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Analysis of Problem Solving Skills and Students Scientific Attitudes through the Implementation of Problem Based Learning Module

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Abstract

The purpose of this study was to describe the physics problem solving skills and scientific attitudes of students after applying the Problem Based Learning (PBL) module, obtaining a valid and practical PBL devices and modules, knowing whether the application of PBL learning modules has an effective to improve physics problem solving skills and students scientific attitudes and to know the students response to the application of PBL learning modules. This study uses research on concurrent embedded design combinations, which is a combination research that combines two types of research namely quantitative and qualitative. The sample in this study was selected one class as an experimental class which was treated with PBL learning with PBL modules. Then 6 students were chosen from the experimental class to conduct more in-depth observations about problem solving skills and scientific attitudes. After the application of PBL learning modules, physics problem solving skills and scientific attitudes of students have increased. PBL learning modules are valid and practical. The application of PBL learning modules has effective to improve physics problem solving skills and scientific attitudes of students. There were 88.24% of students giving positive responses and interested in participating in learning activities using PBL learning modules.

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INTRODUCTION

Education is an important aspect in human life. Considering that life in the future era of globalization is full of problems and challenges that are very complex, education must be able to prepare a generation that is able to answer the challenges and problems faced, namely preparing a generation that has personality and is able to solve various problems faced.

Based on the 2013 Curriculum, high school has a learning goal not only to master the information provided by the teacher, but also to develop positive attitudes in learning, research, and discovery and problem solving on one's own skills with scientific steps approach. Learning activities with scientific steps are designed in such a way that students actively construct concepts, principles or laws through observing, questioning, associating, experimenting, and networking.

Students thinking skills need to be grown, so that the mastery of concepts and students problem solving skills increases. The students not only memorize a number of concepts they have learned but they are also able to apply to other aspects. To realize this, schools and teachers as the main component of education need to manage learning in accordance with the principles of teaching and learning activities, among others (1) student-centered activities, (2) learning through action, (3) independent learning and learning to cooperate. So learning is expected not to focus on the teacher, but students can be active in learning (student active learning).

One factor that can support the learning process goes well is the availskills of tools/teaching materials that have been adapted to the needs of students. This device/teaching material is expected to provide convenience and help teachers in carrying out teaching and learning activities in the classroom. According to Aslamiyah et al. (2017) the use of media in learning can also generate motivation to learn and make it easier for students to understand what they are learning, so that students can achieve learning outcomes as expected compared to without using the media. Whereas according to Ukhtinasari et al. (2017) it is necessary to have media/teaching materials in learning so that students do not feel bored and the material can be understood by students. Thus the teacher has an important role in creating interesting and enjoyable learning situations for students so that students become more enthusiastic, focused, and active during learning. According to Rengganis et al. (2015) motivation is the heart of learning, without motivation, so there is no willingness to learn which results in the learning process being difficult to achieve optimum success, learning outcomes are low. This teaching material can be in the form of a module. Modules that are created and developed by educators themselves can be adjusted to the characteristics of students. So far the teaching materials used are still relying on LKS books and general printed books on the market. Another factor that can support the learning process well is to apply learning models that are appropriate to the learning objectives and needs of students.

The conventional learning process that has been practiced so far is less able to train students to learn actively and creatively in solving problems and learning is not yet fully student-centered. This causes the science process skills of students to be poorly trained, even though the science process skills are useful for finding a concept, solving problems and developing their knowledge so that it can be applied in everyday life. The appropriate physics learning strategies and models are needed so that students achieve the expected basic competencies and the learning process takes place effectively and efficiently.

In PBL, all learning arises from consideration of problems. From the beginning, learning was synthesized and organized in the context of problems. Savery & Duffy (1995) states that in PBL students are actively involved in authentic tasks and activities. The focus is on students as constructors of their own knowledge in a context similar to the context in which they will apply that knowledge. Students are encouraged and expected to think critically and creatively and monitor their own function of understanding at a metacognitive level.

The results of Akinoglu & Tandogan's (2007) study state that the PBL model influences student achievement compared to traditional learning which has been applied in schools. In addition, other studies mention that PBL is more effective than classical models based on discovery. According to Wasiso & Hartono (2013) states that the PBL model can improve students skills in problem solving. In addition, according to Nuswowati et al. (2017), the application of PBL models is able to improve students thinking skills and creative actions. In PBL it appears that many students like this model. This is because PBL models can improve problem solving skills and work together in one group. This is reinforced by the results of Wulandari's (2011) research which states that PBL models are able to train students skills in critical thinking, problem solving, collaboration, expressing opinions in writing and verbally. The PBL model also produces higher average learning outcomes, and higher affective assessment than conventional learning. In addition, Satrianingsih et al. (2017) stated that PBL models have a positive effect on cognitive skills and attitudes toward science.

Thus, the PBL model can stimulate students to think critically in problem-oriented situations. Students are faced with a problem that still has to do with everyday life so that physics lessons are more meaningful and useful. Students are required to be active and creative in solving these problems so they can find their own answers to the problems faced by them. By using this model, it is expected that students scientific attitudes can be grown and students problem solving skills can be improved so that learning achievement in physics can increase.

Based on the background described, research was conducted at Futuhiyyah Mranggen High School to analyze problem solving skills and scientific attitudes of students through the application of Problem Based Learning modules. The purpose of this study is to describe the physics problem solving skills and scientific attitudes of students after the application of Problem Based Learning (PBL) modules, to obtain valid and practical tools and PBL learning modules, to find out whether the application of PBL learning modules has effective character improve students physics problem solving skills and scientific attitudes, as well as knowing students responses to the application of PBL learning modules.

METHODS

This research uses mixed methods research with concurrent embedded design, which is a combination research method that combines two forms of research namely quantitative and qualitative research. The subjects for this study were considered 6 students, namely the experimental class students who in the preliminary tests occupied the upper group, middle group, and lower group. Data collection is carried out in natural conditions, primary data sources, and more data collection techniques on role observation (participant observation) as well as in-depth interviews (in depth interviews) and documentation.

The population in this study were students of class X IPA SMA Futuhiyyah in the academic year 2017/2018 consisting of 5 classes. The sample in this study selected one class as an experimental class which was treated with PBL learning with PBL modules to overcome the findings of the problems obtained previously. Another class was chosen as the control class given conventional learning treatment. Then 6 students were chosen from the experimental class to conduct more in-depth observations about students problem solving skills and scientific attitudes. The research design developed in this study is presented in Figure 1.

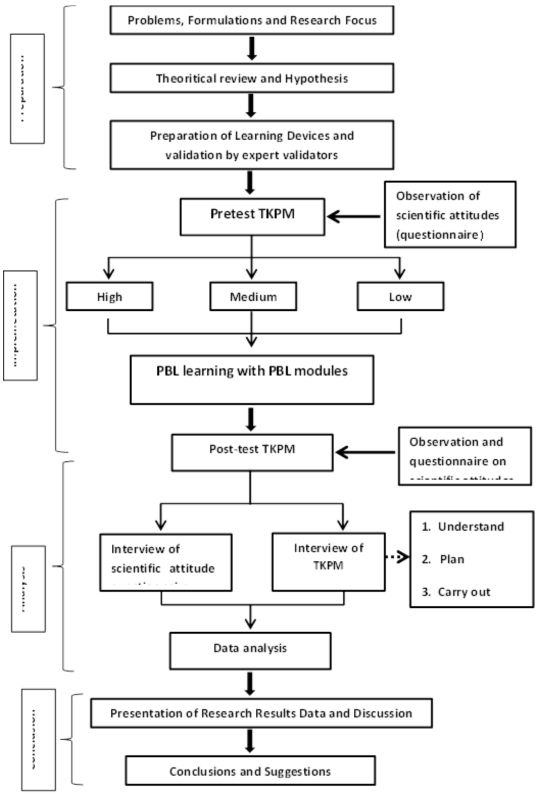

Figure 1. Research Design of a modified Concurrent Embedded Method

RESULTS AND DISCUSSION

Validity of PBL learning modules

Validation results of PBL learning modules.

Table 1. Validation Results of learning device validation from experts

Learning media	Validation average value			Average of each device
	V1	V2	V3	
Syllabus	4,71	4,14	4,24	4,36
RPP	4,21	4,07	3,93	4,07
Module	4,57	4,29	4,18	4,35
TKPM	4,53	4,35	4,36	4,41
Average of all devices				4,30

Based on Table 1, it is shown that the final validation results by expert validators after going through revisions several times indicated that PBL learning tools/modules received an average score of 4.30 in very good criteria. So the PBL learning module is valid.

Practicality of PBL learning modules

Student response

Based on the results of the student response questionnaire, it was concluded that the average of all student response questionnaire results showed that 79.58% gave a positive response to the application of PBL learning and PBL modules. 88.24% of students were interested in participating in further learning activities as they had been followed at the time namely PBL learning with PBL-assisted modules.

The Skills of teachers to manage learning

The results of observing the skills of teachers to manage PBL assisted learning in physics modules to improve problem solving skills and scientific attitudes of students obtained an average score of 4.19 from an average score of 5.00. This shows that learning has been carried out well or can mean that the teacher's skills to manage physics learning is good.

Based on the results of student responses and observations of the teacher's skills to manage PBL assisted learning, the PBL module shows that PBL learning modules are valid. Based on the description above, it can be concluded that the PBL learning module is valid and practical.

The effectiveness of PBL learning modules to improve students problem solving skills and scientific attitudes

Completeness of learning outcomes

Based on the results of the t-test output, students physics problem-solving skills obtain sig 0 < 0.05 in the experimental class and control for pretest questions, so that Ho is rejected or the average value of students does not reach completeness. While for sig values in the experimental and control classes for posttest question is equal to 0.76 and 0.34 (the sig value is more than 0.05). Thus means that Ho is accepted or the average value of students reaches completeness.

Improved students problem solving skills

To find out the magnitude of increasing students problem solving skills, researchers must analyze the data of observations using the Gain formula (g) that is comparing the pretest score and posttest score. The average posttest result is 77.97, so it has a value of g = 0.47. Thus for the experimental class the gain value is in the medium category. From the calculation results in the control class obtained the average value of the pretest results is 60.88 and the average posttest results are 73.45, so that it has a value of g = 0.32. Thus for the control class the gain value is also included in the medium category.

Although the control class and experimental class are both in the medium category, there are differences between the two, namely the gain value in the experimental class is higher than the control class. Based on these results the researchers concluded that the improvement of problem solving skills in the experimental class was better than the control class.

The application of the Problem Based Learning module has an effective to improve students physics problem solving skills and scientific attitudes. Learning devices are said to be effective because (1) the average physics problem-solving skills of students who follow learning with PBL models is equal to 77.97 better than the average problem-solving skills of students who take learning with conventional learning models that is equal to 73.45; (2) the average learning outcomes of the experimental class of 77.97 have achieved completeness; (3) there is a positive influence of students responses to the application of PBL learning modules; (4) an increase in students physics problem solving skills; (5) an increase in students scientific attitudes.

Students responses to the application of PBL learning modules

Data on students responses to learning devices were collected using instruments of student response questionnaire sheets that had been provided by researchers. From the results of filling out the student response questionnaire, it was found that 88.24% of students gave a positive response interested in following the learning activities as they had been followed at that time which was according to the learning device using PBL learning modules. These results show students responses in the very good category. The strategy to foster student learning motivation according to Mulyasa (2009) has been used in the learning process, so students are easier and more happy in learning. Pleasant feelings will result in students having a positive response to learning. This shows that motivation and learning are two things that are mutually influential.

Problem solving skills of students

Profiles of students problem solving skills are analyzed based on test results of problem solving skills. Based on the results of the study it was found that students problem solving skills using PBL module assisted PBL learning model has increased. Behavioristic learning theory views learning as the process of forming a relationship between stimulus and response with habituation. Learning outcomes are expected in the form of habitual behavioral changes. The learning process with the scientific model provides opportunities for students to get used to generating ideas. The habit of generating lots of ideas has helped students to learn problem solving.

Learning problem solving as the highest type of learning is successfully done by students by working hard to find solutions, choosing solutions that are efficient and interpreting solutions to solve problems faced everyday. From this habituation obtained positive habits in dealing with problems so that the problem solving of students in the experimental class achieved 83.25% classical completeness. In the control class where no problem solving skills are used, the percentage of classical completeness is 70.59%. This shows that the habituation of problem solving skills has resulted in better individual and classical learning completeness.

PBL assisted physics module learning can make the program more enjoyable for teachers and students, and most importantly, this can cause students to be able to solve problem solving. For this reason, educators must give confidence that students cannot learn a material without the teacher's intervention in facilitating it. Students will not understand a material until they actively do something and reflect on the meaning of what they do in learning. Sujarwanto et al. (2014) argue that giving complex and contextual problems will help students to train physics problem-solving skills. Giving complex and contextual problems also allows students to have more awareness of the environment.

The constraint factor faced in this study is that the students use too much time to understand, find ways, and solve physics problems, rather than directly drawing conclusions from a procedure/concept. Another obstacle is that there are some students who tend not to be ready or not interested in the PBL learning process so they feel reluctant to try. This is confirmed by the results of research by Chin & Chia (2014) which states that although PBL has the potential for more active students and student-centered learning, there are difficulties in implementing PBL. Learning with the PBL model requires a lot of time and energy for both students and teachers. It may also not appeal to all students. As Greenfield (1996) notes, students who do not enjoy PBL are those who prefer competition rather than collaborate, abstraction rather than application, or passive and direct learning rather than active and independent learning. Teachers can also find uncomfortable experiences because they cannot control students during learning. This is also experienced by researchers who in this study acted as teachers, it was quite difficult to optimize student interaction in learning.

Teachers play an important role in contributing to the success of learning through PBL. If students face difficulties identifying problems, they need to provide excellent ideas by providing direction in the form of appropriate guide questions and providing examples to help them overcome obstacles to learning. It must also keep students on the right track by checking the information they collect from the media that is relevant to their problem, and that they critically evaluate the validity and reliability of the information that has been collected. To help students develop and organize their thinking, teachers must plan further action steps, and document their progress, and provide a work guide sheet.

PBL provides many opportunities for group discussion. To minimize bad working relationships and off-task behavior, and maximize effective collaboration and productive conversation. Students must be equipped with cooperative skills. They need to be taught proper social behavior in asking for opinions and support, and in managing different perspectives and conflicts.

Scientific attitude of students

Data on students scientific attitudes were collected using a scientific attitude questionnaire sheet. The results of the questionnaire of the experimental class students scientific attitudes after the application of PBL assisted learning PBL modules can be shown in table 2.

Table 2. Questionnaires results of students scientific attitude in the experimental class

Scientific Attitude	The average score of the questionnaire results	Category
1. Honest	3,73	Good
2. Discipline	3,93	Good
3. Hard work	3,07	Medium
4. Independent	3,29	Medium
5. Curiosity	2,74	Medium
6. Caring for the environment	4,40	Very good
7. Responsibility	3,96	Good
8. Democratic	4,03	Good
The average score is a total of 8 scientific attitudes	3,64	Good

Based on Table 2 shows that the results of questionnaires given to students the last meeting after using PBL assisted PBL modules showed that the average total score for all aspects of students scientific attitudes reached 3.64. This means students have scientific character/attitude in good category. While the average of all aspects of the scientific attitude indicator observed from the first meeting to the last meeting was shown that students scientific attitudes had increased.

Thus it can be concluded that student learning activities in solving physics problems with PBL models can help students to be accustomed to being scientific. Yulianti, et al. (2017) states that the character starts to be influenced by various factors, both internal and external. Some external factors include: students getting character education from parents, students learning to adapt to the norms/customs of the surrounding environment, and students receiving character education in the school environment. According to Hayat (2011), changes in the scientific attitude of students after teaching and learning activities show that the attitude possessed by a person is not always static but can change due to the process of self-habituation during learning activities. With the process of getting used to repetitive and continuous scientific behavior, students scientific character can be formed. However, the development of the scientific attitude of students in this study is not significant enough, this is because this research activity is only carried out within one month. A very short process will not be enough to shape the character of students can remain attached to the personal self of students. The formation of scientific character takes quite a long time and the process of self-habituation must be repeated and continuously.

CONCLUSION

PBL learning modules are valid and practical learning tools. 79.58% of students gave a positive response to the application of PBL learning and PBL modules. 88.24% of students are interested in participating in PBL learning activities using PBL learning modules. The application of Problem Based Learning modules is effective to improve students physics problem solving skills and scientific attitudes. Physics problem solving skills and scientific attitudes of students after the application of Problem Based Learning modules have increased.

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