

The Effectiveness of Physics Learning with Science Environment Technology and Society Approach to Improve the Students Competence

Usmeldi

Department of Electrical Engineering, Universitas Negeri Padang, Padang 25131, Indonesia

usmeldy@yahoo.co.id

Abstract. Physics is one of the subjects at Vocational High School. Preliminary surveys show that many students do not mastery learning, making it difficult to mastery and apply the concept of physics in technology and the surrounding environment. Therefore, physics learning with Science Environment Technology and Society (SETS) approach is implemented. The aim of this research is to know the effectiveness of physics learning with SETS approach to improve students' competence. This research used the quasi-experiment method with pretest-posttest group control design. The research subjects were the students of tenth grade in Vocational High School in Padang, Indonesia. Data were collected use observation sheet, learning outcome test, and questionnaire of student response to the implementation of physics learning. The result shows that physics learning with SETS approach effective to improving the student competencies, in terms of (1) mastery learning of students have been achieved by the majority of student, (2) improvement the student competence were including high category, (3) the majority of the students stated that physics learning with SETS approach can be implemented.

1. Introduction

One of the efforts taken by the government to realize the national education goals was to implement the 2013 curriculum. The 2013 curriculum was a curriculum that is expected to produce students who are productive, creative, and innovative through structuring mindset, deepening and expanding the subject matter. Curriculum change is basically a change in mindset and learning methods in the classroom. The 2013 curriculum emphasizes the pedagogical dimension of learning, namely use the scientific approach. The scientific approach in learning is observing, asking, trying, reasoning, and communicating. Learning material is related to facts or phenomena that occur in everyday life. The learning process is student-centered and allows students to be more active in learning. The availability of teaching materials in schools is one factor that greatly influences the quality of learning. The teaching method was related to the teaching material used. Teaching materials should facilitate students to construct their knowledge and find concepts through problem-solving.

Based on preliminary studies it was found that the implementation of physics learning at Vocational High School was not in accordance with the learning objectives. Students do not understand various natural phenomena. Want to know the students about physics material and its

relationship with the environment and technology is still difficult to grow. Students have difficulty in integrating the knowledge they already have with new knowledge. Students have not been able to apply the physics material that has been studied on natural phenomena and technology. This problem occurs because students' understanding of the subject matter is not good. Students understand the subject matter in the form of solving problems and memorizing physics formulas. Application of physics subject matter in technology and daily life/society is still very lacking, so learning becomes less meaningful. The impact is that many students are not motivated to learn physics, this causes low student learning outcomes. The average semester exam scores for tenth-grade students have not reached the minimum mastery learning criteria for physics subjects, which is 70. According to the teacher, the learning outcomes are also influenced by students' attitudes. Learning outcomes are low because during the learning process students do activities that are not useful. For example, when the teacher asks students to discuss in small groups, most students do not participate in discussions. When the teacher explains the subject matter many students are noisy. In addition, few students want to express their opinions about the subject matter. The problem is thought to originate from the unconnected learning material by students' daily lives so that students do not know the benefits of studying physics.

Efforts that can be made by teachers to solve this problem include choosing and using relevant learning approaches. Already many researchers have conducted research to find suitable learning approaches to solve the problems related to the application of physics in technology, environment, and society. The approach chosen is an approach whose objectives were suitable to the demands of the 2013 curriculum. The intended learning approach is the learning approach of the Science Environment Technology Society (SETS). Dynamic electrical learning in physics is suitable to be conducted by the SETS approach because dynamic electrical material will be easily understood if it is related to the technology and daily life of students. With SETS stages students are invited to observe dynamic electric phenomena that occur in the environment, technology, and society. Learning with SETS requires students to explore knowledge initially based on daily experience. Observation of natural phenomena through several stages of learning, namely invitations, exploration, principle formation, application of principles, strengthening of principles, and assessment.

SETS learning steps are suitable for the scientific approach. Students are required to observing, asking, trying, reasoning, and communicating. Observing and questioning activities are carried out at the exploration stage. At this stage, students are required to explore their initial knowledge. Data collection and reasoning activities are carried out at the principle formation stage. Students are guided to collect data and reasoning through theoretical and practical learning. Furthermore, at the application stage, students are required to be able to understand the concept and apply science in the environment and society. In the stabilization stage, the principle of students is guided to be able to express their observations. This can be done by presenting the results of the observations in class. Other students can express their opinions if there are differences in the results of their observations. At this stage there is communication between students, the teacher gives an explanation on the learning material which is still considered confusing to students.

The SETS approach can connect the real-world life of children as members of society with the class as a learning space for science [1]. This learning process can provide learning experiences for students in identifying problems, collecting data related to problems, considering alternative solutions, and considering the consequences based on certain decisions. Science education is essentially an understanding, awareness, and development of positive values about the nature of science through learning. Science is essentially a science and knowledge of natural phenomena which includes processes and products.

The SETS approach is an integrated learning approach that involves elements of science, technology, environment, and society. Through this approach, students are raised their awareness of the relationship between SETS elements and condition students to be able to apply science to produce technological work, followed by the development of critical thinking on the possibility of the emergence of positive or negative impacts of technological products on the environment and society.

The SETS approach is learning that links the four elements, namely science, environment, technology, and society in learning [2]. Study material is associated with real examples that relate to the community around students that are often found in everyday life so that it is easy to understand the material. SETS-approached learning offers the advantage of forming graduates who have reasoning ability and comprehensiveness of thinking when students are faced with a problem to be solved [2]. In SETS learning teachers and students alike have a decisive role in achieving learning goals. The role of the teacher creates a pattern of thinking that sees the future with its various implications, bringing students to always think integratively and critically in dealing with problems with reference to SETS.

The SETS approach is intended to bridge the gap between advances in science and technology. The SETS approach in the view of social sciences and humanities provides an understanding of the link between science, technology, and society, sensitizing students' assessment of environmental impacts as a result of the development of science and technology [3]. The decisions made by the community usually require the use of technology to implement it [4]. In fact, society and science use technology as a means to store information.

The purpose of the SETS approach is to form individuals who have scientific and technological literacy and have a concern for the problems of society and the environment [3]. Learning with the SETS approach seeks to provide an understanding of the role of the environment in science, technology, society. Instead of the role of the community in the development of science, technology, and the environment. Do not miss the role of science to find effective physics concepts, their involvement in technology and the mutual influence on society and the environment. The formulation of the research problem is how is the effectiveness of physics learning with science environment technology and society approach to improve the student competencies?

2. Method

The quasi-experimental with pre-test post-test group control design [5] used for this research. The same matter of pre-test and post-test conducted to student's experimental class and control class. The experiment was conducted on tenth-grade students at Vocational High School (SMKN 1 Padang) in physics subject. The research stage was: (1) preliminary survey, (2) develop of instructional material with SETS approach, (3) validate the instructional material, (4) develop of the research instrument, (5) testing the instructional material and instrument, (6) provide pre-test, (7) implemented the physics learning with SETS approach in experiment class, (8) provide post-test, (9) analyzed the data. The research instruments were the observation sheet, achievement test, and questionnaire.

Effectiveness of implementation of physics learning with SETS approaches in terms of learning outcomes and student responses to the implementation of learning. Improving student learning outcomes were analyzed by the normalized gain score of scores of pre-test and post-test. The mean differences of the students' learning outcomes in the experimental class and the control class were analyzed using the t-test. The data of students response to the implementation of learning was analyzed by comparing the scoring average with score category.

3. Result and discussion

Effectiveness of implementation of the physics learning with SETS approaches to improve the student's competence based on (1) students learning mastery, (2) improved of the student competence, (3) student response to the implementation of physics learning. Furthermore, analyzed each of this aspect to determine the effectiveness of the implementation of the physics learning with SETS approach.

3.1. Students' learning mastery

The student's competence of knowledge domain can be seen from the pre-test and post-test. Pre-test conducted before the students learning with SETS approach, Post-test conducted at the end of each session (class meeting). The analysis result of students learning mastery in the knowledge domain can be seen in Table 1.

Table 1. Students learning mastery in the knowledge domain

Sessions	Average	Learning mastery (%)
1	76.0	68.2
2	79.1	86.3
3	85.0	90.9
4	88.7	95.45
Average	82.2	86.4

Table 1 shows that each session has an increased percentage of students learning mastery. The average value of all sessions was 82.2 with a percentage of students learning mastery was 86.4%. From the result, it can be concluded that the students learning mastery are more than 85%, which state that physics learning with SETS approach effectively in improving students competence in the knowledge domain.

3.2. Improvement the student competency

Improvement the student competence in the knowledge domain was analyzed using a normalized gain score. Table 2 can be seen that the student competence in the knowledge domain has increased at each session. The value of gain score at the high category at the fourth sessions.

Table 2. Gain score of students on the knowledge domain

Sessions	Pre-test	Post-test	Gain score	Category
1	63.2	76.0	0.3	Medium
2	63.2	79.1	0.4	Medium
3	63.2	85.0	0.6	Medium
4	63.2	89.7	0.7	High

Assessment of students competency in the psychomotor domain is obtained when student do the experiment. Assessment of student psychomotor was performed at each session by the observer using the skill assessment sheet. The student psychomotor assessment can be seen in Table 3.

Table 3. The student psychomotor assessment

Sessions	Average	Percentage of the student who has good skill
1	79.5	80.9
2	80.7	83.5
3	84.1	95.8
4	87.5	100

Table 3 can be seen that the student's skill has increased based on the average value from the first to the fourth sessions. From these result, it can be concluded that the student's skill was classically more than 85% which good categorized at the third and fourth sessions. This show that physics learning with SETS approach is effective in improving students competence in the psychomotor domain.

Student competence in the affective domain observed during the learning process. Assessment of student attitude conducted every time the sessions by the observer use the attitude assessment sheet consisting of four aspects of assessment. The student attitude assessment can be seen in Table 4.

Table 4. The student attitudes assessment

Sessions	Average	Percentage of students who have a good attitude
1	66.4	77.9
2	82.1	85.6
3	85.0	100
4	87.0	100

In Table 4 it can be seen that students attitudes have increased based on the average value from first to fourth sessions. From these result, can be concluded that student attitude classically more than 85% are a good category. This show that physics learning with SETS approach is effective to improve student competency in the affective domain.

3.3. The student response to the learning implementation

The student response of implementation of physics learning shows that the average score of student response was 86.3 with deviation standard was 7.8 and included the very good category. The scoring category of student response based on ideal mean and ideal deviation standards. These show that most students can implementation physics learning with SETS approach.

Based on the data analyzed that has been described can be concluded that: (1) mastery learning has been achieved by the majority of the student, (2) improving the student competency include high category, (3) the average score of the student's response to the physics learning implementation was a very good category. Thus it can be concluded that physics learning with SETS approach effectively to improve the student's competence.

3.4. Discussion

The good learning approach was the learning approach that accordance with the learning material. The physics learning with Science Environment Technology Society (SETS) approach can help the students learning the process. The effectiveness of physics learning can be seen from the improvement of student competence in the knowledge, attitude, and skill domain after using the learning process. Student competence in the knowledge domain at the first sessions there are still many students who have not mastery that their learning. This is because at the first session the student was not familiar with the physics learning with SETS approach. They find it difficult to follow the physics learning with SETS approach.

The SETS approach always connects the learning process with real events encountered in everyday life (contextual) and comprehensive (integrated four components of SETS) [6]. The teacher can connect the physics concepts taught with problems in the community so that the learning done in schools is beneficial for the community. The SETS learning approach can connect students' daily lives as members of the community with the class as a place for students to learn. The SETS approach process can provide learning experiences for students in identifying problems, analyzing data related to problems, considering alternative solutions to problems, and their consequences. SETS learning approach to understanding and knowing that physics can produce technology that serves to improve the environment so that it can benefit the community. The generating idea for the use of science concept in new situation use creativity skill, including questioning, proposing explanatory explanations using community resources conversing about science at home taking actions in the community result of science study [7]. Students are easier to understand physics lessons when related to knowledge, attitudes, and skills. SETS acquisitions focused on three main dimensions: (1) nature of science and technology, (2) relations between science and technology, (3) social and environmental context of science and technology [8].

The student's competency in the psychomotor domain was obtained from the observation sheet observed by an observer at each session. The average student skill increases at each session. On the

first sessions the students still difficulty in using the experimental equipment, reading, and recording of the experimental result were also not maximized so that the impact on skill student. At the second to the fourth session, there was an increase.

The student competence in the affective domain shows an improved in each session. This improves occur because the use of physics learning with SETS approach can require the student to find out for themselves and carry out an experiment based on the concept they have learned. The student was independent and responsible for themselves in the learning process in the classroom and in everyday life. Students are accustomed to discipline in doing the task. Students have shown hard work in answering the question of summative evaluation and formative evaluation.

The implementation of the SETS approach can increase student interest and learning outcomes [9]. The SETS approach is effective for teaching students in physics lessons [10]. The implementation of SETS-related learning can be a significant effect on students' cognitive and affective learning outcomes [11]. Physics learning with the SETS approach can improve student critical thinking skills [12].

The Science Environment Technology and Society is effective for science teaching. Students can learn science properly, motivate students, meet their adaptive needs, enhance their interest in sciences, and students become informed citizens and take responsibility [13, 14]. The physics learning using SETS approach can improve students' critical thinking skills and abilities [12]. Physical learning based on SETS can improve student creativity [15] and student learning outcomes [16]. The application of the SETS approach can improve student learning outcomes, especially at the level of thinking of students' analysis by using socio-cultural, political and moral perspectives [17]. The implementation of the SETS approach can improve high-level thinking skills, student learning activities and outcomes [15]. The implementation of the SETS study found that [18]: (1) there were differences in cognitive learning outcomes between students who learned using the SETS approach and conventional learning, (2) students' learning activities using the SETS approach were higher than conventional learning, (3) students gave a positive response to the application of the SETS approach to learning.

The application of the environment that is closest to students, such as daily experience can facilitate problems seen and identify, in this case, the problem is seen as a student learning process [19]. In the learning process of physics in Vocational High Schools, teachers tend to teach subject matter without linking the science with the environment, technology, and society as a whole. Besides that, learning is generally oriented towards the completion of all subject matter without relating to the student's life, as a result, the student lacks the ability to understand the subject matter as a whole with the environment, technology and society [20]. In conventional learning, teachers emphasize subject matter on conceptual understanding without linking the science concept with the environment, technology, and society. Therefore, through the SETS approach, it is expected that students understand knowledge integratively, by paying attention to the elements contained in SETS. Teachers can connect scientific concepts that are taught with problems that occur in the environment around students so that they can help students apply the results of their learning in daily life.

4. Conclusion

The physics learning with SETS approach was effective to improve the students competencies, in term of (1) mastery learning of physics have been achieved by the majority of student, (2) improve the student competence were include high category, (3) the average score of the student response to the learning implementation was very good category, this means that most students can implement physics learning with SETS approach. Suggestion to physics teacher to implemented the physics learning with SETS approach.

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