Annual Meeting of Mathematics and Natural Sciences Forum of Indonesian Institutes of Teacher Training and Education Personnel (MatricesFor IITTEP)

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DEVELOPING OF PHYSICS TEACHING AIDS WHICH ARE ORIENTED ON SCIENTIFIC APPROACH TO SUPPORT THE IMPLEMENTATION OF CURRICULUM OF 2013 IN SENIOR HIGH SCHOOL THROUGH TEACHING EXPERIENCE PROGRAM (PPL)

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Abstract

Generally, this research aims to develop teaching aids of physics instruction that consists of syllabi, lesson plans, and students' worksheet which are oriented on scientific approach. Especially, this research aims to (1) determine the worthiness of teaching aids in physics instruction that is created by physics teacher candidate in Teaching Experience Program (called PPL); (2) determine the scientific ability of senior high school student while teaching aids were implemented in the classroom.

Four-D's Model of instructional design is adopted as a research design that is developed by Thiagarajan (1974). This design consists of four steps such as define, design, develop and disseminate. Then, this research was conducted till develop steps. Subject matter experts were involved as validators. Hence, these teaching aids were implemented in physics instruction that involved of senior high school of SMAN 2 Yogyakarta and SMAN 1 Prambanan. Data were gathered through observation, interview and test. All data were analyzed by qualitative descriptive analyzes.

Results show that (1) physics teaching aids which are developed by physics teacher candidate were appropriate and worthy to improve scientific abilities of the student through physics instruction in Teaching Experience Program; 2) Questioning and observing are scientific abilities of senior high school students that are in low category. The percentage of these achievements are about 50 - 60%.

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Keywords: physics teaching aids, scientific approach, Curriculum of 2013

Backgrounds

The curriculum is one of the supporting elements in the implementation of the educational system. The components of curriculum addressed to give guidance for educational practitioners (teachers) at each level. Teachers should conduct a series of teaching phases such as planning, implementing, assess of learning process, to follow up the results of the assessment, coaching and training of learners, as well as conduct research, and develop a sustainable professionalism. All these competences will improve of their professionalism.

In order to address the needs of the development of science and technology, aspect of the curriculum has always experienced some improvement each period. These aspects have suffered modifications and adjustments based on the needs of the development of science and technology. However, improvements and modifications to these aspects that will be achieved (competencies) in every level of education in practice have not been matched by the readiness of the competence of the teacher who is reaching the achievement of improvement aspects of the curriculum.

The results achieved by Indonesian students of elementary, junior and senior high school in PIRLS and PISA tests are always setbacks and always indicate the tendency to place the learners in the lower ranks than other countries in the Asian region. This condition is one of reasons to develop of The School-Based Curriculum (KTSP) into Curriculum of 2013. This curriculum is implemented in the beginning of academic year of 2013/2014 for targeted elementary, junior and senior high school in Indonesia.

Its implementation begins with the socialization process and public test that involves all aspects of education providers. The implementation of the curriculum begins in grade 1 and 4 for the SD/MI and grade 1 for students of SMP/SMA/MA/SMK. However, in the reality, they often found pros and cons to the improvement of the curriculum. It also occurs in the implementation of the curriculum in 2013 on physics instruction in senior high school.

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Physics is a part of natural science that supports the development of advanced technology and the concept of living in harmony with nature. As the study of natural phenomena, physics also give a good lesson for humans to live in harmony based on natural law. At the senior high school/MA, physics deemed important to be taught as a separate subject with some consideration. First, in addition to providing supplies knowledge to students, the subjects of physics is intended as a vehicle to foster thinking skills that are useful for solving a problem in daily life. Second, the subjects should be taught in physics for a more specific purpose, namely to equip students the knowledge, understanding and a number of capabilities required to enter higher education and develop science and technology. To that end, students need to be equipped with sufficient competence, especially in activities of learning process. However, the ability to think, work, communicate, and students' scientific attitude are not optimal. It can be indicated by the ability of science process skills.

There are a lot of research that studied about science process skills. Findings showed that science process skills of elementary school students of Sekaran Gunungpati Semarang in classifying, observing, minimizing of errors, and concluding is in low category, amounting to 65.90% (Sochibin A, Dwijananti P, Marwoto P, 2009). Then, Widayanto found that the average value of the percentage of science process skills of students of SMAN 3 Sragen, i.e. observing, classifying, predicting, inferring, identifying variables, creating a table of data, creating graphs to analyze variables, constructing hypotheses, measuring, and designing research at 48.66 % (Widayanto, 2009). Moreover, Triwiyono in Jayapura junior high school research found that the average percentage of students' ability to communicate and make inferences is 52% (Triwiyono, 2011). This condition is not only happened in Indonesia but also in other country. The West African Senior Secondary School Certificate in Nigeria has studied about students' ability in science process skills for 10 years. Results show that the percentage of their science process skill abilities are 17,20% in manipulating of variables, 14,20% in measuring, 13,60% in collecting of data, 12% in observing, and 11,40% in communicating (Akinyemi Olufunminiyi Akinbobola & Folashade Afolab, 2010).

The lack of chances to develop science process skills in teaching-learning process makes students' ability in science process skill difficult to improve. In order to solve this problem, the government tries to develop the curriculum into Curriculum of 2013. But, there are a lot of obstacles while this curriculum is

implemented in some targeted schools. Most of the obstacles is caused by the condition of the teacher that is inability to achieve the indicator of the curriculum. Department of Physics Education Yogyakarta State University, YSU, tries hard to solve this condition through teaching experience program, namely PPL. Students are trained to do some teacher activities in this program. They learn more about teaching approach, teaching materials, teaching aids and some skills that support them to be a professional teacher. They have to be aware with the educational system included the curriculum development. So, they learn about how to implement scientific approach in the classroom through PPL program.

Methods

Research Purposes

This research was guided by the following research purposes:

- Developing teaching aids of physics oriented on scientific approach that capable of preparing prospective teachers of physics that have professional competences in accordance scientifically-based learning physics of curriculum of 2013.
- Determine the feasibility of teaching aids of physics that resulting by student of teacher candidate of physics in PPL activities as product development results.
- Knowing the scientific abilities of senior high school students after the implementation of the teaching aids of physics oriented on scientific approach as a product of development

Participants

Three students of Physics Education Department Yogyakarta State University and 90 students of targeted school participated in this research. Participants enrolled in Micro Teaching participated as a teacher candidate. Students of senior high school in grade X are involved as the subject while the teacher candidates conduct teaching-learning process.

Procedure

Participants (students as teacher candidates) completed courses of micro teaching and teaching experience program. They were guided by the lecturer to develop teaching aids based on Curriculum of 2013 for senior high school in the subject of Physics. Teaching aids were developed through Four D's model adopted from Thiagarajan, Semmel, and Semmel (1974:5) that consists of define, design, develop and disseminate phases. All products were validated by experts and implemented in the classroom. Experts were requested to respond and evaluate the teaching aids. Then, students' achievements in physics which are taught by the teacher candidate measured, especially for scientific abilities based on scientific approach in the Curriculum of 2013. Data were gathered through interview, observation, questioner, and test (performance assessment, paper and pencil test).

Results and Discussion

In the define phase, this phase is done by the student (teacher candidate) through observation of pre-teaching experience program (PPL) in senior high school of YSU partners. At this defining stage, the teacher candidate has studied of physics classroom characteristics, characteristics of scientific approach in the curriculum in 2013, Students' Worksheet and the accuracy of the media to be used as well as the appropriate type of evaluation. Through this stage the problems that arise in trying to develop learning tools and teaching aids with the scientific approach including evaluation instruments capable of measuring the ability of the scientific and students' understanding of a concept of physics. Analysis of the physics syllabus for senior high school, mapping of competences in order to obtain indicators of learning as outlined in the Lesson Plan (RPP) is part of defining the initial stages. Based on the identification during the implementation of the observations set of learning materials studied physics, namely: Measurement.

In design phase, this phase tried to make planning, including designing the kinds of skills, set goals, determine the contents of teaching material, and small scale evaluation that can be applied in physics instruction, especially in the materials of

Measurement. Format of teaching aids refers to and adopts the learning activity in Teacher's Book and Student's Book by Curriculum of 2013.

Researchers involve physics teachers and experts as validators to develop the necessary teaching aids in the teaching materials of measurement. Subjects tested to the initial draft that includes the class X at SMAN 1 Prambanan and SMAN 2 Yogyakarta as PPL schools partner.

Implementation of the initial draft of students' psychomotor assessment that oriented on scientific approach carried out at SMAN 2 Yogyakarta in Class X PMIIA1 and class X PMIIA2. Teachers conduct learning activities in accordance with the learning scenarios that have been developed researcher. The next step, the teacher divides the students into 8 groups and each group consisted of four or five students. Students are given the opportunity to carry out practical activities which has been prepared in Student Worksheet under the direction of teachers. After completion of the laboratory activities, the teacher with the class discussion of the results and their analysis has been done. The following observations on the Practicum 1 and 2 for class X PMIIA 1:

Table 1. Observation Results in Practicum I

Aspects	Percentage of success
The accuracy of selection tools	75%
Procedure of assembling the tool	50%
The accuracy of series of the tool	50%
Procedure of Measurement	62,5%
Data analysis and Table	50%
The accuracy of the conclusion	75%

Table 2. Observation Results in Practicum I I

Aspects	Percentage of success
The accuracy of selection tools	82,5%
Procedure of assembling the tool	75%

The accuracy of series of the tool	75%
Procedure of Measurement	75%
Data analysis and Table	50%
The accuracy of the conclusion	62,5%

Based on observations of student activities in class X PMIIA 1 during practicum 1 and 2 can be observed that the aspects of the procedure of assembling the tool, the accuracy of a series of tools, measurement procedures and data analysis has yet to show the maximum results. This has an impact on the ability of putting together a practical conclusion which is not well developed. Observations process is also carried out on the implementation of the learning process, the results are as shown in the following table:

Table 3. Observation Results in Learning Process

Aspects	Percentage of success
Questioning activities	18,2%
Focus on the explanation of the materials	90,9%
Enthusiasm	100%
Team work	100%

Observations on the implementation of learning in class X PMIIA 2 can be seen in the following table:

Table 4. Observation Results in Practicum I

Aspects	Percentage of success
The accuracy of selection tools	62,5%
Procedure of assembling the tool	50%
The accuracy of series of the tool	50%
Procedure of Measurement	50%
Data analysis and Table	50%
The accuracy of the conclusion	62,5%

Table 5. Observation Results in Practicum I I

Aspects	Percentage of success
The accuracy of selection tools	75%
Procedure of assembling the tool	75%
The accuracy of series of the tool	50%
Procedure of Measurement	50%
Data analysis and Table	50%
The accuracy of the conclusion	62,5%

Tables 4 and 5 show that the results achieved by students in class X PMIIA 2 is also not different with the results of class X PMIIA 1. Observation of student activity during the execution of the learning process in class X PMIIA 2 as shown in the following table:

Table 6. Observation Results in Learning Process

Aspects	Percentage of success
Questioning activities	15,63%
Focus on the explanation of the materials	78,13%
Enthusiasm	100%
Team work	100%

Questioning activities are still low for both classes. Students observe and not take advantage of the activities that have been designed to ask the teacher. The next teaching aids tested to class X in SMAN 1 Prambanan involving two classes. The observation of the learning process and the achievement of results during the laboratory activities did not show a difference results with the results of the achievement at SMAN 2 Yogyakarta. Here is presented the acquisition of the cognitive learning in both schools:

Table 7. Students' Achievement in Cognitive Aspect

No.	Aspects of achievement	Partner School 1		Partner School 2	
		X_1	X_2	X_A	X_B
1.	Highest Score	90	100	100	85
2.	Lowest Score	50	50	75	52
	Average	79,4	80,61	90,27	74,78

Cognitive achievement of learning outcomes in both partner schools PPL showed good results. As for the percentage of the acquisition of five learning experiences during the implementation of learning can be seen in the following:

Table 8. Percentage Achievement of Learning Outcomes

No.	Learning Outcomes	%			
		Partner School 1		Partner School 2	
		X_1	X_2	X_A	X_B
1.	Oberving	**51**	**60**	**55**	**52**
2.	Questioning	**55**	**50**	**50**	**55**
3.	Collecting of information	82	75	75	65
4.	Associating	75	65	75	70
5.	Communicating	90	75	80	75

The above data was obtained by recording the facts processes and products generated during the implementation of learning students. A learning experience that is still not well developed are observing and questioning. Observations during learning activities also showed that both the activity has not appeared well.

Conclusion

Research carried out has successfully developed a physics teaching aids oriented on scientific approach that capable of preparing prospective teachers of physics that have professional competences in accordance scientifically-based learning physics curriculum of 2013. Based on the analysis of research findings, it can be summarized as follows:

1. Teaching aids oriented on scientific approach resulting in a physics student teachers through PPL activities have met the eligibility criteria based on the expert judgment validators and empirical testing in schools as persons try PPL partner.
2. Scientific abilities of senior high school students showed that aspect in order to observe and ask the data acquisition is in low category as indicated by the percentage of success in the range of 50-60%.

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