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Developing Student Worksheet Based On Higher Order Thinking Skills on the Topic of Transistor Power Amplifier

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Abstract. The purpose of this study is to develop a student worksheet about the transistor power amplifier based on higher order thinking skills include critical, logical, reflective, metacognitive, and creative thinking, which could be useful for teachers in improving student learning outcomes. Research and Development (R & D) methodology was used in this study. The pilot study of the worksheet was carried out with class X AV 2 at SMK Negeri 5 Surabaya. The result showed satisfies aspect of validity with 81.76 %, and effectiveness (students learning outcomes is classically passed out with percentage of 82.4 % and the students gave positive responses to the student worksheet of each statement. It can be concluded that this worksheet categorized good and worthy to be used as a source of learning in the learning activities.

1. Introduction

Globalization is a very real phenomenon that is transforming the world economic system including nearly all aspects of life. With the emergence of a new development model, particularly in the highly industrialized economies, knowledge and information take on increasing importance[4]. Thus, the era of globalization has tremendous concomitant implications for knowledge, education and learning. Educational aspect is intended to advance the quality of education in Indonesia as contained in enacted a new Law No. 20 of 2013 on *National Education System*.

The Law sets forth aims and functions of education, and national standards and the principles of the education system. It applies to all educational institutions that exist or may be created in the Republic of Indonesia. Its underlying philosophy is that education is a national movement in order that different stakeholders participate in the development of education as a life-long process. As such, the Law recognizes active partnership with local government and other local authorities in the process of education decentralization.

In order to realize the goal of national education in Indonesia that then formed a new curriculum in the 21st century, the 2013 curriculum[3]. The application of Curriculum 2013 at the Vocational High School (SMK) refers to the paradigm of 21st century learning curriculum which leads to changes of the Education Unit Level Curriculum (KTSP) to the 2013 Curriculum. These changes include the change of teaching to learning, from a teacher-centered learning into a student-centered learning, and from passive learning to active learning.

All the teaching and learning systems are updated in accordance with the 2013 curriculum. Not only the system of teaching and learning, but also learning device was overhauled to re-adjust to the learning system used. Learning device in question includes syllabi, lesson plans, worksheets,



evaluations, modules, and other learning tools that support the learning process. Using the 2013 curriculum, the process of learning is the process of Higher Order Thinking (HOT).

Higher order thinking skills include critical, logical, reflective, metacognitive, and creative thinking[1]. They are activated when individuals encounter unfamiliar problems, uncertainties, questions, or dilemmas. Successful applications of the skills result in explanations, decisions, performances, and products that are valid within the context of available knowledge and experience and that promote continued growth in these and other intellectual skills. Higher order thinking skills are grounded in lower order skills such as discriminations, simple application and analysis, and cognitive strategies and are linked to prior knowledge of subject matter content. Appropriate teaching strategies and learning environments facilitate their growth as do student persistence, self-monitoring, and open-minded, flexible attitudes.

This definition is consistent with current theories related to how higher order thinking skills are learned and developed[2]. Although different theoreticians and researchers use different frameworks to describe higher order skills and how they are acquired, all frameworks are in general agreement concerning the conditions under which they prosper.

On the subject Basic Electronics Engineering at SMK Negeri 5 Surabaya, the 2013 curriculum has been implemented properly by using cooperative learning model as recommended by the education minister[8]. Applying bi-polar transistor as the power amplifier is the basic competencies that have not been obtained by the students of class X AV in the process of teaching and learning in the classroom, and worksheets to the basic competence is also not available from the teachers of the concerned in SMK Negeri 5 Surabaya, to the researchers want to use such material as the material development of worksheets in a study conducted with the hope of helping teachers to make students' better understanding of the material. The purpose of this study is: Determine the validity, practicality, and effectiveness of student worksheet based on HOTS which the 2013 curriculum implementation in the basic competence to apply bi-polar transistors as power amplifier in SMK Negeri 5 Surabaya.

2. Methodology

This research study was carried during the academic year of 2013-2014 in the class X Audio Video department at SMK Negeri 5 Surabaya. Research and Development (R & D) methodology was used in this study [6].

A worksheet based on HOT, which could be useful for student to support their awareness and knowledge of bi-polar transistors as power amplifier, was developed about factors effecting solubility. While the worksheet was developed, these next steps were taken:

1. A topic was determined for preparing the worksheet.
2. Which HOT could be gained from the worksheet were confirmed.
3. A draft of the worksheet was prepared.
4. Experts' input was solicited and received for consideration.
5. The worksheet was revised according to experts' recommendations.
6. The worksheet was applied as a pilot study to bi-polar transistors as power amplifier

In addition, we used FJ King et al approach for teaching strategies. Lessons involving higher order thinking skills require particular clarity of communication to reduce ambiguity and confusion and improve student attitudes about thinking tasks. Modelling of thinking skills, examples of applied thinking, and adaptations for diverse student needs were part of Lesson plans. Scaffolding (giving students support at the beginning of a lesson and gradually requiring students to operate independently) helps students develop higher order learning skills. However, too much or too little support can hinder development. Useful learning strategies include rehearsal, elaboration, organization, and metacognition.

Lessons specifically designed to teach specific learning strategies. Direct instruction (teacher-centered presentations of information) used sparingly. Presentations were short (up to five minutes) and coupled with guided practice to teach sub skills and knowledge. Teacher- and/or student-generated

questions about dilemmas, novel problems, and novel approaches elicit answers that have not been learned already.

Sincere feedback providing immediate, specific, and corrective information informs learners of their progress[5]. Small group activities such as student discussions, peer tutoring, and cooperative learning effective in the development of thinking skills. Activities involve challenging tasks, teacher encouragement to stay on task, and ongoing feedback about group progress. Computer-mediated communication and instruction provide access to remote data sources and allow collaboration with students in other locations.

Valid assessment of higher order thinking skills requires that students be unfamiliar with the questions or tasks they are asked to answer or perform and that they have sufficient prior knowledge to enable them to use their higher order thinking skills in answering questions or performing tasks. Psychological research suggests that skills taught in one domain can generalize to others. Over long periods of time, individuals develop higher order skills (intellectual abilities) that apply to the solutions of a broad spectrum of complex problems.

Three item/task formats are useful in measuring higher order skills: (a) selection, which includes multiple-choice, matching, and rank-order items; (b) generation, which includes short-answer, essay, and performance items or tasks; and (c) explanation, which involves giving reasons for the selection or generation responses[7].

In addition classroom teachers recognize the importance of having students develop higher order skills yet often do not assess their students' progress. Several performance-based models are available to assist them in teaching and assessing these skills. Comprehensive statewide assessment of higher order skills is feasible but would be expensive.

3. Results

The results from this study are the student worksheet based on higher order thinking skill, which is used as a source of learning in the learning process. Details of worksheet development are as follows and part of the worksheet can be seen in Figure 1.

- a. Defining the problem
- b. Determining solution
- c. evaluating solutions
- d. applying the solution
 - (1) Formulating Problems
 - (2) Formulate Hypothesis
 - (3) Determining Variable
 - (4) Designing Step Trial
 - (5) Conducting Experiments
 - (6) Write the Experimental Results
- e. Analyze

This study was conducted to determine the feasibility of student worksheet. It can be seen from the results of the validation, the results of student responses, and student learning outcomes-based the 2013 curriculum for basic electronics engineering subjects on the basis of competence apply bipolar transistor as power amplifier.

Evaluation phases done by evaluate learning process used student worksheet and analyze data of practicality and effectiveness. Validation student worksheet is categorized into three criteria: appearance, language, and content. Based on validation calculations to the overall criteria indicates that the worksheets are valid with a percentage value of 82 %. From these categories can be concluded that the worksheet suitable as a source of learning in the learning activities.

A. Problems
How to create a simple mini amplifier to work properly to generate great gain (output greater than input)

1. Definition of Problems
Based on the problem review given above, define the problem definition by applying a simple mini amplifier to the electronics device to apply bi-polar transistors as a power amplifier.

2. Determining Solutions
From the above problem, find some alternative solutions that might solve the problem.

3. Evaluating Solutions
From these solutions, determine the best solution to solve the predetermined problem.

4. Implementing the Solution

a. Formulating Problems
→ Question research that contains two variables, namely variable manipulation and response variables
Make a problem formula related to the problems that have been determined!

b. Formulating Hypotheses
→ temporary answers (guesses) to the results of the experiment to be performed
Based on the problem formulation, write a hypothesis!

c. Define Variables
Based on the problem formulation, determine the experimental variables!
(1) Variable Manipulation → variables that deliberately made a difference
(2) Control Variables → variables are created equal
(3) Variable Response → variable of manipulation variable manipulation result

d. Designing an Experiment Step
To test the truth of the hypothesis you have written down, you can do an experiment. Arrange the experiment design based on the formulation of the problem you have created. These tools and materials will make it easier for you to set up a test step.

Experiment Steps
Write down the experiment steps that you will do in the fields provided below.

c. Conducting an Experiment
Experiment in accordance with the experimental steps you have made in accordance with the circuit drawing below!

Figure 1. Mini Amplifier Circuit Scheme

f. Experiment Results
Based on the experiments you have done, write down the results of the experiments you obtained.

5. Analyze
After experimenting, analyze the results of the experiments (shortcomings and strengths) by writing it down below.

B. Conclusions
Based on the experiments that have been done, write down a conclusion that you get!

Figure 1. Part of worksheet development of bi-polar transistors as power amplifier

In addition the results of student responses of 17 students who work on worksheets, there are three students who received a score of 70; 6 students who received grades of 80; and 8 students received grades of 90, which means that amounted to 17.65% from 17 students obtained a score of 70; amounting to 35.29% of the 17 students received grades of 80; and amounted to 47.06% from 17 students received grades 90. The total overall value of these was in 1390, with an average value of 81.76. Finally, practicality quality using student response questionnaire based on actual score is 81.5 %, it means student worksheet is practice.

The measurement of higher order thinking skills requires that students are unfamiliar with the questions or tasks they are asked to answer or perform and that they have sufficient prior knowledge to enable them to apply their higher order thinking skills to answer the question or solve the problem. Meeting these requirements is problematic in dealing with either real-life or subject-matter domain problems. Student profiles of correct answers can help to determine the extent to which the overall assessment is novel for individual students.

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