The development of physics learning tools in vocational high school based constructivism approach using learning cycle 5E model

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Abstract. Teachers should be able to develop a learning tools that can improve the students’s ability to build knowledge and formulate their own concepts in the learning process. One of learning models that can support these purpose is learning based constructivism approach using learning cycle 5 E model. The type of research is research and development using 4-D model consist of define, design, development and disseminate. The research instrument used was a questionnaire (RPP validation, validation module, validation worksheets, assessment and response validation teacher) and RPP feasibility sheet. The data analysis technique used is descriptive statistics to obtain an average value and the percentage of the validity and practicality of learning tools. Based on the analytical validation of data is known that the developed learning tools considered valid. Based on the data analysis of the test results is known that the learning tools developed practical and effective category. From these results it can be concluded that the learning tools of physics based constructivism approach using learning cycle 5 E model at class XI TITL SMK Negeri 1 Rao Selatan developed are valid, practical and effective and it can enhance student competence.

1. Introduction
Vocational secondary education prioritizes the development of students' abilities to be able to work in certain fields, the ability to adapt in the work environment, see work opportunities and develop themselves. This is in accordance with the National Education System Law 2003 article 15 which states that "Vocational education is secondary education that prepares students primarily to work in certain areas of expertise". Therefore, the government must be able to develop vocational curriculum so that it synergizes with the industrial world, including facing other technical challenges, namely preparing professional teaching staff and understanding the goals of vocational education and skills in schools.

The purpose of vocational education is in line with the objectives of learning physics. The purpose of learning physics is to form a good human nature, leading to habits of thinking and behaving scientifically, confident and having high work ethics to get the best work, be responsible for utilizing the environment productively as a source of learning, and be able to work with others. This goal implies that learning physics is expected to help students understand the concepts and principles of physics correctly through learning. Furthermore, concepts and principles of physics should be applied by students to solve problems of daily life. This can help students develop more critical thinking and physics learning ways.
Vocational High School requires students to be able to understand and apply physics to support the mastery of productive subjects. Based on observations on learning physics at SMK N 1 Rao Selatan, it was revealed that the implementation of learning as expected was not done well and there were still many students who did not like physics. This is caused by students' views about physics lessons that are less interesting and teacher-centered. The teacher explains, students do the work, and the teacher evaluates the task. Physics learning still emphasizes the concepts contained in the book and does not utilize the environment and learning resources around the school. As a result, students have not been able to grow the ability and character of critical thinking, work and be scientific, communicate and apply what is learned in school to solve problems in everyday life.

The learning tools used in learning physics at SMK Negeri 1 Rao Selatan also do not yet support the achievement of physics lessons. The syllabus used by teachers is not in accordance with the characteristics of students, as seen from indicators of achievement of competencies and learning activities contained in the syllabus. Indicators of competency achievement in the syllabus have not clearly described behaviors that can be measured to show the achievement of basic competencies. In addition to the syllabus, the lesson plans used by teachers are still incomplete. In the learning planning that has been made, the teacher has not used a learning model that is in accordance with the characteristics of the material and the development of students' level of thinking. In addition to minimal textbooks, students also do not have worksheets that guide students to conduct experiments. Meanwhile, the assessment sheet used by the teacher is not in accordance with the indicators of student competency achievement, so that the assessment performed is not optimal. Assessments conducted by teachers are more focused on the cognitive domain of students only, while for psychomotor and affective there is no assessment sheet, so the teacher's assessment of competence is ambiguous and not directed. From observations of the learning tools used, it can be concluded that the learning tools used by the teacher have not been able to support the achievement of student competencies.

One way that can be done by the teacher in guiding students in finding concepts is to apply a learning approach that is in accordance with the characteristics of the material. One approach to learning that is relevant to learning physics is the constructivism approach. In the constructivism approach students find themselves or apply knowledge and actively solve problems in order to understand that knowledge. One model that uses a constructivism approach that can be used in learning in schools is a learning cycle model. The learning cycle model involves students in learning activities that actively assimilate, accommodate, and organize the organization into cognitive structures. The 5 E learning cycle consists of five phases, namely Engagement, Exploration, Explanation, Elaboration and Evaluation. The learning cycle model 5 E actively involves students in finding ideas / ideas through investigation to form a concept, solidifying the concepts learned, preventing the occurrence of concept errors, and providing opportunities for students to apply concepts that have been learned in new situations. By involving students actively and directly to build their own concepts of learning will be more meaningful. The implementation of the learning cycle 5 E model in learning is in accordance with the view of constructivism in which knowledge is built on the students.

2. Method
The method of research is research and development. The development research methods are research methods used to produce certain products and test the effectiveness of these products [9]. This development research is used to create new products in learning, namely developing constructivism-based physics learning tools using the learning cycle model 5 E class XI of Vocational High School. The product developed consists of syllabus, lesson plan (RPP), handouts, LKPD and assessment. The development of this learning tool uses the 4-D development model (four-D model), namely defining, designing, developing and disseminating proposed by Thiagarajan, Semmel and Semmel (1974) [10].
3. Result and Discussion

3.1. Defining Phase Results

The definition phase aims to define the learning requirements. Activities carried out at this stage include collecting, analyzing curriculum, materials, and students. The analysis of the curriculum aims to find out and examine the extent to which competencies must be possessed by students who are demanded by the curriculum based on competency standards and basic competencies, so that learning tools that are useful in conducting learning activities in class are produced. Curriculum analysis is carried out referring to the principles of curriculum development, such as centering on the interests of students and the environment, diverse and integrated, relevant to the needs of life. Analysis at the curriculum stage results are obtained from four components namely the components of objectives, content, methods and evaluation. Based on the results of curriculum analysis the results are as shown in the table 1.

| Table 1. Results of curriculum analysis |
|-----------------------------------------|
| Curriculum Components and Curriculum Analysis Results | Purpose | |
| The curriculum is developed in accordance with the principles of development such as centering on the interests of students and the environment, diverse and integrated, relevant to the needs of life. | |
| Analysis of Competency Standards and Basic Competencies is specific to the Temperature and Heat material studied in semester XI of 1st semester SMK. In accordance with the standard content of Physics subjects at the Vocational High School level, the competency standards required of students are to apply the concept of temperature and heat. | |
| Furthermore, the Basic Competencies required are: | 1. Mastering the concept of temperature and heat. | |
| 2. Mastering the effect of heat on substances. | 3. Measuring temperature and heat. | |
| 4. Calculate the heat. | |
| Component Contents | Temperature and heat are divided into 4 meetings with an allocation of 3jp for each meeting. The concepts to be studied in temperature and heat material are temperature and heat, expansion, changes in the form of substances and the principle of Black, and heat transfer. | Component Method |
| 1. Approach: constructivism | 2. Model: Learning Cycle 5 E | |
| 3. Learning is student centered. | |
| Evaluation Component | 1. Assessment of cognitive competence through written tests. | |
| 2. Evaluation of affective competence through observation during the learning process. | 3. Assessment of psychomotor competence through observation during the learning process. | |

Concept analysis is intended to identify concepts that will be taught so that they can be arranged systematically in the order in which they are presented. The results of this concept analysis will be elaborated on the physics learning device designed. Concept analysis is intended to identify concepts that will be taught so that they can be arranged systematically in the order in which they are presented. The results of this concept analysis will be elaborated on the physics learning device designed.

Analysis of students is a study of the characteristics of students in accordance with the design of the development of learning tools and the implementation of learning can take place smoothly. In this study the researchers took samples of class XI TIPTL SMK 1 Rao Selatan because students in this class are considered to have a high level of knowledge and they have formal levels that are expected to be directed towards systematic and complex thinking.
3.2. Designing Phase Results

After curriculum analysis, student analysis, and material analysis, the design phase will be carried out on the development of constructivist-based vocational physics learning tools using the learning cycle model 5 E. The learning devices designed include syllabus, lesson plans, handouts, LKPD, and assessments made based on constructivism using the learning cycle model 5 E.

3.3. Development Phase Results

After the stages of defining and designing constructivist-based physics learning devices using the learning cycle 5 E model are completed, the learning tools consisting of syllabus, lesson plans, handouts, LKPD and the assessment will be validated by several validators to see the feasibility of the product being made. The validation was carried out by 5 validators namely 3 validators came from UNP lecturers and 2 other validators came from physics teachers who taught at SMK Negeri 1 Rao Selatan. From the suggestions given by the validator, a revision of the learning kit was carried out before evaluating the device validation sheet. After the revision, the learning kit is submitted to the validator for re-evaluation. The device can be tested if the validator assesses that the learning device is valid.

After the validation process is carried out by experts, a field trial is then conducted. The trial was conducted at SMK Negeri 1 Rao Selatan Class XI TIPTL. The trial run was held four times. A trial was conducted to obtain the practicality and effectiveness of the learning tools that had been developed. The practicality values obtained include observations of the implementation of lesson plans, teacher questionnaire responses, and student questionnaire responses.

Analysis of the data obtained from the results of observations of the implementation of lesson plans at the four meetings can be seen in table 2.

Table 2. Observation Results on the Lesson Plan Implementation of Test Class

| Meeting | % Average Observer Rating | Average MD | AU |
|---------|---------------------------|------------|----|
| 1       | 84,5                      | 88,1       | 86,3|
| 2       | 86,9                      | 91,6       | 89,2|
| 3       | 91,6                      | 91,6       | 91,6|
| 4       | 94,1                      | 95,2       | 94,6|
| Average |                          | 90,4       |    |

Based on table 2, it appears that during learning activities take place, the implementation of lesson plans is at an average of 90.4% with a very practical category. So it can be concluded that the implementation of constructivism-based RPP using the Learning Cycle 5 E model that has been developed is very practical in its use and has been carried out as well as possible.

Teacher response questionnaire is given to find out the teacher's response to the learning device that has been developed. The questionnaire was filled by two physics teachers. The questionnaire compiled consisted of practical sheets, lesson plans, handouts, LKPD and assessment. In summary the results of the practicality sheet on the teacher's response can be seen in table 3.

Table 3. Practicality Results Questionnaire Teacher Test Response Class

| No | Teacher Response Questionnaire | Average Observer Rating | Average (%) |
|----|--------------------------------|-------------------------|-------------|
|    |                                | MD                      | AU          |
| 1  | Syllabus                       | 85                      | 90          | 87,5        |
| 2  | Lesson Plan                    | 85                      | 90          | 87,5        |
| 3  | Handouts                       | 91,67                   | 95,83       | 93,75       |
| 4  | Student’s Worksheets           | 93,75                   | 93,75       | 93,75       |
| 5  | Assessment                     | 87,25                   | 87,5        | 87,25       |
|    | Average                        |                         | 89,95       |
Table 3 shows that the teacher’s assessment of constructivist-based vocational physics learning tools using the Learning Cycle 5 E model that has been developed has an average value of 89.95% and is in the very practical category. Thus, practitioners consider that learning tools that have been developed are very practical to use and help facilitate teachers in conveying the concept of temperature and heat and are practical in their use.

Questionnaire responses from students were given to all students in the study class concerned to determine the practicality level of constructive visibility handouts and LKPD using the Learning Cycle 5 E model that has been used. In brief, the results of a questionnaire analysis of student responses can be seen in Table 4.

| Teaching Tools          | Average(%) | Category  |
|-------------------------|------------|-----------|
| Handout                 | 83.5       | Very practical |
| Student’s Worksheet     | 84.7       | Very practical |
| **Average**             | **84.1**   | **Very practical** |

Table 4 shows the results of the analysis of students’ responses to the device that has been developed is 84.1% and is in the very practical category.

From the results of the three questionnaires, namely the implementation of the lesson plan questionnaire, teacher response questionnaire, and student response questionnaire obtained an average of 88.15%. According to the practicality category, the value is in the 81-100 interval with a very practical category. So it can be concluded that the learning tools that have been used in the form of handouts and LKPD are very practical to use and help and facilitate students in the learning process.

Effective use of learning tools seen from the results of learning in the realm of cognitive, affective, and psychomotor. The cognitive assessment results of students are obtained by analyzing the ability of students in answering the questions given at each meeting at the end of learning. After that, the average scores for the four meetings and completeness were obtained at each meeting. The average value of the four meetings was 73.8 with a percentage of completeness of 85.4%. From these results it can be concluded that students have experienced classical completeness above 85%. This percentage shows that the device used is effective in improving student learning outcomes in the cognitive realm. The results of the students’ attitude assessment are obtained from the observations of the students’ attitudes during the learning process. The data obtained from the observation sheet was filled with 2 observers to observe the students’ attitudes during the learning process. There were 7 aspects of student attitudes that were observed. At each meeting there was an increase in the attitude of students which was seen from the number of students who were in the category of "good" and "very good" attitudes increasing and had achieved classical completeness for each meeting. Psychomotor assessment results were observed when students conducted experiments. The average value of student learning outcomes in the psychomotor domain ranged from 62.2 to 91.3 while the psychomotor scores in all aspects of 80.4 with a good category. Thus at every meeting there is an increase in the skills of students.

3.4. Dissemination Phase Results

The dissemination phase is carried out after the device developed has been declared valid, practical and effective. In this study the deployment phase was carried out on a small scale, namely in different classes at the same school. The distribution phase was carried out in class XI TKJ 1 with 28 students consisting of 9 men and 19 women. The device distribution was carried out four times. The deployment phase is carried out to determine the feasibility of learning using constructivist-based tools using a learning cycle model 5 E that has been valid, practical and effective. The implementation of learning in the distribution class is known from the results of observations of the implementation of lesson plans and the learning outcomes of students in the distribution classes in all three domains.

The results of the implementation of the RPP for each meeting are in the very practical category both from the preliminary stage, core activities, and closing. During the learning activities, the
implementation of the RPP was on average 93.3% with a very practical category. So it can be concluded that the implementation of constructivism-based RPP using the Learning Cycle 5 E model that has been developed is very practical in its use and has been carried out as well as possible.

The average student learning outcomes in the cognitive domain can be known at the first meeting, out of 28 students 24 students were known to be complete and 4 students were incomplete because they scored below the KKM (<70). Whereas for meeting II and meeting III there were 3 students who were incomplete. At the fourth meeting there were 3 students who were incomplete. The average value of the four meetings was 78.3 with a percentage of completeness 89.3%. From these results it can be concluded that students have experienced classical completeness above 85%. This percentage shows that the device used can improve student learning outcomes in the cognitive realm attitude assessment for all aspects obtained an average of 74.9% with good criteria. At each meeting there is an increase in the attitude of students which can be seen from the number of students who are in the category of "good" and "very good" attitudes that have increased and have achieved classical completeness for each meeting. The average value of student learning outcomes in the psychomotor domain ranged from 63 to 93.6, while the psychomotor scores in all aspects of 81.7 with a good category. At each meeting there is an increase in students' skills. This shows that the device used can improve student learning outcomes in the psychomotor domain.

From the results of observations of the implementation of lesson plans and student learning outcomes in all three domains, it can be concluded that constructivism-based learning tools using the learning cycle 5 E model have been implemented well in the dissemination class.

4. Conclusion

Based on the development and trials that have been carried out on constructivism-based vocational physics learning devices using the 5 cycle learning shows that constructivism-based vocational physics learning tools use the 5 E learning cycle model that is developed in the valid, very practical, and effective category. As for the dissemination of constructivism-based vocational physics learning devices using the 5 E learning cycle model can be carried out well in the disseminate class.

5. References

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