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# THE DEVELOPMENT OF *PEKA*-BASED THINKING ACTIVITY WORKSHEET TO MEASURE THE STUDENTS' THINKING SKILL

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## Abstract

This research was aimed to develop *PEKA*-based thinking activity worksheet based, find out the feasibility of the worksheet, and determine the mastery level of thinking skill on the work and energy subject by using *PEKA*-based Thinking Activity worksheet. This type of research was research & development with 4-D model (Define, Design, Develop, and Disseminate). The initial product was validated by lecturers and teacher, and revised in the first revision. The revised worksheet was used in the limited testing then performed second revision. The final product was used in extensive trial. The results of this research shows that *PEKA*-based Thinking Activity worksheet is in good category with average score of 4.12. The level of student mastery in thinking skills was 55% at excellent, 36% at credit and 9% at satisfactory levels.

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## INTRODUCTION

The characteristic of physics is related to the way of finding out information about nature systematically, so that physics is not limited to the mastery of knowledge in the form of fact, concept, or principle, but also a discovery process. The understanding of physics characteristic affects the learning process in school. Physics is expected to help the students learn about themselves and nature. It is also developed and applied in the daily life. The scope of physics in school is not only a set of facts, but also a process to find the facts based on critical thinking skill to predict or explain some phenomena.

Students were able to find the facts if they were involved in learning activity (Hwang, et al., 2007; Cock, 2012; Kusumawati, et al., 2015). Experiment and demonstration method is one of the alternative methods used by the teacher in physics learning process which involves the students in it. However, students' knowledge about scientific inquiry and the nature of science does not occur automatically once they are placed in a laboratory (Coll et al., 2010). Students do not develop an understanding simply through experiment inquiry; instead they need to learn from their experiences in the laboratory under expert guidance (Hume & Coll, 2008). This method is some of the teaching styles to train the students to have a scientific thinking. Besides, this method will show the students' thinking skill.

The application of experiment and demonstration method in physics learning can be done for work and energy material which is related to our daily life. The characteristic of work and energy is that its phenomena can be observed by the students (Neumann, 2012). Therefore, through this method, students are able to do an activity involving their thinking skill in science. However, this ability is not only measured when doing the experiment through observation, but also in doing the exercise to measure students' thinking skill and to find whether they understand the concept or just memorize it.

In its application, experiment and demonstration method is supported by an instrument like worksheet. In fact, worksheet affected the teacher to be lazy and not creative (Nunggaran, 2013). In addition, worksheet often contains of incorrect questions, whether from typo or the use of irrelevant words or contra-productive with the characteristics. Worksheet should be used as a supporting tool to improve students' activity and optimize the learning result. The learning result is related to students' skill especially in students' thinking skill.

In Malaysia, the assessmentto measure thinking skill has been developed. Thinking skill assessment is calledPEKA (Penilaian Kerja Amali) (Ministry of Education Malaysia, 2005). The assessment is a process of getting evidence to make judgments on student's acquisition and performance in the construct that have been identified and defined according to the performance indicators in The PEKA Guide (Meerah et al., 2005). PEKAis conducted to provide a manual for the teachers to help them doing an assessment efficiently (Kheng, 2008). Besides, PEKA also helps the students to realize some aspects such as: the skill that will be assessed, and how the skill is assessed. PEKA also assesses Scientific Process Skill (SPS), Scientific Manipulative Skill (SMS) and Concept Mastery Skill (Ministry of Education Malaysia, 2008). Therefore, students will be able to produce some proofs needed based on the skill and readiness. The advantage of PEKAis that teacher will be able to assess students' thinking skill from the beginning to the end of learning activity (Kheng, 2008). The initial assessment is conducted before the experiment in the form of experiment planning. The second stage of the experiment is data collection and data recording. The last stage is data interpretation and drawing conclusions, and each data will be elaborated into the skills that will be assessed.

PEKA assessment is understandable for teachers because the scoring and rubric have been determined first (there is a difference between the form of rubric and performance assessment) (Ministry of Education Malaysia, 2008). Assessment method is not conducted through direct observation, but using the proofs created by the students. Other problems associated with practical work in schools include the lack of facilities (Abdullah et al., 2007). To direct PEKA learning activity, worksheet is used especially in the form of Thinking Activity. In this form, the learning activity is more complete because demonstration and experiment activity is combined with thinking activity in the

accordance with science thinking skill. This method fits in with the problems in SMAN 1 Pakem and SMAN 10 Yogyakarta, in which the learning activity is teacher centered. Most of the assessment processes are done for learning result only because the assessment for thinking skill is difficult to be done by a teacher especially in observing the students.

Based on the explanation above, this research develops a PEKA-based Thinking Activity worksheet to measure students' thinking skill for work and energy material.

## METHOD

The product that would be developed was *PEKA*-based Thinking Activity to measure students' thinking skill for work and energy material. It was developed using 4-D (Four D)models consisted of define, design, develop and disseminate stages (Thiagarajan, *et al.,* 1974).

**1. Time and Place**

The research was conducted on June to November 2013. The time was chosen considering the work and energy material that was given in that range of time. The research take place in SMAN 10 Yogyakarta and SMAN 1 Pakem.

**2. Research Subject**

The subjects of the research were 5 students from XI NS 1 and XI NS 2 in SMAN 10 Yogyakarta. The subjects of the try out were the $11^{th}$ graders of SMA N 1 Pakem.

**3. Research Procedure**

A. Define Stage

The purpose of this stage was to determine and define the learning requirements. It was begun with the goals or purposes analysis of the limitation of material. This stage covered 5 main steps, such as: 1) front end analysis, 2) students analysis, 3) assignment analysis, 4) concept analysis, 5) learning purposes formulation.

B. Design Stage

The purpose of this stage was to prepare the worksheet prototype. This stage consisted of 3 steps, such as: 1) the formulation of standard test, which is an initial step connecting define and design stages. The test was designed based on the formulation of specific learning purpose. It is a tool to measure the change in students' behavior after teaching and learning activity, 2) the selection of media to deliver the material based on the learning purpose, 3) format selection. Format selection was done by analyzing the formats which had been developed in some developed countries.

C. Develop Stage

The purpose of this stage was to produce a revised worksheet.

1) Initial product

It was formulated by the researcher based on the products in design stage. The products were syllabus, lesson plan, *PEKA*-based Thinking Activity worksheet completed with the assessment rubric, posttest review, posttest manuscript, and the assessment rubric for posttest. The worksheet emphasized on the Thinking Activity related to students' thinking skill (Longman, 2013).

2) Product Validity

It was done to measure the instrument feasibility before it was tested. The validity analysis was done by experts.

3) First Revision

It was done after the product was validated. In the validity analysis, the weaknesses of initial product would be found through the discussion among experts. The weaknesses would be fixed through the first revision. The revision of the design was done by the researcher to produce an appropriate product.

4) Limited Try Out

After the product was validated and revised, it was tried out in a small scale (limited). The try out could be used as a medium to collect the empirical data about worksheet and question feasibility (Trianto, 2010). The data that could be gained were reliability, validity, difficulty level, answer pattern, the effectiveness of distraction, etc.

5) Second Revision

The weaknesses of the instrument that had been made and tested were found in the limited try out.They were fixed in the second revision. The result of the second revision was a more accurate product.

6) Large Try Out

The product that had been tested in limited try out and revised was then tested in a large try out in groups. It was done to find the result of worksheet and students' test. The result was quantitative data in the form of score. The score was interpreted into a standard score with specific criteria.

D. Disseminate Stage

It was a stage in which the developed instrument was used in a larger scale, for example in other classes, schools, and by other teachers. The purpose was to assess the effectiveness of the instrument in learning activity.

## RESULT AND DISCUSSION

A. The Validity and Reliability of *PEKA*-based Thinking Activity Worksheet.

Based on the experts and teachers' suggestions, some revisions were done for *PEKA*-based Thinking Activity worksheet. The result of worksheet assessment given by the lecturers and teachers can be seen in Figure 1 below.

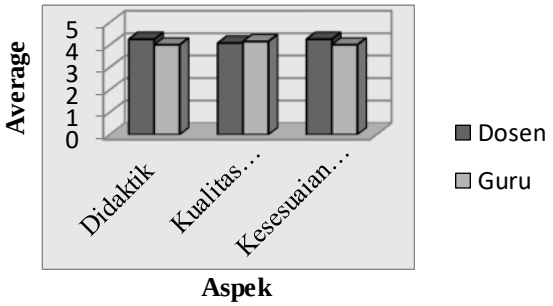


**Figure 1.** The Result of Thinking Activity Worksheet Validity

According to Figure 1, it can be seen that the average score given by lecturers and teachers is good in all aspects. The aspects assessed were didactic, quality, and conformity with the material (Prastowo, 2011). However, the worksheet should be revised based on the suggestions given by the lecturers and teachers.

Seen from the reliability, worksheet 1, 2, and 3 had a high reliability except for worksheet 1 in the last point about the work on inclined and vertical plane. In this point, only one student who could solve the problem correctly and the student was the smart one. The first and second assessments had different scores, therefore the reliability was very low. This point was re-examined, but the problem was not changed because it was made intentionally to develop students' thinking ability in concluding different phenomena. Assessment rubric was fixed into a clearer version. However, it can be concluded that the rubric used in Thinking Activity worksheet is reliable or not ambiguous.

B. Posttest Validity and Reliability

Posttest was conducted in the second day after Thinking Activity was done by the same five students. After that the validity and reliability of the posttest were analyzed. The validity was analyzed using SPSS 17, while reliability was analyzed using Iteman™.

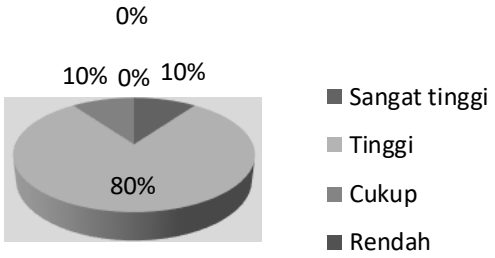


**Figure 2.** The Result of Posttest Analysis

According to Figure 2, most of the questions in the post test have high validity namely 80% out of 10 multiple choices questions. However, there are some questions with intermediate validity. At this rate, revision is needed by considering the difficulty level and distinguishing capacity. The reliability of the worksheet is 0.794, interpreted as very good. For the essay part, the validity was analyzed based on the assessment given by lecturers and teachers, while the reliability was seen from percentage of agreementin which the assessment was given by 2 assessors. All questions were valid and reliable.

C. Feasibility Level of *PEKA*-based Thinking Activity Worksheet

The result of questionnaire feasibility given to 22 students is presented in Figure 3 below.

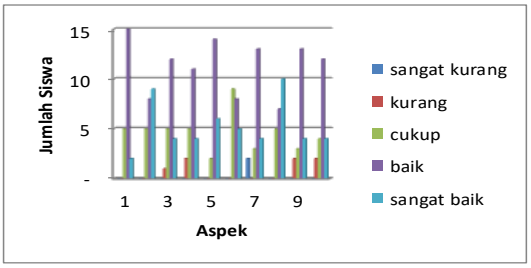


**Figure 3.** The Analysis of Students' Response

It can be seen on the graphic that students gave positive responses for almost all aspects of Thinking Activity worksheet with average score of 3.81. However, for aspect number 3 about the completeness of the material, students

thought that some parts showed incomplete information, for example the experiment design in worksheet 3 about kinetic energy. This incomplete information was intentionally made by the researcher for the students to complete so that the students were able to develop their thinking skill. There were some students who gave negative responses for aspect number 4 about the clarity of the information. It was because some sentences in the direction were not clear enough. In addition, the assessment for aspect number 9 and 10 emphasized on fontand layout. There were some negative responses from the students for these aspects because not all students liked the display. It depended on one's taste. Nevertheless, some revisions were done considering the suggestions from the students.

D. The Mastery of Students' Thinking Skill

The Mastery of Students' Thinking Skill or SPS assessed with *PEKA* in the try out can be seen in the figure below.

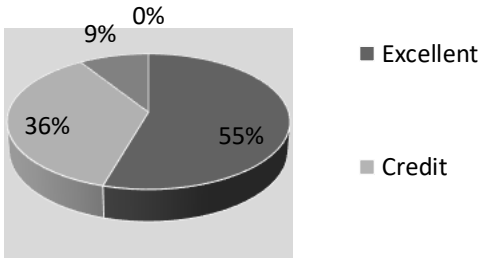


**Figure 4.** The Mastery of Students' Thinking Skill

Figure 4 shows the mastery of scientific thinking skill of the students on some aspects. The aspects of scientific thinking skill which were tested consisted of: classifying, concluding, predicting, communicating, controlling the variables, stating hypothesis, and conducting experiment. 55% students master SPS in *excellent* level,36% students in *credit* level, and 9% students in *satisfactory* level. It means that students have already been able to master some aspects of SPS, although not all aspects are developed. Besides, there is a difference in thinking skill mastery which shows that *PEKA* can be used to assess in the learning process especially for School-Based Curriculum or *KTSP*. It goes along with a research conducted by Kuasai & Kamurudin (2013) which shows that the characteristic of *PEKA* is hand-on and mind-on which is appropriate for many curriculum. Teachers do not find any difficulties in observing the individual, but the assessment can be done using the proofs made by the students. This *Grade* can be re-conversed. The score of thinking skill assessment can be included into cognitive aspect because it is part of cognitive process aspect, or included into assignment score.

E. Post test Result

Post test result on the try out is presented in the diagram below.

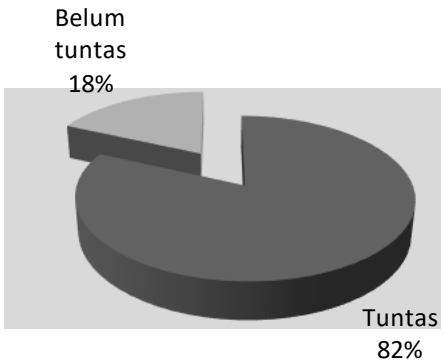


**Figure 5.** Post test Result

The post test result after using *PEKA*-based Thinking Activity Worksheet was good. About 82% of the students passed the post test. The passing grade of Physics in SMAN 1Pakem was 73. The percentage showed that material mastery and thinking skill indicators had been delivered well, although there were some students who did not pass the test.

Based on the research, Thinking Activity worksheet is appropriate to be used in the learning process. The use of the worksheet is effective and efficient as seen from its content which is able to develop students' thinking skill on science along with the assessment for those aspects. The characteristics of *PEKA* are: 1) based on the curriculum; 2) students-oriented; 3) appropriate and systematic; 4) opened and transparent; 5) may use several instruments; 6) continuous assessment; 7) valid and reliable; 8) Positive Reports; 9) continuous supervision.

## CONCLUSION

Based on the research and analysis on the findings, it can be concluded that according to

validity analysis, *PEKA*-based Thinking Activity worksheet is appropriate to be used in physics learning activity with good feasibility. The mastery of thinking skill shows that: 55% of the students are in *excellent* level, 36% are in *credit* level, and 9% are in *satisfactory* level.

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