Developing physics lesson plan for SMA by using problem based learning model with saintific approach

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Abstract

The standard of content and the standard of process of curriculum 2013 require scientific learning, a scientific approach involving models that emphazise the problem. The purpose of this research to develope physics lesson plan for SMA by using Problem Based Learning with saintific approach with criteria valid, practis, efective. The kind of research is used research and development. The model development is used ADDIE model, it consist of analysis, design, development, implementation, evalution. The test of validity were done through validity sheet of learning device, practicality testing through observation sheet, questionnaire response of the teachers and the students, affectivity testing were obtained from the assessment of knowledge, attitude, characters, skills. Thisresearch was conducted at grade X of SMAN 4 Kerinci which consists of 35 students and two physics teachers as respondents.This research produces physics lesson plan used problem based learning model with saintific approach material Temperature, Heat and Transfer that valid, practis, efective.

Keywords : problem based learning model, saintific, lesson plan

Introduction

The 2013 curriculum emphasizes the application of a scientific approach to the learning process. The scientific approach includes inquiry learning that has constructivism breathing. Learning targets with a scientific approach include the development of an elaborated attitude, knowledge, and skill area for each educational unit. These three domains of competence have different paths of acquisition (process) psychologically. Attitude is gained through activity: receiving, running, appreciating, living, and practicing. Knowledge gained through activity: remembering, understanding, applying, analyzing, evaluating, and creating. Meanwhile, skills are acquired through activities: observing, asking, reasoning, tasting, and creating (Permendikbud Number 65 Year 2013).

In order for the lesson of physics to be a meaningful lesson and establish the independence of learners in learning, then the learning activities should be arranged in such a way. Learning is a systematic development process of several components that include teachers, learning tools, learners, learning process and assessment. This means the learning device is one component in the learning process. For that, the required learning tools that vary so that the learning process can run well. This means that every teacher in the educational unit should be able to structure the learning tools well.

Scientific learning should be designed with good planning contained in syllabus, lesson plans, teaching materials such as learning modules, LKPD, and appraisal so that it can be applied into the learning process using various learning models and approaches.In addition, the selection of models or approaches in learning, should also be seen from the characteristics of the material, learners, and support facilities in schools. Thus the assessment of the sphere of attitude, knowledge and skills can be done well too.The learning tools available in schools emphasize more on the physics concept than the process of inquiry to obtain the concept and have not optimized the ability of different learners for cooperation in learning.One way that can be done to overcome this problem is by developing a device of physics learning with a scientific approach. Learning tools developed include syllabus, lesson plan, learning module, and assessment. The scientific approach involves a learning model that emphasizes problem-solving, one of which is a Problem Based Learning (PBL) model.PBL learning model is one of the learning model that starts from one problem and solve it is the focus of the lesson (Eggen and Khauchak: 2012: 307). In PBL learners can not only understand learning materials, or basic knowledge but can also use their knowledge and experience to solve real-life problems (Bilgin, et.al: 2009).

The learning model is defined by Joyce & Weil (1980) as "the conceptual framework used as a guide in learning." Problem based learning according to Arends, Richard I. (2008: 41) is "learning that presents a variety of problematic situations that are authentic and meaningful to learners, which can serve as a springboard for investigation and investigation".Holbrook & Rannikmae (2009) states that "science will be easier to learn when the lessons are reasonable in the learner's view and relate to human life, interests, and aspirations." Thus, the role of teachers in learning is to pose problems, question, and facilitate investigations and dialogue. Problem-based learning is useful for learners to develop thinking skills and train learning about investigating contextual issues and training students to become self-reliant individuals.

According to David Bound and Grahane I. Feletti, problem based learning is a conception of knowledge, understanding, and education profoundly different from the more common conception underlying subject-based learning. Based on these opinions can be seen that PBL is a picture of science, understanding, and learning are very different from subject-based learning. (Putra, 2013: 64)Problem-based learning is the process of learning activities by using or raising real-world problems as a material for students to solve problems to gain knowledge of a subject matter. (Putra, 2013: 64)

Scientific learning is a learning that adopts the steps of scientists in building knowledge through scientific methods. The required learning model is the one that enables the cultivation of scientific thinking skills, the development of a "sense of inquiry" and the creative thinking ability of learners (De Vito, 1989). The required learning model is capable of producing the ability to learn (Joice & Weil: 1996), not only acquired a number of knowledge, skills and attitudes, but more importantly is how the knowledge, skills, and attitudes are gained by learners (Zamroni, 2000).

According to Suhendi (2013), the scientific approach involves three instructional models that emphasize problem-solving, including problem-based learning, project-based learning and discovery learning. The application of a scientific approach to learning not only focuses on developing the competencies of learners in conducting observations or experiments, but also focuses on developing knowledge and thinking skills so as to support creative activities in innovating or working. So, learning based on a scientific approach, is learning that uses a scientific approach as an effort to enable learners based on real experience.

From the above description, the authors develop a learning tool that is oriented to the model of Problem Based Learning with a valid, practical, and effective scientific approach. Learning tools that are developed include Syllabus, Learning Implementation Plan, learning module, and assessment.The purpose of this research is to develop high school physics learning tool using Problem Based

Learning model with scientific approach on the material of material Temperature, Heat and Transfer that valid, practis, efective.

Method

The type of research to be conducted is the type of research and development (Research and Development) because in this study will be developed learning tools. Learning tools developed include syllabus, RPP, Module, and assessment. Sugiyono (2010: 311) suggests that research and development methods (Research and Development) is a research method used to research to produce new products, and then test the effectiveness of the product. The products produced in this study are learning tools that include syllabus, RPP, Module, and assessment.

Furthermore, the research model used in this research is the ADDIE model. Molenda (2003: 1) states that the development procedure in the ADDIE model consists of five stages. The five stages are analyze, design, develop, implement, and evaluate.

Research subjects are physics learning device using Problem Based Learning model with scientific approach that is syllabus, RPP, Module, and assessment. As for the respondents in this research is the class X students interested in Mathematics and Natural Sciences (MIA) SMA Negeri 4 Kerinci and physics teacher.

Data collection was done by using test method, observation method and questionnaire method. The test method is used to determine the learning outcomes of learners after following the learning model of PBL with scientific approach, observation method used to know the implementation of learning, the activities of students, while the questionnaire method used to determine the validity of the device and the response of learners after following the lesson.

Data analysis result of research done to know validity and practice of learning device that have been made. The data of the research were analyzed using descriptive statistics to get the average and percentage. The calculation of the final value data of the validation result is analyzed using Cohen's Kappa formula, where at the end of processing obtained kappa moment by using formula:

$$Kappa\ (k) = \frac{P - Pe}{1 - Pe}$$

For categories and product validity intervals can be seen in Table 1.

Table 1. Category of learning device validity based on Cohen's Kappa

No	Interval / Achievement Rate (%)	Category
1.	$\geq 0,61 - 1,00$	Valid
2.	$< 0,61$	Invalid

(source: Anthony et al., 2005)

The calculation of the final value data of practicable data results analyzed on a scale (0-100) is done by using the formula:

$$P = \frac{f}{N}\ x\ 100\%$$

For the categories and product practical intervals can be seen in Table 2.

Table 2. Practical Product Performance Categories and Intervals

Interval	Category
0 – 60	Not practical
61 – 100	Practical

(Modified from Riduan, 2009: 89)

Analysis of competency data of learners on attitude competence, and skill use equation:

$$S = \frac{B}{C} x 100\%$$

$$K = \frac{B}{C} x 100\%$$

Description: S = attitude value, K = skill value, B = score obtained, C = maximum score (modified from Riduan, 2009: 89). The category of competency attitudes and skills of learners can be seen in Table 3.

Table 3. Category of Attitudes and Skills Competencies

No	Value	Conversion	Interval	Predicate	Value
1	≤54	1,00	0,00 < Value ≤ 1,00	D	Less
2	55 – 59	1,33	1,00 < Value ≤ 1,33	D+	
3	60 – 64	1,66	1,33 < Value ≤ 1,66	C-	Enough
4	65 – 69	2,00	1,66 < Value ≤ 2,00	C	
5	70 – 74	2,33	2,00 < Value ≤ 2,33	C+	
6	75 – 79	2,66	2,33 < Value ≤ 2,66	B-	Good
7	80 – 84	3,00	2,66 < Value ≤ 3,00	B	
8	85 – 90	3,33	3,00 < Value ≤ 3,33	B+	
9	91 – 95	3,66	3,33 < Value ≤ 3,66	A-	Very good
10	96 – 100	4,00	3,66 < Value ≤ 4,00	A	

(Kurniasih dan Berlin Sani, 2014:103)

Results and Discussion

One of the teacher's role is as facilitator in carrying out the learning process. Teachers should be able to find ways to encourage and develop the potential of learners (Hammond & Brannsford, 2005). Besides, the learning tools based on the scientific approach also have an effect on the students' learning outcomes, both in the form of RPP and teaching materials (Yerimadesi 2016) The 2013 curriculum is used as a reference in developing learning tools, where the 2013 curriculum explains that learning activities begin with observation or visualization of events real in life about natural phenomena. This is in accordance with that proposed by Kemdikbud (2013) which states that "The learning process in the Curriculum 2013 for junior and senior high school or equivalent implemented by using a scientific approach". Here's a discussion of each category of learning tools.

Stage Analysis

In the curriculum analysis, an observation of the curriculum used in SMA 4 Kerinci was conducted. From this stage, results are obtained where the class X in this school has been using and implementing the 2013 curriculum. In the objective component analysis phase, it is found that Core Competence and Basic Competence are appropriate to be applied by using elements in the scientific approach ie observing, questioning, collecting information , reasoning / associating, and communicating (Sani, 2014: 53). This Core Competence and Basic Competency is the main objective in learning. Mulyatiningsih (2012) states that in the curriculum there is a competence to be achieved.

Based on the analysis of KI and KD then one of the appropriate materials is the material Temperature, Heat and Displacement. The time required learners in studying this material is for 4 x 3 JP.

Based on the curriculum analysis that has been done, then the contents of learning tools contain the competence of attitudes, knowledge and skills. This is in accordance with that proposed by Kemdikbud (2013) that "The learning process touches three domains, namely attitude, knowledge, and skills". Competence of attitude in the form of spiritual attitudes and social attitudes in accordance with KI 1 and KI 2. Knowledge competencies developed based on KI 3 while the skills competencies developed from KI 4. Any evaluation tool developed is an evaluation tool covering all the competencies of the learners.

After doing curriculum analysis, then the next step is the phase of material analysis. Based on the analysis that has been done to get the result that the appropriate Physics material is the material Temperature, Heat and displacement is taught in class X MIA.

The last analysis done in the analysis phase is the analysis of learners. Analysis of these learners aims to determine the problems experienced by learners in the learning process and identify the characteristics of these learners. Mulyatiningsih (2012) states that teachers should recognize the characteristics of learners who will use teaching materials. Furthermore, to provide the teaching materials must be in accordance with the characteristics of learners (Yerimadesi.2016). Based on the analysis that has been done to get information that as many as 48.75% of students experience problems in determining how to learn well. This certainly has an impact on learning motivation of learners. In addition, it will make learning more monotonous and less good interaction between fellow learners or with teachers in the classroom and ultimately lead to the goal of learning is not achieved.

So that learning is not monotonous it is necessary to develop learning device with problem based learning model with scientific approach, because learning activity model problem based learning, learners become the main character who directly involved in learning, not just become passive listener to all information submitted by teacher Sulardi, 2015). While scientific learning is a learning that adopts the steps of scientists in building knowledge through scientific method (Nurmaliati, 2015).

Design Stage

At this stage the authors do the design of the device (design prototype) which must be completed before the device development (Mulyatiningsih, 2012). Design through three stages of designing, collecting materials, and preparation. The design stage is carried out after an initial needs analysis that demonstrates the need for the development of learning tools (Susdarwati, 2016).

Learning device design stage produces a learning tool that includes syllabus, RPP, module, and assessment. Learning tools are structured systematically by using simple and easy-to-understand language.

In order for learners to be interested then the learning tools arranged systematically follow the planned layout and use colors that can attract the attention of learners. After the design, the collection of materials and the preparation of the draft I generated a learning device that is consulted on the supervisor lecturer. Once fixed, the first draft of the learning device is validated to determine its feasibility (Susdarwati, 2017).

Development Stage

This stage is a stage in doing the validity test of learning devices that have been made. According Sugiyono (2010: 173) an instrument is said to be valid if the instrument can be used to measure what

should be measured. Validity performed includes: content validity, construct validity, and language validity. The validity of the content declared valid by the validator because the developed learning device has been in accordance with the material that should be presented. While the construct validation according to Riduwan (2009: 87), "to test the validity of the construction can be used expert opinion". In this study, the validation made emphasize the validation of content, constructs, and language. Then performed a limited trial in view of the level of practicality.

The validation results obtained on instructional tools consisting of syllabus, RPP, module, and assessment obtained that the developed device has been valid either from component of content, construct, or language. As in Table 4 below.

Table 4. Device Validation Results

Device	Average Value	Category
Syllabus	0,92	Valid
Lesson plan	0,93	Valid
Module	0,90	Valid
Assessment	0,95	Valid

Thus, the learning device used has been in accordance with the criteria that have been determined and the device has been compiled meet the requirements of preparation of learning tools. This is also in line with the meaning of the instructional tool that is said to be valid, in which Nieveen (1999: 34) explains that "a learning device is said to be valid (good / proper), if it has been assessed either by experts or validators and the results of development based on theoretical rational strong and there is consistency internally ".

Implementation Stage

Practicality of a learning device is related to the level of ease of use of learning tools by both teachers and by learners. From the results of data analysis of the implementation of RPP that has been processed, it is stated that the device learning physics using learning-based problem learning model with a scientific approach is on practical criteria. This is evidenced by the percentage of the average value of the implementation of RPP which reached 97.07%. As in Table 2 below.

Table 5. Device Practical Results

No	Activities	Average (%)
1.	Observation of the implementation of RPP	97,07
2.	Teacher Response Questionnaire	98,96
3.	Student Response Questionnaire	76,90

Not only in the implementation of RPP, the practicality level of the learning tools can also be seen from the teacher response questionnaire and the questionnaire response of the learners. According to Elniati (2007), "the criterion of a practical learning tool is its usability and effectiveness". From this point of view it is clear where the usability can be interpreted where teachers and learners can use easily created tools. Furthermore, from this opinion it is also said that the implementation refers that the tools developed can be used by the teacher to deliver the learning materials during the learning activities in progress.

Based on the results of data analysis teacher questionnaire responses that can be known where the average percentage of teacher's response to the device is in the practical category. This shows that physics learning device using problem-based learning model with scientific approach makes it easier for teachers and learners in the learning process because learners become active and can learn

independently or in groups using the module. In addition, teacher activities only facilitate learners in learning. Then, the practicality level of a learning device is also seen from the response of learners. The results of the student response questionnaire also show that the module developed is practically used in the learning process with the percentage for the module 76.90%. As Yerimadesi (2016) says learning tools in the form of modules seen from the module benefit aspects are categorized as very practical.

In general from the results of this data analysis can be concluded that the device learning physics using learning model problem based learning with scientific approach can facilitate learners in learning. This tool can help learners to understand the concepts of physics through solving problems given based on scientific steps. With these results the criteria of practicality are in accordance with that proposed by Nieveen (in Ermawati, 2007: 25), the characteristics of educational products that have a high quality of practicality when experts and teachers consider the product to be used and the reality shows that it is easy for teachers and learners to use the product.

Evaluation Stage

Evaluation Phase is a research section that aims to disseminate the tools that have been developed to see the effectiveness of the device. Furthermore, according to Nieveen in Yadnya (2012), there are three aspects that need to be considered in assessing the quality of a product, namely: validity, practicality, and effectiveness. The effectiveness of the product can be seen from the usefulness of the product in accordance with its function. On the basis of this assessment of the effectiveness of the use of learning tools should be seen from the learners learn on the competence of knowledge, attitude and skills.

Based on Bloom's opinion in Sudjana (2008) mentions where, the outline of learning outcomes is divided into three domains namely, the cognitive domain (knowledge); with respect to intellectual learning outcomes, affective spheres (attitudes); with respect to attitudes, and the psychomotor realm (skill) regarding learning outcomes in the form of skills and ability to act. Therefore, the learning outcomes of these learners should be taken during the learning process takes place using physics learning devices using learning model problem based learning with a scientific approach so that product effectiveness can be seen. Evaluation results are used to provide feedback to users of learning devices using Problem Based Learning model with a scientific approach.

Table 6. Results of Knowledge Competency Assessment

Activities to	Average value	Predicate	Completed Educator (person)	Incomplete Educator (people)	Completeness (%)
I	85,46	B+	30	5	85,71%
II	82,86	B	31	4	88,57%
III	83,71	B	32	3	91,43%
IV	85,57	B+	34	1	97,14%
Average	84,40	B	31,75	3,25	90,71%

Analysis of learning outcomes of learners on knowledge competence shows the level of mastery learners classically high enough with a percentage of 90,71% mastery of the four meetings. The average score of learners is good with an average score of 84.40% as shown in Table 6.

Based on these values can be said that learning tools developed, in general can improve the competence of learners knowledge. This is in line with research conducted by Akinoglu and

Tandogen (2006) that the PBL model can have an effect on improving learning achievement of learners. Then Sulardi (2016) stated that the learning process using PBL model succeeded in making the students achieve the standard of competence with the achievement of expected indicators in the learning process.

Stage value analysis of learners on the competence of the attitude is divided into two assessments, namely the assessment of spiritual attitudes and social attitudes of learners are also done during the learning process takes place. An assessment of the spiritual and social attitudes of the average learner suggests an increase from meetings to meetings for every aspect even though the increments are incremental. The average overall assessment of the attitudes of learners during the meeting is on either category with 90.36% complete learners as in Table 7.

Analysis of the social competence assessment of students' attitudes shows that of the seven aspects observed, the discipline has the greatest average value of 3.34. This indicates that the developed learning device raises a high discipline attitude to the learner. In general, the assessment of the competence of social attitudes of learners is good with the average value of 2.87. This means that the use of learning tools developed can help learners in improving the competence of social attitudes of learners. This is in line with Demirel and Turan (2010) studies of an increase in learning, attitudes, metacognitive, and motivation in classes treated with PBLs compared with control classes.

Table 7. Recapitulation of Attitude Stability Assessment Results

Aspect of Observation	Value / Activity				Average	Category
	1	2	3	4		
Religious	3,06	3,82	3,83	3,94	3,66	Very good
Honest	2,51	2,72	2,73	3,00	2,74	Good
Discipline	3,32	3,24	3,36	3,47	3,35	Very good
Hard work	2,44	2,76	2,80	3,16	2,79	Good
Curiosity	2,24	2,64	2,77	3,26	2,73	Good
Cooperation	2,07	2,64	2,80	3,06	2,64	Good
Confidence	2,19	2,43	2,71	3,26	2,65	Good
Responsible	2,19	2,43	2,71	3,26	2,65	Good
Sum	20,01	22,68	23,72	26,41	23,21	
Average	2,50	2,83	2,97	3,30	2,90	Good
Rata-rata					2,90	Good
Completed Student Value (%)	81,43	90,00	92,86	97,14	90,36	

The result of analysis of skill competency assessment of students obtained average value 92,99 with very good category. Of the seven aspects observed, the precision aspect using the tool obtains the highest value at each meeting is 96.19 as shown in Table 8. This indicates that learners pay close attention to the use of tool manuals written in the LKPD well and strive to finish each activity on time. On the aspect of presenting the group report with the value of 84.40 and is in good category. The other aspects are already in the category of good and very good, so it can be interpreted that the device of physics using the problem-based learning model with a scientific approach developed to enable learners in the learning process. Research conducted by Sulardi (2015) states that the learning process using the PBL model successfully makes the students achieve the standard of competence with the achievement of expected indicators in the learning process.

Table 8. Results of Skills Competency Assessment of learners

No.	Student Activity	Average Value (%)	Value Conversions	Predicate	Information
1.	Set up experimental tools	93,33	3,66	A–	Very Good
2.	Assembling experimental tools / materials	93,57	3,66	A–	Very Good
3.	Participation in each of the experimental steps	94,52	3,66	A–	Very Good
4.	The accuracy of using the tool	96,19	4	A	Very Good
5.	Read and record experiment results	93,33	3,66	A–	Very Good
6.	Timeliness of preparing reports	95,60	3,66	A–	Very Good
7.	Present group reports	84,40	3,00	B	Good
	Average value	92,99	3,66	A-	Very Good

This shows that this physics learning device has been effective where effectiveness can be seen the usefulness of the product in accordance with its function Yadnya (2012). From Table 9, it can be seen that the result of learning (attitude), knowledge, and also the skill of the learner by using physics learning device learning model problem based learning scientific approach reach 89,25% toward achievement of learning effectiveness goal.

Table 9. Recapitulation of Learning Device Effectiveness Data

No	Assessment Type	Value (%)
1.	Knowledge	84,40
2.	Attitude	90,36
3.	Skills	92,99
	Average	89,25

Furthermore Mahmudi in Prihatmanti (2013: 2) states that "effectiveness is the relationship between output and objectives, the greater the contribution of output to the achievement of objectives, the more effective the organization, program or activity". Based on this it can be said that the learning device of physics using learning model problem based learning with scientific approach in SMA effective use.

Conclusions

Based on the results of device testing, analysis, discussion, discussion and research findings, it can generally be concluded that the learning model of Problem Based Learning with Scientific Approach on the temperature, calor and displacement material that has been developed is valid, practical, and effective.

Acknowledgments

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