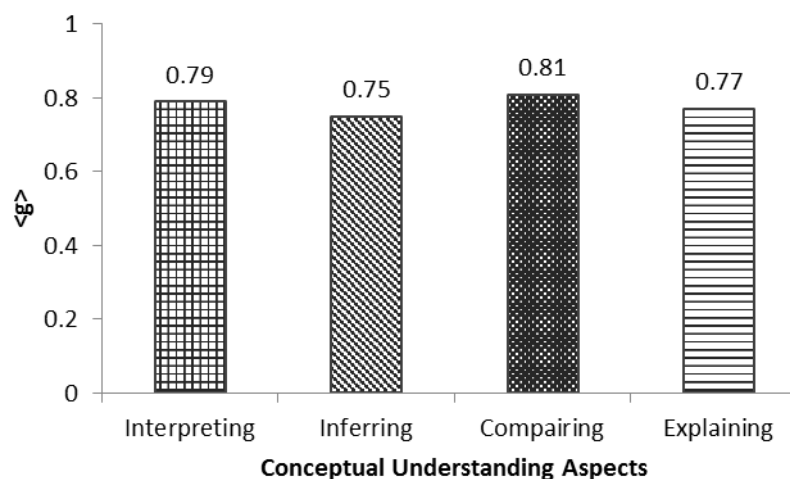


FIGURE 1. Improvement of student's conceptual understanding aspects on simple harmonic motion

Based on Figure 1, the conceptual understanding of learners to every aspect consists of the ability of interpreting, inferring, comparing and explaining increased with of high normalized gain categorized as problem-based learning model implemented using a scientific approach. The conceptual understanding of comparing aspect have the highest mean score of normalized gain ($\langle g \rangle$) 0.81 that is a high category, while the conceptual understanding of inferring aspect have the lowest normalized gain mean score ($\langle g \rangle$), 0.75 but still high category. The conceptual understanding of comparing aspect showed the highest increase, this is possible because of the ability to understand in comparing aspect only requires that learners are able to detect the similarities and differences between two or more objects that observed, events, ideas, problems or other circumstances (Anderson et al, 2001) based on problems that are relevant to the material being studied.

CONCLUSIONS

Implementation of problem-based learning model through scientific approach can improve the conceptual understanding of students in simple harmonic motion of matter. The conceptual understanding improved to interpreting, inferring, comparing and explaining aspect that have high category.

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PHY-01327

Design Student Worksheet as A Facilitator of Student Scientific Argumentation Skills

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Abstract

The learning that takes place in school less facilitate students to develop the ability of scientific argumentation. Students simply conditioned to being able to use his knowledge of physics formulas to solve the given problem. Based on the results of TIMSS assessment, an average score of Indonesia is at a low level in the completion of soal-soalnya need to provide scientific argumentation and reasoning. This shows that scientific argumentation is very important in the formation of the younger generation of Indonesia. The purpose of this research is to design student worksheet as a facilitator of student scientific argumentation skills. This research uses research methods development of Borg and Gall. However reported in this study, researchers using only three-step implementation strategy: research and data collection; planning; the development of a draft product. Engineering data collection done by the spread of the now and test. The results of this research indicate that (1) the learning process have yet to hone students ' scientific arguments; (2) the scientific argumentation skills students are still low; (3) the need for on-site study worksheet learning scientific argumentation skills as facilitators of students who have a component presenting phenomenon in the form of pictures or stories, stating the claim, presents data, providing a guarantor (warrant) and support (backing), as well as added qualifications (degree of certainty) the argument.

INTRODUCTION

Based on the results of several global assessment such as PISA and TIMSS, average score students Indonesia is at a lower rank. The example on the last TIMSS assessment in 2011, Indonesia is on the order of 41 of the 43 participating countries for a science field (TIMSS, 2011). If traced, problems on the global assessment includes three cognitive domain of knowing, i.e., applying reasoning. While the learning process in the us currently only limited to knowing (knowing). Students study various regular but less knowledge is required to apply and menalar in using the knowledge acquired from the learning process. One step to invite students doing the reasoning is to familiarize students hone skills of scientific argumentation. This is rarely done the teacher in the learning process. Research done on any student pointed out that arguments are still at level II, that reveal a claim accompanied by reasons (Herliyanti, 2001). Whereas, scientific argumentation skills is one of the components that support critical thinking students.

In addition it should always be trained, scientific argumetasi skills are also influenced by how much experience and knowledge that students have. The findings suggest that previous experience of participants may affect the content knowledge they make to support

their scientific arguments (Mc Donald, 2014). In this case it is obvious, that the skills of scientific argumentation is a stage how students use and pour all the information and knowledge assets in the context of the problem presented.

Many people think that the reason the same as arguing. Means of expressing his opinion arguing in front of audiences. However, it is not the case in science learning. Scientific argumentation is not should be debated. Scientific argumentation is also not to be delivered orally. In science, the argument can be either verbal or written, and they generally use visualization supporters in the form of a graph or symbolic model (Osborne, 2010). Most teachers consider the argumentation only limited activities explore opinions of students. It is performed by asking the question "why" and "how". However, scientific argumentation is not as simple as that. Then it is important for teachers to know the components of the arguments of imiah and teach it to students. The four form the components of the arguments i.e. theoretical, logical, pragmatic, and rhetorical (Bravo, et al. 2005). Four conditions i.e. justification opinion, sufficient information, justification of the validity of the guarantees can be applied, the justification of the assumption that there are no exceptions, is sufficient for the purposes of his own reasoning intended for a correct answer of a question (Hitchcock, 2006). According to Marttunen (2005), students have the prerequisite for argumentative reasoning and writing but need further practice in reading anilitis and read critically. Scientific argumentation skills must be supported by the existence of enough knowledge from the results of reading and writing skills are also informed.

Each component must be frequently practiced so that students are accustomed to. The students had a hard time in arguing because of lack of training and conditioning teacher conducted during the learning process. Marttunen (2005) suggested that further research in order to gain a better understanding in developing suitable teaching material. Not all the teaching material in science especially physics can be developed to train students ' scientific argumentation skills. In numerous previous studies, many researchers use the subject matter related to the socio-scientific issues. The value of social and cultural values affect the student's argument on SSI (Socio Saintific Issue). Moral issues of trust and sometimes also get into the responsibility of the students (Simoneaux, 2007). On discussion about scientific, socio students need to use the knowledge and the necessary. Students are no longer asked to mention, differentiate, and as usual give teachers in a range of about.

Most teachers don't want to damn give problems such as exercise or daily repeats. Teachers can easily take problems such as present on the student worksheet collection sheet is reserved. This type of matter contained in it was only a matter of simple knowledge that demands students to merely mention the formula, distinguish, mentions traits that indeed there is a summary of the material on the student worksheet. However, the students ' worksheets was instructional tool that consists of a series of questions and information designed to guide students in understanding the complex ideas because students work through it (Choo, et al. 2011). It is unfortunate if students are given only a collection of the obvious problem the answers are in the students ' work sheet itself. More worksheets enable pupils and increase its success (Toman, 2013). Therefore, in this case it must be ensured that if wanted to hone the skills of scientific argumentation of the students then worksheets are designed based on the learning process in the classroom and the components of the scientific argumentation.

Scientific Argumentation

Andriessen (2008) States that a good argument has been designed to have a certain kind of based on the structure i.e. determine the argument, analogy with the syntax form

good sentences. For instance, Toulmin in Andriessen (2008) identify the components of the arguments, i.e. the claim stated viewpoint or conclusion. The data is a fact. Guarantor (warrant) provides the justification for using the data as support for the claim. Optionally, support (backing) provides certain information that supports the guarantor. Qualification level adds certainty to the conclusion, that shows the level of strength, which is presented in the claims. Exceptions to the claim expressed by the objections.

Student Worksheet

Student worksheet is one form of a program based upon the task and the has diseleaikan by students. According to Prianto and Harnoko (1997), the benefits and goals of the working width of the students is (a) enable students in the process of teaching and learning, (b) assist students in developing the concept, (c) train students to discover and develop the teaching and learning process, (d) assist teachers in learning crafting, (e) as guidelines for teachers and students in the learning process, (f) helps students acquire notes about material that is learned through learning activities (g) assist students to add information about a concept learned through systematic learning activity.

According to Widjayanti (2008), as well as student worksheet learning media also has several other functions, namely: (a) is a great alternative for teachers to direct teaching or introduce a certain activities as teaching and learning activities; (b) help students to be more active in the process of teaching and learning; (c) can improve students ' ability in solving problems.

METHOD

The methods used in this research is the research and development procedures Borg and Gall (2003), there are 10 step implementation strategy research development namely: 1) research and data collection; 2) Planning; 3) draft Development products; 4) field trials beginning; 5) revision of the trial results; 6) field trials; 7) Consummation product results; 8) Test execution of the field; 9) Perfecting end products; 10) dissemination and implementation. This article only reported three steps namely development of research ranging from the research and data collection, planning, and development of draft product. The steps of research presented in Figure 1 below.

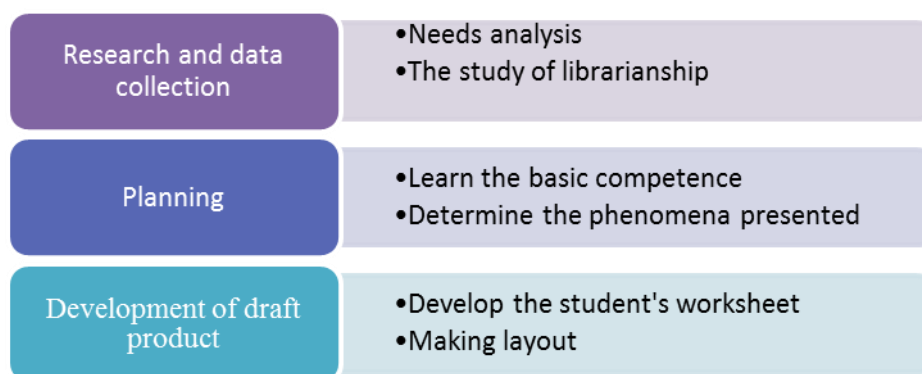


Figure 1. Steps Of Development

Research development in this article are:

Research and collection of data

Research and data collection this is the first step in the research is to map the permasalahan wants to canvassed and gave rise to the idea of the product to be developed.

The form of research and the collection of data in the form of an analysis of the needs of the field and the study of librarianship. Needs analysis is done by giving the now needs analysis to students and teacher SMA Negeri 1 Bangunrejo. The study of librarianship is done by reviewing several books and research results that are relevant to the research development.

Planning

In the planning phase was conducted an analysis of the basic competencies of physics. Define a few basic competence that can fenomenanya and easily found by students. This is done for scientific argumentation is only matched by the discussion of the nature of sosiosaintifik. After that compose a natural phenomenon which can be served in accordance with the order of basic competence. Specify the format for preparing the preliminary draft and the student worksheet.

Development of draft product

The parts that had already been planned in the planning stages will be arranged and designed in such a way that it becomes a draft product in this stage.

RESULTS AND DISCUSSION

The stages that have been done in this research are:

1. Research and collection of data

At this stage carried out needs analysis and the study of librarianship. The results of the question form and interview with one of my physics teacher SMA Negeri 1 Bangunrejo, revealed that in the learning of teachers already give some natural phenomena associated with the subject matter. However, not to stimulate the students to use the scientific argumentation. During this time, the teacher as students explore the argument in simple terms. For example, ask students stating his opinion orally about a phenomenon. Whereas, most students are reluctant or embarrassed to talk to her friends. Interview teachers also stated not knowing what is meant by scientific argumentation. So in learning and teachers ' media use have not provided facilities for skilled students to argue scientifically. As for the original profile of the scientific argumentation skills students only to the stated claims or opinions. As for the original profile of the scientific argumentation of the students, presented in Figure 2 below.

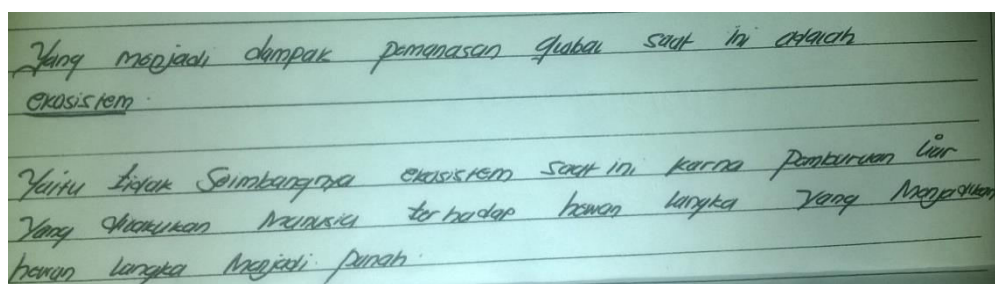


Figure 2. Early scientific argumentation skills profile students

Based on the results of the needs analysis conducted at SMA Negeri 1 Bangunrejo obtained information that has not been the existence of facilities to hone the skills of the student scientific argumentation.

2. Planning

The following basic competence presented some high school physics will be content in the student worksheet.

- à. optical tools to analyze qualitative and quantitative

- b. Applying optical tools in everyday life
- c. Menganalisi heat transfer ways
- d. Explain the application of elektomagnetik wave on daily life

3. development of draft product

The results at this stage is the design of the student worksheet. Student worksheet designs developed in the form of guides students in drawing up scientific argumentation. The sequence of activities students are made in accordance with the components of the scientific argumentation.

As explained earlier that the scientific arguments contained in some components, including the claims, data, warrant, backing, and qualifier. To include a fifth component, initial activities on worksheets students presented phenomena (picture/story) or question the current selidik students observe. In this case it is used to form the student's claim as the first step of composing a scientific argument. Furthermore, the four components of other scientific disajikan argumentation in order that students are allowed to write in mengakskes various sources of information. Be it in the form of books, the internet, or just ask other people who supposedly understand the context they are discussed. After all components are loaded, then the scientific arguments held class discussions provided an opportunity for students to convey scientific argumentation. Later it will be known whether or not there is a difference with the other students scientific argumentation. As for the description of the scientific argumentation of the student worksheet students presented in Figure 3 below.

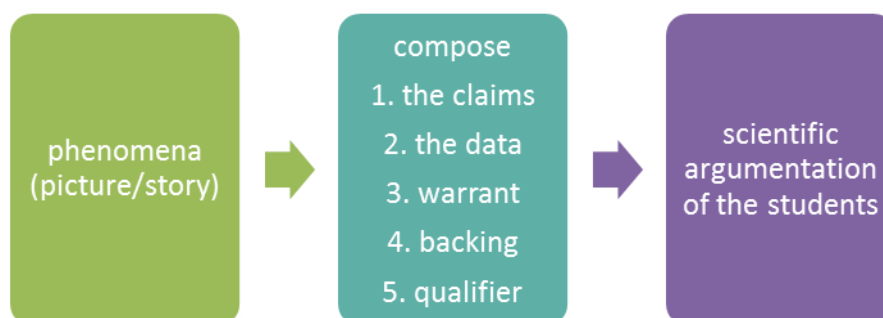


Figure 3. Hipotetik scientific argumentation is CATEGORIZED AS model students

CONCLUSION

Based on the results of a study of the literature and analysis of the needs of the mind that the learning process has not been trained scientific argumentation of the students. Required worksheets students can train for scientific argumentation students with some of the components of the arguments, i.e. have a component presenting phenomenon in the form of pictures or stories, stating the claim, presents data, providing a guarantor (warrant) and support (backing), as well as added qualifications (degree of certainty) the argument.

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PHY-01345

Requisite Analysis of Earth and Space Science Teaching Materials That Accommodates Multiple Intelligences and Embed Junior High School Students' Personal Character

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Abstract

Junior high school students have low understanding of Earth and Space Sciences (ESS) materials. This is partly due to relatively limited the availability of ESS teaching materials. Students and teachers generally use 9th grade Physics textbooks with limited material, in addition the textbook does not develop students' multiple intelligences nor embed students' characters. Based on this situation the integrated ESS teaching materials development that accommodates multiple intelligences and embeds students' character is indispensable. The book is developed based on current curriculum, prior knowledge, the availability of learning resources, students' conditions and characteristics, materials presentation which is connected to real-world situations in accordance with the up-to-date of science and technology, meet the content validity and legibility of students as well as the ability to develop multiple intelligences. The presence of the teaching materials is expected to assist teachers in implementing learning of ESS in creative and innovative way besides students can develop their multiple intelligences and have good character (moral).

INTRODUCTION

Earth is a complex system of interrelated components as well as being the main subject in science. Life and Earth's future depends on how deeply we understand this Earth. Earth and Space Science (ESS) is defined as the integration and synthesis of Physics, Biology, Chemistry, Geology, Oceanography, Climatology, Meteorology, and other science that studies the life, Earth, and outer space². Through ESS, students are able to describe natural phenomena and their physical linkages as well as its impact on everyday life. Students have an understanding of the concept as a whole, meaningful and contextual also.

Curriculum of 2013 mandates the learning process carried out with thematic and integrative learning, give attention to individual differences, forming character and good personality, mastery of the material as a whole, intelligent, develop scientific attitude and so forth. Contrary to this, in practical the learning process of ESS in junior high school is dominated by teacher's talk and student group presentation³ so that students are less developing their intelligence to understand the fundamental concept of ESS⁴. Intelligence is one of the main factors which determine the success or failure of students learning. According to Gardner⁸ there are eight types of intelligence (Multiple Intelligence, MI) in every individual. Those are linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal and naturalist. Through these eight types of intelligence every individual accesses to the informations, so that teachers accommodate all of these types of intelligence in their learning process. In addition, based on interview

of some teachers we found that they find difficulties to deliver ESS contents in the classroom as well as difficulties to elaborate⁵. Teachers are lack of ability to develop innovative learning on ESS topics that can enhance students' understanding of concepts inside besides ESS contents are identical with memorizing. On the other hand the availability of textbooks of ESS in secondary school is still relatively limited, especially books or teaching materials that support the implementation of curriculum of 2013. Teachers and students in general use learning materials from natural science textbooks (physics chapter) for junior high school with limited content that does not integrate various of disciplines, not accommodate students' MI⁵ and not embed students' character.

As manifestation of the curriculum of 2013, in the learning implementation needed learning component, one of which is the availability of teaching materials. Based on this, it is necessary to prepare and develop integrated ESS teaching materials that also accommodate multiple intelligences⁵, embed the characters, students' prior knowledge, circumstances, medium, environment and the context of everyday life. Given that the curriculum of 2013 has not been implemented by all schools, therefore we expect to assist teachers in implementing the curriculum of 2013 with this teaching material.

RESEARCH METHOD

This study uses Research and Development (R & D) approach with a modified 4-D model⁶ consists of four phases, namely defining, designing, development and dissemination. In this paper data and results presented come from defining and designing phase. The discussion is limited to the identification of junior high school students prior knowledge who have acquired ESS topics in schools, the availability of textbooks at this time, learning resources, analysis and implementation of curriculum of 2013, the identification of students' multiple intelligences, character education and substance of teaching materials that meet the identification results with regard to the environment conditions and students intellectual (multiple intelligences) development as well as embed students' characters. The subject of research was grade 9th junior high school students and teachers in Bandung city and West Bandung regency. School sample selection was based on rating of high, medium and low involved 5 to 6 schools.

We used test instrument in the form of twenty questions (multiple choice and the reason) to measure students' prior knowledge about ESS contents, questionnaire to determine students' prior knowledge about learning sources available, integrated ESS contents and looked for data on ESS teaching materials usage. We used also a questionnaire with semi-open answer and interview for teachers and students.

RESULTS AND DISCUSSION

Students' ESS Concept Mastery Identification

Identification of students' prior knowledge was done to know the prerequisite knowledge of the students. Test of concept mastery consisted of 30 multiple choice questions and distributed to 164 junior high school students of 9th grade who have studied ESS in school. Results of students' concept mastery on ESS is presented in Table 1.

Table 1 Recapitulation of students' concept mastery on ESS

NO	SCHOOL	Σ STUDENTS	AVERAGE
1	SMPN 7 BANDUNG	35	53
2	SMPN 29 BANDUNG	22	42
3	SMPN 26 BANDUNG	62	35
4	SMP BAITUL IZZAH	8	20
5	SMPN 3 LEMBANG	37	32



NO	SCHOOL	Σ STUDENTS	AVERAGE
TOTAL/AVERAGE		164	36

Based on the Table 1, the ability of junior high school students to mastery ESS concept is very low with average score 36 of 100. Many factors play on this situation, for example learning method, teaching materials and also learning resources. This means ESS learning method as well as teaching materials and the text books are not effective yet. The highest average score of students' concept mastery was obtained by students of SMPN 7 Bandung which is one of school in cluster 1 (top rank schools group), while the lowest was at private school (SMP Baitul Izzah) and state school in cluster 3 (lower rank schools group). This indicates that students in cluster 1 school have ability to master ESS concept better than the other clusters. Good cognitive capability allows students to have a better understanding about the material.

Students' Multiple Intelligences and Characteristic Analysis

Junior high school students (age group of 12–15 years) have unique characteristics. They experienced stage of intellectual development such as operational formal which has relation with abstract thinking and hypothesis ability. They were also thinking about the various possibilities that may occur in a particular situation without empirical observations, operating the rules of formal logic to solve problems and also ability to develop an opportunity based on two or more possibilities⁷. Additionally there is an increase in intellectual function, memory capability in language and conceptual development. In other words, language is a vital tool for cognitive activities of junior high school students. Affective development of junior high school students includes learning of behavior with others when socializing. Most of socialization takes place through modeling and imitation of others, while in the psychomotor development junior high school students often consider themselves completely capable, so often they seem not thoughcarefully about the consequence of their actions.

According to Gardner⁸, intelligence is the ability to solve problems that occur in human life, the ability to generate new issues to be resolved, and the ability to create something or offer a service that will give rise to an award in one's culture. Smart students not only have high Intellectual Quotient (IQ) and achievements at school, but can solve real life problems also. Every student has different intelligences and different dominant intelligence in which student can overcome his/her own learning difficulties.

According to Gardner⁸ there are eight types of intelligence possessed by each individual. But there are still many students with difficulties to understand the ESS material because teachers do not teach students in accordance with students' dominant intelligence. For example, a physics teacher teaches Physics by means of mathematical logic, formulas and exercises. This method is suitable for students who have a logical mathematical intelligence, but not suitable for students with another intelligences. Therefore, if every student has the opportunity to learn through his/her dominant intelligence there will be a positive changes in cognitive, emotional, social, and even physical¹. The following is identification of multiple intelligences of junior high school in Bandung using a multiple intelligences questionnaire adopted from Gardner

Table 2 Recapitulation of students' multiple intelligences

NO	SCHOOL	Σ STUDENTS	Ver	Log	Msc	Kin	Vis	Inter	Intra	Nat
1	SMPN 7 BANDUNG	34	67	70	71	67	67	73	71	63
2	SMPN BANDUNG	29 34	66	65	71	65	64	69	72	62
3	SMPN	26 84	65	65	68	68	65	68	72	61

NO	SCHOOL	Σ STUDENTS	Ver	Log	Msc	Kin	Vis	Inter	Intra	Nat
	BANDUNG									
4	SMP BAITUL IZAH	21	66	66	65	68	62	67	72	63
5	SMPN 3 LEMBANG	36	65	66	73	69	70	73	71	69
6	SMPN	14	38	69	67	69	66	67	73	62
	BANDUNG									
	TOTAL/AVERAGE	247	66	67	70	67	66	71	72	63

Annotation: Lin–Linguistic, Log–Logical-Mathematical, Msc–Musical, Kin–Kinesthetic, Vis–Visual-Spatial, Inter– Interpersonal, Intra–Intrapersonal, Nat–Naturalist

Based on Table 2, the highest and the lowest students' percentage of multiple intelligences are intrapersonal intelligence (72%) and naturalist intelligence (63%) respectively and homogenous students' distribution of intelligence in general. This result is in agreement with research conducted by Liliawati⁹ and Gutierrez¹⁰ that intrapersonal intelligence is the most prominent relative other intelligences.

Students' naturalist intelligence obtained the lowest result among others. This indicates the students' ability to identify, distinguish, express and create categories to things they encounter in nature and environment is still low. ESS contents can equip students with sensitivity about natural phenomena to develop students' naturalist multiple intelligences by applying the concept in everyday life. For examples, when a solar eclipse occur students do not look at the sun directly and awareness to the changes in the phases of the moon as lunar calendric basis.

Curriculum of 2013 Analysis

Based on minister of education and culture regulation No. 58 in 2014, learning content in junior high school level in the form on integrated concepts from different disciplines as the purpose of education is natural sciences and social sciences subject. Natural sciences content comes from the discipline of biology, physics and chemistry while for social sciences is from history, economics, geography and sociology. Both of these subjects are education program with applicable oriented, developing of thinking skills, ability to learn, curiosity and the development of caring and responsible attitude towards the social and natural environment.

The integration of various concepts in natural and social science subjects is using trans-disciplinarity approach where the boundaries of disciplines are no longer seem firmly and clearly, because the concepts of disciplines mixed together in real-life problems. Such conditions will facilitate students to learn natural and social science into contextual learning. Learning process in natural science subject was conducted by integrating the content of biology, physics and chemistry. The integration can be implemented in connected-way, in other words teachers teach a particular content in physics, for example, and also discuss the content of other relevant fields.

Character Education and Learning Analysis

Based on results of questionnaires and interviews to eight teachers of state junior high school revealed the ESS learning process has already supplied 89.6% of students character while the rest has not yet. The embedded character aspects are religious, discipline, responsibility, tolerance, respect to others, curiosity, like to read and care for the environment. The ESS learning method used by teachers was group discussion (75%) and doing experiments (25%).

Textbook Analysis



The goal is to know the textbooks used in schools by students and teachers as needed to design and develop ESS textbook. Based on results of questionnaires and interviews to eight teachers of state junior high school revealed the textbook currently used has not been attractive to students (50%), as many as 75% of teachers own 1-3 books related to ESS, 12.5% teachers own more than 3 books as well as 12.5% teachers does not have books at all. The questionnaires and interviews also revealed that 87.5% of junior high school teacher argued that content related to ESS are only found in natural science textbooks and according to the teachers no content related to ESS could be found in non-natural science textbooks (75%).

New Textbook Format

The new ESS textbook is arranged by some additions to optimize the development of students' multiple intelligences. Some differences from existing textbooks are instructions for directing students to do certain action as an effort to develop students' multiple intelligences, summary at the end of each sub-chapter discussion, the use of images column can help students to express their understanding of certain concepts in a visual format, as well as exercises and activities to train students' multiple intelligences. Examples of inspiring event related to ESS contents also shown to support the establishment of positive characters to students.

CONCLUSION

Based on study has been conducted the presence of an integrated ESS textbook that accommodate multiple intelligences and embed the character to the students become a necessity. The lack of textbooks available related to ESS in schools makes teachers and students rely more on common natural science textbooks. Majority of teachers cannot deliver ESS contents integrally with other subject content which has resulted in low mastery of ESS concept of junior high school students. Students' interest to ESS is very high but they are not supported by appropriate prior knowledge. As character and moral crisis is becoming a hot issue in Indonesia the presence of this new textbook is indispensable for realizing the goal of national education.

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PHY-01358

The Need Analysis Development of Test Instrument Based on Inquiry for Uncovering Students Higher-Order Thinking Skills

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Abstract

Kurikulum Tingkat Satuan Pendidikan (KTSP) stated that the implementation of learning physics is not just a theoretical mastery, but also growing the thinking skill and scientific attitude. The higher-order thinking skills could be widen through thinking practice process by answering the question which high-order skills oriented. But, the fact in the purview showed that test instrument was used only applied for low-order skills. The purpose of this study was to describe the needs analysis development of physics learning test instrument based on inquiry. This study used Borg and Gall development research method, which limited on three steps, they were: research and collecting data, planning, and product developing. Collecting data technique was done by spreading the questionnaire and literature review. The result of this study showed that; 1) inquiry learning model could promote higher-order thinking skills; 2) test instrument was used did not apply the inquiry learning model and the question was still on low-order; 3) instrument test based on inquiry needed to uncover students' higher-order thinking skills. The presentation of the phenomenon and the higher-order question which integrated with inquiry learning steps could be used to train inquiry skills so that it could reveal the students' higher-order thinking skills.

INTRODUCTION

Thinking skills become a skill that is very important to be developed at this time. Richmond (2007), in his research states that good thinking skills can be a powerful capital for students in Asia to be able to face the complex problems that exist in the development of the modern era.

The development of students thinking skills can not be separated from their lessons. As stated in the Kurikulum Tingkat Satuan Pendidikan (KTSP), that the implementation of physics learning is not just a theoretical mastery, but also growing the thinking skills and scientific attitude. One of learning models that can be used by teacher is inquiry.

Inquiry is a learning model that emphasizes the process of thinking critically and analytically, helping student build their own knowledge and dock with the knowledge initially (prior knowledge). This learning model can provide a valuable opportunity for students to improve their achievement learning outcomes. Through inquiry, students are given the opportunity to explore their answer, formulate explanation using the data that they collect, connect with daily life, and presents the results of learning (Khan et.al, 2011; Shih et.al, 2010; Supasorn & Lordkam, 2014; Thaiposri & Wannapiroon, 2015). Inquiry model can be used to promote students higher-order thinking skills and enable them to develop their knowledge, understanding of the content and scientific concepts (Power, 2012; Rooney, 2012). Inquiry model has six principle steps, which were presenting problems, making hypotheses, designing experiments, conducting experiments, collecting

data, analyzing the data and making conclusions (Eggen & Kauchak, 2012).

Higher-order thinking skills are very important for students to be able to express their opinions, to think critically, make decisions and solve the problems after being in society (Ramirez & Ganaden, 2008). Higher-order thinking skills are defined as the use of a person's thoughts more widely to find new challenges, take and apply new information or prior knowledge and manipulate the information to achieve the goal of reaching a possible answer in a new situation (Heong et.al, 2011; Lewis & Smith, 1993). When viewed from the six levels of Bloom's taxonomy of cognitive thinking skills revisions, higher-order thinking skills characterized by the top three levels (analysis, evaluation, and creation), namely C4, C5, and C6. At that level, students are engaged to hypothesize, invent, criticize, compare, assess and organize (Duron et.al, 2006; Peter, 2012).

Assessment is an integral part of a learning (Lissa et.al, 2012). Assessment instruments in the form of a written test can be used as a way to train the student's ability to think on a higher level. The questions were used contain some questions that train students in terms of problem solving, critical thinking and creative thinking (Rofiah et.al, 2013). According to Yildirim and Ozkahraman (2011), thinking skills can be developed through a process of thinking exercises by answering the questions that higher-order thinking skills oriented, so that students are able to follow developments in science and technology.

Test instruments used by teachers in physics teaching often not help students develop higher-order thinking skills. Based on the results of questionnaire that given to teachers and students at SMAN 1 Pesisir Tengah, note that 100,0% of students and teachers or all of respondents stated that the questions provided are in lower-order, just in knowledge and understanding level. Similar results were also obtained by Lissa et.al (2012), the research also found that the assessment instruments that used in the schools, only measure aspects of memorization and understanding concept. Based on the Bloom taxonomy are in C1 and C2. This condition would not be better to train the students higher-order thinking skills. Moreover, although in the learning process are already using the model of inquiry learning, but teachers have yet to implement the inquiry-based questions in the test instrument. According to Gautirez (2015), one of the challenges in implementing inquiry-based learning is the excessive emphasis on assessing learning content rather than learning through inquiry. Therefore, we need a test instrument based inquiry to uncover students' higher-order thinking skills.

This study aimed to describe the needs analysis of the development of test instruments inquiry-based learning physics to uncover students' higher-order thinking skills. The results obtained in this study can be used by other teachers or researchers to develop a test instrument that is students' higher-order thinking skills oriented.

METHODOLOGY

This study used Borg and Gall (2003) development research methods, namely: 1) research and collecting data; 2) planning; 3) product developing; 4) preliminary trial; 5) improvement of primary products; 6) the main test; 7) improvement of operational products; 8) operational trials; 9) improved final product; 10) dissemination and distribution. However, this study limited in three steps, they were: 1) research and collecting data; 2) planning; 3) product developing.

RESULTS AND DISCUSSION

Here are the results and discussion for each step that has been done.

Planning and Collecting Data



At this step, needs analysis and literature study done. The needs analysis questionnaire was given to 30 students and 3 physics teachers at SMAN 1 Pesisir Tengah. The questionnaire results showed that the implementation of learning, teachers are already using inquiry learning model. However, as many as 85% students and 83.5% teachers said that test instruments used were not based on inquiry. The questions in the test instrument is still same as a matter of physics in general. Based on the results of questionnaires also showed that all of the students stated that the question is still at the lower-levels of Bloom's Taxonomy, namely the level of knowledge and understanding. Furthermore, only 63% of students stated that the questions in application level. For higher-level questions, as many as 17% of students stated the question at analysis level, and as much as 7% of students stated at evaluation level. While the results of a questionnaire that given to teachers, showed the similar results. The question is still at the knowledge and understanding level. Furthermore, 67% of teachers stated that the questions provided are at the application level. As for the question of higher-level, only 33% of teachers who provide analytical level questions.

The same tendency results obtained Kocakaya and Gonen (2010), in their study showed that 72.5% are lower order question, with details 6.3% at knowledge level, 13.9% at comprehension level, and 52,3% at applications level. Only about 27.5% of questions are in higher-order cognitive domain, such as analysis, synthesis, and evaluation.

The questionnaire results were indicating that it is required an inquiry-based instruments to express students' higher-order thinking skills. All respondents, or as much as 100,0% of the respondents expressed the need for such instruments and they are willing to use it.

According to Madhuria et.al (2012), inquiry-based learning is better than conventional learning. This model can promote higher-order thinking skills and applied in disciplines such as mathematics and physics. The results of research conducted by Hugerat & Kortam (2014) and Sohibin et.al (2009), indicates that inquiry significantly can improve conceptual understanding, critical thinking and students higher order thinking skills.

Planning

At this steps, the researcher plan to develop a test instrument with the form of multiple choice questions. According to Paul & Nosich (1993), the type of question which can be used to assess the ability to think critically, namely multiple choice, multi-storied, and essays. According to Kominski (2012), multiple choice is one of the type of structured test. The excess of structured test are comprehensive knowledge which is considered to be more efficient, faster scoring, can be analyzed with statistics, and can use comparative data.

Based on basic competencies which is analyzed by researcher, following some high school physics basic competencies planned will be content in the test instrument, they are: 1) analyzing the regularity of planetary motion in the solar system based on Newton's laws; 2) analyze the effect of force on the elastic properties of the material; 3) analyze the relationship between effort, energy changes with energy conservation laws of mechanics; and 4) analyzing the laws relating to the fluid static and dynamic as well as their application in daily life.

The test instruments are planned to be evaluated using the Rasch model. According Sukor et.al, (2013), applying Rasch Modeling in the development of test items can be a powerful tool for the evaluation and repair items.

Product Developing

The results at this step, in the form of test instruments that required plans based on the results obtained in the previous step. This test instrument is planned in the form of

questions based on inquiry that when viewed from Bloom's Taxonomy is at a higher level, which is the realm of C4, C5, and C6.

Thought not driven by the answers but with questions. Questions stimulate the mind so that students can practice thinking through information or ideas, or generate new questions for further study. Consequently, it is important that teachers know how to develop a real assessment that can test the students higher-order thinking skills. Brain researchers showed that teachers should use a variety of high-level questions in a supportive environment to strengthen the brain (Paul & Elder, 1999; Cardellichio & Field, 1997).

The questions presented will include six-steps of inquiry learning, covering presents a problem, making hypotheses, designing experiments, collecting data, analyzing the data and making inferences. This inquiry presented are six steps in sequence, by giving phenomena in everyday life firstly that related to learning materials.

Inquiry can significantly improve conceptual understanding, critical thinking and students higher-order thinking skills (Hugerat & Kortam, 2014; Sohabin et.al, 2009).

CONCLUSION

Based on the need analysis by spreading questionnaire and literature review, it is known that: 1) inquiry learning model could promote higher-order thinking skills; 2) test instrument was used did not apply the inquiry learning model and the question was still on low-order; 3) instrument test based on inquiry needed to uncover students' higher-order thinking skills. The presentation of the phenomenon and the higher-order question which integrated with inquiry learning steps could be used to train inquiry skills so that it could reveal the students' higher-order thinking skills.

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PHY-01387

The Description of Learning Physics in HighSchool of Bandar Lampung City: Perspectives of Inquiry Based Learning

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Abstract

Unit level education curriculum or KTSP directing the learning Physics is done through scientific enquiries. One of the appropriate model is Inquiry-Based Learning (IBL). IBL gives space to develop Higher Order Thinking Skills (HOTS) students. The purpose of this research is to know the description of the implementation of the IBL in learning Physics SMAN in Bandar Lampung city. This research was conducted through the dissemination of the anqueta, interview, observation of teaching learning device and the Student Work Sheet (SWS), and observations of the learning process in three schools SMAN in Bandar Lampung. The analysis results show the majority of teachers do not implement learning Physics through the IBL. Learning Physics is still conventionally implemented that is explain the material, giving examples, exercises and problem solved. In addition, the learning is done yet to cultivate students ' HOTS. Weak in math skills and lack of SWS suitable with IBL so that become the problem in learning physics.

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INTRODUCTION

The progress of a nation is started by the advances of science and technology. We can find that where there are developed countries certainly have the capability of high science and technology, because it is very necessary to process all the existing resources for the prosperity of a country. Mastery of science and technology will encourage the emergence of a community of scientific activity of love, which will give birth to new technological innovations in order to improve the economic progress. Therefore it can be said that the scientific activity is the Foundation of the early key at the same time economic growth and prosperity of the nation (Stolyarova et al., 2000). For xample, Taiwan policy as Research and Development (R & D) so that the country's technology exports increased significantly, although the Taiwan government interfere in the market (Mah, 2015).

Science and technology could not be released from the development of physics, even the great discoveries in technology has always been pioneered the physics. The rapid development in the field of information and communication technologies in the field of materials physics findings triggered that is microelectronics devices that are able to contain a lot of information with a very small size (BSNP, 2006). We can see this condition today where the tools of electronic communication and other more sophisticated though it is small in size.

Mastery of physics allows a country to develop a range of technologies that will help achieve well-being at the same time security. Therefore, the Government of South Korea since 1948 make physics as the Foundation for developing nuclear weapons, nuclear power plants, and the semiconductor industry for the Betterment of his country (Kim, 2002). Indonesia also has the same potential to be a developed country, while mastering science and technology especially physics. Can be predicted if Indonesia mastering

physics, then natural resource management which is very rich in this great country prosper. However, to master the physics takes effort so that students don't just memorize, but able to grow the HOTS to complete the problems encountered.

KTSP mandates that the physics learning accomplished through scientific enquiries to foster the ability to think, work and be scientific as well as communicate (BSNP, 2006). A very good landing in the context of human development. Learning scientific enquiries one of which can be done through IBL is a model of learning is done through investigation as scientists of the scientific work. IBL implicitly involve students doing investigations in order to answer a question or solve a problem (Aditomo et al., 1995). In other words the IBL can strengthen the relationship between the learning by research (Spronken Smith et al., 2010). So the implementation of learning in students not only recall their existing knowledge, but more emphasis on finding existing theory through scientific work. No exaggeration if it is said that presumably IBL can give influence on the increased intelligence (Madhuri et al., 2012).

IBL is built upon a question that oriented on a phenomenon that will build the spirit of student learning (Barrow, 2006). As for the steps in the IBL used consisting of: asking, defining the term, acting, discussing, and summarizing (Nuangchalerm, 2001). This model will familiarise students to train HOTS that occurs when someone is in need of new information and information that is stored in memory and are interconnected and/or develop and extend this information to achieve a goal or find an answer (Lewis et al., 1993). This can be made possible because of the student in the process of analyzing data results of an experiment to find a concept in physics. Not only that, the IBL also facilitates the students to train the ability to communicate, because in the process students will be communicating results found to other students through discussion groups. In addition IBL can also develop a good attitude value through an investigation of the value of the human being in the process of building knowledge (Steed, 2009). Learning physics through IBL will give progress to the students that can solve personal problems even Nations and ready to meet the future of civilization happily (Nuangchalerm, 2001).

Learning Physics requires sufficient mathematical background, because in physics to analyze the natural phenomena that occur using mathematics. Theoretical physics can be a mathematical model of some part of the physical phenomena that is rendered in the math term (Quale, 2011). In other words mathematics help opens insights into physics concepts better (Uhdén et al., 2012). The mathematical background of low or discrepancy between physics and mathematics would be troublesome students in learning physics. The discrepancy in question is not of mutual support between the curriculum of mathematics and physics. For example, material vector quantity in grade ten, requires knowledge of trigonometric who turns out to be studied in the new class of eleven. This needs to be addressed appropriately by the teacher of Physics in order for the duration of learning physics is not depleted to discuss mathematical material required.

The purpose of this research is to know the description of learning physics in high school in Bandar Lampung city in running the IBL. The usability study was to know the obstacles faced by teachers and students as the basis for giving a donation solutions.

METHODOLOGY

The population of this research is the entire SMA Negeri that still apply KTSP in Bandar Lampung city. School samples obtained through cluster sampling while samples of students at each school is obtained by a simple random sampling (Cohen et al., 2007). Therefore, this research was conducted in three SMA Negeri in Bandar Lampung. Data obtained through three methods: (1) spread of the anqueta to 45 students and the entire



school physics teacher sample; (2) Observation Learning implementation plan (RPP) and the SWS media; and (3) learning activities through video Observations. Data analysis is done through a percentage.

RESULTS AND DISCUSSION

The conditions of learning activities that occurred beginning with the linking material to be learned at a natural phenomenon that occurs. This important activity is carried out in order to allow students to appreciate the importance and relevance of concepts with real life (Madhuri et al., 2012). The data in Table 1 shows 80% of the teachers carried out these activities and 86% of students justify it. This is the first step taken in implementing the IBL.

The granting of this phenomenon are not growing the HOTS students. This is due to more on notification only, not to the extent of making the students to ask. When asking questions can be a positive impact on the learning process and one of the ways to cultivate students HOTS (Dori at al., 1999). In addition, asking is the heart of the success of the IBL (Youth Learn Initiative (US), 2009). Proven 80% of teachers are aware of the given phenomenon does not pose a problem that makes students to dig it. But there are 18% of students feel what is delivered by teachers is a problem. This is a potential that should be processed in order for students to build knowledge. This situation occurs because the learning activities in the teachers just gave the phenomenon of spontaneous and not planned, so that its impact was not maximal. Will make it easier for the teacher when there is media of learning that helps them bring inspiration phenomenon related to the learning activities.

Learning activities are further explained the matter, give examples about, and practice matter. This condition evidenced by 100% of teachers who did not facilitate students to provide answers while, collecting data and information to build his knowledge, and describes what is found. So, it can be said that the teachers haven't done IBL. The teacher's teaching and learning activities is still conventionally in the class. A learning that is still centered on the teacher and does not correspond to KTSP. So it's no wonder if the students are still experiencing a variety of problems in the learning activities as in Table 2.

Table 1. Analysis of students and teachers anqueta related learning activities

Learning Activities	Teacher		Student	
	% Y	% N	% Y	% N
The phenomenon is related to the material being taught	80%	20%	86%	14%
The phenomenon could bring problems	20%	80%	18%	72%
Give answers while	0%	100%	10%	90%
Collecting data and information	0%	100%	9%	91%
Describe the findings obtained	0%	100%	7%	93%
Explain the material, examples, and exercises a matter reserved	100%	0%	56%	44%

Table 2 illustrates the problems faced by teachers and students. Given the planned learning activities have yet to give a wide space on the activity of the students, then the student passive learning activities in this looks even reaches 78%. During the learning process of the students many who just quietly listening to the teacher presents the material in front of the class. This condition will not develop the ability to think the students. Whereas in this era required trained human being he thought patterns so you can eventually contributed to the progress of the age (Tim paradigma pendidikan, 2010). The opposite will probably happen when the teacher gives the opportunity to students to explore a wide range of information. Students will be active by itself. But this is not going

to exploration activities running smoothly when there is no such guide the student Worksheet that are appropriate for the learning of IBL, which gives an overview and instructions or rules that can help students complete each stage of learning (Kirschner at al., 2006).

Table 2. Problems in the process of learning

Kind of Problem	Teacher		Student	
	% Y	% N	% Y	% N
Students are not active	70%	30%	78%	22%
Low student math skills	80%	20%	89%	11%
Low student motivation	70%	30%	67%	37%

Another problem faced by teachers in learning physics is weak math skills of students (Rusilowati, 2006; Wijayanti, 2010), where 80% of the teachers stated student math skills is low and 89% of students justify it.

Mathematics is very important in learning in physics, because math is a tool to understand the various concepts of Physics (Al-Omari at al., 2006). The closest thing to make students having trouble in terms of mathematics is not appropriate curriculum mathematics and physics. Many mathematical material required on a new level but will be studied at the next level. Therefore, it is SWS which can increase mastery of mathematics students, so teachers are no longer spent the duration of the study to discuss mathematics.

Students are not active and the ability of mathematical reasoning certainly makes a low power or capture information on students is low anyway. This complexity will cause students to feel despair even his motivation in learning physics. Proven to be about 70% of the teachers stated students have low motivation and 78% student response justify it.

The above issues should be resolved while the teachers back in the learning guide that suggests the KTSP physics via IBL. This model will be more engaging students in the learning process. But to maximize the learning activities need to be made in the form of learning is SWS as media to suit the learning IBL. This is to facilitate the student as well as the teacher.

CONCLUSION

Based on the deliberations presented above can be obtained the conclusion that learning physics SMAN in Bandar Lampung city still going offline. Activities performed was a clarifying material, giving examples, exercises and problem solved. Thus it can be said that during this learning physics yet appropriate referral KTSP. Obstacles still facing teachers and students in learning physics among others: weak math skills, low motivation of students, students may be low, and low reasonably. This problem will be resolved if the learning is done in accordance with the provisions of the curriculum. But for the effective implementation of the learning activities need to be developed which contains SWS help completion of math-based and IBL.

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PHY-01388

The Combination of Experimental Laboratory and Simulations (CELS): An Integrated Media To Understand Force Diagram Concept For Senior High School Students

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Abstract

The research on Combination of Experimental Laboratory and Simulations (CELS) media was aimed to figure out senior high school students' understanding of force concept. The research is a follow-up study of students' lack of force concept understanding caused by the lack of experimental ability and learning motivation. The instrument used in the research was essay test that allowed the students to write all concepts related to force diagram freely. The method applied in the research was experimental method with a class of grade ten in one of senior high school in the city of Bandung as the subject of research. The tenth graders did pre-test and post-test. Effect size was used to find out the increase of students' force diagram concept understanding after CELS media was employed. The result of force diagram test showed that CELS media improved students' understanding by 0.41 (average level) according to Hake (1998) and it was in high category for effect size (Cohen) by 0.8. This result verified that CELS media can improve students' understanding of force diagram concept.

INTRODUCTION

The essence of science (Physics) are process, product, and attitude. Therefore, Physics taught in school is not only emphasize on understanding the concept and theory of physics (as the products) but it also highlights students' understanding of those concept and theory discovering process. In the other words, students should get the experience directly and find out that process by themselves (Depdiknas, 2006). The process of self discovery that takes place during the learning process can be achieved when the students perform experimental activity-based learning. Instead of that, understanding physics concept will be more meaningful by using computer simulation. Combining those two activities (experiment and computer simulation) will give positive effect in implanting physics concept particularly force diagram concept to the students.

However, in actual condition students prefer to use formula based approach (mathematical approach) rather than scientific learning process that construct concept understanding through experimental activity (practical work). This results in the concept acquired by the students tend not to last long. It means that the consistency of the scientific conception of the students are still lacking. Another thing to be put into account is students' initial concept is beneficial for the concepts that have been learned (as apperception) or the materials that will be learned (initial conception). In one of popular

senior high school in Bandung, the eleventh graders had difficulties in understanding Newton law. The material that they would learn was the concept of motion and force. Additional concepts for grade XI is the influence of friction which is not overlooked. To get an accurate understanding of the concept, students need to learn force diagram concept through the combination of two media including computer simulation media and real experiments. To solve that research problem, CELS media was implemented during force diagram learning process of grade ten in the senior high school in Bandung.

It is necessary to understand force diagram concept because that concept is the roots (the most essential concept) of force concept itself. If the students do not understand force diagram concept, they will have difficulties in understanding force concept comprehensively. Students' understanding of a concepts is commonly named as conception. Students' conception of force diagram can be in the form of (a) students' initial conception which is not inline with the scientific conception of scientists. This conception is defined as students' initial conception (Van den Berg, 1991 as in Suryadi, 2005). One of the reasons is incomplete information received by the students, (b) students' initial conception can influence, help and postpone or even can create another problems for the students in understanding physics concept (Tandilling, 1996 as in Hamalik, 2003).

RESEARCH METHODOLOGY

The research method employed was experimental method which involved a class of grade ten in a senior high school in Bandung. CELS research instrument is in the form of essay test that give students the autonomy to write their whole understanding about force diagram concept. The research design was pre-test and posttest one group design (Fraenkel & Wallen, 1990). This research design was used to figure out the increase of students' force diagram concept understanding after implementing CELS media. Two tests were conducted: pre-test and post-test were given to students. Effect size (Cohen) was utilized to find out the significance of increase after CELS media was implemented.

RESULTS AND DISCUSSION

Based on the data analysis, the research results are generally as follows: 1) The average score of the normalized Gain of force diagram concept in **Table 1** and 2) Effect size (Cohen) of force diagram concept in **Table 2** .)

TABLE 1. The normalized Gain average score of force diagram concept

Score	Mean (Number 2, 6a, and 7a)	The average of gain <g>	Criteria
Pre-Test	10.3	0.52	Medium
Post-Test	28.3		

TABLE 2. Effect Size for test items number 2, 6a, and 7a (Force Diagram Concept)

Score	Mean	σ_{pooled}	Cohen's d	ES ($r_{v\lambda}$)	Criteria
Pre-Test	10.3	7.28	2.47	0.8	High
Post-Test	28.3				

The subject of this research was grade X Science 2. This class was chosen by the physic teacher of this class by considering the research schedule of researcher's lecturer. That consideration made the sample was not chosen randomly or in the other words, the sample was chosen by using purposive sampling technique. The consequence of this technique is the hypothesis of the research cannot be tested parametrically. Therefore, the

research data was tested by using effect size toward the significance of students' improvement by using Cohen formula. Data distribution of concept understanding in describing force diagram can be seen in figure 1 and 2. It obviously showed that CELS media is sufficiently improve students' understanding of force diagram concept. It is caused by several factors including computer simulation media and experimental media using board and beams with force arrow variation. Students' concept understanding is constructed through thinking and analyzing process connected to direct learning experience using the media that help students identifying force concepts involved in force diagram concept.

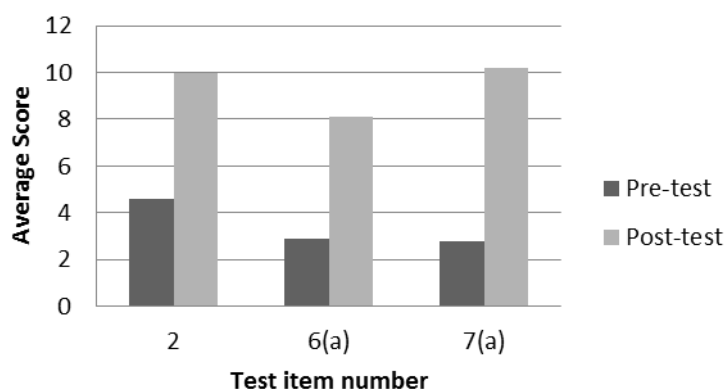


FIGURE 1. Students' score for force diagram concept test items

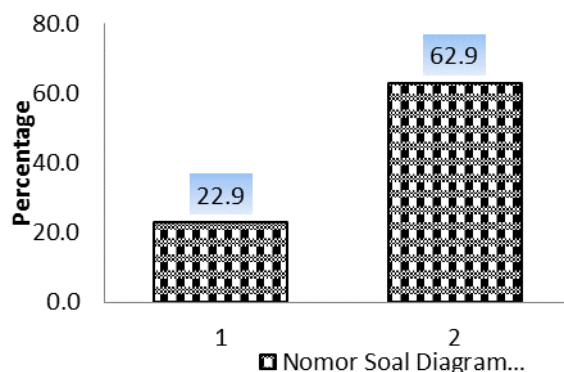


FIGURE 2. Percentage of students' average score for force diagram concept

Force diagram concept can be taught through real experiment and computer simulation. Computer simulation was selected to realize force vectors in an object (beam) on flat surface or inclined surface. However the major difficulty of students is in understanding the concept to describe force diagrams that acts at an object on inclined surface.

Most of the students found difficulty in describing the force diagrams at an object particularly whose surface is not flat, for example inclined surface. There were 19 out of 38 students who could answer correctly. Students also had some misconceptions.

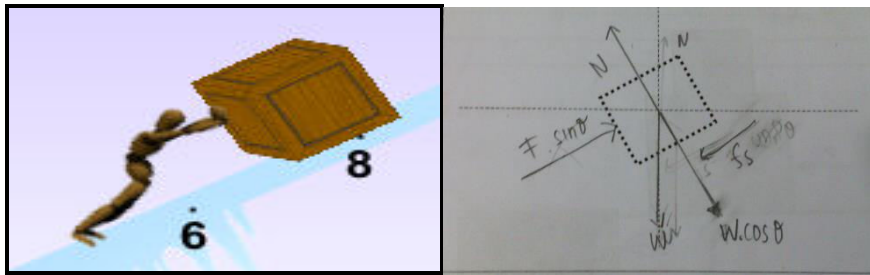
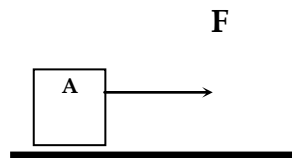


FIGURE 3.The description of force diagram at an object on the inclined surface

Most errors were found when projecting a force in the x-axis and y-axis.

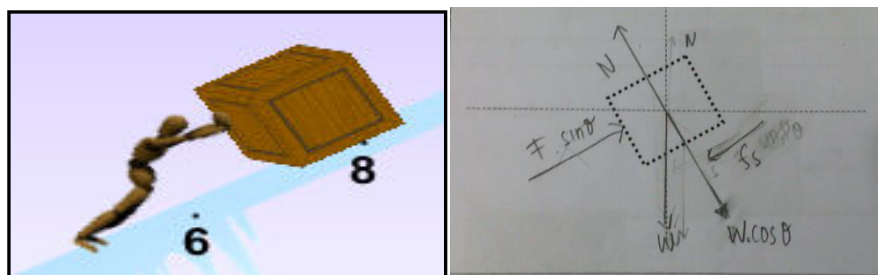
Instead of that, the analysis of pre-test data found several result as follow. *The First*, Almost all students (89,47 %) could solve the problems related to the implementation of Newton law in general test items and those that had been taught by the teacher. The data showed that 34 students of 38 students answered test item number 1 correctly. The test item is as below.



“ A beam of 20 kg mass is pulled by a horizontal force $F = 200N$ on a slippery flat surface as shown in the picture. How far will the beam move after 10 second? “

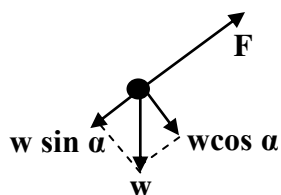
Based on the teacher’s and students’ interview analysis, it was stated that students were familiar with this type of test item and teacher gave this type of test item regularly. So the repetition of material helped students’ cognitive. However, there were students who could not answer the question because they forgot the concept. This case proved that students did not understand motion and force concept, they just memorized it.

Second, Most of the students still had difficulty in drawing force diagram at an object particularly when it is not on a flat surface, for example inclined surface. There were only 19 students who answered it correctly. Some students had misconception.



Describe the forces acting on the crate!

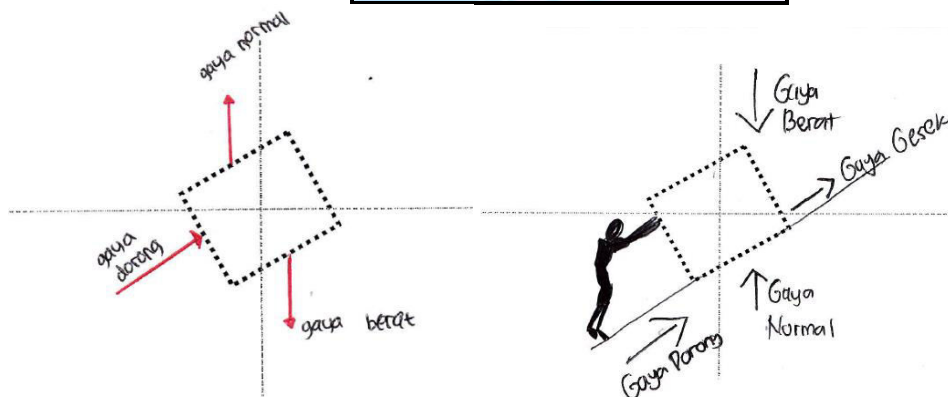
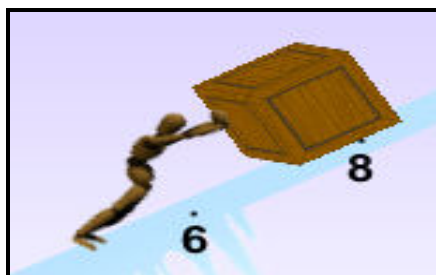
Most errors were made when projecting a force in the x and y. For this object system, heavy projection to the x-axis becomes $(w \sin \alpha)$ and to the y-axis is $(w \cos \alpha)$, with α is the angle between the inclined surface to the floor. In general, the projection is described correctly as follows.



It happened because students had not understood force projection concept completely. In informal interview some students argued that whenever there is a force that is not flat, it must be projected onto the x-axis as (force $\times \sin \alpha$) and the y-axis to be (force $\times \cos \alpha$). It made the thrust F on the image was projected again when in fact it had been in x-axis. The reason is describing coordinate axis x should be parallel to the incline.

To decrease the misconception, students should practice and get the basic understanding of projection principles. One of the alternatives is by introducing Pythagoras formula for a right-angled triangle that they have learned in Mathematics.

Third. There is an assumption that the normal force direction is always in the opposite direction to the weight of the object. It can be observed from some of the students' answers as follows.



Students had error in deciding the point where the force acted in describing force diagram. Students randomly described the point; in fact for homogeneous object, the point of force is in the center of object to describe the weight of the object, and in the square area to describe the normal force. Or for the most secure solution, because the object is regarded as a particle (object point) where we can view objects as objects point, so the depiction of objects is only represented by a point and all forces act at that point.

Fifth. Students had problem in describing the size of vectors as indicated by the length of the vector. For example in the case of objects driven on an inclined surface, in describing the vector length of normal force (N) with a weight that is projected perpendicularly to the inclined surface ($w \cos \alpha$) was described with a different vector

length. In fact, it should be the same because there is no resultant force in a perpendicular direction toward the surface.

Sixth. Students did not understand the essence of normal and gravitational force. Normal force is a contact force whose direction is always perpendicular to the contact surface. It means that whenever there is contact between the two surfaces, there must be a normal force. In contrast, gravity is the force of attraction between two objects with mass. In this case the gravity is directed towards the center of the earth. Earth's gravitational force experienced by this object is also called as the weight of the object (w).

Seventh. Frictional force is a force whose direction is always the same as the direction of objects' movement. Students assumed that when objects come into contact there must be friction, and this friction was in the same direction with the direction of movement of objects. In fact, generally, the direction of the frictional force is opposite to the direction of the object because it normally slows the movement of objects. Although in some cases, it is showed that the frictional force is in the same direction as the direction of objects' movement. But in the case of this objects system, the direction of the frictional force is opposite to the movement of objects.

Implementing CELS-based learning is able to facilitate students' understanding of concepts and increase the interest of students towards physics. This conclusion based on the students' posttest results. It showed a significant score compared to the pretest. The analysis of this posttest proved that the mistakes due to misconception or lack of understanding that occur during the pretest are no longer found. In addition, the results of the student questionnaire indicate that by CELS-based learning, students become more enthusiastic and interested in learning physics.

CONCLUSIONS

Based on the data analysis, it can be concluded that CELS media can improve students' understanding of force diagram concept. To maximize the results of research on CELS, it is necessary to develop CELS learning media that can improve students experimenting performance particularly in force concept.

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PHY-01396

Didactical Design Research : Analyzing Learning Process of Eyes Condition Concept Based on Students' Learning Obstacle Using Retrospective Analysis

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Article info	Abstract
Keywords: didactical situation, retrospective analysis, learning obstacle, learning process	One of teachers' thinking process phases is to retrospect process. Teacher should analyze, is learning process which occurs (see) appropriate with didactical situation before learning process (plan) or not with discern learning process itself (do). The research is purposed to analyze whole of learning process using students' learning obstacle. Obstacle in students' learning is focused in epistemology and didactical obstacle. Respondent Competency Test (TKR) is used to find out learning obstacle of student. learning obstacle is not only diagnosed by student that has early experience on eyes condition concept but also diagnosed by student that has no experience on eyes condition concept. all students that has early experience are come from same school at same class which has been teaching by the same teacher as well as student that has no experience on eyes condition concept. didactical situation is made using learning obstacle and will be used to teach student that has no experience on eyes condition concept. design that used in this research is didactical design research which is conduct with retrospective analysis. Video and its transcript are used to analyze learning process that occurs. The result of analyzing students' working on TKR, learning obstacle of student that has early experience still appear to student that has later experience. Moreover, unpredictable didactical situation and its spontaneous anticipation even emerge during learning process.
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INTRODUCTION

According to Suryadi (2010), process of teachers' thinking occurs on three phases, before the learning process, during the learning process, and after the learning process. Before learning process, teacher not only prepare lesson plan, but also prepare the learning sources and predict any students' response that might appear along with didactical anticipation or alternative didactical. During the learning process, teacher is demanded to identify and analyze students' response while applying learning sources that has been prepared before. Teacher needs to do the follow up based on result of students' response in order to reach the learning purpose. After the learning process, teacher need to analyze back is the learning process appropriate with the plan. Third of the phases is known as didactical design research. The learning design is arranged by modifying the understanding that be found through de-contextualization. Brousseau (2002) state that didactical design made based on Theory of Didactical Situation.

For making didactical situation, teacher need to predict students' responses that appear along with anticipation. This anticipation is about didactical relation (HD) between student and matter, pedagogical relation (HP) between teacher and student, didactical and pedagogical anticipation (ADP) between teacher and student. Didactical design research consist of three steps, prospective analysis, metapedadidactical analysis and retrospective analysis. Prospective analysis is analysis of didactical situation before the learning. Prospective analysis consist of depersonalization and de-contextualization while in metapedadidactical analysis, teacher implement didactical design and analysis its students' response during the leaning. In the other hand, retrospective analysis is analyzing didactical situation before the learning (prospective analysis) and metapedadidactical analysis. In retrospective analysis, teacher make revision of didactical design based on analysis result after implementing didactical design.

Basically, the learning in Indonesia did not do de-contextualization and depersonalization. It is supported by Basar (2004) that Physics teacher in school is often discuss the theory from the book and give the formulas then the example. The learning process in science especially in Physics tends to lead on imitative thinking. With this learning process, students are able to solve the question that similar to the example, but if the student was given different question, they would have some obstacles. That obstacles is called epistemological obstacle. According to Duroux (Suryadi, 2010), epistemological obstacle is obstacle that appears as consequence of limited knowledge on certain context. Epistemological obstacle is appeared from students' dependence on previous problem solving experiences. Teacher should anticipate and also decrease the emerged obstacles during the learning process. The learning obstacle can be decreased with de-contextualization and depersonalization. According to Brousseau (2002), depersonalization is process that producing concept as result from scientist concept comprehension that proper with limitation of students' ability. Brousseau (2002), epistemological obstacle can be determined by historical analysis. Historical analysis talk about students' method on :

1. Explaining the learnt knowledge
2. Understanding the use of learnt knowledge
3. Looking the relation of learnt concept with other related concept
4. Identifying situation of the problem and giving the reason of the answer
5. Repeating the wrong responses on similar problem and student understanding to every single problem

Beside of epistemological obstacle, another obstacle that might appear is didactical obstacle. Didactical obstacle is caused by teachers' teaching that is not good enough. Therefore, we need solution to solve the problem. With analyzing learning process using retrospective analysis based on students' learning obstacle, we expect that the next learning become more reflective and the learning obstacle will even decrease.

RESEARCH METHODOLOGY/EXPERIMENTAL METHOD

Raw materials

The method that is used in this research is descriptive method. Meanwhile, design that is used is Didactical Design Research (DDR). Participant on this research consist of two subjects. First, subject on diagnostic test to find students' learning obstacle. They come from student that has early experience on eyes defect concept. Diagnostic test that used is called Respondent Comprehension Test (TKR). From that subject, we found obstacle on eyes defect concept that will be used to make didactical design. Second subject is coming from student that has no experience on eyes defect concept. This second subject is implemented didactical design that made before. After that, they test using the same TKR



to find is the same obstacle still appears or not. Video and its transcript are used to see students' responses and didactical obstacle during the learning. Both of obstacle that still appear and video transcript are used to make revision of didactical design.

Characterizations/Analysis

There are several step to analyze the data that is found. In prospective analysis, we should analyze the matter first to find the essential concept. This step is known as depersonalization and de-contextualization. After analyze the matter, students is given TKR. In analyzing result of initial TKR, we analyze students' learning obstacle and agglomerate every kind of students' obstacle. This kind of students' obstacle is used to make didactical design. After implementing didactical design, in metapedadidactical analysis, we analyze the result of didactical design implementation using video and its transcript. From that video and its transcript we are able to find students' responses during the learning. After that, we analyze is students' responses that appear appropriate with the prediction of students' responses or not in retrospective analysis. Then, we analyze the result of final TKR and see is students' learning obstacle that similar still appears or not. Using that finding on students' responses and result of final TKR, we revise back the didactical design called revision of didactical design.

RESULTS AND DISCUSSION

Eyes defects concept tested with one question in TKR. On that question, kind of eyes defect is asked explicitly. Information that is given is the value of distant point. Kind of eyes defect is able to determine with comparing the near point or distant point to the normal eyes. Moreover, kind of eyes defects is able to determine from kind of auxiliary lenses. Kind of auxiliary lenses is determined using the focus first. Based on the question about eyes defects, we are able to make coding for students' learning obstacle.

TABLE 1. Coding of students' learning obstacle on eyes defects concept

Coding	Obstacle
A	Hard to determine kind of eyes defects based on distant point (Punctum Remotum)
B	Hard to determine kind of eyes defects based on kind of auxiliary lenses

Based on coding that has been made before, we got the result of students' working on TKR. Student that has experience on eyes defects concepts' working on TKR is called initial TKR. And student that has no experience on eyes defects concepts' working on TKR is called final TKR. Analyzing students' working on TKR, we got the result that shown on table bellow.

TABLE 2. Analyzing students' working on TKR based on coding

Coding	Initial TKR	Final TKR
A	27 of 36 students that answered	8 of 35 students that answered
B	26 of 36 students that answered	10 of 35 students that answered

Based on students' learning obstacle which is came out from students' working on initial TKR, we made an initial didactical design. The initial didactical design is shown on table below.

TABLE 3. Initial didactical design based on students' learning obstacle in eyes condition concept

Response Prediction	Didactical Anticipation
Hard to determine kind of eyes defect based on further	• Student differentiate lens through demonstration about eyes

Response Prediction	Didactical Anticipation
point (Punctum Remotum) Hard to determine kind of eyes defect based on auxiliary lenses	defect, so students are able to conclude more focus of lens, less convex the lens. <ul style="list-style-type: none"> • Student see the shadow on the screen become not clear after changing the lens with other lens through demonstration about eyes condition, so student are able to understand those condition is called eyes defects because focus of lens changing from normal. • Student are asked to write back the explanation about eyes defect definition, kind of eyes defect with the reason or cause on worksheet through discussion about eyes defect, so student are able to conclude the definition of eyes defect, kind of eyes defect, and the reason that cause the eyes defect.

To explain kind of eyes defects, we change the lens focus on demonstration become bigger than before. It is shown on dialogue between teacher and student related with the changing of lens focus.

Teacher : "...previously, we use +50 for the focus of the normal lens. Now, what will happen to retina and the shadow if I change the focus become +100 ?"

Student : "The near point will be different."

Based on that pronouncement, there is a student who knows if the focus on lens is changed, **the near point will be different**. Those students' answer is correct, but there is a step that students should do during demonstration. Therefore, teacher direct student to the step until find an answer "the near point is different".

Teacher : "Let's see, there is no near point. How is the shadow ?"

Student : "Not clear."

Teacher : "Not clear ? Why ?"

Student : "Because, the focus of lens has been change from +50 become +100, isn't it."

The meaning of teachers' pronouncement "**Lets' see, there is no near point**" is there is no object in front of the lens. Therefore, student are unable to conclude that the near point is changing before it is proved by demonstration. Teacher direct student through a question and get an answer "**because the focus of lens has been change from +50 become +100, isn't it ?**". After that, student lead the student to determine the shadow position from lens that has focus +100.

Teacher : "The shadow become unclear. Why ? Because the shadow do not form in the retina. Can you guesst where the shadow is ?"

Student : "Behind of the retina."

Teacher : "Where ? Here or there ?"

Student : "Behind of the screen."

Teacher : "Now, let's find where the shadow is. Now, can you see clearly ?"

Student : "Yes."

From that dialogue, it is shown that student are able to predict that shadow will be form behind the screen (retina) if the lens focus is changed become bigger than normal. That prediction is proved through the demonstration. On that demonstration, the shadow will be form behind the screen (retina) if the lens focus is changed become bigger than normal. The same way with lens focus that bigger than normal, the lens with focus +200. Student predict again that shadow will be appears behind the screen. From that demonstration, student are able to see the shadow pattern that form and conclude if the lens focus is bigger, the shadow will form behind the screen (retina). Previously, student are able to differentiate the lens curved based on the focus, so teacher direct student to relate the shadow position with the lens curve. Therefore, from that activity, student are able to understand kind of eyes condition.



Based on students' answer, the scaffolding that is given by teacher is success to attract student to relate the curved level, shadows' position and eyes condition. From that dialogue, there are two students' opinion related with eyes condition. It indicates that student still does not understand to determine kind of eyes condition. Therefore, teacher asks back to student.

Teacher : "So, what kind of eyes defect will happen ?"

Student : "Far sighted."

Student : "Near sighted."

Teacher : "Why ?"

Student : "Because the near point is formed in front of the retina."

Teacher : "The near point ? Lets' see, I do not put any object around that."

On that dialogue, there are several students that has 2 different opinion relate with eyes defect. On the other hand, there is student answered "***because the near point is formed in front of the retina.***" Students once again bring up the word "near point". Before discuss about the near point, teacher discuss about shadow position first if the lens focus changed become smaller than normal.

Teacher : "I change the lens focus from +50 become +25, how is the shadow ? And where is the position of the shadow ?"

Student : "In front of the retina."

Teacher : "Right here ?"

Student : "Yes."

Teacher : "So, what kind of eyes defect will happen if the shadow formed in front of the retina ?"

Student : "Near sighted."

From that dialogue, students already know if the lens focus is smaller than normal, the shadow will be formed in front of the screen (retina). Students have known about the pattern of shadow position for the lens focus that is bigger than normal. After that, teacher discuss the relation between near point, distant point and kind of eyes defect.

Teacher : "Assume that this is normal eyes condition. So, what point is this ?"

Student : "The near point."

Teacher : "The near point. What kind of eyes defect if I change the lens focus become bigger ?"

Student : "Near sighted, far sighted."

Based of word "***the near point***", we can see that students is still remembering the near point for the normal eyes. After hearing students' answer, teachers discuss the relation between near point and kind of eyes defect that shown on dialogue bellow.

Teacher : "I change +50 become +100. Lets' see where the near point is. Is the near point same with normal eyes or not."

Student : "It should be different."

Students' statement "***it should be different***" is shown that student already knows the near point of the bigger lens focus will be different with the near point of normal eyes. Teacher discuss with student while demonstrate the near point for the bigger lens focus.

Teacher : "Right here ?"

Student : "Yes."

Teacher : "Why ?"

Student : "Because of far sighted."

Teacher : "Where is the near point ?"

Student : "Further."

Teacher : "Further than what ?"

Student : "Than normal."

On that dialogue, it is shown that student already know that the near point of bigger lens focus is further than the near point of normal lens. Teacher then demonstrate the near point of bigger focus. In fact, the near point for bigger focus is further than near point of normal focus. After knowing the relation between the near point and far sighted, teacher direct student to determine the relation distant point with far sighted.

- Teacher : “Remember for the far sighted, how is the near point ?”
 Student : “Further than near point of normal eyes.”
 Teacher : “And how is the distant point ?”
 Student : “Become further.”

When teacher ask student about the distant point for far sighted, there is student answer “*become further.*”, whereas the distant point for far sighted is same with distant point of normal eyes. It is supported by teachers’ statement bellow.

- Teacher : “Is there any further than infinite ? It exactly the same infinite. So, how is the distant point ?”
 Student : “Still same.”
 Teacher : “So, for far sighted how is the distant point ?”
 Student : “Same.”

Teachers’ statement “*Is there any further than infinite ? It exactly the same infinite.*” support that the distant point for far sighted same with the distant point of normal eyes is infinite. Beside far sighted, teacher also discuss about the near point and distant point for near sighted.

- Teacher : “How is the near point for near sighted ?”
 Student : “Less than near point of normal eyes.”
 Teacher : “What do you mean ?”
 Student : “Less than 25 cm.”

Because students already know the pattern for near point of far sighted, student are able to determine the near point for the near sighted easily. From that dialogue, it is shown that student know the near point for near sighted. The dialogue between teacher and student about the relation of near point and distant point for near sighted is shown bellow.

- Teacher : “How is the distant point for near sighted ?”
 Student : “Closer.”
 Teacher : “Closer ?”
 Student : “Less than infinite.”

After knowing the pattern of near point and distant point for far sighted, student are able to understand the relation between near point and distant point on far sighted. From that dialogue, it indicates that student already know that the near point for near sighted less than the near point for normal eyes. To strengthen students’ conclusion, teacher write the key word on the board.

Based on Table 2, the same obstacle still appears on final TKR. So, the initial didactical design that has implemented before should be revise. The final didactical design is shown on table bellow.

TABLE 4. Final didactical design based on students’ learning obstacle in eyes condition concept

Response Prediction	Didactical Anticipation
Hard to determine kind of eyes defect based on further point (Punctum Remotum)	<i>Addition for initial didactical design</i> <ul style="list-style-type: none"> • Every row students is given the tools for demonstration • Before write back the explanation about eyes defect definition, kind of eyes defect, and its causes, teacher ask student that use glasses to put off the glasses and see the pencil on the near point he can see clearly through demonstration so student are able to compare that
Hard to determine kind of eyes defect based on auxiliary lenses	



near point for eyes defect exactly not same with the near point of normal eyes.

CONCLUSIONS

Based on research result, students' learning obstacle in eyes condition concept is found out using TKR instrument. Using that obstacles, we make an initial didactical design which is able to anticipate obstacle that is shown related with eyes condition concept. After implementing initial didactical design, we make a final didactical design for fixing or adding initial didactical design before.

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PHY-01397

Using Computer Simulation to Understanding The Concept of Star

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Article info	Abstract
Keywords:	The aims of this study to increase student understanding of the concept of star using computer simulation as media at earth and space science lecturer. Action research is used in this study. Seventy six (76) physics education students participated in this study. The result is an increase in the student's understanding of the stars concept of physics education by an average of 51 % on every indicator . So that the use of computer simulation can be used optimally in earth and space science lecture with attention to appropriate learning method.
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INTRODUCTION

Physical education courses as LPTK that produce physical education personnel have a vision to excel in producing educational personnel recognized field of physics education of competent, dedicated and highly synergistic and regionally based (Curriculum Team, 2011). So that in practice physical education FKIP Untan formulate curriculum based on the needs and the development of school curricula at both the intermediate and elementary. In the school curriculum there are subjects studied astronomy in the form of earth and space science is integrated in physics and geography (Senior High School) and science (Junior High School). Application of astronomy needs to be done wisely to maintain and preserve the environment (Depdiknas, 2006)

Earth and Space Science lectures aims in physical education courses are college students have greater knowledge about the Earth and space, and be able to apply physics in understanding the phenomena of the universe through the study of physically (Syllabus Development Team, 2013). Education courses of physics or physics still do not have a laboratory of earth science and space so that the subject has not been implemented IPBA laboratory activities. However subjects earth and space science is a course based on the observation and investigation in accordance with the principles of science. Learning science should be taken of scientific inquiry (scientific inquiry) to foster the ability to think, work and act as a scientific and mengkomunikasikanya important aspect of life skills (Liliawati and Hendiwijaya, 2011).

Science learning approach (inquiry) is one approach that has emphasis on the cultivation of concepts, such as the introduction and extracting concepts contained in such approaches typically use props to show natural phenomena. However, limited props are owned by causing difficulty of presenting a phenomenon that occurs. In addition Pyle (2008) mentions an investigation on earth science is indirect as well as investigations on the physics. Earth and space variables such as shape, the formation of a material requires a very long time so it is very difficult to control all the variables and present a representation of the real world in the laboratory.



To overcome these limitations, has now developed media-based learning computer simulations only on the material available to the devices IPBA general nature without the aspect of science learning (inquiry). This development was made possible by the rapid development in computing technology both in the hardware and its software and devices supporters. With the integration of information and communication technology in the form of interactive multimedia learning it is hoped that require observation on a smaller scale and on a larger scale can be facilitated. Interactive multimedia is a combination of text, graphics, sound, animation, and video where the user gets the flexibility in controlling (Tay, 2000). Multimedia development that has been done (Oktavianty, E., 2013) on the material the kinetic theory of gases help students to understand the concept of kinetic theory of gases which are microscopic and abstracts resulting in a significant improvement of the skills of critical and creative thinking of students. So that based on the materials studied in the course of Earth and Space Sciences who is macroscopic and it is difficult to observe directly the integrated learning of science and technology can be developed. Research in the field of IPBA still rarely performed.

Starting from this premise, this study has a strategic value to add insight and experience of both lecturers and students in Physics Education Study Program FKIP Untan in organizing lectures Sciences Earth and Space based on the results of studies thinking skills of students and the development of lecture-based science and technology so improving the quality of the learning process in the subject of earth and space science can be achieved.

RESEARCH METHODOLOGY/EXPERIMENTAL METHOD

The method used in this study is an action research with descriptive data analysis. This study aims to determine the increase student understanding of the concept of star through using computer simulation in earth and space science lectures physical education courses . Students who participated in this research is the 4th semester students in the academic year 2014-2015 were taking earth and space science courses. The test instrument used to evaluate the student understanding of the concept of stellar matter in earth and space science.

RESULTS AND DISCUSSION

Understanding the concept of students were analyzed qualitatively based on test results on the concept of understanding the concept of the star. Tests conducted on students of physical education courses 2014-2015 academic year who took a course earth and space science with a number of 76 students were divided into two regular classes. The following table recapitulation of understanding the concept of the maximum score is 87.

TABLE 1. Data understanding of the concept of stars

Test	Score	Percentage
Pretest	48	45%
Posttest	87	96%

Based on the data in the image above can be seen that there is an increased score at the end of the study using computer simulations by 39 percentage understanding of the concept of rising stars average of 51% on every indicator. The indicators used in this study is the temperature of the star, the speed of light, the Earth's orbit of the sun, solar energy, solar revolution, the position of the sun - planets, and constellations.

The largest increase occurred in the indicators of the Earth's orbit to the sun and constellations (60.53%), solar revolution (57.89%), the position of the sun - the planet (52.63%). While the smallest increase in the concepts of the speed of light (30.26%). On the concept of the students already understand the speed of light velocity of light and large proved the speed of light so that when the pretest scores on the concept of the speed of light has reached 60% of the students could answer the question.

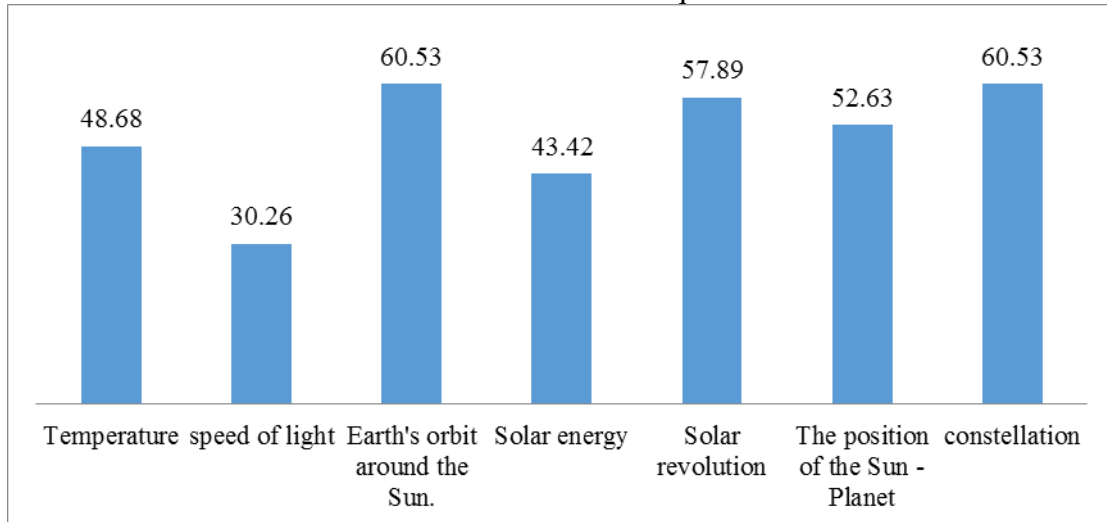


FIGURE 1. The percentage increase understanding of the concept of student scores on each indicator

Action research conducted by one cycle at about the concept. Indicators of success in this research is the understanding of the concept of student achievement gains at 65%. Planning is done by paying attention to the conception of students who are not consistent with the concept of the star. Such as the concept of constellations, the speed of light, the temperature of the star, the phenomenon of bright stars at night. At the temperature indicator of stars, the student is still considered the most high-temperature star is the sun, it can be seen from the acquisition of the percentage of students who are not consistent conception still huge 37% in the early group, 50% in the middle group and 69% in the final group. Whereas at the end of the group should have passed the subjects related to the color spectrum (optical) (Oktavianty, E., 2011). Based on the results of the pretest, 75% of students thought that all that glow at night is a star, and students can not distinguish the term elongation and conjunctions. it also netted Besides understanding the student does not come to the position of the sun - the planet, the students are not familiar with astronomy terms so that the difficulty in resolving the given problem. This is shown in about 13 and 14, the students do not understand the term conjunctions and elongation.

Based on the results of the previous study, the pretest and proceed with designing plan based learning constructivism by using computer simulations. At temperatures star is a concept that is the most frequent errors were students assume that all of the light at night is a star, but by learning to use a computer simulation in this case Stellarium software can show students that not all visible at night is a star. Observations made by students independently with the naked eye and assisted Stellarium. So that students can show directly the position of celestial bodies observed and matching software. Stellarium software is used because it can be easily obtained by students with a free download. This gives the advantage to the students to install on laptops and smartphones, respectively. Interactive multimedia is a combination of text, graphics, sound, animation, and video where the user gets the flexibility in controlling (Tay, 2000) Furthermore, in the



implementation of learning, professors follow the lessons that had been designed by making use of computer simulations. Learning step begins with the conception of the students showed inconsistent as shown in the results of the pretest, students were asked to perform a hypothesis based on the problems created. On the concept of star temperatures students are asked to pay attention to several different types of star colors shown in the form of images, then the students were asked to name the most hot star. At this stage, the students still assume that the hottest stars is the sun, the stars are yellow. Furthermore, the lecturer reminded the students in the visible light spectrum. Lecturer using computer simulations using flash animation optical concepts, shows the student wavelength and frequency appear on a star and star class based on the star's surface temperature and energy star. On the concept of the Earth's orbit of the sun, the students have the assumption that the earth was the center of the solar system. This assumption can be based on the apparent motion of the earth to the sun, where students get the movement of the sun from east to west. At this asusmsi then learning to use would require direct observation of the position of the earth to the heavens. In the study carried out observations using computer simulations by combining the video movement of the planets and the sun, animation aberration (small change positions of stars as the rate of the earth), parallax (changes in the positions of stars due to the change in position of the earth) and the effect dopler (discoloration stars because the rate of the earth) and by using Stellarium software that shows the star's position change - change at any time. With shows the changes experienced by the star positions the student to the conclusion that the earth and planets are moving towards the sun. Sma thing also happened in explanation of the concept of constellations, at the beginning of the course the students feel already know about the constellations, but among the 76 students taking the course none mahaiswa commonly observed constellations. Then the professor asked mahaiswa to observe the constellations at night. The result of students still can not specify the nature of the constellations they get. observation of the night sky is very likely there kendalam like the sky is cloudy or rainy so can not see the sky at night. therefore by utilizing the computer simulation the students can get to know a lot of constellations, even mahaiswa can distinguish the stars and celestial bodies such as planets. Student interest appears to be increased by using a computer simulation because the observation of the night sky is not easily done with the naked eye so that students also possess a good understanding of the concept.

The combination of Stellarium, video and flash animations that are then used in the lecture give good impact to the students in understanding various concepts star. According to Pyle, 2008, earth and space science learning a lesson that is unique because students are in the lab, but due to the large scale and requires a long time so that the student is difficult to know all the variables change earth and space science directly.

However, there are some limitations in the use of direct or flash animation software that is downloaded for free which need a long time to control and adjust the concepts that will be covered by existing simulation. So there needs to be planning both in terms of preparing in advance or multimedia interkatif develop custom concepts and variables are discussed.

CONCLUSIONS

Based on data from the study and discussion it can be concluded that learning to use a computer simulation can enhance student understanding of concepts in the concept of star with an average increase of 51%.

Therefore, it should be considered to develop a computer simulation or teaching materials that can be tailored to the needs of learning achievement.

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PHY-01399

Profile Misconceptions and Conception Of Students Pre-Service Physics Teacher on Topic Heat and Heat Transfer

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Abstract

This research is motivated by the achievement of mastery of concepts students on the topic of heat and heat transfer are still not as expected. One cause is suspected because of the misconception. The purpose of this study to know the profile of misconceptions and conceptions student pre-service teachers of physics on heat and heat transfer topic. The method used is descriptive analytic with a sample of 23 students representing different grade of student teachers of physics at one University in West Java. The research sample was determined by using purposive sampling technique. Data collection tool that is used in the form of diagnostic test with three-tier analysis. The results showed the most student misconceptions is principle Black in determining the final condition of the system after thermal equilibrium is reached between the two systems. This concept represented by four questions (11,12,13 and 14) that 22.23 % of students was misconceptions. For example a student for reason 13, when the ice is mixed with steam, then the final condition of system certainly is water. Though opinion to determine the final condition should be consider the initial temperature and mass of each system before thermal interaction. The second student misconceptions is heat transfer conduction, convection and radiation. Heat Transfer represented by four questions (15,16,17,18,19,20 and 21) as much as 24.26 % of students was misconceptions. For example, to question 18 on the flow of heat transfer convection on heating water. Students are many who have the conception that the convection flow occurs gradually ranging from small circulation in the lower part then enlarges to the top circulation. Further analysis of the reasons the students, in general, this misconception occurs because students tend to follow the preconceptions and incomplete reasoning.

INTRODUCTION

Every lecturer always expects the learning objectives that have been set can be achieved by students in learning process. Lecturer sometimes have felt totally in teaching students, but the reality when the test carried out, many students are not able to achieve the expected learning objectives. During teaching, the lecturer sometimes difficult to determine how many students actually have achieved the learning objective and how many students are still having difficulty learning, especially when in a large classroom lectures. Difficulties student's should be detected as early as possible by lecturers in order to immediately planned learning programs (including reinforcement of lesson). Learning difficulties of students is certainly varied, either wide or cause. Some of the symptoms that indicate a student with learning difficulties such as: acquisition shows lower educational outcomes, unequal results achieved by the efforts that have been made and slow in performing tasks and learning activities. Based on these indications, it is an effective way

to detect learning difficulties of students, especially in a large lecture class, namely by measuring learning outcomes, for example by using diagnostic tests.

Similar methods are also used by the Physics Education Research Group (PER) pioneered by Lillian C. McDermott, for almost two decades, to investigate the understanding of concepts and conceptual difficulties experienced by students^[1]. Two methods are used by PER, namely individual demonstration interviews (individual demonstration interview) and descriptive study through written tests (written tests)^{1, 2}. Pengamatan and interaction with students in the classroom also provides in-depth information about how students learn well.

The concept of heat is one of the concepts of physics very closely with everyday life. Although very familiar turns sometimes students still have difficulty in understanding the concept of heat. This study did not focus on improving the learning outcomes directly, but are looking for the causes of student difficulty in understanding the concept of heat. Allegedly students experiencing misconceptions. This research will be focused on the exposure profile of misconceptions and student conceptions on topics of heat and heat transfer. Results of this study can be used as the basis for subsequent research in determining the appropriate treatment to improve understanding of the concept of heat and heat transfer physics student teachers.

RESEARCH METHODOLOGY

This research is descriptive analytic describe students misconceptions's on the concept of heat and heat transfer. As many as 23 research subjects Physical education students from three different forces, namely the class of 2011, 2013 and 2014. Collecting data using three-tier instrument shaped test analysis the number of questions as many as 21 questions that represent subconcepts. Sub tested concepts include definitions of heat, heat effect (expansion, temperature rise substances, and phase transition), azaz black, heat transfer (conduction, convection, and radiation). As for categorization misconception refers to the categorization Kaltakci Derya (2007)³ as shown in Table 1.

TABLE 1. Categories Of Three three tieranalysis

Categories	Response Types
Scientific knowledge	Correct response + scientific explanation +sure
Lack of Knowledge	Correct response + scientific explanation + not sure incorrect response + scientific explanation + not sure correct response + unscientific explanation + not sure incorrect response + unscientific explanation + not sure
Error	incorrect response + scientific explanation + sure
Misconception	correct response + unscientific explanation + sure incorrect response + unscientific explanation + sure

RESULTS AND DISCUSSION

Table 2 shows the students experiencing misconceptions in almost every sub concepts. Experienced the biggest misconceptions many students to the concept of Black and heat transfer principles.

TABLE 2. The Result Of Misconception Student

Categories	Heat (%)	Black Principle (%)	Heat Transfer (%)
Scientific knowledge	58.70	28.26	47.20
Lack of Knowledge	50.32	45.33	24.29
Error	5.23	4.18	4.25
Misconception	15.75	22.23	24.26

Further analysis of the works heetrof the students found some students some erroneous conceptions of the understanding of the concept of heat and heat transfer. On the concept of heat, which is the biggest misconception about No. 7. Problem No. 7 as follows: "Pure water in a liquid state when put in the freezer will turn into ice. When the ice is removed from the freezer and placed in a room, the ice will melt back into a liquid. Why does this happen? ". Most of the students answer (B) ice absorbs heat and the temperature rises. This is clearly wrong. In the event of melting solids to liquid heat required to change the form of the substance. So clearly on this occasion the heat absorbed by the ice for transforming it not to raise its temperature. In other words, the process of phase transition temperature of the substance is fixed.

On the concept of the principle of Black, the biggest misconception is at No. 13. Problem at number 13: "One hundred grams of ice at 0°C and 100 g of steam at 100°C thermal interact in an isolated container. How is the final state of the system? ". All students answer incorrectly and be sure to answer. Most of the students answer (B) by reasoned that the ice is mixed with steam to reach equilibrium conditions to form water. This condition is not the standard conditions. Supposedly, this can be solved by using the principles of Black. The amount of heat that is released vapor into water vapor required for heating ($Q = m.c.\Delta T$) amounted to 226 000 joules. While the heat needed to melt the ice ($Q = m.L$) of 33300 joules. As for raising the water temperature at 41 900 joules. So that the heat needed to change the form of ice into water and raise the temperature sufficiently fulfilled with the amount of heat released water vapor, but not enough to change the entire water vapor into water, when the conditions of thermal equilibrium is reached. That is the final condition of the system is a water-steam mixture at a temperature of 100°C (option E). On the concept of heat transfer, the biggest misconception in heat transfer by convection is presented in pictures. Problem No. 18: "When we heat the water with pans, fire given continuously causing the water temperature to rise even to a boil. If made in the form of visual, heat transfer occurring during the heated water right is right. **Figure 1**

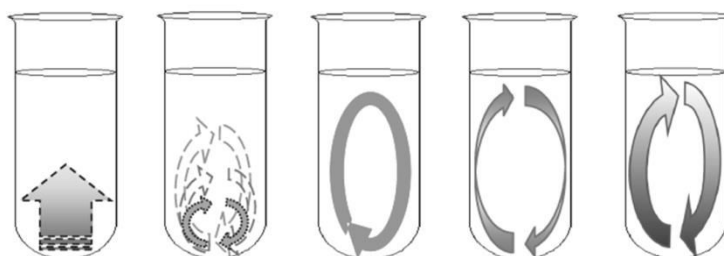


FIGURE 1. Transfer of Heat :Convection

Many students answer (B), because the heat transfer occurs slowly from the bottom up with the growing flow of circulation. In fact, is the most appropriate option (E). Heat flow

in the event of heating water to boiling is by convection. In the container, the water receives a larger heat as close to the source, the heat received by the bottom of the water causes the water density is lower than the top of the water. This condition causes the water to move to the bottom up and the top down. This movement occurs as a whole not just the outer / wall.

CONCLUSIONS

Based on the discussion that has been presented, it can be concluded that students experienced many misconceptions in principle the concept of black determination of the final conditions of the system after the condition of thermal equilibrium is reached between the two second largest misconception associated with the heat transfer of heat conduction, convection and radiation. As an example of the depiction of the flow of heat by convection on heating water. Students are many who have the conception that the convection flow occurs gradually ranging from small circulation at the bottom then enlarged circulation to the top. Further analysis of the reasons the students, in general, this misconception occurs because students tend to follow the preconceptions and incomplete reasoning.

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PHY-01424

Investigating The Ability in Solving Higher Order Thinking Test of Circular Motion

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Abstract

The purpose of this research is to identify the higher order thinking ability of senior high school students through the analysis of national examination and school test of circular motion concept. The research is qualitative descriptive. The sample was taken using purposive random sampling consisted of three schools in Surakarta region: SMA Muhammadiyah 1 Klaten, SMA MTA Surakarta and SMAN I Karangpandan. The instrument used to identify the student higher order thinking skills are the national exam test at 2013 and 2014, teacher made test for circular motion. The average score test of national exam at 2013 is 51.55, 58.88 at 2014, and 42.55 for teacher made test. To find out the explanation to the low average score of student, the learning process of students was observed. From the observation it was shown that the low score of student in c4-c6 types problem of circular motion concepts were due to the teaching-learning process which was still teacher centered where student did not involved actively in learning process and student did not train to use prior knowledge and daily experience to understand of new concept, so that the higher order thinking skills of learners was not proper developed so it was very low. To empower higher order thinking skills learners should involve actively in multi activities such as learning through demonstration, experiment, daily experience or project base by using media and process approach.

INTRODUCTION

Physics is a branch of Natural Sciences. It is interconnected concepts as a result of observation. Physics is a process, product, or attitude. As a form of experimental physics processes that include; discovery and formulation of the problem, formulating hypotheses, designing experiments, take measurements, analyze data, and make conclusions. As a product Physics is the result of a process carried out by experts. It consists of facts, concepts, principles, laws and theories. Scientific is formed when the students were doing the physics process through the scientific method. Positive attitude was formed only if the student applied scientific method as scientific did.

The aims of learning Physics are to understand the concepts, to develop skills and positive attitude. To develop skills by doing observation, measurement, comparing, making hypotheses and inference. Students have the opportunity in the search, discovery and investigation. Students are expected to develop an attitude that are: curious, willing to ask, understanding and developing new ideas, explaining the phenomena and natural events. Learning is used to develop cognitive abilities in formal operation. According to Piaget, students that are older than 11 years old have been able to hold a formal operation, even though the condition was not applicable in general.

Circular motion is the motion of objects that have equidistant from a given point to a fixed rate. The object which moves in circular motion has magnitude: distance, displacement, time, mass, period, frequency, speed linear and angular, velocity, acceleration and force. Circular motion is a simple concept, but in the abstract subject and the application of circular motion get more difficult. Experiments in groups, or qualitatively demonstration is needed to improve student understanding (1). Students must learn to think, solve problems with creative and able to think critically (2), further expected to be higher order thinking.

Higher order thinking is necessary competencies of students, involving high cognitive order of Bloom's taxonomy. Bloom's Taxonomy consists of six orders: knowledge, comprehension, application, analysis, synthesis, and evaluation, which was later revised (3) remembering, understanding, applying, analysing, evaluating, creating. Remembering, understanding, applying, categorized belong to recalling and processing, while analysing and evaluating categorized as critical thinking. Critical thinking is one of the main goals of modern learning (4), critical thinking and creative thinking are called higher order thinking skills (5).

Higher order thinking skills can be revealed by a test or reflected in item test that consisted of c4-c6 based on Bloom's taxonomy. The item test of national exam is assumed to covers c1-c4, but usually the c4 item test are only small part. To determine the skills of higher order thinking, further more write special test for 10th grade high school students. To study higher order thinking skills of the students. The result can be used to evaluate how far the student achieve the higher order thinking. The purpose of this research is to identify the higher order thinking ability of senior high school students through the analysis of national examination and school test of circular motion concept.

RESEARCH METHODS

This research is descriptive qualitative. The sample was taken using purposive random sampling consisted of three schools in Surakarta region: SMA Muhammadiyah 1 Klaten, SMA MTA Surakarta and SMAN I Karangpandan. The procedure of the research:

1. Investigate the word structure of the national exam to know whether the item test content include higher order thinking that are c4-c6 types.
2. To investigate the score of the student from national exam report.
3. Write easy test for circular motion consisted 6 problems for c4-c6 types test and tested to tenth grade student.
4. Analyze the score of student from national exam and from teacher made test.
5. Due to the low score of student for c4-c6 type test then the learning process was observed.

RESULTS AND DISCUSSION

National Exam

Each item of national examination test in 2013 regarding the application of circular motion. The test described combination of wheels, and to answer test required analysis. Some wheels were connected with rope, or same of wheel center, or contacted one and the other. Student must know that wheels rotate, where the same linear velocity and angular velocity.

National exam test in 2014 is a test of understanding and recalling. If students have already known the formula so that students can answer correctly. Test at 2013 concerning the processes, analysis, comprehension and calculation. Test of 2014 related remembering and understanding only. The average score of test in 2013 is 51.55, while the average score



in 2014 is 58.88. Scores in 2013 was lower than the score in 2014. Based on these data it can be said that the test involving process skills, including analysis and higher order thinking proved to be more difficult than the understanding and recalling test.

Higher Order Thinking Test

Higher order thinking test is made 6 item test and must be answered with a short answer. Most of the answers in the form of a closed and partly open. The test covers observation, measurement, process, changing of variable, hypothesis, completing the picture of events, the depiction of the vector, comparing, differentiate, analyze, evaluate and create combination wheels. The test was tested, including the type of analysis, application, evaluation and creation of the dimensions of conceptual and procedural knowledge. The test of process skills test covers experiment and observation. The average test score 42.55 is low criteria.

Conditions of Learning

To know the problems of learning at three schools research conducts observation. The result of classroom observation show that: first teacher centered learning in the classroom. Students have not been involved actively conducting experiments. Students have not been actively linking the prior knowledge to the new concept. Second, the media in circular motion learning in schools is limited. Learning conditions have not empower a higher order thinking skills.

CONCLUSION

From the explanation above it can be concluded;

1. The national exam test in 2013 is a test that involves understanding, processing, and analysing (higher order thinking test). Test in 2014 with the verbal form containing understanding and recalling. The average score in 2013 is 51.55, the average score in 2014 is 58.88. The results of the higher order thiking test are lower than ordinary test.
2. The higher order thinking test score of circular motion of matter is 42.55. The test scores indicate that higher order thinking skills student is low criteria.
3. The circular motion learning in classroom is not maximun because of the teacher centered learning. The students have not been actively involved in conducting experiments. Students have not been actively linking the prior knowledge to the new concept. They indicate that process skills approach and higher order thinking questions have not been applied

SUGGESTION

Based on the research results the researcher suggestes that in circular motion learning has to use media more adequate. Piaget, said that the ability to abstract for the students of more than 11 years old is good at formal operations, but not all them good at formal operations (6). Therefore the area and certain conditions still needs concrete objects (7). Process skills approach can be used to enhance the ability of formal, it can also affect the ability of formal thinking (8). The use of media and this approach is expected to help the student abstract thinking. By experiments students can observe and pay attention (9). Students who examine the body, observe phenomena, design experiments, collect data, or discuss ideas to increase the motivation of students (10). Process skill approach can be used to empower in higher order thinking skills. Basic skills and higher order thinking learning can be interwoven in the classroom (11). Higher thinking skills that include creative thinking and critical thinking, can be easily combined and synergy in education

(12).

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PHY-01446

The Implementation Of Remedial Teaching Assisted With Interactive Demonstration Towards The Achievement Of Mastery Learning And Students' Learning Motivation In Heat Concepts

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Abstract

This research was conducted based on the phenomenon that there are many teachers who are lack of knowledge and less-aware about remedial teaching as one of the efforts to overcome the students' mastery learning. A quasi-experiment with nonequivalent control group design was chosen as the method of this research. The research instruments used were cognitive test that consisted of C₁, C₂, and C₃ aspects and questionnaire of students' learning motivation. The findings show that there are significant differences of mastery mastery learning between experiment class and control class. The cognitive aspect that increased are C₁ and C₂ whereas in the control class is C₃. Next, the students' learning motivation towards remedial teaching in experiment class reaches 82.20%, and 66.83% in control class. Specifically, the correlation between mastery learning and students' learning motivation is in its highest category with significance value of 0.602 in experiment class, and average category with significance value of 0.419 in control class. Based on those results, there are significant differences between mastery learning and learning motivation between remedial teaching assisted with interactive demonstration and conventional remedial teaching, and there is also a correlation between mastery learning and students' learning motivation.

INTRODUCTION

Remedial teaching is important since it is one of the treatments to help students reach mastery learning. It is an education service to help students reach content standard and graduates standard. Ischak and Warji^[6] state that remedial activities are intended to give assistance in a form of teaching to students who are slow, difficult and failed, in order to help them master the materials given. This remedial teaching helps students who face difficulties in learning. The difficulties may vary from lack of knowledge and prerequisite skills, or late in reaching competence. This is in line with the main goals of mastery learning principles that operationally attempt to improve the mean scores of all students in class unit, and to shorten the distance between fast and slow learners.

Based on the result of students' daily test in heat material, in one of state junior high schools in Purwakarta Regency, only 6 of 39 students got score above KKM (criteria of minimum achievement), and in the other class with 40 students, there were only 7 students who passed the KKM. Based on those result, there were more than 75% students who had not accomplished the KKM, therefore, according to Permendikbud Republic of Indonesia No. 81A of 2014, a remedial teaching must be conducted. However, the classroom

observation revealed that the observed teacher did not conduct any treatment to those who had not accomplished mastery learning. Whereas, the students can only move to the next learning unit if those certain students have mastered at least 75% of established basic competence (Departement of National Education of Indonesia Republic^[2]). In meaning, the students who have not mastered certain basic competence need to pass it before learning the next competence. The treatment given by teacher was only by asking the students to make a paper as a requisite to get KKM score. However, this treatment is not appropriate with the regulation of remedial teaching, since there were more than 50% students who needed remedial class. A proper treatment for those students is by teaching the same material with different method and media. This condition reveals that there is an inappropriate of remedial teaching implementation at school, and lack of teachers' awareness regarding the importance of remedial teaching in teaching-learning processes.

Based on the findings above, this research develops a remedial teaching to solve problems related to students' mastery learning. Oyekan^[10] and James found that remedial teaching can improve student's achievement. The teaching model used in the class was assisted with interactive demonstration. Interactive demonstration is a teaching model developed by an education expert from Illinois University, Wenning^[14] who states that interactive demonstration generally consists of teacher's demonstration, and teacher's questioning about some possibilities (prediction). Interactive demonstration is not only about teacher's demonstration but the teacher has to ask and improve students' prediction, to provide responses, to gather further explanation, and to help students find conclusion and basic facts. In a journal article entitled 'The Learning Physics Impact of Interactive Lecture Demonstration, written by Slekiene and Raguliene^[12], it is stated the use of interactive demonstration method can improve students' mastery learning. Simanjuntak P^[11] states that motivation at school is a process to develop and create studying encouragement. Students who have high learning motivation will lead their power to improve their learning potential as optimal as possible, in order to reach satisfying learning outcomes that lead to mastery learning.

Based on aforementioned problems above, therefore this research focuses on the implementation of remedial teaching assisted with interactive demonstration towards student's mastery learning and students' motivation in heat concepts. Research on this topic is rarely conducted since this method is seldom used by the teacher, especially when considering the timetaken. Another research on this topic was about remedial teaching assisted with website. On the other hand, the use of web cannot be conducted in schools that are far from technology. So that, the teaching method employed in this research used common method, which was the use of simple tools.

RESEARCH METHODOLOGY

This research employs quasi-experimental method with nonequivalent control group design. It is a combination of comparative (to compare), associative (correlation), and descriptive (to describe) studies. Specifically, this study tests the influence of remedial teaching implementation that is assisted with interactive demonstration towards the student's mastery learning and students' learning motivation; which was done by comparing experiment and control groups and by testing the correlation between mastery learning and motivation.

The populations of this research were seventh grade students of State Junior High School 5, Purwakarta Regency, in 2014-2015 academic year. The samples of this research were control and experiment groups, where each of them consisted of 33 students who had not completed heat and heat transfer materials.

The data collection was done by giving cognitive test in a form of instrument consisted of 27 multiple choices questions and students' learning motivation questionnaire consisted of 11 questions. In detail, the cognitive test covered recalling knowledge aspects (C_1), comprehension aspects (C_2), and application aspects (C_3). Next, to measure students' learning motivation, the questionnaire was arranged based on intrinsic and extrinsic motivation indicators, which consisted of four indicators, namely: presence of desire and willingness, presence of learning encouragement and needs, presence of future expectation and goals, and presence of conducive learning environment.

RESULTS AND DISCUSSION

Mastery Learning

Based on result, generally the students achieved their mastery learning. However, the students in experiment class, who were treated with interactive demonstration method, performed better in mastery learning, compared to students in control class who were treated with conventional remedial teaching. In interactive demonstration method, the learning activities fully involved the whole students' ability to seek and investigate heat and heat transfer concepts in systematic and critical ways. In detail, the students experienced heat experiment, so that they could find the concepts of heat by themselves and they also could easily comprehend and recall the materials.

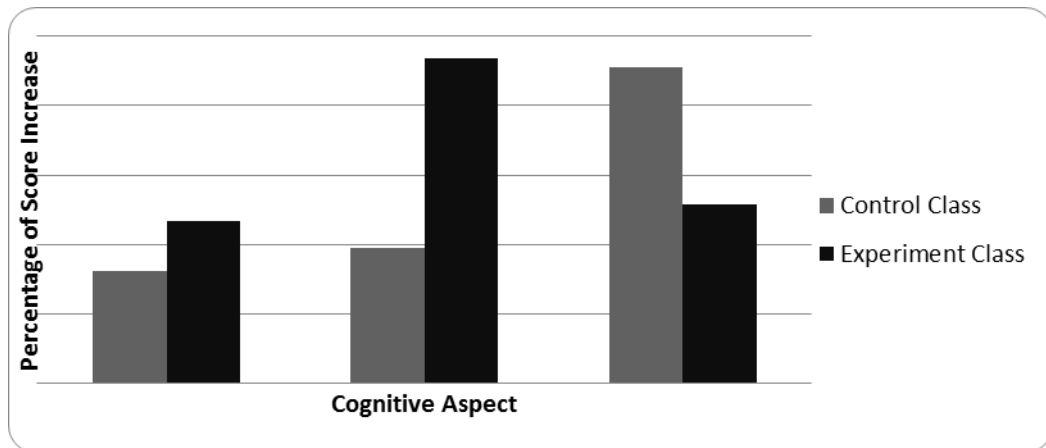
However, there were several students who had not reached the mastery learning both in experiment and control classes. It happened because during the demonstration some students did not see the occurred phenomena. Some of them also sat in the backside of the class, so they did not get enough information about heat concepts. The findings discover the following mastery in every cognitive aspect:

TABLE1. Pretest and posttest results in every cognitive aspect in experiment and control classes

Cognitive Aspect	Control Class		Experiment Class	
	Pretest	Posttest	Pretest	Posttest
C_1	165	218	173	250
C_2	90	148	69	208
C_3	108	228	103	171

Based on the posttest results above, compared to control class, experiment class performed better in knowledge and comprehension aspects. However, in the application aspect, control class performed better. Remedial teaching assisted with interactive demonstration emphasizes on concept comprehension because the of its characteristic that the students are involved in explanation and making prediction processes, which allow the students to gain, identify, face, and solve alternative concepts (experiences of prior knowledge) (Wenning^[14]). On the other hand, in control class which was treated with conventional remedial teaching, the students only listened to information about heat concepts during learning, so they asked more about formula usage, therefore the their implementation aspect was better compared to experiment group.

Moreover, the increase in cognitive aspect score can be seen in the following Graphic 1.



GRAPHIC 1. The increase score in each cognitive aspect, in experiment and control classes

The difference of mastery learning in experiment class, which was treated by remedial teaching assisted with interactive demonstration method and control class that was treated with conventional remedial teaching, is seen from the results of following N-gain test.

TABLE 2.Score description of cognitive aspects in experiment and control classes as a whole

	Experiment Class			Control Class		
	Pretest	Posttes t	N-gain	Pretest	Posttes t	N-gain
Number of samples	33	33		33	33	
Mean	10,45	19.06	0.49	11	18	0.42
Max Score	17	23		16	20	
Min Score	6	16		8	14	

Based on statistical formulation, the significance is 0.0000. The significance $0.000 < 0.05$, H_0 is rejected, which means that there are some differences between the attainment of mastery learning in experiment and control classes.

Students' Motivation

The data collection regarding students' motivation on remedial teaching was done by administering learning motivation questionnaire that consists of 11 statements. Following is the questionnaire results.

TABLE3. Student's learning motivation in experiment and control classes

Indicators	Class	
	Experiment	Control
Presence of desire and willingness	85.45	66,26
Presence of learning encouragement and willingness	85.45	78,48
Presence of conducive learning environment	80.00	59,39
Presence of expectation and goals	78.99	67,07

Based on the result above, the percentage of students' learning motivation was higher in experiment class. However, in the presence of expectation and goals indicator,



specifically in statement 11: “I am determined to accomplish my score, so I don’t need to join remedial classes”, the experiment class showed smaller percentage than control class. The motivation to accomplish mastery learning in control class was higher than in experiment class, since the students in control class were not motivated to join conventional remedial learning, which they considered uninteresting and nothing new that they could learn. In contrast, the students who joined remedial teaching in experiment class got different way of teaching, so they were happy to study in remedial classes. It is in line with one of the motivation indicators, proposed by Uno [13], that the students’ learning motivation will emerge when the learning activities are interesting, so the students will learn better.

Based on the result above, the percentage of students’ learning motivation was higher in experiment class. However, in the presence of expectation and goals indicator, specifically in statement 11: “I am determined to accomplish my score, so I don’t need to join remedial classes”, the experiment class showed smaller percentage than control class. The motivation to accomplish mastery learning in control class was higher than in experiment class, since the students in control class were not motivated to join conventional remedial learning, which they considered uninteresting and nothing new that they could learn. In contrast, the students who joined remedial teaching in experiment class got different way of teaching, so they were happy to study in remedial classes. It is in line with one of the motivation indicators, proposed by Uno[13], that the students’ learning motivation will emerge when the learning activities are interesting, so the students will learn better.

To see the differences of learning motivation in experiment and control classes, an independent sample t-test of motivation score was conducted. Based on the calculation of Mann-Whitney U, the significance of motivation score is 0.000. Since the significance value $< \alpha$, so there are some differences in students’ motivation in experiment and control classes.

According to Ishack and Warji[6], the method used in remedial class is one of the factors that should be taken into account in remedial classes. It should be an interesting method, so that the students will have better learning motivation, fully comprehend the materials and get enough skill exercises in the classes, so they will master the material better. In line with the aforementioned explanation, students who attended remedial class assisted with interactive demonstration have higher motivation compared to students who are taught using conventional remedial teaching method.

The Correlation between Learning Motivation and the Attainment of Students’ Mastery Learning

The results of correlation test are 0.602 for experiment class, and 0.419 for control class. In both of the classes, the P -value < 0.05 so it can be interpreted that there is a significant correlation between both variables, or in the other words, both of the variables are positive. In experiment class, the Pearson correlation value is in the range of 0.60-0.79, which means that there is a strong correlation between motivation and mastery learning. Besides that, in control class, the value of Pearson correlation is in the range of 0.40-0.59, which means that there is medium correlation between motivation and mastery learning. Li, P & Pan, G found on their research that there are relation between student’s motivation dan learning achievement. If the student’s have a high motivation, they will be study hard in order to obtain learning achievement so they will reach mastery learning.

CONCLUSIONS

Based on the research findings, remedial teaching influences students' mastery learning. In a class where the remedial class is assisted with interactive demonstration, there are increase scores in C1 and C2 cognitive aspects. In contrary, the students who are taught using conventional teaching remedial perform better on C3 aspects.

Students' learning motivation in remedial teaching class assisted with interactive demonstration is higher than those who are taught using conventional remedial teaching. In meaning, the chosen method in remedial teaching can influence students' learning motivation.

To conclude, learning motivation and achieving mastery learning have good correlation. The higher students' motivation means the higher mastery learning.

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The Three-Tier Test (TTT) for Identify the Quantity of Student's Misconception on Archimedes's Law.

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Abstract

The aim of this research is to reveal students' misconception in Archimedes Laws. This research is belongs to the descriptive research. The samples that use in this research are all of the students (186 students on the 9th grade class) from one of junior high schools in Pandeglang Regency. The diagnostic test to reach the aim is using a three tier-test (TTT). The result had shown that founded misconceptions in the each sub-concept. The highest percentage of students' quantity who had misconception is misconception about thick liquids would be floating in the surface is 84, 38%. In the other side, the lowest percentage of students' quantity that had misconception is misconceptions about objects could be floating if the container's volume is larger than before that is 53.13%. For the further researchers, suggested overcoming these misconceptions with some teaching methods/models.

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INTRODUCTION

When students came to their class, they had kept their prior knowledge about their surrounding then they think about phenomenon during in the learning process. If their prior knowledge will useful to his new class, it were would give benefit to the students. However, if it different with scientific knowledge, it would be a trouble in the students' cognitive. Some of scientists' call it with misconception (Yin, *et.all.*, 2008). It supported by Wasis (2013) had said that in line with the development of students' cognitive, they have to expand their conception. Nevertheless, most of them are opposite with the true concept. Its must be solve so this problem is not long draw out.

Misconception is a prior conception, some it is an intuition that is not agree with scientists' explanation (Wasis, 2013). Misconception is an entire concept or a partial knowledge that it was not in line with the scientific opinion (Kopitzki, 2011). Misconception is definition as a conception that is different with expert on this field (concept matter) (Mulyani (2015). On this paper, the author use term "misconception" to any idea that is not scientific knowledge

Therefore, this misconception must be solving. There are some methods to overcome it, planning a new or innovative teaching to apply to those students that misconception, to seek their causal factors, and to identify the misconception what (Mulyani, 2015). In this paper, the author choose the last one that to find the "form" of misconception that was held by student.

Physics concepts had much misconception indeed. Therefore, many studies investigate on physics education, and it is belonging to fluid statics concept such as are floating and sinking (Çepni *et.all.*, 2010), floating and sinking (Kopitzki, 2011), statics fluids (Wasis,

2013), floating and sinking (Yin *et.all*, 2008). Cause sinking and floating concept was a exist misconception on fluid, so the author tried to identify the students' misconception on

Archimedes Laws by using a diagnostic test in reasoning multiple-choice form with an addition self-confidence that called TTT.

TTT has designed to identify misconception and students' conceptual understanding. It is easier and more efficient to distinct their different conceptions (especially, misconceptions). The first-tier, is to test students' conceptual understanding, the second-tier, is to test students' reasoning, and the third-tier is to know students' confidence (Muliyani, 2015). Based on that background, the author tried to provide some data of distribution of misconception that it held by student, and give the information the number of students that misconception on fluid static.

RESEARCH METHOD

This is a descriptive research. The sample of this research is all of students (186 students on 9th grade class) in the one of junior high school in Pandeglang, Banten, Indonesia. The sample had taken by purposive technique sampling. This study's aim is to know the quantity of students that misconception. The author tried to identify students' answers that misconception or not used the TTT. This test has administrated with multiple-choice format.

The knowledge content has examined on TTT was about Archimedes's Laws. The decision of students' answers on TTT had adopted by Muliyani (2015).

TABLE 1. Categories of Three Tier-Test

Tier-1	Tier-2	Tier-3	Categories
Right	Right	Sure	Right concept
Right	Right	Not sure	Lucky guess
Right	Wrong	Sure	Misconception
Right	Wrong	Not sure	Guess
Wrong	Wrong	Sure	Misconception
Wrong	Wrong	Not sure	Lack of Knowledge
Wrong	Right	Sure	Misconception
Wrong	Right	Not sure	Guess

(Muliyani, 2015) Based on Table 1, the result of students' answers on TTT analyzed used right only method. Result of Table 1 became a source data for decision category of misconception. Therefore, the category of misconception recapitulated to Table 2. This categorization has adopted by Muliyani (2015) as the following:

TABLE 2. Criteria of Misconception

Criteria Misconception	Decision of Category
< Misconception 0 □ 30	Low
< Misconception 30 □ 70	Medium
70 < Misconception □ 100	High

Based on Table 3, the author tried to describe clearly the number of students that misconception. Assumed that data represented that all problems in that school about these misconceptions.

RESULTS AND DISCUSSION

This study has examined students' conception by using a three tier-test format. Students' answers analyzed with consideration as given on Table 2. Based on analyzing and calculating data, the distribution of students' answer that belonging a misconception as the following:

TABLE 3. The List of Students' Misconception

Misconception code	Misconceptions
Misc-1	A large sum of water in the container, it make the object will be float
Misc-2	If the object larger/heavier than it initial, so that object will be sink.
Misc-3	If object's size bigger than it initial so that object will more sink.
Misc-4	The thick liquid will make the object to float.
Misc-5	The flat objects will be float
Misc-6	If the object smaller than it initial so that object will be float

TABLE 4. Decision of Misconception Category

Criteria Misconception	Decision of Category
Misc-1	Medium
Misc-2	Medium
Misc-3	Medium
Misc-4	High
Misc-4	High
Misc-6	Medium

For the clearly, observation the recapitulation of the number of students that misconception, for each misconception, has described as the following:



The Quantity of Student that Misconception

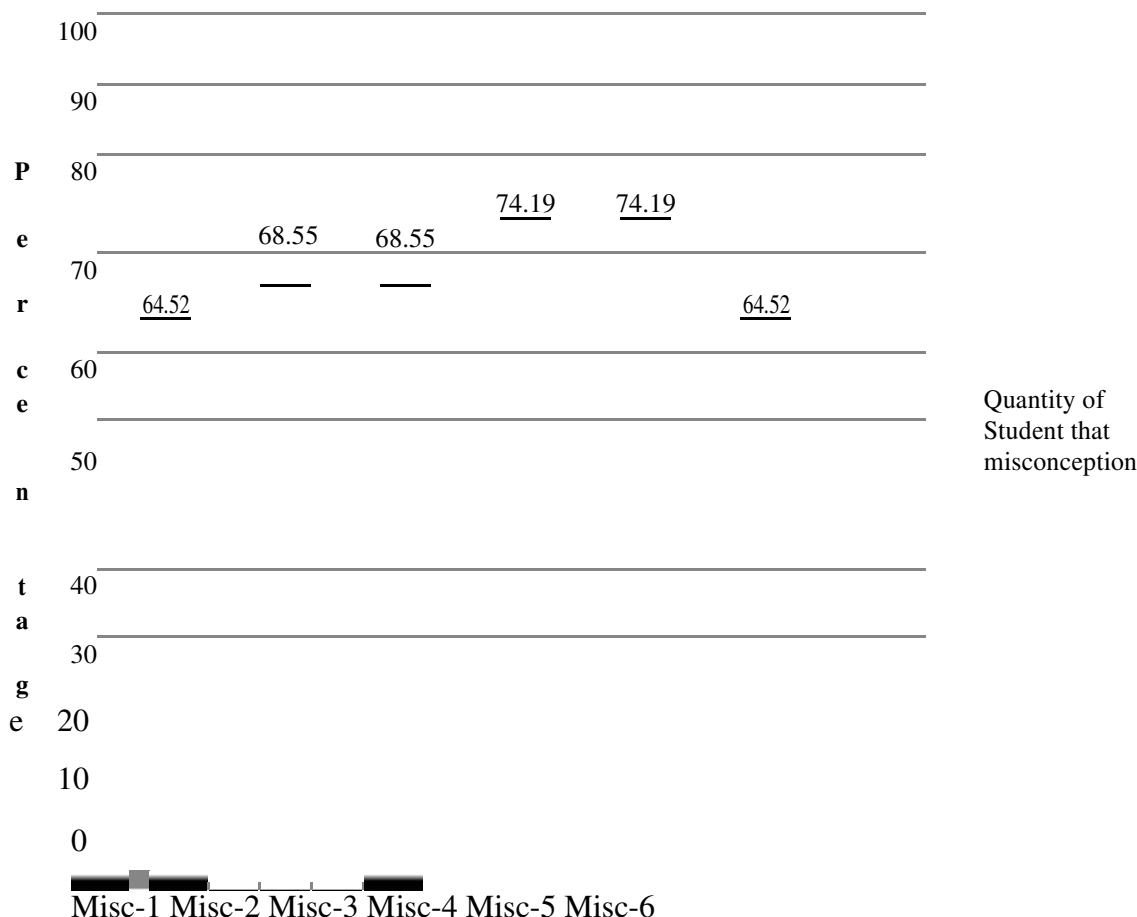


FIGURE 1. Distribution of Students That Misconception

Based on Figure 1, has known that Misc-4 and Misc-5 are the largest number of students that misconception. These misconceptions are difference. Misc-4 is the thick liquid will make the object to float and Misc-5 is the flat objects will be float. In addition, the lowest percentage of the number of students that misconception are Mis-1 and Misc-6. Although, there are some item on that Figure 1 had same percentage. For clarify, this number of percentageis base on analysis result, not opinion by author. This misconception had tested with different conceptual context. At a glance, the distribution of students that misconception is almost same to each sub-concept that is more than 50%. This information, implicitly a big problem that students have in their cognitive and it must be to solve as soon as possible.

This finding has similar with other studies. Wasis's research (2013) revealed that absolute majority students have misconception on fluid topics. Many phenomenon that student think their conceptions are able to explain phenomenon. Therefore, they tend to keep their conception. This statement supported by Kopitzki (2011) that if student confuse about the new concept, they usually reject it and hold their preconception.

Some other researchers, many reasoning can be analyzing those students' conceptions is belonging misconception. As like as result of study by Yin, *et.all* (2008), many daily

experience has similar with students' conception. Therefore, this result of this study suggested for the future researcher to solve this problem immediately. This study tried to provide information to the next researcher optimally.

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The Culture of Teachers Using Authentic Assessment Instruments in Physics Learning

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Abstract

Teachers play an important role in presenting quality and meaningful learning processes. The aim of this study is to describe the culture of teachers using authentic assessment instrument in learning Physics. The research method is descriptive, with the data being gathered using in-depth interview technique involving several Physics teachers in the city of Bandar Lampung in order to discover which teachers used assessment instruments and to identify the weaknesses in the use of such assessments and to identify appropriate assessment instruments to meet the demands of the conditions in the real life situation and the 2013 Curriculum. The sampling technique used was purposive sampling. The results of the study are categorized into potentials and problems. The potentials attested at the schools included the availability of teacher's handbooks and student's textbooks provided by the Ministry of Education and Culture, containing authentic examples of the assessment instruments. In addition, the schools in question had implemented the newly introduced 2013 Curriculum for classroom teaching-learning activities. However, for the topic of discussion regarding Fluid, the authentic assessment instruments were absent. In addition, no teacher had designed or even used authentic assessment instruments in Physics classroom teaching-learning activities. Based on the research findings it can be concluded that the teaching of Physics carried out by the teachers did not lead to the achievement of learning objectives. It is because there was no culture of teachers using authentic assessment instruments in learning Physics yet.

INTRODUCTION

Teachers play an important role in presenting quality and meaningful classroom learning processes. In relation to that, it is undeniable that a teacher's main responsibilities are: (1) designing lesson plans, (2) performing the teaching activities, and (3) administering *assessment* as well as obtaining feedback from such assessment. ¹ In a learning process, those three steps on the part of teachers are intertwined, influencing each other, aiming at a goal for the sake of the success of the learning process.

Physics, being a branch of Natural Science dealing with how naturally occurring phenomena are explained, is accordingly expected to directly present those phenomena for the students to observe firsthand in the hope that they understand and explain the natural process behind the phenomena they encounter in their environment. In line with that, Physics can also be considered products, processes, applications as well as changes in attitude. If it is considered as products, Physics comprise a set of facts, concepts, laws or principles, equations and theories to study and comprehend. If it is considered as processes, such processes are solutions to problems by means of scientific method steps comprising observation, hypothesis proposal, experiment design, investigation, hypothesis

testing by means of conducting the experiment, evaluation, measurement and conclusion drawing. If Physics is considered as applications, they are ones in which methods or scientific works and Physical concepts are put into application in daily life context. If Physics is seen as a contributing factor in triggering changes in attitude, it deals with curiosity, care, responsibility, honesty, openness and cooperation. The four views on how to treat the subject of Physics compose an integrated unity that the outcomes of the learning processes are highly competent students.

As can be observed, Physics is a subject which one can easily visualize and perform as well as emphasize on quantitative variables in order to test and see what the implication of a model brings about.² In addition to that, Physics is at the core of studying naturally occurring phenomena closely related to thinking logically and scientifically.³ Another reason is the availability of research-based instrument standard to assess students' understanding of Physical concepts. For one, it is in support to Heron et al.'s research, namely: to let the students investigate firsthand in the laboratory the concept of mass and subsequently allow them to realize how helpful it is in understanding the closely-related buoyancy phenomena.⁴

Learning activities with such emphasis implicitly suggest that test is an evaluation tool which is commonly used to assess how far a student has achieved the aims of learning, with the scores obtained from the tests used as the single indicator in assessing the students' mastery of the concepts, the effectiveness of teaching-learning activities, the teachers, as well as other aspects about the students in educational practices.⁵ It should be noted, however, that in such tests the students' affective and psychomotoric aspects are not accommodated. In other words, they are not properly measured. Consequently, the results of such tests are not subject to generalization as several aspects are left unincluded in the assessment.

The information on students' performance or achievement is obtained from the measurement and non-measurement data analysis to decide whether or not the students have mastered or achieved the targeted competence. Measurement may be administered by means of test or non-test.⁶ The instruments of test may be in the forms of oral questions, multiple choice, objective essays, short answers or short gap-filling, matching, portfolio, as well as live performance (demonstration). Non-test instruments may appear in the form of questionnaire, inventory and observation.⁷

A question may now arise: How can teachers obtain information on their students? Assessment refers to evaluating by means of measuring, as well as interpreting the results of measurement and deciding on how well each student has attained the aims of learning.⁷ Rustaman, et al state that the evaluating or measuring learning outcomes is frequently associated with formative and summative tests, whereas the evaluation of the learning process itself is known as assessment.¹ Although the terms evaluation and assessment may be used interchangeably, assessment has a deeper meaning, including both the measuring of students' learning outcomes as well as individually taking into account each student's potentials for the sake of their future prospects.

Based on in-depth interviews conducted in Bandar Lampung regarding several teachers' habit in employing authentic assessment instruments, several facts emerged: (1) all teachers unanimously stated that they had difficulties in determining what aspects to assess, how to implement the assessment procedure, as well as how to analyze the results of the assessment, (2) the teachers had limitations in deciding on the appropriate assessment for each topic of discussion in the learning of Physics which may impede the revealing of the complicated effects of education, (3) the teachers were overwhelmed by the high number of assessment instruments, (4) no chance for the teachers to administer assessment on psychomotoric and affective aspects outside the classroom because of



restrictions posed in effect of school regulations, (5) the teachers did not have ample of time: all they had was the time allotted by the school to deliver the materials, (6) the limited ability on the part of the teachers to perform multitasking, which in this case was conducting the teaching-learning activities along with assessing the students' progress, (7) the teachers only administered an evaluation which was summative in nature that some aspects of the students' abilities, namely skills and creativity, passed undetected by means of written test.

The facts as evident in real life school setting have the potentials of bringing about the possibilities of (1) the students' abilities and understanding—in putting their knowledge and skills into practice—going unnoticed, (2) their abilities in performing the learning outcomes being left undiscovered and (3) the small number of pieces of work showcasing the students' creativity. Consequently, the assessment (1) was not administered continually (2) failed to fathom the students' progress within the learning process, as well as, (3) failed to increase the level of effectiveness of the learning activities. Authentic assessment, in its idealized form, is expected to provide valid and accurate information on subject matters with which students are familiar and which they are capable of performing. In addition, the results of authentic assessment should be available for educators to be used as a basis on which to plan remedial, enrichment, or counseling programs.

Based on the facts presented above, the writers attempt to discover the reasons for the teachers having difficulties in administering proper assessment. The research is entitled "The Culture of Teachers Using Authentic Assessment Instruments in Physics Learning."

RESEARCH METHODOLOGY

The methodology employed for this research is a descriptive one in order to identify teachers' culture of using authentic assessment instruments in the processes of Physics teaching-learning. The data for analysis was collected using in-depth interview technique carried out by the researchers involving several Physics teachers in Bandar Lampung, namely those from SMA Negeri (State Senior High School) 1, SMA Negeri 4, SMA Negeri 11, SMA Negeri 16, SMA YP Unila and SMA Al-Azhar. The technique employed in gathering the samples for the subject of this research was *purposive sampling*. The schools were selected based on careful consideration on the quality and locations of the schools, which are downtown, semi-downtown and uptown. The source of data for this study is in-depth interviews with the teachers on the availability of authentic assessment instruments with reference to the 2013 Curriculum, the use of the authentic assessment instruments, the types and techniques chosen by the teachers to assess their students' progress, the availability of assessment instruments to measure—planning, executing, and reporting—of an assessment administration, the design and use of authentic assessment instruments for the planning, executing, and reporting of an assessment administration with reference to the 2013 Curriculum, the difficulties teachers had to endure in designing and using the authentic assessment instruments, as well as the need to develop the authentic assessment instruments.

Research Instruments; Instruments are tools or equipments whose function is to facilitate the process of performing an action. The instrument used in this study was interview to obtain information regarding the teachers' culture of using authentic assessment instruments in Physics teaching-learning activities. The interview was used in this research to obtain information on authentic assessment instruments in use at the schools previously mentioned. The interview was also conducted to obtain information on the weaknesses of the authentic assessment instruments so far used in those schools. It is

expected that the interview results be of useful reference in developing authentic assessment instruments in Physics teaching-learning activities.

RESULTS AND DISCUSSIONS

The findings of this study resulting from observation and in-depth interviews fall into two categories, namely potentials and problems. Those are described in the following. Potentials comprise every resource put into labor to yield an added value of the final product. In contrast, problems are any deviation or transgression from what is expected. Both potentials and problems need to be empirically proven.

The potentials in the schools included the availability of teacher's handbooks and student's textbooks provided by the Ministry of Education and Culture, published and distributed in the event of the introduction of the 2013 Curriculum. The content of the books included *authentic assessment* instruments at the teachers' disposal in assessing their students' progress. In addition, the schools in question had implemented the then newly introduced 2013 Curriculum for classroom teaching-learning activities. However, for the topic of discussion regarding Fluid, the *authentic assessment instruments* were absent. It might be the case that the instrument examples presented were general in nature: no specified performance tasks were available in sight. Apart from that, no teacher had designed or even used authentic assessment instruments in Physics classroom teaching-learning activities. At this stage the researchers collected the data regarding the *authentic assessment instruments* available at the schools by means of conducting interviews. The purpose of conducting the interviews is to discover what kinds of assessment instruments had been used and to find out the weaknesses of the use of such assessment instruments as well as to identify the suitable ones, appropriate for the situation and condition of the schools and the 2013 Curriculum.

Potentials are every resource yielding an added value if properly put into use. On the other hand, problems are transgression from what is expected. The analysis on the potentials and problems was carried out involving SMA Negeri 1, SMA Negeri 4, SMA Negeri 11, SMA Negeri 16, SMA YP Unila, and SMA Al-Azhar, all located in the city of Bandar Lampung in the Academic Year of 2014/2015 based on the in-depth interviews regarding the Physics learning. The analysis on potentials and problems based on the interviews is presented in the Table 1 below.

Table 1. Analysis on Potentials and Problems

No	Aspects Discussed in the Interviews	Potentials	Problems
1	The availability of the <i>authentic assessment</i> instruments with reference to the 2013 Curriculum	The examples of authentic assessment instruments are available in the teacher's handbooks and student's textbooks distributed to each school.	Some teachers limit the use of the assessment instruments only to cover the cognitive aspect. Some teachers subjectively administer the assessment of affective and psychomotoric aspects.
2	The use of learning and assessing instruments with reference to the 2013 Curriculum.	The teachers apply the learning instruments with reference to the 2013 Curriculum.	Some teachers do not administer the authentic assessment of cognitive, psychomotoric and affective aspects of the students.
3	The administration of assessment on student progress in the teaching-learning activities.		Administering assessment only at the end of teaching-learning activities.



No	Aspects Discussed in the Interviews	Potentials	Problems
4	The administration of authentic assessment in the teaching-learning activities.	Some teachers use the assessment instruments in accordance with the 2013 Curriculum to assess their students' progress, however discontinually.	No authentic assessment instruments with reference to <i>special learning strategies</i> in administering the assessment.
5	Obstacles in designing <i>authentic assessment</i> instruments.		On average, the teachers have difficulties if asked to design <i>authentic assessment</i> instruments. All the teachers admit that they have never used <i>authentic assessment</i> instruments.
6	The need for the development of <i>authentic assessment</i> .	All the teachers state that they are willing to design and develop the <i>authentic assessment</i> instruments with reference to the 2013 Curriculum. All the teachers state that they agree if the <i>authentic assessment</i> instruments with reference to the 2013 Curriculum are designed and developed.	

Based on the Table 1, it is obvious that the authentic assessment instruments for the topic of discussion regarding Fluid were not available in SMA Negeri 1, SMA Negeri 4, SMA Negeri 11, SMA Negeri 16, SMA YP Unila, and SMA Al-Azhar. The only authentic assessment instruments available at those schools were mere examples in the teacher's handbooks already put into use by the teachers in the teaching of Physics. General in nature, the examples were not specifically focused on the characteristics of a particular topic of discussion, Fluid being the case in point.

Authentic assessment is direct evaluation and measurement. On administering assessment, many activities are more accurately observed if they are directly assessed, such as the ability to defend an argument, the ability to put logical thinking into reasoning, as well as the skill to perform an experiment. The same goes for assessing students' attitude or behavior toward something or at the time of doing something.

Furthermore, still based on the Table 1, it is shown that some teachers did not administer authentic assessment to evaluate the students' progress. Indeed, some teachers did use assessment instruments in accordance with the 2013 Curriculum to administer assessment, however discontinually. However, basing their scoring solely on written tests, the teachers ended up subjectively assessing affective or psychomotoric aspects of their students, which were not unimportant in the overall evaluation. That aside, actually all the teachers were eager to design or develop an authentic assessment instrument for each subtopic of discussion regarding the subject of Physics but they were worried by possible flaws in the instrument models they design as a result of the lack of guidance from experts, apart from the fact that to this point, no specific models of authentic assessment instrument were readily available. It is in the absence of such models that the researchers are developing authentic assessment instruments for Physics learning to facilitate teachers in, among others, administering assessment.

Some teachers were not interested in and would not line to administer authentic assessment. They generally were of the opinion that administering such assessment was time-consuming, not to mention energy-and money-wasting. Moreover, authentic assessment needs careful designing. However, only half of it is true. Assessing performance by means of written test can never be validated, since it never measures what

there is to measure. Performance needs to be assessed during the activity; while it is going on. If performance assessment is administered on some students without careful designing, or carelessly administered, it will consequently be hard to account for because of its inconsistency. As such, we may have been acting in an unfair manner in terms of how we assess our students' performance.

CONCLUSION AND SUGGESTION

Based on the research findings, it can be concluded that the teaching of Physics so far performed by teachers has not successfully attained the aims of teaching. It may be the case that the teachers have not incorporated and implemented the culture of using *authentic assessment* instruments in the processes of Physics teaching-learning activities.

For improvement in future practices, it is suggested that teachers make use of authentic assessment instruments synergized with the teaching and learning of Physics, since synergy attests the consistency between aims, activities, as well as the assessment.

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PHY-01488

Developing Teaching Materials And Assessments Of Introductory Physics Based On *Taxonomy Of Introductory Physics Problem (TIPP)* And Local Culture To Improve Problem Solving Ability Of Teacher Candidate Students

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Abstract

This Research is a developmental research aims at developing valid teaching materials and assessments of basic physics Subject applying Taxonomy of Introductory Physics Problem (TIPP) and Local Culture to be taught to the teacher candidates Students of Physic Education Program, Universitas Tadulako. The quality of teaching material was examined by expert judgment, attainment of problem solving skills, and teacher candidates students' responses. Procedure of development adapts to Research and Development (R&D) model) which involves preliminary, developing of, experiment in which highlight the following steps to produce a product. This research develops a material for Basic physics. This research has developed successfully printed teaching material and CD. The quality of the teaching material is very good; therefore it is suitable to be used in teaching and learning activity.

INTRODUCTION

The results of the Trends in International Mathematics and Science Study (TIMSS) 2011 ranked Indonesian students 39th out of 42 participating countries. In the cognitive domains of science in particular, Indonesia dropped from and average score of 430 in 2007 to 413 in 2011. These results indicated that Indonesian students lacked ability in reasoning and problem solving (Jakarta Globe, 2012). To address this and other indications that Indonesian students were not achieving at levels comparable to students in other countries, the Indonesian government developed the 2013 National Curriculum that focuses on developing problem solving skills that will prepare students for the demands of their post-school environment.

Problem solving is regarded as one of the key competencies in science education (Scherer, et al, 2012). Sautter, et al (2011) suggest that teaching and prompting problem solving strategies can be effective way to encourage more complex problem solving. In physics specifically, students' attitudes and approaches to problem solving may strongly affect their motivation to learn and develop expertise (Mason, et al, 2010).

Teodorescu (2013) describes research on a classification of physics problems in the context of introductory physics courses. This classification, called the Taxonomy of Introductory Physics Problems (TIPP), relates physics problems to the cognitive processes required to solve them. TIPP was created in order to design educational objectives, to develop assessments that can evaluate individual component processes of the physics

problem-solving process, and to guide curriculum design in introductory physics courses, specifically within the context of a “thinking-skills” curriculum.

Taxonomy of Introductory Physics Problem (TIPP) is based on the New Taxonomy of Educational Objectives (NTEO) developed by Marzanodan Kendall (2007). The difference between NTEO and TIPP (Teodorescu, 2013) are: NTEO is used to achieve the learning objectives for all subject matter as conducted by Wankat and Oreovocz, while TIPP was designed specifically for learning physics. NTEO is about the thinking process in learning various subjects, while TIPP is about cognitive processes applied in physics. One of the advantages of is TIPP raise physics problems involving memorization of mental procedure, which usually do not appear in the textbook.

Successfully in studying how to solve problems in scientific fields, such as physics, requiring the construction of conceptual knowledge (Lucangeli, Tressoldi & Cendron, 1998). Results of a survey of more than 5000 students from 30 physics institutions showed that students’ conceptual understanding was unsatisfactory (Maloney, O’Kuma, Hieggelke, & van Heuvelen, 2001).

Maximizing the Physics learning should be supported by teaching materials composed of systematical teaching materials (Setiawan & Denny, 2007). According to the result of observation, teaching materials which were used in Basic Physics subject is not uniform yet in all parallel classes and did not directly teach the students to the problem solving thinking process, Whereas, problem solving is one of the abilities that should be possessed by teacher candidates as the learning objectives in the curriculum of 2013.

In addition to teaching materials, assessment is one of the pedagogical competence that should be taught to the teacher candidates in accordance to the objectives of curriculum 2013. Through assessment, the students’ problem solving skills can be sharpened and measured that can be divided into several levels of ability or called taxonomy.

In connection with the issues aforementioned above, it is important to design teaching materials and assessment tools using TIPP which could improve the ability to solve problems based on local cultures in the community of Palu City. The success of the process of learning science, especially physics in school is strongly influenced by cultural background which is owned by the students or the community where the school is located (Aikenhead dan Jegede, 1999).

Okebukola (1986) states that the cultural background of students has a greater effect on the educational process than the effects contributed by subject delivery. In other words, the effect of the learning process is carried out in the classroom by teachers and students 'lost' by the effect of culture that has been absorbed by the students and which is brought into the process of learning in the classroom. Eyford (1993) also confirms that the cultural background of students have a strong influence on the way of someone (student) learning. He gave the reason that the students have spent their time, in the middle of a neighborhood or community which is influenced by the culture of the people rather than by formal education theories.

Baker and Taylor (1995) present the results of their review are particular on cultural influences on the learning process of science in the classroom / school.

RESEARCH METHODOLOGY

This research applied mixmethod research design. Qualitative data analysis is done continuously from the beginning to the end of data collection. This analysis is done in three stages, namely:

1. Data reduction

2. Data Presentation
3. Withdrawal Decision

The main objective of this research is to produce teaching materials and assessment of Basic Physics subject based on Taxonomy of Introductory Physics Problem (TIPP) and local culture were tested therefore it can be used by teacher candidate students at the University of Tadulako in Physics Education Study Program.




RESULTS AND DISCUSSION





Teaching Material and Student Need Analysis





It can be concluded that students require instructional materials which contains local culture in their surrounding. There are some local culture of Palu that can be used to explain the concept of physics.

Local Culture Survey Results

Some local culture of Palu that can be inserted in the teaching materials to explain physics concepts include:

No	Concept	Palu local culture
1.	Measuring physical quantities (mass, length, and time)	<p>Convert depth measurements of the sea, such as 1 engker = 10 fathoms, and 1 fathom = 8 meters. Measuring instruments used to measure the depth of the sea is "unggutasi". 1 unggutasi = 5 engker</p>  <p>In the production of "toru" and "kamboti" using tools "coconut stick" to measure the diameter and the length.</p> 
2.	Vector addition	<p>Explaining the position (vector application) to the position of fishing on the Palu River</p> 

No	Concept	Palu local culture
3.	Kinematics	<p>Explains the concept of displacement of people movement who cross the Palu suspension bridge</p>  <p>Wind speed Matantimali Hill</p>  <p>Explaining the concept of circular motion using a horse statue</p> 
4.	Applying Newton's law as a fundamental principle of dynamics for straight motion, vertical motion and uniform circular motion	<p>Concept of force</p>  <p>Horse pulling a buggy. A buggy will be accelerated to right side if the rope tension force that used by a horse buggy is greater than the friction force that used by buggy on the ground.</p>

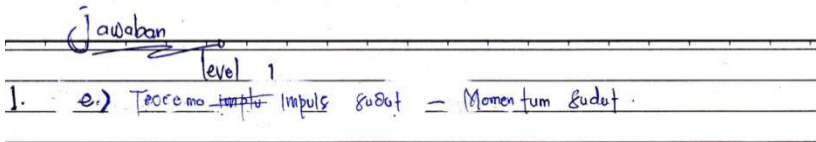
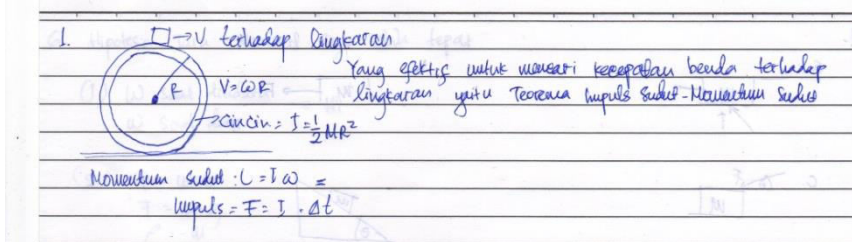
No	Concept	Palu local culture
5.	Usaha dan Energi Effort and energy	<p>Explaining the concept of the law of energy durability (potential energy and kinetic energy) use the waterslide on Millenium Swimming Pool.</p> 
4.	Rotation motion	<p>Explaining the rotational motion with the movement of buggy's tire.</p> 
5.	Elasticity and Equilibrium	<p>Palu Bridgecan be used to explain the elasticity of the material.</p>  <p>Making the "Pila" in the mid of "Sakaya" (boat) to a counterweight (balance concept)</p> 

Preliminary Test Results of Student Problem Solving Ability

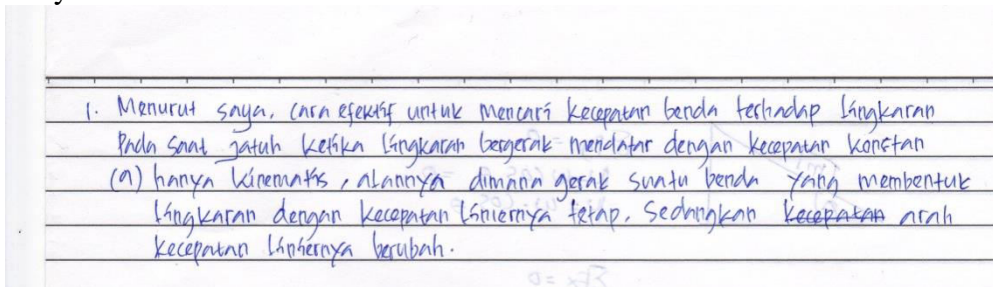
Students' answer on question number 1, in general can be concluded that the problem solving ability of students at level 1 (retrieval) were still low. This evidenced by most of the students' answer did not respond the question appropriately.

Almost all of the students answered that the most effective concept impulse-momentum theorem is only kinematic, and Newton's laws.

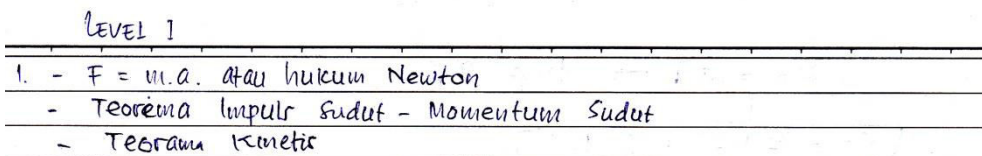
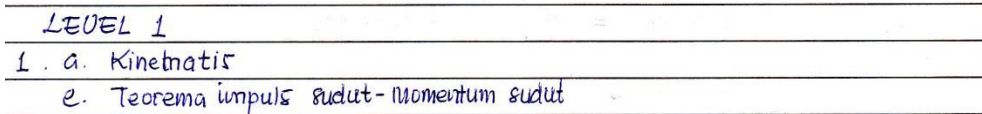
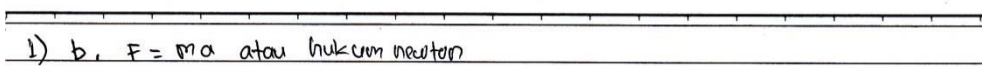
Impulse-momentum theorem



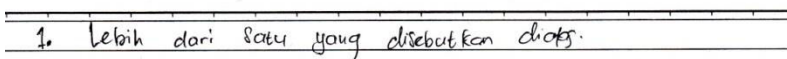
Only kinematics



Newton's Law.



Only a small number of students who answered more than one as the example above, but without providing reasons (style, effort theorem-energy).



Students' answer for question number 2 (Level 2 Understanding), in general it can be concluded that the students are not familiar with the type of problem-solving strategies. Most students had straightforward answer for section b by using a strategy to resolve the issue. However, only one student who had almost correct answer.



2.

$$\begin{aligned} \sum F_y = 0 & \quad \sum F_x = m \cdot a & \quad W = F \cdot s \\ N = w & \quad -f_k = m \cdot a & \quad \Delta E_k = F \cdot s \\ = m \cdot g & \quad -\mu_k \cdot N = m \cdot a & \quad \frac{1}{2} m \Delta v^2 = F_k \cdot s \\ -\mu_k \cdot m \cdot g = m \cdot a & & \quad \frac{1}{2} m \Delta v^2 = \mu_k \cdot N \cdot s \\ \mu_k = \frac{a}{g} & & \quad \frac{1}{2} m v^2 = \mu_k \cdot m \cdot g \cdot s \\ -0,3 = \frac{a}{10} & & \quad s = \frac{v^2}{2 \mu_k \cdot g} \\ -a = 3 \text{ m/s}^2 & & \quad = \frac{30^2}{2 \cdot 0,3 \cdot 10} \\ a = -3 \text{ m/s}^2 & & \quad = \frac{900}{2 \cdot 3} = 150 \text{ m} \end{aligned}$$

$$\begin{aligned} v_t &= v_0 + at \\ v^2 &= v_0^2 + 2as & \quad X &= v_0 t + \frac{1}{2} at^2 \\ X &= v_0 t + \frac{1}{2} at^2 & &= 30 \cdot t + \frac{1}{2} \cdot (-3) \cdot (10)^2 \\ 0 &= 30 - 3t & &= 300 - 150 \\ t &= 10 \text{ s} & &= 150 \text{ m} \end{aligned}$$

Almost all of the students' answer for section b was not true. It can be concluded that the skill of the students' problem solving on the 2nd level of understanding was still low. The evidence can be seen from the sample of student's answer below:

LEVEL 2

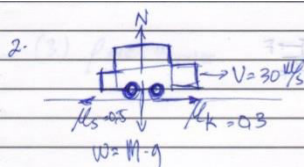
2. a. Tuliskan strategi Anda untuk memecahkan masalah?

Perkara - lama kita memahami soal yang ada, pikirkan apa yang terjadi jika roda itu dihilangkan secara perlahan - lahan kemudian ketajuannya makin lama berkurang dan lama-kelamaan akan diam ~~total~~

$$v = 30 \text{ m/s}$$

$$\mu_k = 0,5$$

$$\mu_k = 0,3$$



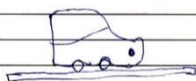
$$\begin{aligned} \text{jika } s &= 0 & \quad v &= v_0 + at & \quad s &= s_0 + v_0 t + \frac{1}{2} at^2 \\ v_0 &= 30 \text{ m/s} & \quad 0 &= 30 + at & \quad s &= 0 + 30t + \frac{1}{2} (-30)^2 \\ v &= 0 & \quad at &= -30 & \quad s &= 30t + 450 \\ t &= t & & & & \end{aligned}$$

2. Dik : $v = 30 \text{ m/s}$

$$\mu_k = 0,5$$

$$\mu_k = 0,3$$

2. → Gambar untuk memperjelas gambarnya terlebih dahulu



→ Dik : $v = 30 \text{ m/s}$

$$\mu_k = 0,5$$

$$\mu_k = 0,3$$

Students' answer on Question 3 (Level 2 of understanding), in general it can be concluded that the students were unfamiliar with the type of questions on how to make a flow chart that illustrates the steps to be followed to find the answer. Almost all of the students answered on mathematical problem solving. This is evident from the sample answers below:

3. a. Gerak translasi → Gerak rotasi → Momen inertia

$Mg \sin \alpha - f = Ma$ $fR = I\alpha$ $R\alpha = a$

$f \leq \mu Mg \cos \theta$

$f/2 \cdot Mg \cos \alpha \geq g \sin \alpha - Mg \cos \alpha$

$\mu \geq \frac{2}{3} \tan \alpha$

b. $R\alpha = a \rightarrow$ tanpa slip

$E_k = \frac{1}{2} Mv^2 + \frac{1}{2} I\omega^2$

$E_k = \frac{1}{2} m (at)^2 + \frac{1}{2} (I_p \cdot \frac{a}{R})^2 t^2$

$E_k = (\frac{7}{10}) Ma^2 t^2$

3.

$\sum F_y = 0$

a) $\sum F_y = N - a$
 $W \sin \theta = f = \mu a$
 $W \sin \theta - \mu N = \mu a$
 $W \sin \theta - \mu W \cos \theta = \mu a$
 $\mu W \cos \theta = W \sin \theta - \mu a$
 $\mu = \frac{W \sin \theta - \mu a}{W \cos \theta}$

b. $E_k = \frac{1}{2} Mv^2$ $I = MR^2$
 $= \frac{1}{2} M^2 \omega^2$
 $= \frac{1}{2} I \omega^2$

3.

$\theta = \alpha$

a. $\sum F_y = 0$ $\sum F_y = m \cdot a$
 $N - W \cos \theta = 0$ $W \sin \theta - f = m \cdot a$
 $N = W \cos \theta$ $W \sin \theta - \mu N = m \cdot a$
 $W \sin \theta - \mu W \cos \theta = m \cdot a$
 $\mu W \cos \theta = W \sin \theta - m \cdot a$
 $\mu = \frac{W \sin \theta - m \cdot a}{W \cos \theta}$

b. $E_p + E_{k_0} = E_p' + E_k'$
 $mgh + 0 = 0 + \frac{1}{2} I\omega^2 + \frac{1}{2} mv^2$
 $E_k' = mgh$
 $E_k = \frac{1}{2} I\omega^2 + \frac{1}{2} mv^2$ $v = r\omega$
 $= \frac{1}{2} m r^2 \omega^2 + \frac{1}{2} m v^2$
 $= \frac{1}{2} m r \omega^2 + \frac{1}{2} m \omega^2 r^2$
 $= \frac{1}{2} m \omega^2 r (1+r)$

A possible answer of the above question is normal strength is always perpendicular to the intersected surface. The amount of force can be greater than, less than, or equal to.

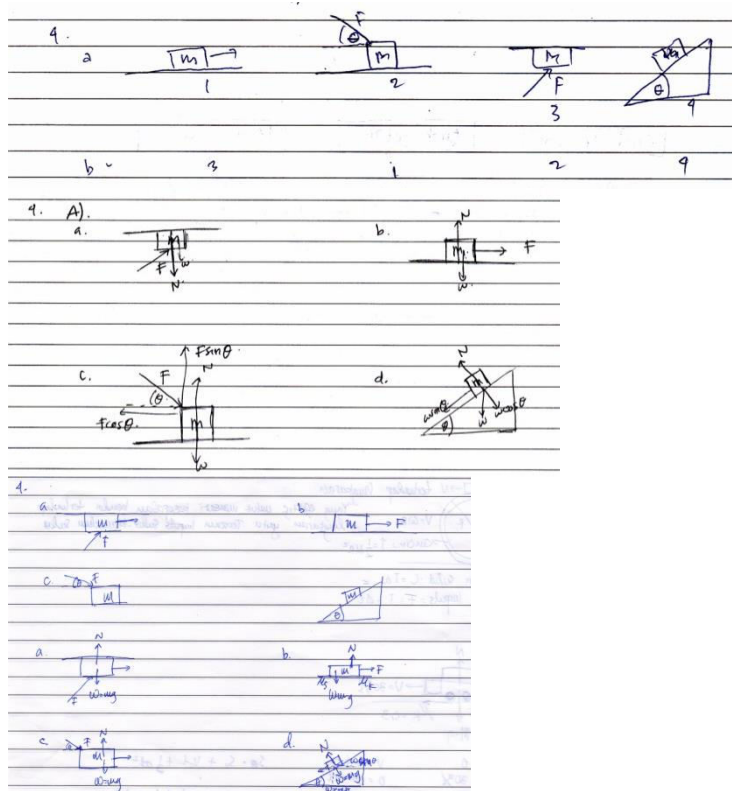
Only a small number of students answered with the correct analysis. Most of them answered without explanation / reason or did not answer.

$\sum F_y = 0$
 $N - W \cos \theta = 0$
 $N = W \cdot \cos \theta$

$\sum F_x = 0$
 $W \sin \theta = mg$
 $mg \sin \theta = \mu a$

$\sum F_y = 0$
 $N \cdot \sin \alpha - W = 0$

$\sum F_x = mg$
 $F \cdot \cos \alpha - F_c = ma$



All of the students did not answer the question on how to make a general procedure for solving kinetics questions involving dynamics, because they just got such questions and most of the students have forgotten the material taught in the subject of Basic Physics 1 .

All of the students did not answer questions on the hypothesis of the most appropriate method to determine the density of an object, because they just got the types of questions of problem solving level 4. In general, the assessment of physics teaching materials used Palu local culture-Based TIPP in the category of **Very Good**.

CONCLUSIONS

Based on the achieved results, it can be concluded that:

1. The results of the analysis of Basic Physics teaching material and teaching material needs analysis indicated the need of teaching materials using the TIPP and Palu-based culture.
2. The survey results provided some data of the local culture which can be incorporated into teaching materials to explain the concept of physics.
3. The results of the initial test of problem-solving skill using the Taxonomy of Introductory Physics Problem (TIPP) showed that the students still had a low problem-solving skill and unfamiliar with the TIPP related questions.
4. The results of expert validation of each component of the quality of teaching materials (Presentation, language, feasibility content) has a category of **Very Good**.

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PHY-01509

Pre-identification of physics students' mental models in the concept of heat convection through prediction

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Abstract

The excavation of early identification of students' mental models in the concept of convection heat has been performed in this study. The purpose of this research, therefore, was first excavate 33 physics students' conception of heat convection as early students' mental models, and then to examine the relationship between their early mental models predictions of convection-related phenomena. The students were treated to five essay questions relate to the concept of heat, convection heat and example of phenomena in daily life. Moreover, they were asked to predict which of the tube would be quicker to boil when heated at the different position: at the bottom of the tube (tube 1) and at the middle of the tube (the tube 2) and the last, they were asked to describe the events of heat convection in the both tubes. Student' answers are analyzed by using constant comparative methods. The results showed that students' early mental models could be categorized into four categories: the Entire Convection, the Convection around sources of heat, Molecular/ granule, and not including to the third category. Overall, for defining the heat, heat convection and prediction, less from 50% who answered correctly; contrary to mention examples of the phenomena of heat convection almost all participants answered correctly. While, the depiction of events convection heat in the tube 1 is correct, but many are mistakenly describe in tube 2. The portrayal in the tube 2, as much as 46% describe the entire Convection category, 12 % who draw events with a category of convection around heat sources, 24% draw with molecular/ granules category and 18% of the draw is not in the third category. It can be summed up in the pre-identification, still has not found a student who portray mental model intact, which approaching true or scientifically accepted. These results require deep excavation on student mental models in the concept of convection of heat through semi-structured interviews to get a depth description of students' mental models.

INTRODUCTION

One of the biggest challenges in learning physics is to assist students in developing scientific understanding of a compatible physical phenomena based on existing ideas and beliefs¹. Understanding that is in the person's thinking, will help in describing a physical phenomenon and can cultivate that understanding when they faced with other physical phenomena in the form of internal representation. Internal representation of a person against a phenomenon based on an understanding of a concept that has been learned is called Mental Model. Moreover, the main purpose of Physical Education is helping students/ learners in building mental models suitable and scientifically accepted²⁻⁷. In Indonesia, Research of cognitive science is still rarely performed and it is tend to be dominant in the study of the students' misconceptions⁸. Research on how the mechanism

of the misconceptions, on the other words, mental models is still very limited. Excavation research of mental models in specific topic is needed, especially as input for the development of strategies, methods and models are suitable for use in teaching in order to form a mental model that scientifically accepted.

In addition, the excavation of mental models in certain topics can also provide important input supplying a scientific method in predicting ability and explain a physical phenomenon that occur in everyday life relate to the concept of physics. Physics, as we all know is very closely relate to physical phenomena in daily life and certainly very dynamic process like heat convection mechanisms, the flow of electric current, fluid flow, etc. It is possible a student looks like to know and master the concepts of physics when they answer the given problem correctly, especially in multiple choice questions. But, if we probe in greater depth, we would be appalled with what is happening in their cognitive structure when he used his thought and the way he analyzed a given physical phenomenon. It's the kind described by Chiou² which states that there are some students who think that convection heat flow is the flow of a substance/ particle and not considered as a stream of energy. Chiou² also stated that he found the students nearly half held flawed mental models in heat convection phenomena, whereas the students who involved in his study were the physics students and they have had all physics subjects included thermal physics. Those findings are interesting. The excavation of mental models give us more description about what really happened in students' thinking when they solved problem relate to daily phenomena.

This research investigated students' early mental models in heat convection and the relationship between students' conception of heat, heat convection and the students' prediction of heat convection-related phenomena. Moreover, this present study also compared to the mental models that resulted by the Chiou' research. The further research will be performed by greater depth of excavation of students' mental models based on the early students mental models and the profile of students' misconceptions of heat transfer concept.

RESEARCH METHODOLOGY

Research Subject

The subjects of this research are students in Physics Education Department at different level, start from sophomore until senior level. The sophomore were identified have not taken thermodynamic subject yet. The total numbers of this subject are 33 students. The senior level were identified have taken all physics subjects.

TABLE 1. Data of students who involved in this research

No	Level of students	Male	Female	Physics Educ	Physics	Have registered the Thermodynamic	Have not registered the Thermodynamic
1	Students grade 2	6	18	17	7	7	17
2	Students grade 3	2		1	1	2	
3	Students grade 4	2	4	6		6	
4	Students grade >4		1	1		1	

Data Analysis

In this research, All the students were treated to five essay questions relate to the concept of convection heat and they were asked to predict which of the tube would be quicker to boil when heated at the bottom of the tube (tube 1) and in the middle of the tube (the tube 2) and the last, they were asked to describe the events of heat convection in the

both tubes. Student answers are analyzed and categorized by responding to questions based on Constant Comparison Method¹⁻⁵. Based on students' answers, we categorized the depict of convection heat in Tube 2 into varies category. On the other hand, we also measure the correlation between the define of heat, heat convection and the prediction which tube will be boil first. As the last, we also performed comparison the results with the Chiou' mental models.

RESULTS AND DISCUSSION

Students' response of heat concept

Students' responses of heat concept were first analyzed by key words of heat concept as 'energy' and 'flow from higher to lower temperature'. From both key words, we analyzed whether the response is correct or incorrect. For correct response, it is graded by 1, otherwise 0. The results show in the Figure1.

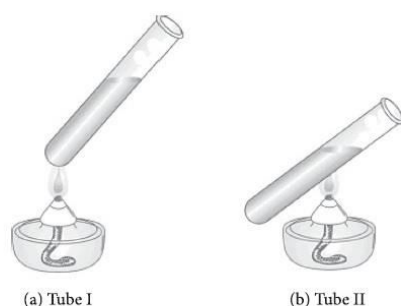


FIG. 1. An example of the interview questions in the second protocol.

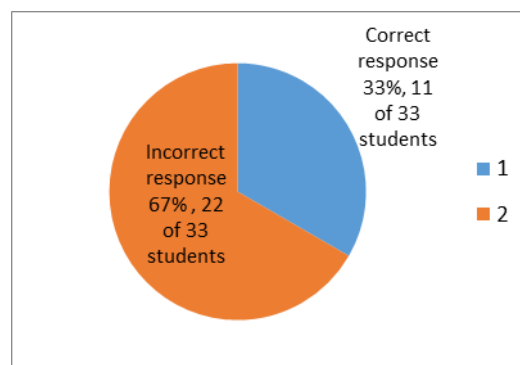


Figure 1 Diagram of students' response of heat concept

The incorrect responses of students vary from heat as hot, without any additional explanation; define heat as formulae of Black Principle ($Q = m.c.\Delta T$); heat as temperature; define heat as energy generally; define heat as reverse concept. However, as mentioned above, heat concept is true if in students' answer contain three key words: 'energy', 'different temperature', and 'flow from higher to lower temperature'.

Students' response of heat convection concept

Students' response of heat convection concept were first analyzed by key words of heat convection as 'heat transfer through medium' and 'there are molecules movement due to heating process'. From both key words, we analyzed whether the response is correct or incorrect. For correct response, it is graded 1, otherwise 0. The results showed that only 8 students who answer heat convection concept correctly, the 24 others student answered heat convection as "heat transfer through medium" without any additional explanation that refers to concept of heat convection. Heat transfer through medium is not only description of heat convection but also heat conduction. Both heat convection and heat conduction are heat transfer through medium. Those responses showed that students could not describe the concept of heat convection specifically. On the other hand, students could not distinct between heat conduction and heat convection.

Students' response of heat convection example phenomena in daily life

In probing students' comprehension, we asked the students to mention the example of heat convection phenomena that they knew in daily life. Contrary to students' response of heat and heat convection concept, 28 of 33 students could mention the example of heat

convection phenomena in daily life. There are only 5 students who could not mention the example of heat convection phenomena correctly. Its interesting, that 2 of 5 students expressed that example phenomena of heat convection in daily life is water heating process that looks true. But, they focused on process of how heat transfer from flame to water through metal. This expression refers to conduction. Others responses are conduction itself. They wrote the example phenomena of heat convection are “people who hold the iron edge, while another edge was heated, they feel hot” ; “people who hold the spatula while they were cooking, they feel hot”. Another incorrect response is “electricity become heat in iron, oven, etc”. That response shown that student did not understand heat convection phenomena in daily life.

Students’ prediction in heat convection phenomena

The next problem, Students were given one picture that shown two tubes which were heated in different position. Once was heated in bottom of the tube, and another was heated in the center of the tube. The students were asked to predict which tube will boil first. The picture of the problem is shown in Figure 3. The students who predicted correctly were 13 students or about 39.4% from the total of 33 students. Two students predict both of the tube will boil in the same time. The other students, over 50%, predicted tube 1, which was heated in bottom of the tube. These students were familiar with the phenomena they often observe that in daily life, when we heated water, we always put the heat source in the bottom of the tube. It’s interesting that most of the students did not consider about the heat convection that cause boiling.

Students’ depict of heat convection phenomena

In the last problem, students were asked to draw the process of heat convection in both tubes that showed in Figure 3. Researchers first analyzed the answers of students and categorized it based on the student answers into four categories: “the Entire Convection”; “Convection around sources of heat”; “Molecular/ granule”; and “Not-the-three-category”. In the Category Entire Convection, both in the tube 1 and tube 2 were described as having the same picture of heat convection. While in each of category, the students were correctly describe the convection process in tube 1. The different description was in the tube 2. In category “Convection around sources of heat” they only draw events around sources of heat convection. For the category of molecular/ granules, they draw convection with dots or granules. As the last category, “Not-the-three-category” The students draw convection phenomena that it cannot be classified into three previous categories: e.g. they draw only with 2 arrows, there are drawing a blank, etc. The table below, describe the numbers of each category and their prediction.

TABLE 2. The students’ depict the process of heat convection in Tube 2

Prediction of which tube will boil first	Category 1: Entire Convection	Category 2: Convection around heat sources	Category 3: Molecular/ Granules	Category 4: Exclude the three categories
Tube 1	7 (39%)	4(22%)	5(28%)	2(11%)
Tube 2	7	0	2	4
Both tubes	1	0	1	0

Overall depiction in the tube 1 was correct. So we highlight the drawing in the tube 2, as the right prediction of the tube will boil first. The above table shows us that the students who predicted the tube 2 will boil first, 39% depict the process of heat convection as entire convection, while there are no students who depicted of convection around heat sources.



The rest students, no more than 50% drew the process of heat convection in tube 2 as category 3 and category 4.

The process of heat convection in tube 2, while the heat source is located in the center of the tube, the process of convection only in the region between the heat source to the surface of the tube, while from the heat source to the bottom of the tube, heat is delivered by conduction process. Actually, there is not one single person student who is able to see this phenomenon in one piece. They mostly thought that in the water/ liquid, heat transfer is only conducted by convection. They did not consider the conduction process could be performed if the heat source was located in the center of the tube. Those reason emerged to support the fact that there is no one of 33 students, who chose category 2 and predict tube 2 will boil first. The figure that approach to the right description of heat convection process is the category 2 which in the tube 2, the convection process held at around of heat source and it could be drawn as arrows. Those arrows start from the heat sources, form a stream of energy, to the surface and back forth to the heat source. There are no students who explain that heat also transferred from heat source to the bottom of the tube by conduction process.

Another finding is the low correlation between defining of heat convection and mention of heat convection-related phenomena examples with correlation coefficient about 0.04. The student who correctly answered the examples of heat convection-related phenomena, he/she is might not certain mastered the heat convection concept. The students tend to remember the example of heat convection-related phenomena e.g. water boiling process but, they do not master the concept itself. Moreover, the correlation between the students' concept of heat convection and their prediction is about -0.02. This correlation is approach to zero, that can be concluded that there is no relationship between students' master in the concept with their ability to predict the heat convection-related phenomena. Choiu² suggested that "running" a mental model refers to mentally simulating the changing states of its components within the constraints of their mutual relationships. Relate to the ability to predict the physical phenomena, Choiu² stated that the result achieved by running mental model can be "read out" as the prediction for the final states of a given system. So, if someone runs his/her mental models, he/she could be able to describe in greater explanation of physical the phenomena through prediction what will happen in the given system. In our findings, we could not see the mutual relationships between students' ability in define the concept of heat, heat convection and the examples with their prediction or their description of heat convection process. Based on that analyze, we can concluded that the students still cannot be able to run their mental models.

The students' description of the convection process in tube 2, It only 22% who draw the convection process as the category 2 and all of those students predicted that tube 1 will boil first. This finding can be read as there is no mutual relationship between the students' prediction and their ability to draw or describe the heat convection process comprehensively.

Based on the Chiou' findings, there are seven mental models in heat convection: 1). Diffusion-based convection; 2). Gradual-expanding convection; 3). Evenly distributed convection; 4). Warmness-topped convection (I); 5). Warmness-topped convection (II); 6). Rim-circulated convection; and 7). Fluent-cycled convection. Although the order was not shown as order from the naive to the scientifically-accepted mental models, but the model of diffusion-based convection is the model that less scientifically than others model and the mental model that approach to scientifically accepted is the fluent-cycled convection. Others mental models have any misconceptions of the heat convection itself. If we compared to our findings, there are differs in categorized the students' answer, and we categorized the description of heat convection process in tube 2 into four categories: The

entire convection; Convection in around heat source, Molecular/granules and exclude the three categories. We can explain that this study was identification of early mental models, not investigated the mental models itself due to the methods and the instruments that we used, was different with Chiou' methods. This study gave the description about the students condition of conception and prediction in heat convection-related phenomena. It still need further research in probing a greater depth of students mental models in heat convection-related phenomena and the comparison between the mental models that Chiou' stated and the mental models that our students have in both same methods and instruments.

CONCLUSIONS

We successfully identified and depicted the conception of heat convection as the pre-identification of students' mental models in heat convection-related phenomena. We also found that there are complex relationships between the conception of heat, heat convection, examples of phenomena and the students' prediction.

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PHY-01517

Analysis of Students's Multiple Representation Capabilities Profile Based The Results of Limited Descriptions Test and Structured Descriptions Test at Junior High School

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Abstract

Concept understanding of students can be seen from students's multiple representation capabilities profil to solve the problem, because the students are required to interpret a concept with various representations (multiple representation) in solving the problems appropriately. Students's multiple representation capabilities profil is based on the tests on two forms of description that are limited descriptions test and structured descriptions test. The purpose of this study was to analyze the students's multiple representation capabilities profile of the test results in the form of limited description test and structured description test. The method research is descriptive analysis method which is based on the percentage interpretation of the student's test results. In the research design is only do the post-test and the group which is compared not determined randomly. Post-test was performed twice in two groups consist of 30 Junior High School students to exchanges test at the next meeting to see test form concistency. The material was tested is sound material of Junior High School using assesment based on multiple ways criteria. The test results showed that the students's multiple representation capabilities profile in the structured description test form is better than in the limited description test form. It is shown by the students's answers were more comprehensive and detailed on each criteria on multiple ways while taking the test in structured description form. Therefore, the test in the form of structured description test is better used at Junior High School that still have concrete thinking.

INTRODUCTION

The role of multiple representations in learning is an important topic in the field of educational research. Multiple representation is re-presented the same concept with different formats, including verbal, drawings, graphs and mathematical. A good understanding of Physics concepts can improve students's skills during Physics problems solving [1]. The ability to understand a Physics concept can be seen from the use of representation in explaining a concept of Physics and translate from one form to another [2].

Multiple representation can not be separated with the student's ability to represent the concepts of Physics known multiple representation capabilities. Multiple representation capabilities used according to Rosengrant rubric (2007) are as follows: 1). Able to

formulate informations and representations correctly. 2). Able to prepare new representations from the previous representation. 3). Able to evaluate the representations consistently. 4). Able to use representations to solve questions. Representation aspects may be made of students are verbal, drawings, graphs, and mathematical. Hence need analysis of students's multiple representation capability so will know multiple representation aspects that tends using by students in Physics problem solving. The more multiple representation aspects used by students, it shows that students understand the concept as a whole [3].

Based on the results of field research at several Junior High Schools, teaching is dominated by the discussion of student's worksheets that contains a summary of the materials, practice questions and learning methods that accentuate the use of formulas without teach physics concepts as a whole. Seen when students solve problems which tends to be oriented toward a final answer and ignore the process or steps in accomplish. This is in contrast to the opinion of Mettalidou, problem solving should leads students's ability to represent the good concept [2].

The importance of multiple representations has also been reported in Physics education research. Van Heuvelen and Zou [4] offer several reasons why multiple representations are useful in Physics problems, build a bridge between verbal and mathematical representation, and help students develop images that give meaning to mathematical symbols. These researchers also argue that one important goal of Physics education is helping students to learn to construct multiple representations of Physical processes, and to learn to move in any direction between these representations. Furthermore, it has been pointed out that in order to thoroughly understand a Physics concept, the ability to recognize and manipulated that concept in a variety of representations is essential [5].

This study is purpose to analyze the multiple representation ability of students at Junior High School using two types of tests form consist limited descriptions test and structured descriptions test. The hope to obtained multiple representation ability's data of students in both the types of problems that will be considered in the preparation of learning strategies which is rich in multiple representation. In addition, also to know the better test form is used between limited descriptions test and structured descriptions test of the Junior High School students.

RESEARCH METHOD

This research was to analyze the multiple representation capabilities of students after finish the test without manipulation of the variables so that this research using descriptive analysis method. The research design was adapted from Statistics Group Comparison but adapted to the purpose of the research that is exchanges test on second material which both of two groups received the same treatment that is learning through multiple representation approach [6]. Test exchange were conducted to know consistency of limited descriptions form test and structured descriptions test in two groups. Chronology of data retrieval is illustrated as Figure 1.

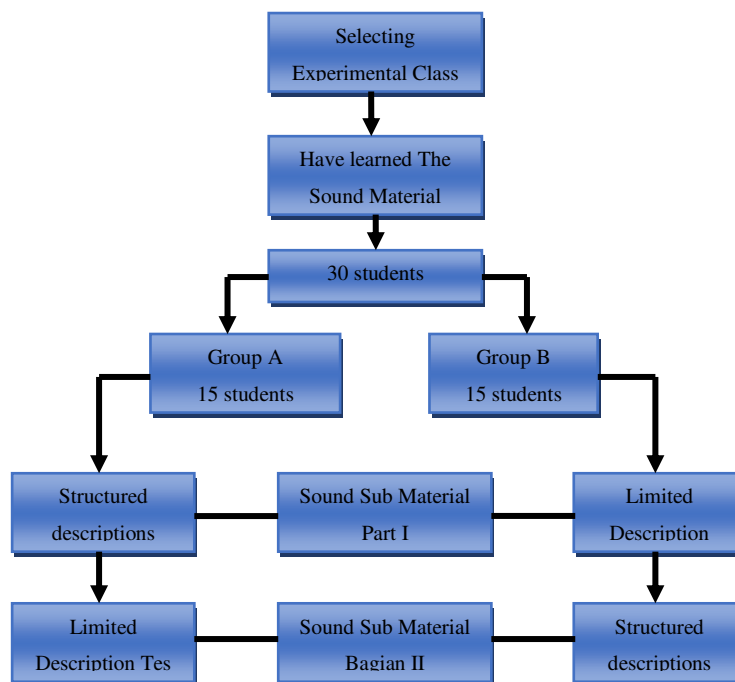


Figure 1. Illustration of Data Retrieval Chronology

Samples in this research were students of Junior High School grade VIII with total of 30 students. The instrument consists of two forms were multirepresentation capabilities test and interview. The test was to know the profile of the student's multiple representation capabilities solve problems in the form of a description. The problem in the form of a description is divided into two types. The first type of problems is the kind of structured question with characteristics there are sub questions that are direction questions on each question, so that the students get guide from direction of questions that has been provided. The second question is about the kind of limited descriptions test with characteristics there is no direction sub questions on each question so that was released on the students to think in answering any question but is still limited in scope to the concept of question. Both of type have the same indicators and made as similar as possible, it means what asked on each type of question has the same representation for the same concept.

Students answer are assessed based on a rubric in the journal Rosengrant called rubric multiple ways. For the scoring in the assessment rubric adapted with consideration of the answer with 0 for lowest score and 3 for the highest score. In every assessed aspects of the response adapted to multiple rubrics way. To determine the significance of difference between both of type structured descriptions test and limited description test used statistical calculations using Mann-Whitney U-Test because the sample tends to slightly so that data is not assumed to be distributed normally.

The second data collection is by interview. Interview techniques used for the first observation. Interview instruments directed to teachers of Physics subject the purpose to find out student's problem-solving skills, learning model that is often used by Physics teachers, and also the state of students during the learning Physics. Data were analyzed as a base to research.

RESULTS AND DISCUSSION

The test results of student's multiple representation capabilities on the first part sound material meeting shown that mean of students's value who did structured descriptions test

is 61.13 whereas mean of students's value who did limited descriptions test is 51.00. At the second meeting mean of students value who did structured description test is 51.40 whereas mean of students's value who did limited description test is 41.60. Structured descriptions test obtain higher scores in both meetings. Furthermore, Mann-Whitney significance test is held on each meeting as presented in Table 1 and Table 2.

Table 1. First Meeting of Mann-Whitney Test

	composite
Mann-Whitney U	55.500
Wilcoxon W	175.500
Z	-2.367
Asymp. Sig. (2-tailed)	.018
Exact Sig. [2*(1-tailed Sig.)]	.016 ^a

The table above shows Asymp. Sig. (2-tailed) .018. Due to the test is two-tailed test, then 0,018 multiplied by two to 0,036. At the significance level of 5%, 0,036 less than 0.5, so it can be concluded that there are differences in mean between structured descriptions test and limited descriptions test significantly.

Table 2. Second Meeting of Mann-Whitney Test

	composite
Mann-Whitney U	63.500
Wilcoxon W	183.500
Z	-2.035
Asymp. Sig. (2-tailed)	.042
Exact Sig. [2*(1-tailed Sig.)]	.041 ^a

The table above shows Asymp. Sig. (2-tailed) 0.042. Due to the test is two-tailed test, then 0,042 multiplied by two to 0,084. At the 5% significance level, 0,084 greater than 0.05, so it can be concluded that there is no difference of mean between structured descriptions test and limited descriptions test significantly.

Student's multiple representation capabilities in problem solving on structured description test is better than limited description test. This happens because in the form of structured description test students are led to answer with multiple representation that needed. Guided to make multiple representation that needed, so will create students's understanding and bounded students's interpretation in order to avoid the error in interpreting the problem. This is corresponding with the main function of multiple representation that are complementary, limiting interpretation, also concept builders [7].

The pattern Form of structured descriptions test percentage and limited descriptions test percentage reviewed from multiple ways criteria are presented in chart 1 and chart 2.

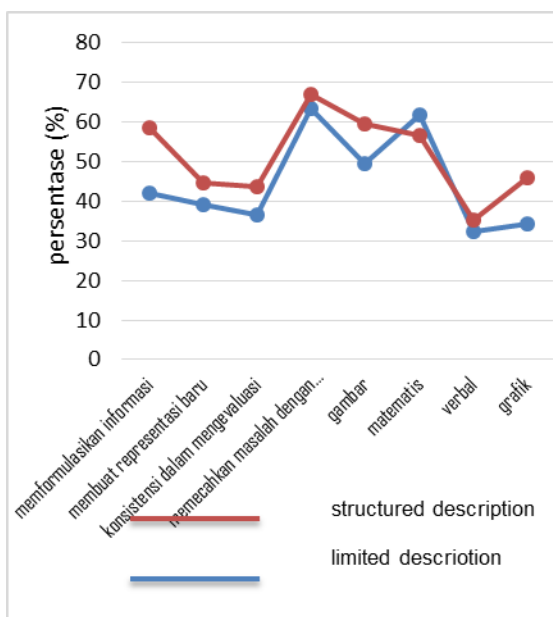


Chart 1.
The Pattern Form of Structured Descriptions Test Percentage And Limited Descriptions Test Percentage Part I

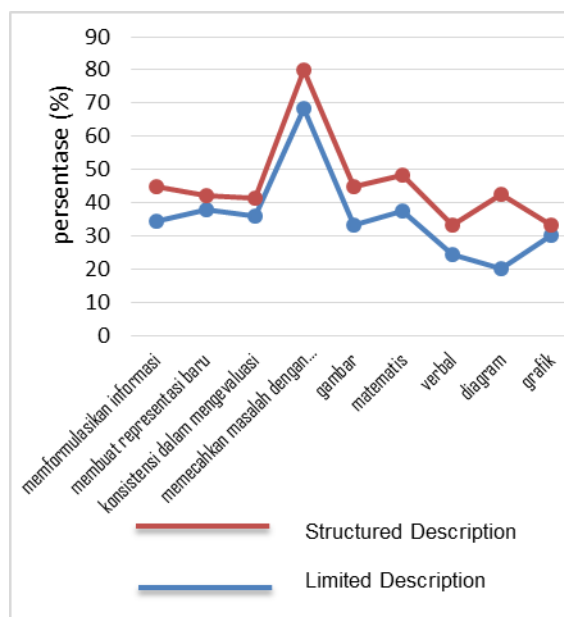


Chart 2.
The Pattern Form of Structured Descriptions Test Percentage And Limited Descriptions Test Percentage Part II

Based on the two charts above percentage of structured description test is greater in seven criteria. That are criteria of ability to formulate informations, criteria of ability to prepare new representation, criteria of ability to evaluate consistently, criteria of ability to solve problems based on representation, the criteria of ability to create an figure, the criteria of ability to create charts, criteria of ability to create diagrams, and also criteria of ability to explain verbally. Structured descriptions test leads students to formulate informations in the form of representation that needed. Limited descriptions test is better in mathematical criteria. This is due to the tendency of students solve the problems mathematically so that when it has a limited understanding of the material they answer mathematically. Whereas the ability to solve problems and apply the knowledge needs to be preceded by a positive attitude and effort to understand the concept of that issue.

CONCLUSIONS

Students's multiple representation capabilities is better on structured description test caused by the character of structured questions that lead students to formulate informations into the required representation so that the students get an idea of the problem solving. Structured descriptions test better to use at Junior High School level who still have concrete thinking. Powerful concept ability of students caused ability in students's problem solving be good. Furthermore, concept ability can be built one of them with multirepresentasi approach in learning.

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PHY-01530

Student's Scientific Consistency of Optics Geometrical Using Three Tier Test

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Abstract

Scientific consistency is the ability of students to answer each question is given in the form of different representations with the same concept correctly. The purpose of this study is to describe the student's scientific consistency after they were treated using three tier test. The pre-experimental design was used in this research. This study was conducted in one of high school in Bandung. The result showed that student's scientific consistency increased with $<g> 0,5023$ in medium category. Interestingly, in sub concepts, there are no students found consistent in sub concepts convex mirror, microscope and eyes before they were treated by jigsaw model. But in second test using the same instrument, we found 26 students consist in sub concepts convex mirror and microscope and 27 students consist in sub concepts eyes. This research suggest that there is an alternative to assess the students consistency by using three tier test.

INTRODUCTION

This during in the scholl, to show about study achievement the teachers always used assessment multiple choice. Whereas, the multiple choice have some weakness.

This weakness of multiple choice by Davies (2002) are due to the student being 'fed' rather than them actually 'knowing' the answer to a question, the answer can be do by a process of deduction, the answer can be guessed and the answer from the students are from the luck. The other opinion by Marsch, etc (2007) that a multiple-choice test may change students knowledge.

Physics lesson have a lot of relevancy with nature, phenomenon and a lot of representations. At School, the students just value with one representation. But with it, we can not to describe as concept understanding. The concept understanding will happen if use three tier test instrument which different representations. If different representation is answered correctly so it's said scientific consistency.

The excess of three tier test by Kaltakci and Didis (2007) is to identification the concept understanding. By Pesman (2010) three-tier tests have the ability to distinguish misconceptions from lack of knowledge by means of third tiers which asking students if they are confident about their answers for the first two tiers. Instrument of three tier test can identification student's concept understanding with easily and do not need much time. And than, can be distinguished between the students who answer wrong because misconception or not understand about material . (Dindar & Geban, 2011).

The importance of optics geometrical is assessment with three tier test because in this material so much phenomenon, for the example are plat mirror, convex mirror, optic tools

is the eyes and else. Which use three tier so level of student's concept understanding can be seen so student's scientific consistency can be know.

With this explanation, we will research about student's scientific consistency of optics geometrical using three tier test.

RESEARCH METHODOLOGY

Methods and Research Design

This research method using pre-experimental design. Pre-experimental research is similar to the experiment but not experimental because there is no equalization characteristics and no control variables. This type of detailed examination is only used for detailed examination training (Arifin, 2011). This Research design is applying of one group pretest and posttest design.

Table 1 Research Design *One Group Pretest-Posttest*

Pretest	Treatment	Posttest
O ₁	X	O ₂

(Arifin, 2011:77)

explanation:

o₁ : *pretest* before give treatment

x : cooperative learning model type jigsaw

o₂ : *posttest* before give treatment

Population and Sample Research

The population in this study was conducted in one of high school in Bandung. The sample of this through is one of class ten in senior high school in Bandung who use as research subjects with using purposive sampling technique. The purposive sampling technique is a method of sampling is based on the consideration and or specific destinations, as well as based on the characteristics that have been previously known. (Arifin, 2011).

Research Instruments

The instrument was used in this study is using a three tier test instrument with 3 representations are verbal, images and mathematically to view student's scientific consistency. Other supporting instruments is observation implementation of learning model format which filled out by observers and learning tools to help cooperative learning model jigsaw consisting of Learning Implementation Plan (RPP) and the Student Worksheet (LKS).

Results of Testing Instruments

The result of reliability calculation according Arikunto (2015) to instrument three-tier test of 0.69 to a high category.

It can be said that the instruments used are reliable so that the three-tier test instrument can be used to test the students' scientific consistency as much as 33 questions.

Data Processing Techniques

For to see the level of scientific consistency, giving the score refers to R-FCI artificial Nieminen et.al. (2010) uses the rules in Table 2 below:

Table 2 Consistency of Rating

Score	Score
2	If you choose three out of three answers are interconnected in terms of representation in a single theme / concept is the same



Score	Score
1	If you choose two of the three answers that are interconnected in terms of representation in a single theme / concept is the same.
0	If the selected answers are not interconnected in terms of representation in a single theme / concept is the same.

Improved student's scientific consistency with using cooperative learning model jigsaw is calculated using the average gain is normalized according to the rules Hake (1999).

RESULTS AND DISCUSSION

1. Implementation Cooperative Learning Type Jigsaw

Implementation of percentage learning model at each meeting are listed in Table 3.

Table 3 Percentage of implementation Cooperative Learning Model jigsaw

	Teacher Activity (%)	Criteria
1	96.15	Almost all the activities carried out
2	100	All activities done
3	100	All activities done

2. Increased consistency Scientific

The result of the increase student's scientific consistency can be seen in the value of the gain rule Hake (1999) through the table 4.

Table 4 Score of Scientific Consistency

Scientific consistency	Average
Pretest	0.37
Posttest	11.13
N-Gain	0.5023

From Table 4 it can be show that increasing student's scientific consistency with normalized gain price of 0.5023 in the medium category. The questions of geometrical optics are 33 questions with 11 sub concepts.

Student's scientific consistency in each sub-concept (theme) of geometrical optics can be shown in the value of the gain in with the rules Hake (1999) at Table 5.

Table 5 Values of N-Gain Each Sub Concepts of Scientific Consistency

Themes	pretest	posttets	N-Gain	Category
T1	0.17	1.43	0.69	Medium
T2	0	1	0.5	Medium
T3	0	1.47	0.73	High
T4	0.1	1.27	0.61	Medium
T5	0	0.43	0.22	Low
T6	0	0.6	0.30	Medium
T7	0.03	1.47	0.73	High
T8	0	0.23	0.12	Low
T9	0	1.2	0.60	Medium
T10	0	0.63	0.32	Medium
T11	0.07	1.47	0.72	High

In table 5 can be found that the biggest increased in sub concept are T3 of the convex mirror, T7 of the eyes, T11 of the telescope with the high category. The smallest increase in sub-concept (theme) are T5 of the convex lens and T8 of the camera with the low category. That is because of T5 of the convex lens, the students still do not understand to change one

representation to another representation. At T8 some students still do not understand the part of the camera, the camera function and the shadow distance to take a picture objects within infinite. That is because the students only learn by looking at the description without experiments so the students can understand about camera.

The number of students who consistently each sub-concept (theme) during the pretest and posttest can be described in diagrammatic form in Figure 1.

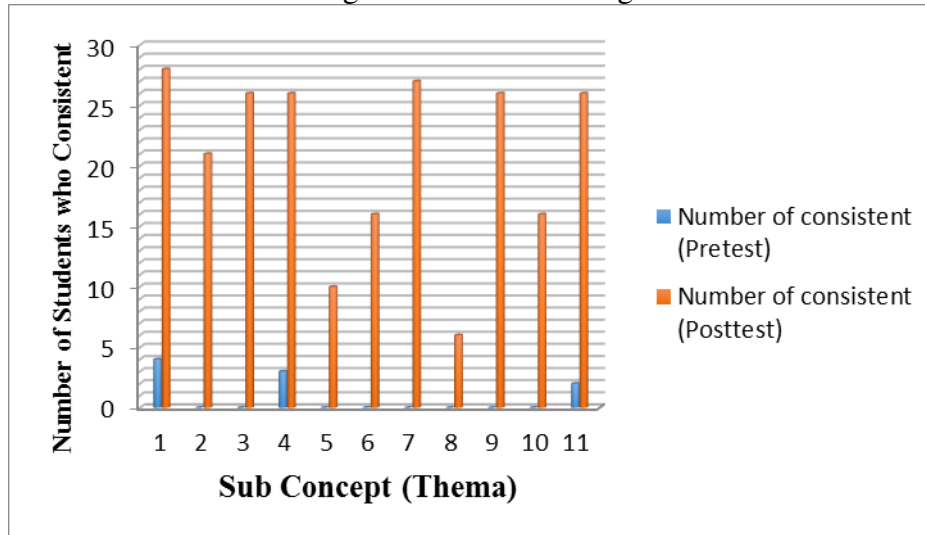


Figure 1 Number of Students who Consistent At pretest and posttest

Based on Figure 1 the number of students who consistently on each theme has increased. The number of student has the biggest increased at T3 of the convex mirror and at T9 of the microscope which there are no students found consistent to be 26 students consist, at T7 of the eyes which there are no students found consistent to be 27 students consist and at T11 of the telescope which 2 students found consistent to be 26 students consist. It's because at all of the theme, the students can be answered the questions with three representation which different. But the number of students has the smallest increased at T5 of the convex lens and the T8 of the camera. The number of students who consistently on each theme is same of the normalized gain value in each sub-concept (theme) based on table 5 where the an increase in the high category are T3, T7 and T11 and the low category are T5 and T8. And at T9 which not same of table 5 because of the students just can be answered two representation of three representations.

CONCLUSIONS

Based on the recapitulation of the average gain normalized is increase the scientific consistency of the result of 0.5023 with medium category.

It shows that there is an alternative to assess the students consistency by using three tier test.

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PHY-01531

Five-Stage Application of Conceptual Models assisted Teaching Hands-On Activity to Improve Student Scientific Consistency in Material Temperature and Heat

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Five Stage Conceptual
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Scientific Consistency.

Abstract

Physics is a branch of science that studies the phenomena that occur in nature. As a science, physics has concepts to be learned with regard to daily life. However, physics is still regarded as one of the subjects that are considered difficult to understand. This is because students are still assumed to always have to remember the formulas. In fact, a good learning is the learning that comes from the experience of the students themselves. Learning models of teaching conceptual stage five-assisted hands-on activity provides an opportunity for students to be able to express knowledge initially then reconstruct the knowledge by themselves, then the students were given new problems associated with these concept. Learning models of teaching conceptual stage five-assisted hands-on activity has been applied to the material temperature and heat to improve scientific consistency of the students. The method used is *one group pre test-post test design* with a sample of one class X in one senior high school in Bandung which consist of 34 students. Form a test used to measure the increase scientific consistency by using Three-Tier Test based multirepresentation where each theme using three forms of different representation, namely verbal, picture, and mathematical. Result from this study that the of scientific consistency is 0,63 which are in the middle category.

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INTRODUCTION

This study was conducted to determine the increase students' scientific consistency after the implementation of the Five-Stage learning models Conceptual Models assisted Teaching Hands-On Activity on the material temperature and heat. The sub-chapters are studied in this study consisted of four sections, namely, temperature and temperature measurements, the effect of heat on the size of objects, the effect of heat on the states of matter, and heat transfer. Learning model used in this study is expected to increase scientific consistency of the students because it can facilitate students to express ideas, ideas or knowledge about the material that will initially be studied, then the student is given the opportunity to put forward ideas or knowledge of each other by way of discussion, further student verifies the knowledge through experimentation, which then their knowledge can be tested with the evaluation.

In the study, the stages are often found, but in this study, do not just use the verification step exercises or discussion, but using experiments that students can acquire knowledge or gain knowledge with his own experience. Thus, it is expected that students are not only given the knowledge, but students can understand it. Thus, if the student is able to understand a concept or theory well, the students were able to answer the various



forms of the problems given to him. Thus, the value will increase student achievement. Given the problems in a variety of forms of representation, is expected to see the extent of the students' understanding if a concept is presented in various forms of representation. If students are able to answer a variety of issues in a variety of forms of representation, meaning that the students have the scientific consistency in itself, because it means he is able to apply their knowledge in a variety of forms of representation.

After learning models Conceptual Five-Stage Teaching Models assisted Hands-On Activity is implemented, then the student is given a final test or the so-called Post-Test. This is done to look for any increase scientific consistency of the students. Instruments used in the study even this is not just a choice of multiple choice, but using the Three-Tier Test. Its stages three issues presented in the form of questions.

RESEARCH METHODOLOGY

Research Methodology

The method used in this study is a quasi experiment is Pre-test and Post-test Design which is a technique of collecting data on the samples before and after treatment, or a treatment in a sample.

In the design of this study students were given the initial test (Pre-Test) to determine the initial ability of students were then given a specific treatment by the investigator and then conducted final tests (Post-Test) by researchers. Thus it would be measured how to increase student achievement and student scientific consistency in answering questions about a certain concept using three forms of presentation within each item you see. It can measure whether students are really able to understand these concepts or students just remember the material. Mastery of concepts will be visible if the student is able to answer questions or test items was given to various forms of presentation matter. The population was class X in one high school in Bandung. While the sample of this study is one class of these levels.

Data Processing Techniques

Analysis of Scientific Consistency

In this study, the authors used analyzes to identify the level of consistency of understanding of the concept refers to the results of research and Didi Kaltakci (2007, 500). They use a Three-Tier Test by using two options confidence level, namely confident and unsure

Analysis of Problem	Categori	Tipe of Answer
Three-Tier	Understand the concept	Correct answer + correct reason + sure
	Lack of Knowledge	Correct answer + correct reason + unsure Wrong answer + correct reason+ unsure Correct answer + wrong reason + unsure Wrong answer + wrong reason + unsure
	Error	Wrong answer + correct reason + sure
	Misconception	Correct answer + wrong reason + sure Wrong answer + wrong reason+ sure

If the student answered correctly on the first three levels of matter and say sure, the students were given a score of 2, if the student answered correctly on the first two levels

of matter and say sure, the students were given a score of 1, In addition to the answers score was zero. Three-Tier Test scores are used to determine the increase in student scientific consistency before and after the treatment carried out. This scientific consistency tests using the average of the normalized scores gain, namely the formula:

$$\text{The normalized gain } (g) = \frac{\% \text{ Posttest Score} - \% \text{ Pretest Score}}{\% \text{ maximum score} - \% \text{ Pretest Score}}$$

RESULTS AND DISCUSSION

Improved Scientific Consistency

1. Improved overall Scientific Consistency

Once all the learning material using the temperature and heat-Stage Five Conceptual Teaching Models and post-test is completed, the obtained average value of scientific consistency of 1.341. When compared with the average value of the pre-test is 0.208, the obtained increase in the average value of the scientific consistency of 1.13 and has a value of gain (<g>) of 0.63 which are in the medium category (Hake, 1999). Students value scientific consistency is obtained by carrying out the pre-test and post-test. In the Three-Tier Test instruments, scientific consistency assessment visits of whether or not the students 'answers and the reasons for any problems or questions that are given, followed by students' level of confidence on the response. At any given sub-chapter representations about three different but with the same concept.

Each sub-section has a maximum score of two to three forms of representation when categorized understand, scores one if there are two forms of representation are categorized understand, and a score of zero for one or no form of representation diaktegorikan understand. Scientific consistency results are presented in this figure,

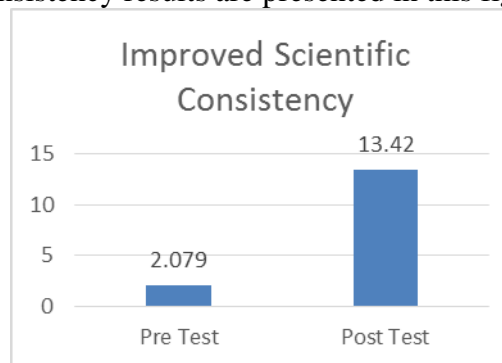


Figure 5. Graph Average Consistency Improvement Scientific Results

Results of the average value increase scientific consistency has a gain of 0.63 is considered moderate. This shows an increase in scientific consistency before and after the study carried out Five-Stage Conceptual Models assisted Teaching Hands-On.

2. Improved Scientific Consistency of each sub-chapter

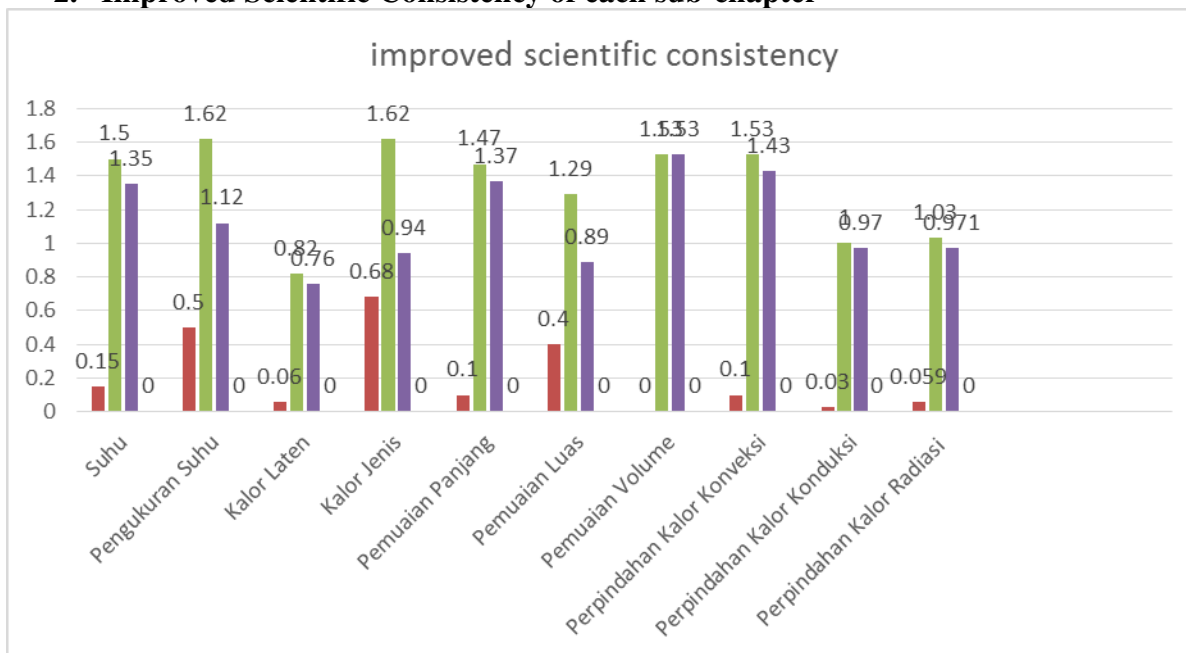


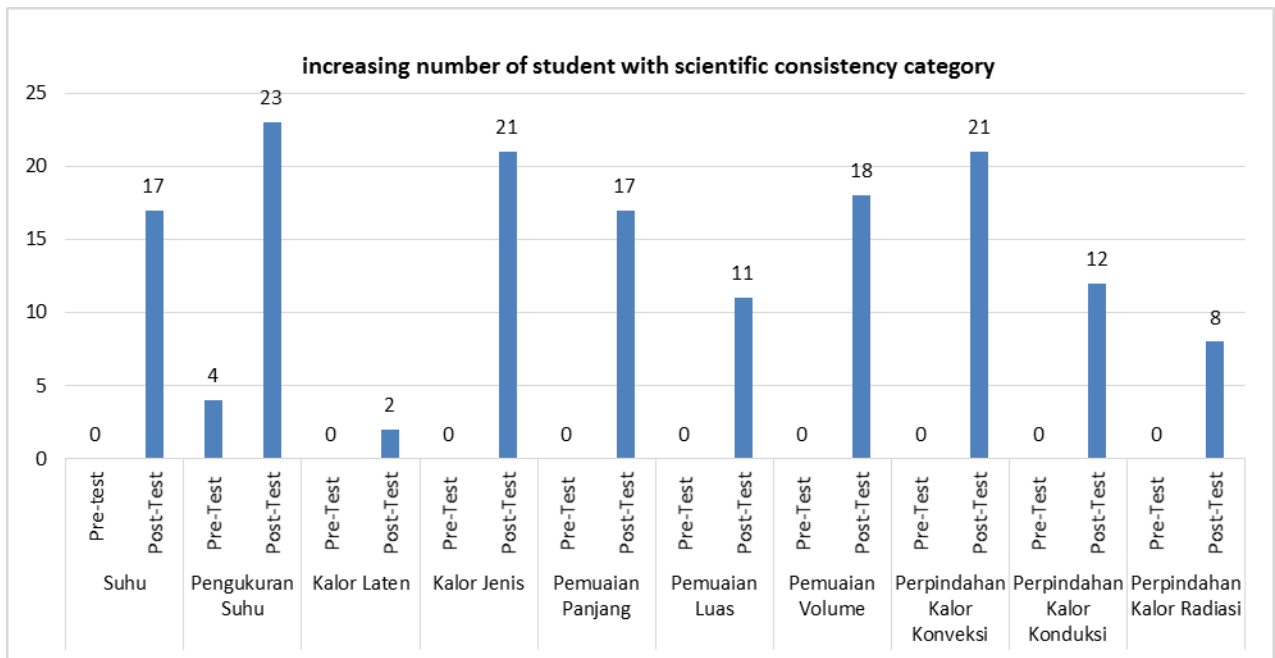
Figure 6. Graph Average Consistency Improvement Scientific Results In Each Chapter

Having obtained an increase in the average value and n-gain in temperature and heat the material as a whole, or an average of the increase in the average value of the scientific consistency of each chapter, then the next to increase in each chapter will be presented in figure 6 as follows

In the sub-chapter temperatures, an increase in the average value of the scientific consistency of 1.35 with a value of gain ($\langle g \rangle$) of 0.72 which is in the high category (Hake, 1999). It is described that the sub-chapter, students increased consistency of before and after the study carried Five-Stage Teaching Conceptual Models. Other sub-section that has a value gain ($\langle g \rangle$) are categorized as high, among others, temperature measurement (0.74), the specific heat (0.71), broad expansion (0.55), volume expansion (0.765) and displacement heat by convection (0.75). While in the sub-chapter has gain value being categorized among others, Latent Heat (0.4), broad expansion (0.55), heat transfer by conduction (0.5), and heat transfer by radiation (0.55). Increasing the value of the gain scientific consistency with the medium category, described that only some students are experiencing an increase inconsistency after the implementation of Stage Five Conceptual learning Teaching Models.

3. Increasing Number of students with scientific consistency category

Five-learning models Conceptual Stage Teaching Models, overall students has increased in the scientific consistency. The number of students increased in every sub-chapter will be described as follows,



Based on the chart above, it is seen an increase in students with good scientific consistency category in the whole sub-chapter. However, the increase inter tendah contained insub-section with the increased amount of latent heat 2. This happens because the sub-chapter discussion of latent heat, learning Five-Stage Teaching Conceptual Models are not running in accordance with the time, so the learning process is not fully completed. The part that is not executed perfectly is part evaluation. While the highest increase contained insub-section specific heat and heat transfer by convection with the amount of increase in 33 people.

CONCLUSIONS

Based on the research results, data processing, analysis, and discussion that has been described previously, it can be concluded that there is an increase in scientific consistency of the students, before and after the learning activities with the Five Stage Conceptual Model-assisted Teaching Hands-On Activity. In detail, the conclusion in general, the increase in scientific consistency occur in each sub concept after implementation of Stage Five Conceptual Model-assisted Teaching Hands-On Activity.dengan normalized gain value of 0.63 and be in the medium category.

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PHY-01536

Describing The Impact Inquiry Based Ecopedagogy on Pre-service Physics Teachers' Achievement and Attitudes

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Article info	Abstract
Keywords:	The purpose of this research describes preservice physics teachers' achievement and attitudes when implementing an inquiry-based ecopedagogy into an Environment Physics instruction. The epistemological theoretical frameworks for this study were inquiry-based learning and ecopedagogy. Fifty five participated in the research study. A control group (N=25) was taught using the Environment Physics handout. An experimental group (N=30) was taught using the strands of inquiry learning. Quantitative data collected were pre-test and post test content and attitude rubric scores. The results show that experimental group content mean total and domain mean scores were significantly higher than control group mean scores. The Ecological Paradigm Scale describes students' attitudes about environmental physics issues on global warning, renewable energy, and pollution. Scores total in the experimental and control groups were analyzed. The analyses found that the students in both groups recognized science problems. Based on the findings, inquiry based ecopedagogy provided students with a holistic and self-directed process to understand the environmental physics concepts. On the ongoing research are necessary to describes the impact of developing inquiry based ecopedagogy instructions' model and to show ecological competencies for both of preservice science teachers and sosial teachers.
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INTRODUCTION

Ecopedagogy is a way to connect to nature to critically examine environmental problems.¹ It is based on the work of Paulo Freire which calls for learners to use dialogue that will lead to action from their experiences.² Hollingshead writes, "ecopedagogy is focused on life. It takes into account people, cultures and lifestyle, and it respects identity and diversity. Ecopedagogy seeks to educate for sustainable development, we must cultivate sustainable lifestyles that connect us to the larger living universe."³ Ecopedagogy enables individuals to develop skills and strategies to foster responsible environmental action along with encouraging individuals to live a more sustainable lifestyle.¹ Environmental education provides individuals with awareness of environment issues and how our actions affect our planet.

Inquiry-based learning provides students with a problem solving approach to explore scientific concepts. Inquiry-Based Learning is a multifaceted activity that involves observations; posing questions; examining books and other sources of information to see



what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results.⁴ Using this definition, the National Research Council (NRC) posited a process for students to increase their scientific knowledge, which is known as the four strands of science learning practice.⁵ Students inquire and question the unknown in order to understand what they are learning, especially in the subject area of science. The inquiry process allows students to observe, ask questions, research, think critically, and plan scientific investigations to understand scientific concepts.⁶

NRC stated, “Standards treated inquiry as both a learning goal and as a teaching method”⁷ The science practices would foster skills that people use every day, like problem solving, creativity, critical thinking, working cooperatively with others, using technology, and becoming life-long learners. The science standards need developing inquiry learning to understand scientific concepts.

The attitudes defined as “affective or evaluative in nature, and that it is determined by the person’s beliefs about the attitudes object. Most people hold both positive and negative beliefs about an object, and attitudes is viewed as corresponding to the total affect associated with their beliefs.”^{8,9} Attitudes and beliefs about science manifest in actions of the teacher in the classroom.⁷ Beliefs about science influence a person’s behavior, which causes a person to act a certain way.⁸ Therefore, attitudes either positively or negatively influence how motivated students are to learn about different scientific concepts.

Attitudes also defined two specific phrases: *attitudes to science* and *scientific attitudes*.¹⁰ *Attitudes to science* refers to views children develop when interacting with different scientific experiences. *Scientific attitudes* are the skills and/ or procedures necessary to think through the scientific process of inquiry. This research was designed to examine *attitudes* about environmental issues

Student attitudes towards science have been extensively researched over the past 40 years. Teachers’ attitudes and methods for teaching science affect their students’ performance and attitudes.¹¹ Some types of questionnaires, surveys, and scales offer teachers a guide to understanding their students’ attitudes about the environment.¹²

Environment Physics is one of the minors instruction on physics education department. The competencies of the curriculum developed to analyses ecologies crisis as global warming, renewable energy resources, and pollution through physics perspective. The physics paradigm invites students to think about the sustainability of the planet earth and the whole universe. The instruction purpose to build awareness of pre-service physics teachers for saving the planet earth and the whole universe. On the other hand, Education should provide insight on the values of natural and social responsibility.¹³

RESEARCH METHODOLOGY

This research used a descriptive design to describe and interpret the impact inquiry based ecopedagogy on pre-service physics teachers’ achievement and attitudes. Research was conducted at Tadulako University in Indonesia. For data collection used two test as instruments. The test used for measure the achievement and the attitudes of pre-service physics teachers as subjects on environment physics instruction.

This study used a methodological theoretical framework of quantitative method. Quantitative analyses were conducted as a two group, pre-test-post test design to compare the achievement. Quantitative methods were used to assess the achievement of the students and attitude changes. Using SPSS program software was used to assess how the unit impacted students’ attitudes about environment physics issues.

The instruments were used in this study: (1) Environment Physics Unit test consists of 15 multiple choice questions that assess students' achievement of understanding environmental physics concepts. The scores of the test ranges from 0 to 75. Each question is worth five points; (2) The Ecological Paradigm Scale consists of 15 Likert scale items. Each item is rated and scored as either strongly disagree =1, disagree =2, not sure=3, agree=4, or strongly agree =5. The scores ranged from 0 - 75 points. Both of unit test and The Ecological Paradigm Scale consist global warning, renewable energy, and pollution with five question respectively.

RESULTS AND DISCUSSION

Students' Achievement Scores

The pre-test and post test scores descriptive showed on the Table 1. For the control group, the mean score for pre-test was 41.20 with a standard deviation of 5.64. The total score for the post test scores was 49.10 with a standard deviation of 6.96, which are reported in Table 1. For the control group, the mean score for post-test was 46.20 with a standard deviation of 5.45. For the experimental group, the mean score for post test was 39.10 with a standard deviation of 3.42.

Table 1 Pre-test and Post-test Scores on Environment Physics Unit Test

	Group	N	Mean	Std. Error Mean	Std. Deviation
Pretest	Control	25	41.20	1.13	5.64
	Eksperiment	30	43.50	1.08	5.89
	Total	55	42.35	1.11	5.77
Posttest	Control	25	46.20	1.09	5.45
	Experiment	30	52.00	1.55	8.47
	Total	55	49.10	1.32	6.96

Both groups began the unit with the basically the same level of knowledge about global warming, renewable energy, and pollution. However, the experimental group scored significantly higher on the post test then the control group. Figure 1 shows changes in the pre-test and post test scores for each student in the control group. Figure 2 shows changes in the pre-test and post test scores for each student in the experimental group.

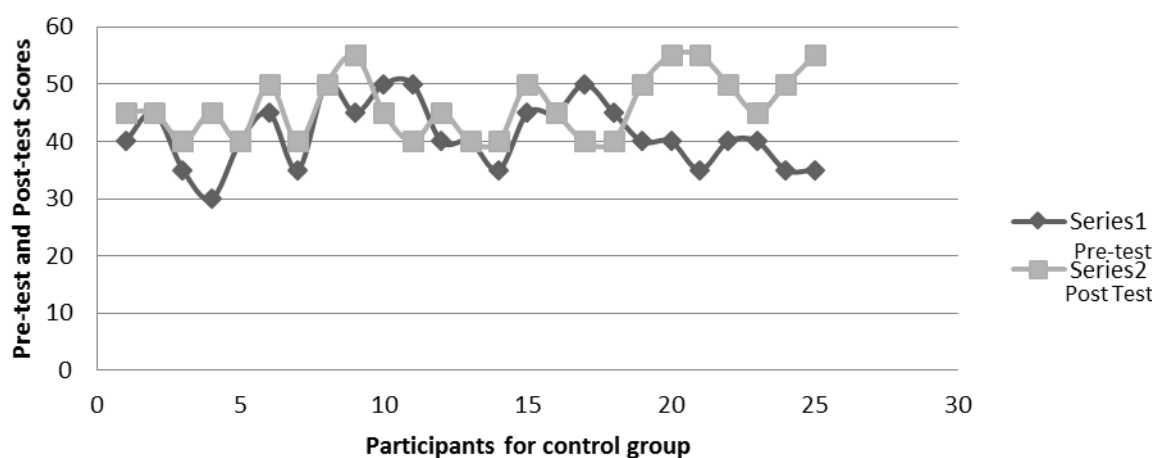


Figure 1 Control group's Scores for Students' Achievement

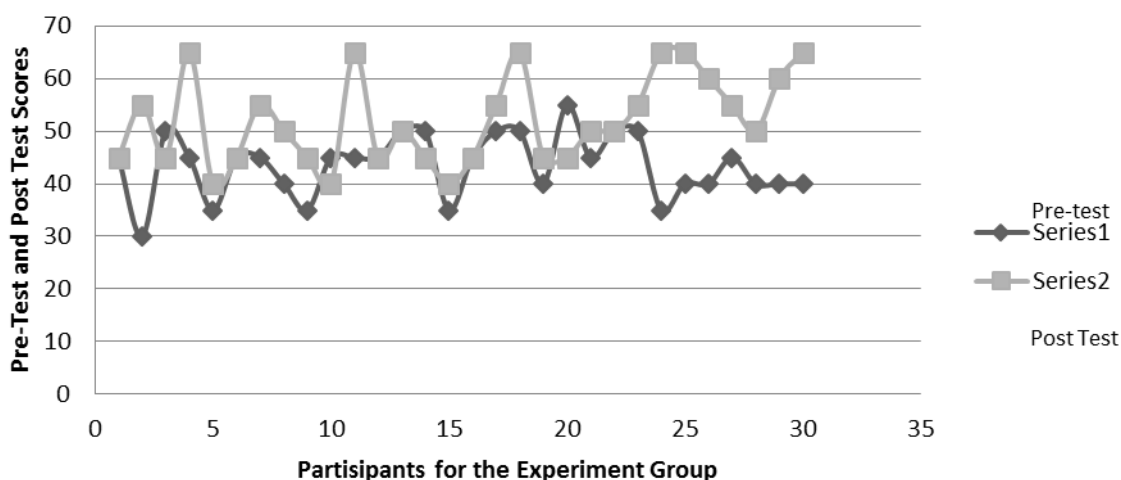


Figure 2 Experiment Group's Scores Students' Achievement

Using the SPSS statistical software, the results for the achievement showed $p = 0.489 > 0.001$ that indicates the relationship between pre-test and post test did not differ significantly. Therefore, the results showed that students in the experimental group ($M = 52.00$) had significantly higher scores on achievement than control group ($M = 46.20$), controlling for pretest scores.

Students' Attitude Scores

The pre-test and post test scores descriptive showed on the Table 2. For the control group, the mean score for pre-test was 47.96 with a standard deviation of 4.39. The total score for the post test scores was 53.58 with a standard deviation of 3.76. For the control group, the mean score for post-test was 51.36 with a standard deviation of 3.85. For the experimen group, the mean score for post test was 55.80 with a standar deviation of 3.66.

Table 2 *Pre-test and Post-test Scores on The Ecological Paradigm Scale Unit Test*

	Group	N	Mean	Std. Error Mean	Std. Deviation
Pretest	Control	25	47.96	0.88	4.39
	Eksperiment	30	46.77	0.91	4.99
	Total	55	47.37	0.89	4.69
Posttest	Control	25	51.36	0.77	3.85
	Experiment	30	55.80	0.67	3.66
	Total	55	53.58	0.72	3.76

The experiment group scored higher on the post test than the control group. Figure 3 shows changes in the pre-test and post test scores for each student in the control group. Figure 4 shows changes in the pre-test and post test scores for each student in the experimental group.

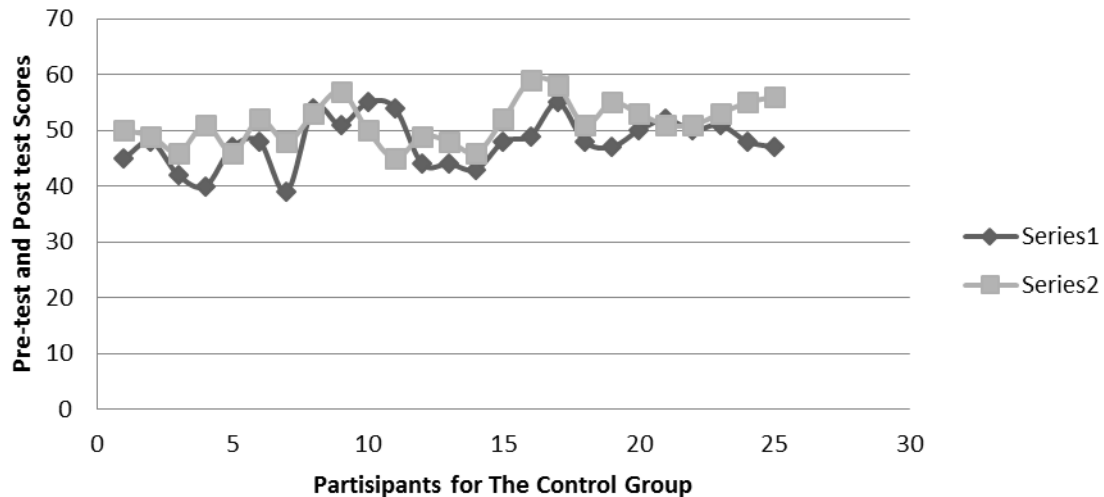


Figure 3. Control Group's Scores Students' Attitudes

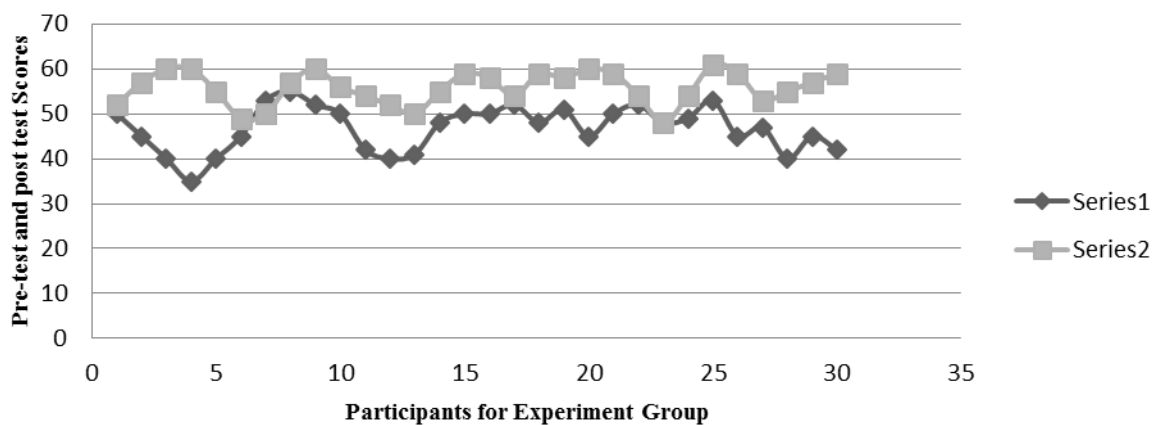


Figure 4. Experiment Group's Scores Students' Attitudes

Using the SPSS statistical software, the results showed $p = 0.208 > 0.001$ that indicates the relationship between pre-test and post test did not differ significantly. Therefore, the results showed that students in the experimental group ($M = 55.80$) had significantly higher scores on attitudes than control group ($M = 51.36$), controlling for pretest scores.

CONCLUSIONS

The analyses founded that the students in both groups recognized science problems. Based on the findings, inquiry based ecopedagogy provided students with a holistic and self-directed process to understand the environmental physics concepts, such as global warming, renewable energy, and pollution. Students need to experience science learning practices for themselves to truly understand what they are learning. The strands of inquiry and saintific practice that developed by the National Research Council, provide students with a framework to develop their own knowledge by producing a product, researched a topic, and reflected on the information. Student should be actively engaged in scientific inquiry based ecopedagogy practices to truly understand the scientific concepts on environment physics instruction.

The analysis also founded that mean test scores from the experimental and control groups improved from the pre-test to the post test, both of the achievement and the



attitudes. These scores suggest that the experimental group using the inquiry-based learning benefitted from this type of instruction more than the students in the traditional science lesson. The findings of this study indicate that inquiry-based ecopedagogy had an impact on student achievement and attitudes.

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PHY-01176

Design of Sky Quality Meter (SQM) Position Control by Employing Visual-Based Programming

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Article info**Keywords:**

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Abstract

The development of positional (azimuth and altitude angle) control for Sky Quality Meter (SQM), an apparatus for measuring sky brightness, on the basis of visual programming is the focus of this paper. This work consist of three parts, those are mechanical system, hardware and software system development. The mechanical system has dimension 300 mm x 300 mm x 1500 mm and gear ratio 25:45 (to convert angle of 1.8 degrees to 1 degree). The hardware system consist of arduino UNO R3 series, motor driver, stepper motor and microcontroller interface with computer and sensor. Voltage needed as a power supply input is 221.97 VAC in average (36.05 VAC as an output) and 0.24 A for average current (0.63 A as an output). The software system in Graphical User Interface (GUI) form is developed by using Visual Studio 2010 with C++ programming. The GUI has facilities for user to control the input value for azimuth and altitude angle to be pointed out by the apparatus, information about direction being measured, auto plot mode, serial and TCP/IP communication. The reading of the apparatus is displayed in the form of textbox, chart and MySQL database.

INTRODUCTION

Sky Quality Meter (SQM) has function to determine the brightness of the night sky in units of magnitudes per square arc second (MPSAS or $\text{mag}/[^\circ]^2$). Characterization of hand-held SQM was conducted by Cinzano¹ under laboratory condition. Unihedron, SQM manufacturer, offers two types of SQM, namely connected and hand-held. The similarity of both types is users must manually direct the instrument to a particular direction (in the horizon coordinate system). This means, for sky measurement at difference direction, user must change its direction manually to a desired new direction. This is the case for fixed SQM installation at Bosscha Observatory and the mobile one at Earth & Space Laboratory of Universitas Pendidikan Indonesia (see **Figure 1**). Based on this condition, the scope of this work is to develop positional (azimuth and altitude angle) control for SQM in visual programming basis.



FIGURE 1. Photograph of SQM installation at Bosscha Observatory in Lembang (top) and at Earth & Space Laboratory of Universitas Pendidikan Indonesia (bottom).

METHODOLOGY

Through experimental method the aim of this work is to design and construct mechanical controls of SQM both in terms of mechanics, hardware and software. **Figure 2** shows a chart of the entire device, i.e. the PC as an interface, user, controller and stepper motors.

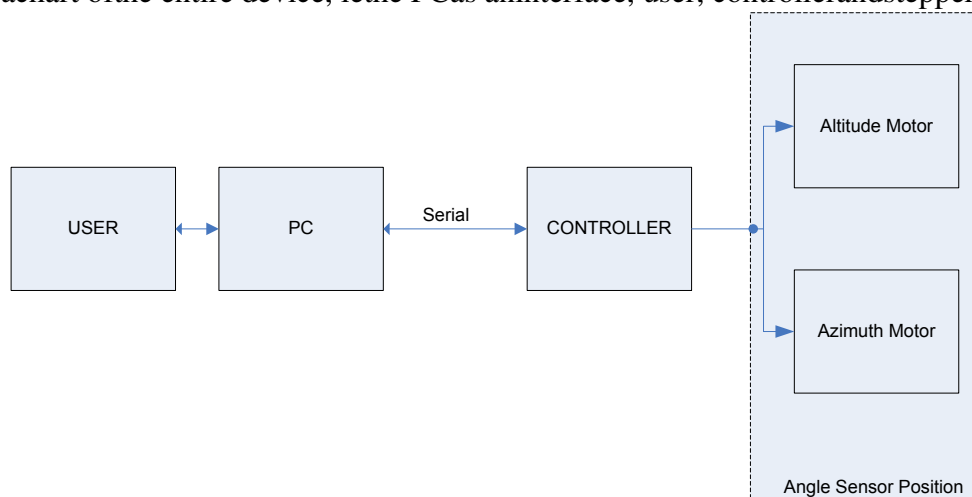


FIGURE 2. Scheme of SQM positional control.

Characterizations

Based on the total load (3.76 kg) includes SQM, the house and altitude system, the stepper motor used must have a minimum torque of 2.82 Nm. We chose Wantai stepper motor dual shaft stepper type 57BYGH115-003B425oz because it has a holding torque

2.94 Nm. Gear design is based on consideration of the desired angle is 1 degree, while the full step stepper motor moves with angle of 1.8 degrees. We found gear ratio of 25:45 to convert angle of 1.8 degrees to 1 degree.

The input voltage measurement was conducted to determine the voltage and current required by the power supply. The average voltage measured was 221.97VAC, and based on the specifications maximum voltage is 230VAC. Whilst the average current output of the power supply was 0.24A and acceptable maximum current is 4A. So the input voltage and current was safe for power supply. We also carried out measurements to determine the output voltage and current of power supply received by motor driver to drive the stepper motor. The result is average output voltage of power supply was 36.05VDC, where as the average output current of power supply was 0.63 A. All values is within safe range. Angle pointing testing was also conducted to know the error value. The average positional error was 2.36 degrees and 1.4 degrees for azimuth and altitude angle respectively.

RESULTS AND DISCUSSION

Figure 3 presents the photograph of mechanical and hardware assembly of the system. The white tube at the top of steel frame is SQM house. In the testing session, SQM can move smoothly pointing to direction given by user through graphical user interface (GUI) developed by using Visual Studio 2010 with C++ programming. The GUI has facilities for user to control the input value for azimuth and altitude angle to be pointed out by the device, information about direction being measured, auto plot mode, serial and TCP/IP communication. The measurement result can be displayed in the form of textbox, chart and MySQL database.

Although there is a pointing error in both azimuth and altitude angles this is not a big problem because the opening angle of SQM sensor reached 20 degrees as mentioned in the product catalog². There is an increase worldwide on sky monitoring among amateurs after the recognition of the biological importance of darkness and continued growth in the amount of lighting worldwide³, so that the use of connected type of SQM that can be controlled remotely of its pointing and be accessed globally through internet has its own advantage.



FIGURE 3. Photograph of fully assembled SQM.



CONCLUSIONS

We successfully designed and constructed mechanical control of SQM. The device can move smoothly pointing to direction given by user through graphical user interface (GUI). By connected to the internet, the device can be controlled remotely and its measurement can be accessed globally.

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PHY-01205

Electrical Characterization of Fe₂TiO₅:1.0 % mole MnO₂ Ceramics Made With Different Sintering Time for NTC Thermistor

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MnO₂,
Sintering time,
NTC Thermistor.

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Abstract

A study on fabrication and characterization of Iron Titanium Oxide (Fe₂TiO₅) ceramics for Negative Temperature Coefficient (NTC) thermistor has been carried out, in order to know the effect of sintering time on the characteristic especially the electrical characteristic of 1.0 % mole MnO₂ doped Fe₂TiO₅ ceramics. These ceramic made by mixing commercial powders of Fe₂O₃, TiO₂ and MnO₂ with composition proportional to produce Fe₂TiO₅ based ceramic. The mixture powder was pressed with 4 ton/cm² pressure to produce raw pellets. The raw pellets were sintered at 1200 °C with sintering time of : 2, 5 and 8 hours in air. Analysis of the microstructure and crystal structure performed by using a scanning electron microscope (SEM) and x-ray diffraction (XRD) respectively. XRD analysis showed that all ceramic Fe₂TiO₅ made at various sintering times has orthorhombic crystal structure. The SEM images showed that the grain size of pellet ceramics increase with increasing sintering times. From electrical resistances data that was measured at temperature 30-200 °C, it is found that the value of thermistor constant (B), activation energy (E_a), thermistor sensitivity (α) and room temperature resistance (R_{RT}) decreases with increasing sintering time. Fe₂TiO₅ ceramic which was produced the value thermistor constants (B = 5733-6643 K), fitted market requirement and can be applied as temperature sensor.

INTRODUCTION

Negative Temperature Coefficient (NTC) thermistor has been widely used around the world today, due to its capability used in various fields of electronics, such as thermometer, electric current limiter, water flow sensor, and pressure sensor [1-2]. The NTC thermistor is generally made of ceramic having structure of spinel of AB₂O₄ where A is the ion occupies tetrahedral position and B is the ion occupies octahedral position [3]. Fe₂TiO₅ ceramic is one of some ceramics that can be applied for NTC thermistor. The thermistor may be produced in the form of disk/pellet or thick film. Here, the object of study is the pellet thermistor.

In this work, a study on fabrication of pellet thermistor based on Fe₂TiO₅ with sintering time variation was performed. The effect of sintering time on the characteristics, especially the electrical characteristics, of the Fe₂TiO₅ pellet ceramics for NTC thermistor was discussed. Fe₂TiO₅ is one of semiconductor ceramics used as based material for main components fabrication of NTC thermistor as temperature sensor. The composition of mineral Fe₂TiO₅ is belong to pseudobrokyte group where the general formula of this



compound is X_2YO_5 with octahedral in both side, X and Y [4]. Generally, Fe_2TiO_5 has been mostly used for gas sensor, non linear optic, magnetic, catalyst, and microelectronics. Since Fe_2TiO_5 actually has semi-conductivity, it is very capable to use Fe_2TiO_5 for NTC thermistor as based material. Thermistor constant B is a quantity which determine typical characteristic of thermistor corresponding to electrical resistance changes with temperature. The larger thermistor constant lead to better thermistor quality. Many works and studies have been conducted by researchers to enhance thermistor constant B and thermistor sensitivity α . They have studied the effect of sintering time to typical characteristic of Fe_2TiO_5 -based ceramics. The research of NTC thermistor for high temperature has been previously reported [5-6]. However, the reports of NTC thermistor in high temperature fabricated by Fe_2TiO_5 -based ceramics for sintering time conditions have not been excessively reported so far. The effect of sintering time on the characteristics, especially the electrical characteristics of 1.0 % mole MnO_2 doped Fe_2TiO_5 ceramics for NTC thermistor is the focus of the study.

MATERIALS AND METHOD

Fe_2TiO_5 thermistor ceramic was prepared by using imported Fe_2O_3 and TiO_2 . Mixture of Fe_2O_3 , TiO_2 and MnO_2 with each compound ratio 49:49:1.0 in % mole, was calcinated at 700 °C for 2 hour. In order to form pellets. The pellets were sintered at 1200 °C with sintering time of : 2, 5 and 8 hours in air. In order to observe crystal structure and formed phases, the crystal structure of the sintered pellet was analyzed with x-ray diffraction (XRD) using $K\alpha$ radiation. The sintered pellets were investigated by an electron microscope (SEM) to evaluate their microstructure (morphology). Electrical characterization was done by measuring electrical resistance of the pellet ceramics at various temperatures (30-200 °C) with 10 °C interval. Both surfaces of sintered pellets had been coated by conductive silver paste colloid silver solution and heated at 600 °C for 10 minutes in advance. Thermistor constant (B) was derived from Ln resistivity vs. $1/T$ curve where B is the gradient of the curve based on [7-9]:

$$R = R_0 \cdot \exp(B/T) \quad (1)$$

Where, R is the electrical resistance, R_0 is a constant or the resistant at the infinite temperature, B is the thermistor constant and T is the temperature in Kelvin and k is the Boltzmann constant. Room temperature resistance (R_{RT}) was determined as the electrical resistance at room temperature (25 °C). From the value of B, the activation energy (E_a) and sensitivity (α) were calculated using equation 2 and 3 [10-12].

$$E_a = B k \quad (2)$$

$$\alpha = B/T^2 \quad (3)$$

RESULTS AND DISCUSSION

XRD profiles of Fe_2TiO_5 pellet ceramics sintered at 1200 °C for 2 hours with sintering time of : 2, 5 and 8 hours respectively are shown in Fig.1, Fig.2 and Fig.3. As shown in the figure Fig.1, Fig.2. and Fig.3, the profiles are generally similar. The XRD patterns show that the structure of the pellet ceramics is orthorhombic after being compared to the XRD standard profile of Fe_2TiO_5 from JCPDS No. 01-070-2728. No peaks from second phases observed. It may be due to the small concentration of impurities which is smaller

than the precision limit of the x-ray diffractometer used. The XRD data of Fig.1- Fig.3 indicates that the synthesis of the Fe_2TiO_5 pellets has been well prepared from Fe_2O_3 and Ti_2O_3 powder sintered at 1200°C with sintering time of : 2, 5 and 8 hours in air

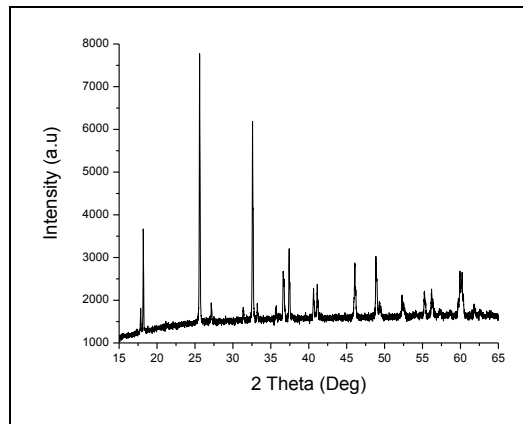


Fig.1. XRD profile of 1.0 % mole MnO_2 doped Fe_2TiO_5 based-pellet ceramic sintered for 2 hours.

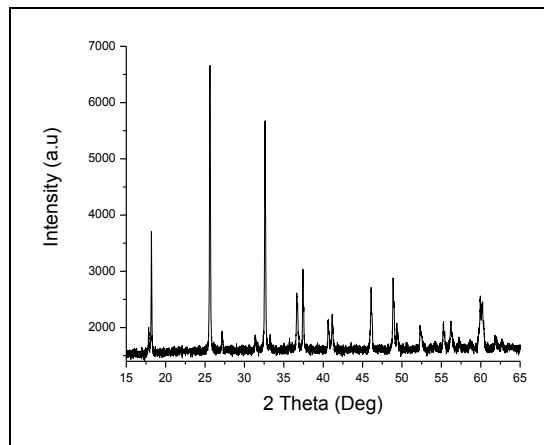


Fig.2. XRD profile of 1.0 % mole MnO_2 doped Fe_2TiO_5 based-pellet ceramic sintered for 5 hours.

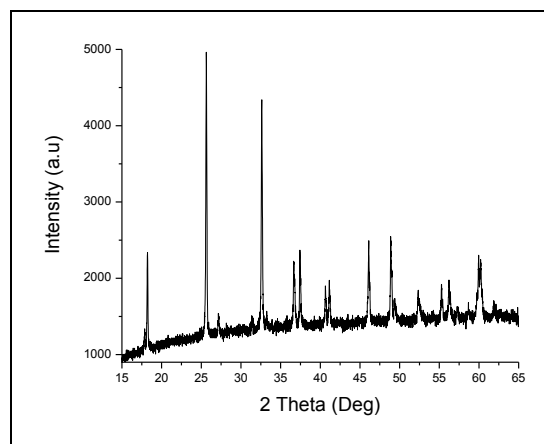


Fig.2. XRD profile of 1.0 % mole MnO_2 doped Fe_2TiO_5 based-pellet ceramic sintered for 8 hours.

Microstructures of 1.0 % mole MnO_2 doped Fe_2TiO_5 pellet ceramic sintered for 2 hours, 5 hours, and 8 hours, respectively, are depicted in Fig.4, Fig.5 and Fig. 6. All of the pellets are characterized in porous structure with different grain size depending on the sintering time condition. The grain size becomes larger following the increase of the sintering time. This is a consequence of the higher mobility of ions at the longer sintering time. The higher the mobility of ions is, the larger the grain growth. The grain size calculated by using of the intercept method is found to be $0.97 \mu\text{m}$, $1.01 \mu\text{m}$ and $1.48 \mu\text{m}$ sintered for 2 hours, 5 hours, and 8 hours, respectively.

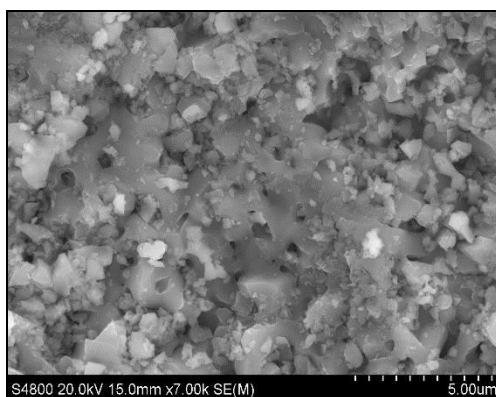


Fig.4. Microstructure of 1.0 % mole MnO_2 doped Fe_2TiO_5 based-pellet ceramic sintered for 2 hours

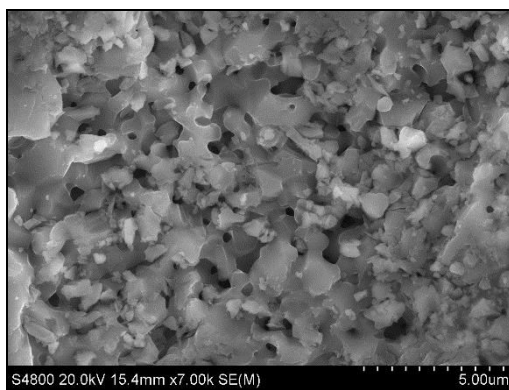


Fig.5. Microstructure of 1.0 % mole MnO_2 doped Fe_2TiO_5 based-pellet ceramic sintered for 5 hours

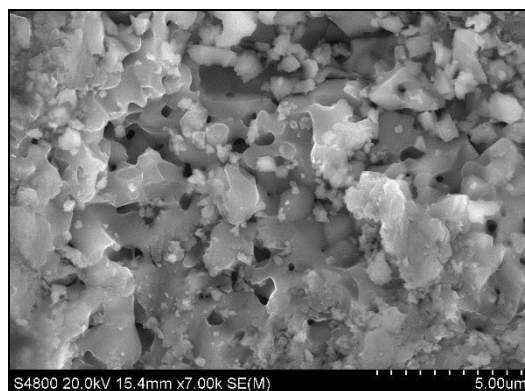


Fig.6. Microstructure of 1.0 % mole MnO_2 doped Fe_2TiO_5 based-pellet ceramic sintered for 8 hours

The electrical data of 1.0 % mole MnO₂ doped Fe₂TiO₅ pelletceramics with sintering time variation is shown in Fig. 6 and Table 1. The electrical data of Fig. 6 shows that the Ln resistivity increases linearly as the 1/T increases, indicating that the electrical characteristics of the ceramics follows the NTC tendency expressed by equation (1). As shown in Table 1, the increase of sintering time from 2 hours to 8 hours decreases the thermistor constant (B), activation energy (E_a), sensitivity (α) and room temperature resistance (R_{RT}) of 1.0 % mole MnO₂ doped Fe₂TiO₅ based-pellet ceramics. The mechanism of this condition can be explained as follow. sintered in 2 hours due to relatively short time, the grains of the pellet are relatively small and interconnection among the grains is few. This situation produces many scattering centers for charge carrier resulting in high resistance. When the sintered time is increased to 8 hours from 2 hours, the grains are larger and the interconnection among grains increases resulting in fewer scattering center for charge carrier and lower resistance. The value of thermistor constant (B) ceramics fitted market requirement for NTC thermistor

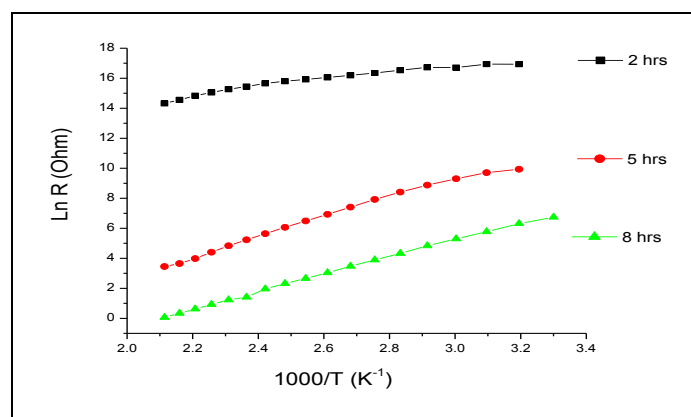


Fig.7. The relation between Ln Electrical Resistance and 1/T of of 1.0 % mole MnO₂ doped Fe₂TiO₅ based-pellet ceramic sintered for 2 hours, 5 hours and 8 hours.

Table 1. Electrical characteristics of 1.0 % mole MnO₂doped Fe₂TiO₅ based-pellet ceramic sintered for 2 hours, 5 hours and 8 hours.

Sintering Time (Hours)	Thermistor constant (B) (K)	Activation Energy (E _a) (eV)	Sensitivity (α) (% K ⁻¹)	Room temperature resistance (R _{RT}) (kΩ)
2	6643	0.572	7.50	129.048
5	5751	0.496	6.50	2.152
8	5733	0.494	6.45	2.117

CONCLUSION

The 1.0 % mole MnO₂doped Fe₂TiO₅ based-pellet ceramic have been well prepared at 2 hours, 5 hours, and 8 hours. All of the pellets crystallize in orthorhombic structure. The increases of sintering time decreases the thermistor constant, activation energy, sensitivity and resistance of the pellets. The electrical characteristics of the Fe₂TiO₅ pellet ceramics follow the NTC characteristic. The value of thermistor constant (B) = 5733-6643K and



room temperature resistance (R_{RT}) = 2.117-129.048 k.Ohm. These values fit the market requirement for NTC thermistor.

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PHY-01526

Synthesis and Characterization of nanocomposite material using epoxy resin matrix and nanosilica

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Article info	Abstract
<p>Keywords: Nanosilica, Compressive Strength, Simple Mixing.</p>	<p>The aim of this study is to synthesize and characterize a composite material made from epoxy resin matrix and nanosilica. A simple mixing method was used for making the composite material. A compression test was conducted to measure the compressive strength of composite material while FTIR analysis was used to investigate the peaks characteristic of epoxy resin matrix and nanosilica. Scanning Electron Microscopy was done to study the morphology and the diameter of nanosilica. The SEM analysis showed that the average diameter of nanosilica was around 100 nm. The optimal ratio of epoxy resin/hardener was 12 : 0.0013, whereas the optimal ratio of epoxy resin/hardener/nanosilica was 12 : 0.0013: 0.5. The compressive strength of epoxy resin matrix was found to be 125 MPa. The addition of nanosilica into the matrix has increased the compressive strength of the composite material up to 6 % of the initial compressive strength gaining a better value at 142MPa. The compressive strength data showed that the composite filled by nanosilica is stronger than the rice husk composite gained from our previous research. Thus, this composite is feasible to be used in many uses especially for the application that require high strength.</p>
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INTRODUCTION

Nanocomposite materials attract serious attention from scientists. The idea of the study was to prepare a material consisting of homogeneous blocks of particles. The result of the study was surprising. A new material with far better physical properties than its constituent materials was discovered. This breakthrough has triggered the development of nanocomposite materials in all fields by utilizing this very simple idea. The composite material can be used for various purposes, such as the material for bulletproof vest [1], drug delivery system,[2], filter [3] and others.

A nanocomposite technology can be used to make nanocomposite materials. This technology refers to a modest idea, which is to build a material consisting of many blocks of homogeneous particles in nanometer scale [4]. The size of the materials used as the filler in the matrix is one of the most important parameters to generate a nanocomposite material [5]. The addition of nanoparticles fillers into the composite materials has generated interesting properties, such as small size, high porosity and large surface. The vast surface of the nanoparticles can interact with the chain or polymer matrix to reduce the mobility of the polymer chains which in turn increases the strength of the composite far above the strength of the polymer itself [6]. Some extra advantages of the addition of filler nanoparticles into a polymer matrix include density reduction, higher stiffness and less cost per unit volume [6,7].

Nanocomposite materials can be made from various polymers, such as epoxy resin [8] and PVAc [5-7]. Sriyanti. *I et al* have managed to produce a strong material by using silica



nanoparticles for furniture with compressive strength as high as 67.8 MPa [6,7]. Masturi *et al* have also managed to create a super material by utilizing nanosilica. However, the fabrication of super strong material by utilizing epoxy resin and nanosilica using simple mixing method has not been performed. In this study, nanocomposite material with filler nanosilica was made. The synthesis and characterization of nanocomposite material using epoxy resin matrix and nanosilica have been investigated. The morphology and structure of the nanosilica were analyzed using scanning electron microscopy (SEM). The nanocomposite was characterized using Fourier transform infrared spectrophotometer (FT-IR). Lastly, the strength of the composite was also examined.

Experimental Details

The silica in nanoparticles form was purchased from Bratachem (Indonesia). A commercial epoxy resin was used as an adhesive. Antacid particles with average size $2.4 \pm 0.35 \mu\text{m}$ was obtained from Pfizer, Indonesia.

Synthesis of Nanocomposite materials with Nanosilica as Filler

The method used in this research to synthesize the nanocomposite was *Simple Mixing* method. First, the epoxy resin and hardener in ratio 12 : 0.0013 was dissolved into 8 mL of water and was stirred using a magnetic stirrer for 10 minutes. The dissolution of the polymer in water aimed to facilitate a homogeneous and even distribution of hardener impregnation (Insertion) into the epoxy polymer chains. Then, the sample was compressed using hot press method. The hot press method was conducted at 15 minutes pressing time, in room temperature with compressive strength amount as large as 50 MPa. The average height of the sample was between 15-18 mm and the diameter was approximately 25-26 mm. The samples containing epoxy resin and hardener with optimum compressive strength are used for further experiment. In this experiment, the silica nanoparticles were added to the samples.

Characterization

The macroscopic morphology and surface texture of silica nanoparticles were assessed by Scanning electron microscopy (SEM, JEOL JSM-6510LV) at excitation voltage of 15 kV. The diameter of the nanoparticles was then calculated at 100 points from the SEM images using Image J software (National Institutes of Health, USA). The Analysis of FTIR was used to determine the typical functional groups in the silica nanoparticles. Wave numbers scanning were conducted within range of $500\text{-}3800 \text{ cm}^{-1}$. The measurement of the materials strength was performed by using a Torse (Tokyo Testing Machine MFG, Ltd.).

RESULTS AND DISCUSSION

Firstly, the optimum mass fraction of epoxy resin was determined. From the experiment, as shown in Figure 1, the optimum mass fraction of epoxy resin/ hardener is 12 : 0.13 From this optimum mass fraction, the optimum compressive strength was found to be 125 MPa.

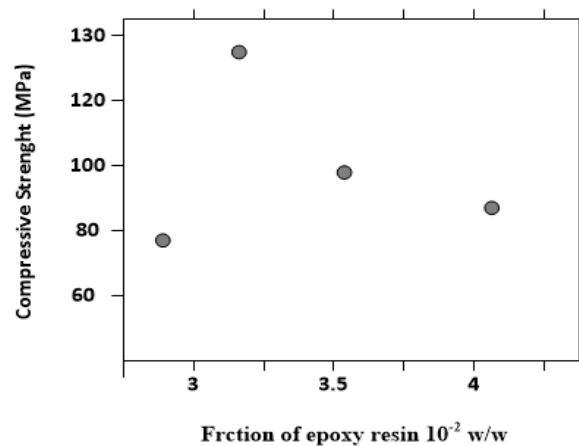


Figure 1. The effect of Epoxy resin weight fraction on the composite compressive strength with pressure 50 MPa for 15 min

The strength of the composite was determined by the structure and properties of the components of the sample. The polymer matrix covered the granules hence binding them together to form strong composites. Due to small size, the filler penetrated the space between granules (pore-like) to produce dense composite. Polymer, in its amorphous state, tends to make a segmental signal [9], which intensifies at higher temperatures. This characteristic of polymer explains the reason for the increase of interaction between particles which is due to the decrease of the distance and the arrangement of the particles. This interaction results in the increase of mechanical strength and stiffness of the material [6,10].

As seen in figure .3a the SEM image shows that the size of nanosilica particles was about 100 nm. The addition of nanosilica filler in the matrix resin has produced some interesting characteristics. Since the surface of the nanoparticles interacted with the polymer chains, the mobility of the polymer chains is reduced. This interaction increases the mechanical strength of the composite which is far above the strength of the polymer itself [8]. Likewise, according to Masturi, et al (2011), the infiltration of very small nanosilica particles occurs more quickly and evenly which strengthen the resulting bond between the particles hence the structure of the particles becomes more solid, the surface interaction area becomes larger, and the amount of interacted particles increase [11]. As a result, the total surface interaction increases therefore raise the mechanical strength of the material. This is consistent with research data which can be seen in figure 4 below.

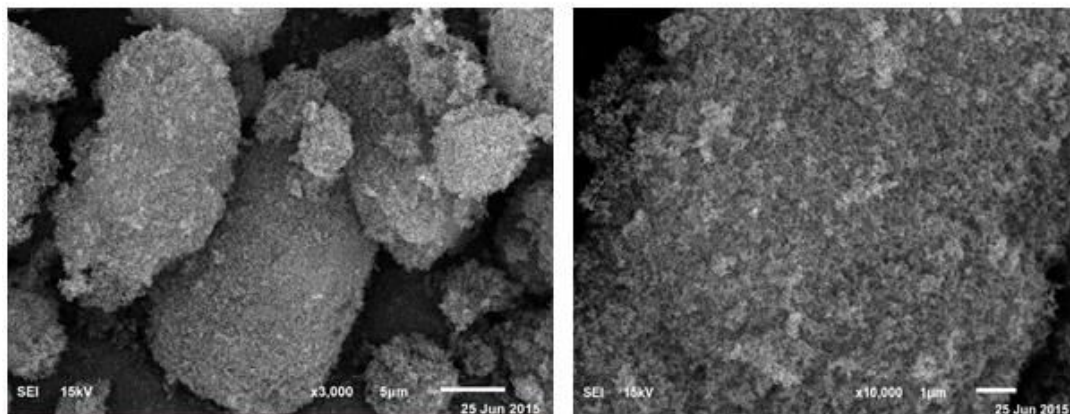


Figure2. (a) Scanning electron microscopy (3000x) of Silica nanoparticles and (b) Scanning electron microscopy (10.000x) of Silica nanoparticles

Based on Figure 4 below, the addition of nanosilica fraction tended to increase the compressive strength of the composite resulting in maximum compressive strength at 142 MPa with the addition of nanosilica fraction of 0.0068. But when the polymer chain was filled by a filler (nanosilica), the particles can not enter the area of the effective interaction which is the optimum condition of the area of interaction. Consequently, the strength of the compressive declined. This situation can be observed from the decrease of the fraction of each sample after passing the optimum condition.

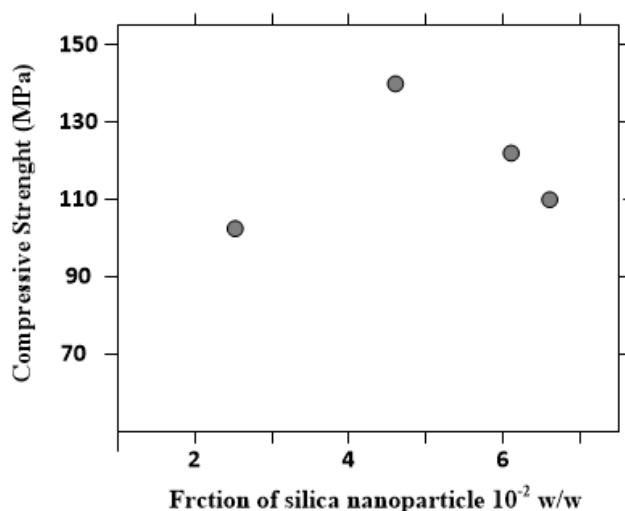


Figure 4. Silica nanoparticle mass fraction effect on the composite compressive strength. The pressing pressure was maintained at 50 MPa, and the pressing time at 15 min.

The improvement of the mechanical strength of the composite that was affected by the addition of silica can be explained by this FTIR analysis approach. Although these spectra are the spectra without the presence of hardener, at least these spectra can explain the interaction between silica with epoxy resin.

The result of FTIR spectra is shown in Figure 4. The peak in 3059 dan 2968 cm^{-1} came from functional group alkenes (C–H stretch) of the epoxy resin. After mixing silica into epoxy resin, both the peaks experienced a slight shift to 3068 and 12972 cm^{-1} which indicated weak interaction and expected to be the Van der Waals interactions of dipoles between the carbonyl group C atoms with oxygen in silica. This interaction emerged because the Carbon atom in acetate functional groups formed carbonyl compounds with oxygen (C = O) so the Carbon atom became more electropositive [12]. This Carbon atom then interacted with the Oxygen atom in silica which is more electronegative [5.11]. The same kind of interaction occurred between the Oxygen atom of the carbonyl group C = O with the Sulfur atom in silica [2].

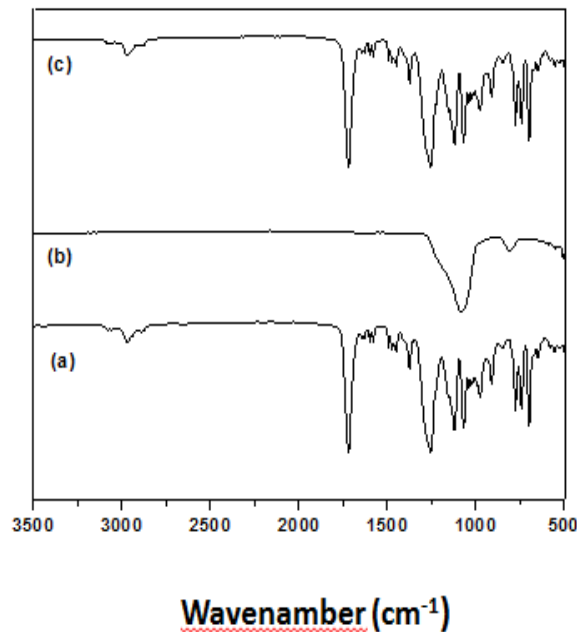


Figure 5. FTIR Spectra of (a) epoxy resin, (b) silica nanoparticles and (c). composite epoxy resin and silica nanoparticles

The peaks of 741, 698 and 650 in epoxy resin (Figure 5a) are the spectra of C-O bond in the acetate group. While the peaks of 552, 803 and 1080 cm^{-1} on silica (Figure 5.b) are the peak of Si-O. The effect of adding silica to the epoxy resin is shown as the shift of 492.806 and 1009 cm^{-1} to 650, 776 and 1038 cm^{-1} (Figure 5c). This small change is also suspected due to the appearance of Van der Waals interactions london dispersion. This interaction occurs between the oxygen atoms in CO with a silicon atom in silica. In general, this interaction occurs between any arbitrary atoms as the result of the appearance of electron polarization effects [11]. Beside the Van der Waals interaction, it is suspected that between Si-O and the functional group of acetate, both CO and C = O, also form new compounds that also play a role in increasing the strength of the composite.

CONCLUSION

We succeeded in making nanocomposites with simple mixing methods by using epoxy resin and silica nanoparticles. The mass fraction of epoxy resin/ hardener of 12 : 0.013 has compressive strength of 125 Mpa. Mass fraction of epoxy resin/nanosilica of 12 : 0.0013: 0.5. has compressive strength of 125 MPa, when tested under pressing temperature of 50°C, and pressing time of 15 minutes. The addition nanosilica increased the compressive strength by about 6% with the rise of the compressive strength up to 142 MPa. These results are better than those of Kumagai and Sasaki of rice husk composite whereby the compressive strength was achieved to be 55.7 MPa [12]. Thus, this composite is feasible to replace wood-based composite especially in application that require high strength.

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PHY-01456

Effect of Treffinger Creative Problem Solving (CPS) Strategy on Physics Learning for Enhancing CPS Thinking Skills in Vocational Students

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Article info

Keywords:

CPS Treffinger strategy, guided inquiry models, creative thinking skills in problem solving

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Abstract

This study aims to determine the different increase creative thinking skills in problem solving among groups of students who are learning in use CPS Treffinger strategies and who learn without CPS Treffinger strategy, both of them used guided inquiry models. This research is a quasi experimental research with pretest posttest control group design. Population in this study is all students in X SMKN I Simpangkatis, districts Simpangkatis, the Middle Bangka Regency. Sample set at 2 grade, 31 in the experimental group and 27 in the control group were determined by purposive sampling. Creative thinking skills data in problem solving collected through a written test in open-ended. Results of the analysis of statistical description obtained an average score of the experiment is higher than control. The data also counted N-gain obtained by the two group. N-gain in experiment were middle category (0.30) and control including low category (0.15). T-test results showed (1) a significant difference between the creative thinking skills in problem solving skill between the experimental and control. This means that the skill of creative thinking in solving problems students who are learn with CPS Treffinger Strategy is better than learning without CPS Treffinger strategy. Most students and teachers also responded positively about Treffinger CPS strategy because it can (2) be able to practice skills of creative thinking in problem solving, (3) create a learning atmosphere that is conducive for physics concept and applying concepts, (4) assist in expression, (5) help achievement of learning objectives.

INTRODUCTION

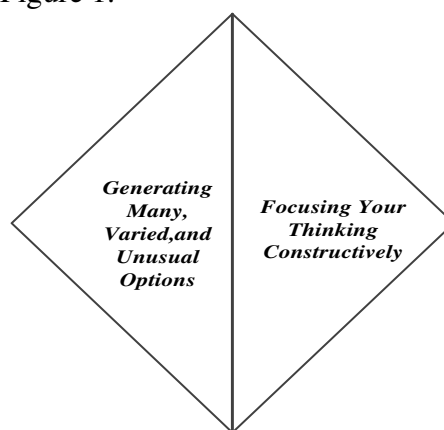
Developments in science and technology is rapidly increasing today provide great demands in education to produce skilled human resources so as to meet the rapid changes in circumstances. Good human resources and quality will only be gained by continuing to improve the quality of education. Both the policy and the strategy of teaching and learning in schools. One of the skills that are expected to be improved through education is a skill in solving problems. As we know that the problems that exist around us today a variety ranging from simple to complex problems. Students will deal with these issues.

Based on the completion strategy of problem solving (problem solving) divided into two routine and nonroutine problem solving [1]. Routine problem solving emphasizes the use of a number of knowledge or algorithms to solve the problem while solving nonroutine emphasis on the use of heuristics and little or no use of the algorithm. Heuristics is the

ability to use a variety of strategies that provide a variety of ways or methods to be able to resolve the issue. As already explained earlier that simple problems can be solved by standard methods as a result of the thought process routine problem solving, but not with the problems more complex requiring more sophisticated methods and the need to make connections / new relationships to various aspects / concepts related and even unrelated [2].

Creative Problem Solving (CPS) strategy is a learning strategy that explore problem-solving skills is based on creative thinking skills and critical thinking. CPS model is a structured methodology to enhance the skills of creative thinking either individually or in groups and emphasizes the divergent and convergent thinking in every step in the troubleshooting process [3]. Treffinger specifically states that "Effective problem solver must do both- generating and focusing-not just one or the other. Generating many ideas will not be enough by it self to help you solve a problem. Similarly, if you rely only on the focusing side, you may have too few possibilities from wick to choose ". According Treffinger creative thinking is a process that produces a lot of possibilities (generate), while critical thinking is to examine the possibility of then (focus) on what is being contemplated. Both of these generate-focus is like a blood flow (heartbeat) in the CPS [4].

Generate activity-focus is always done in each phase so as to produce a creative problem solving as presented in Figure 1.



Gambar 1 The Heartbeat of CPS
(Treffinger. et.al, 2006)

The heartbeat of the CPS is used in all stages of creative thinking in problem solving. According [4] CPS stages are:

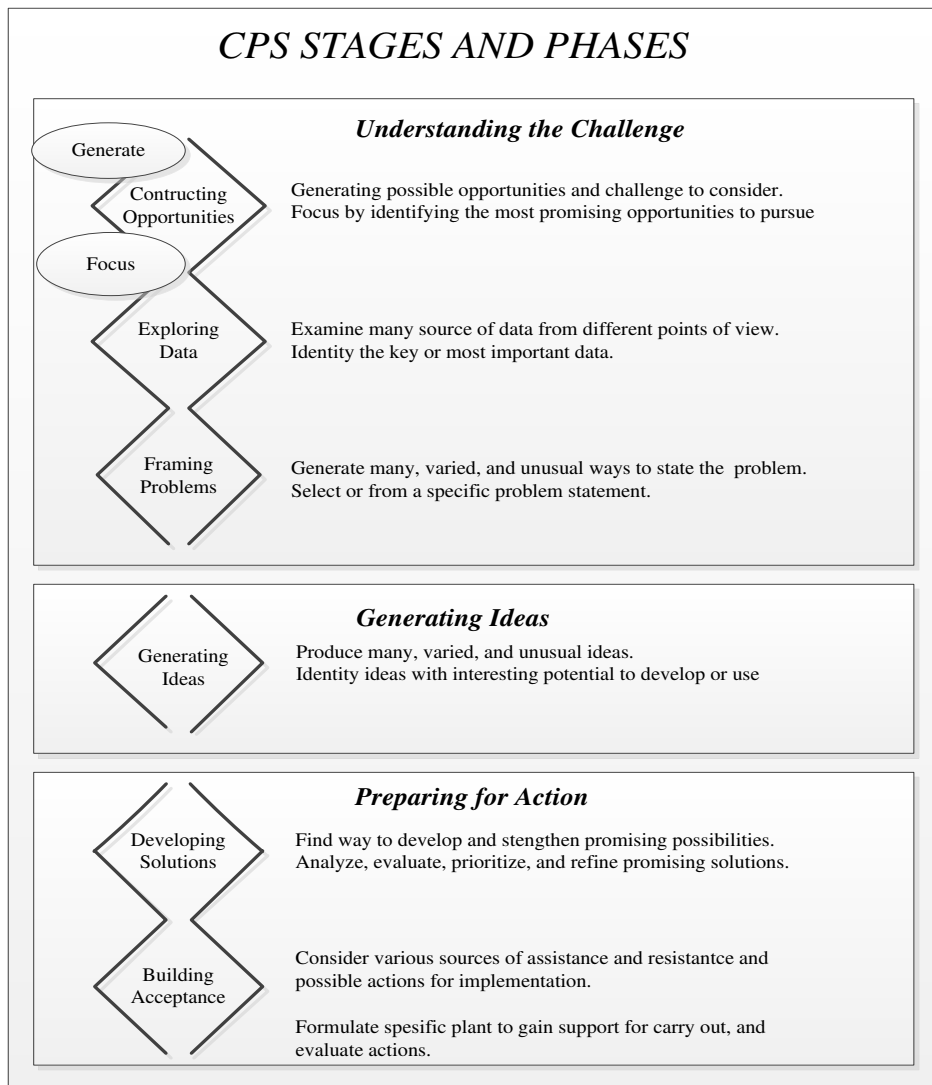
1. Understanding Challenges

Understanding of the challenges include widespread investigation on goal, opportunity or challenge, explanation, formulation, or concentration on the basic and fundamental set of guidelines for the activities to be carried out by someone. There are three phases that can be done so that students understand the challenges are follows:

a) **Constructing Opportunity.** In this phase the teacher conveying the challenges, the problems, the goal of which is still common and widespread that is still not appropriate to be specified. Students are invited to disco-ver the real purpose to be achieved in the troubleshooting process.

b) **Exploring Data.** In this phase, the teacher invites students to gather information related to problem situations. Data obtained based on, among other observations, specific knowledge of relevant and comprehensive and rational strong suspicion is based on the

question of what, where, why or how. The data obtained and classified to obtain more specific information about the problems faced.



c) Framing Problem

In this phase, the teacher invites students to clarify the challenges, objectives, or problems faced by redefining the challenges or problems or goals that have been submitted specifically. In order to be implemented by both the teacher can help students to make questions like "Why is that ...?, What else will happen ...?" Or other questions so that problems, challenges or goals facing becoming increasingly clear.

2. Generating Ideas

At this stage the teacher invites students to discover various ways or unusual ideas and have the possibility to address the problems, challenges, and specific goals based on the understanding that they already have.

3. Preparing For Action

At this stage the teachers guide students to choose, analyze, improve in order to obtain success in the implemen-tation of the solution. In preparing the students act through two phases:



a) Developing Solution. In this phase, the teacher invites students to select and amplify ideas have been and are considered the most potential in solving the problem for example by testing steps and materials (tools) that we select a solution. Experimenting with the working procedures that have been made by students or analyzing step according to the data obtained. In strengthening the notion that chosen may consider cost, acceptance by others / environment, available resources, turn around time and space required.

b) Building Acceptance. In this phase, students are getting the best solution to the problems faced, but to be able to see the correct solution from another point of view needs to be done by others. In this case the teacher with students can evaluate to direct efforts and increase support for the accuracy of the solutions that have been taken.

To solve the problems that have been describes, the variety of theaching material need to be improved so that the learning process can be conducted well, can foester students' independence, so it will improve the skills of creative thingking skills in problem solving . One of models of learning to support that skills in accordance with the 2013 curriculum is researc h based learning model for with guided inquiry. According Kindsvatter in [3] inquiry learning can be divided into two kinds, namely guided inquiry and free inquiry. The difference was more marked with teachers how big intervene in the investigation. In independent inquiry learning, the teacher is positioned as a friend in guided inquiry learning while the teacher a lot of directing and give good guidance through the complete procedure and questions the direction so that the conclusions will be quickly and easily retrieved. Filing the right questions by the teacher will stimulate the creativity of students and assist them in finding new knowledge. Therefore the skills to ask an important thing to be dipersiapkanoleh teachers to the learning objectives can be achieved with the maximum. Learning by inquiry model has several stages, one of them presented by [5] . According [5] model of inquiry has stages, namely: presentation of the problem, make hypotheses, collecting data / evidence, testing hypotheses and make conclusions. At every stage of trying to develop certain capabilities.

The learning process combine the research to get physics concept and meaningful learning with real life problem in open ended form. In the learning process, student need to try the acquire knowledge through research and correlate the learning material with real life. Learning stages of inquiry is expected to deliver the student to the correct understanding of the concepts that are able to apply the concept to the broader problems in daily life. The task learning by using learning strategies CPS Treffinger already packaged in guided inquiry is a stage of learning developed with the aim that students can be more sensitive look at a problem that is around to be solved using the concepts, principles that they have learned creatively.

METHOD

This study included in the category of quasi-experimental research (quasi experimental) because not all the variables and experimental conditions can be set and controlled strictly. This study aimed to examine the effect of independent variables which include the implementation of the Treffinger CPS strategy in experiment group and without Treffinger CPS strategy in control group on creative thinking skills in problem solving. Both of them used guided inquiry models. Design used in this study is *pretest posttest control group design*. This design was chosen to determine the increase and differences in creative thinking skills in problem solving between the experimental and control groups. The research location is SMKN I Simpangkatis Central Bangka regency. When the study was designed in the second semester of 2013/2014. Population is the entire class X SMK N I *Simpangkatis* consisting of 8 parallel classes totaling 240. Sampel

used of two groups amounted to 31 as an experimental and 27 as the control . Techniques used in sampling is *purposive sampling*.

The steps taken in the study were (1) a preliminary study of the development of physics teaching in schools; (2) study of the literature to examine the findings of previous studies and theories related to the achievement of the desired indicators; (3) Preparation of the learning and research instruments; (4) testing instruments that will be used; (5) Implementation of research to conduct pretest, and posttest learning; (6) The data collection and research (7) conducted an analysis of hypotheses and discussion. Data collection methods used in this study is the use of a written test descriptions shaped open (open-ended). Creative thinking skills data in problem solving developed in the test description in accordance with the criteria adopted [4]. Such skills include (1) constructing challenges; (2) exploring data; (3) framing problem; (4) generating ideas; (5) develop solutions; (6) building acceptance. Test instruments used to collect the data has been validated by a competent expert.

Scoring against each item creative thinking skills in problem solving using a rubric developed by [11] and then adjusted to the CPS stages according [4]. Implementation of this scoring is to reduce the element of subjectivity. The maximum value for each stage of the CPS is 4 and the minimum value is 0. Increase in creative thinking skills in problem solving used N-gain normalized according to [6]. As for knowing the difference between the experimental and control classes used descriptive analysis techniques and one-tailed t-test using SPSS 17.0 statistics on level of $\alpha = 0.05$.

RESULTS AND DISCUSSION

RESULTS

According the calculation of scores of pre-test and post-test in the experimental group and control result of data analysis descriptive statistics presented in Table 1.

Tabel 1. Statistic Deskripsi

Statistic	Pre- test		Post-test	
	Experiment	Control	Exsperiment	Control
Testee	31	27	31	27
Maximum	28	27	47	46
Minimum	1	0	15	0
Mean	13,68	14,93	31,48	22,00
Median	12,00	17,00	31,00	22,00
Range	27	24	33	38
Std	6,436	8,255	8,148	11,671
Varians	41,426	68,148	66,391	136,231

Table 1 shows that the experimental group after learning have mean, median, and have higher gain than the control group, it can be said that the overall score of the experimental group was higher than the control group. Based on the scores of pre-test and post-test is then calculated N-gain as a whole and for each category of CPS as presented in Table 2.

Tabel 2. Pre-test score, Post-test score and N- Gain

CPS Skills	Experiment			Control		
	Pre-test score	Post-test score	N-Gain	Pre-test score	Post-test score	N-Gain
CPS Total	13,71	31,00	0,30	13,35	22,26	0,15
CPS-1	2,97	5,29	0,26	2,87	4,33	0,16
CPS- 2	2,10	4,94	0,29	2,06	3,93	0,19
CPS- 3	2,55	5,39	0,30	2,45	3,11	0,07



CPS- 4	2,35	5,26	0,30	2,39	3,93	0,16
CPS- 5	1,97	4,97	0,30	1,97	3,63	0,17
CPS- 6	1,77	5,16	0,33	1,65	3,30	0,16

Notes : CPS -1 = constructing challenges ; CPS-2 = exploring data ; CPS-3 = framing problem ;
CPS- 4 = generating ideas; CPS-5= developing solutions ; CPS-6 = building acceptance.

Based on Table 2. can be seen that in general CPS experimental group experienced a higher increase than the control group. Similarly if each item is reviewed by the CPS [4] stage, after learning the experimental group experienced better improvement based on N-gain normalized. To determine differences in improvement between the experimental and control group conducted t-test. T-test is preceded by checking for normality and homogeneity of data N-gain CPS as a whole or against each item CPS. The test results of normality and homo-geneity of data N-gain in the experimental class and control are more than α ($\alpha = 0.05$) and some less than α . Thus, to see the difference in average in the experimental group and the control, do one-tailed t-test for data pairs were normal and homogeneous and Mann-Whitney test of the tail to couple the data is not normal and homogeneous. Results of t-test and Mann-Whitney test for N-gain the data presented in Table 3 and Table 4.

Tabel 3. T-test for total CPS

CPS Skill	Lavene's Test Quality of variances		t-test Equality of Means		
	F	Sig.	t	df	Sig(2-tailed).
CPS Total	0,024	0,876	7,089	56	0,000

Tabel 4. Mann-Whitney test for each item of CPS

CPS Skill	Mann-Whitney U	
	z	Sig (2-tailed).
CPS 1	-3,704	0,000
CPS 2	-3,725	0,000
CPS 3	-3,115	0,002
CPS 4	-4,287	0,000
CPS 5	-4,340	0,000
CPS 6	-4,491	0,000

According on data in Table 3. and Table 4. it can be seen that if sig.(2-tailed) less than $\alpha= 0.05$. Thus for CPS as a whole as well as for all indicators creative thinking skills there are significant differences between the experimental and control group. In this study the researchers also collect feedback from teachers and students about learning to use strategies Treffinger CPS in the form of a questionnaire. The result in getting that majority of teachers and students agree on the model used in the study of physics because (1) can practice the skills of creative thinking in problem solving; (2) create a learning atmosphere that is conducive to study the concept and applying concepts of physics; (3) assist in expression; (4) help the achievement of learning objectives.

DISCUSSION

Based on the analysis t-test and Mann-Whitney known that there are significant differences in creative thinking skills in problem solving on the students who learn using Treffinger CPS strategy with students who learn without using Treffinger CPS strategy.

The existence of a significant difference indicates that CPS strategies in teaching physics Treffinger give positive effect on creative thinking skills in problem solving. The magnitude of these effects can be seen in the results of the descriptive analysis as well as to the increase in N-gain between the two groups. Significant differences in the skills of creative thinking in solving problems caused by the treatment on measures of learning. As [4] in each phase of the CPS, there are two activities that occur simultaneously i.e. creative thinking (generate) and critical thinking (focus), it is like the blood stream. In another language reveals the stages of CPS are divergent and convergent thinking activities that form a dynamic and flexible system. The rule generate-focus facilitating creative thinking skills in problem solving. That is way learning with CPS strategy to acquire a positive response from majority of teachers and students because it can provide an opportunity to explore creative thinking skills in problem solving, exchange opinions with other people and explore the possibilities of a potential settlement and to apply the concepts already learned. The results are consistent with previous research that has been done by [1] and [7]. In addition to improving the skills of creative thinking in problem solving CPS strategy to improve learning outcomes as research [9] and [10].

Summary

Based on the results of research and discussion that has been described, it can be concluded that there are significant differences in creative thinking skills among students that learned with CPS strategy Treffinger with students who learn without Treffinger CPS strategy. Improved skills of creative thinking in solving problems in the group learn to use CPS Treffinger overall strategy and is reviewed for each item stages of CPS is higher than the study group without CPS strategy Treffinger. The phase and stage of Treffinger strategy is positively for supporting creative thinking skills in solving problems. It can be submitted several suggestions for education, in particular the parties involved CPS Treffinger strategy as one alternative in Physics learning. For other researchers who are interested in strategy Treffinger CPS advised to conduct research with larger samples to determine the effect the implementation of the CPS strategy Treffinger in learning physics in greater depth.

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