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Development of Problem-Based Learning Devices for Training Science Process Skills (SPS) Junior High School Students

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Abstract
One way to overcome undeveloped scientific process skills is by applying Problem Based Learning (PBL). PBL is a learning model that stimulates authentic problems for students to have Science Process Skills (SPS). This study aims to develop learning tools based on Problem Based Learning (PBL) on Environmental Pollution materials that are visible to be used to train students' Science Process Skills. The feasibility of learning is assessed based on validity, practicality and effectiveness. The type of research used is development by applying a 4-D model which includes the stages: Define, Design, Develop and Disseminate with extensive trials using the One group pretest-posttest design and tested on 15 students of class VII SMP Negeri 2 Gondang, Mojokerto Regency, for the 2020/2021 academic year. The data analysis technique used descriptive analysis or afferential statistic analysis. The results showed (1) the learning tools developed in the form of syllabus, lesson plans, worksheet, test about science process skills were included in the very valid category because have average≥ 3.60 . (2) The learning device shows practicality seen from the implementation of each activity which has a very good category and has a reliability coefficient > 75%, student activities also show a very valid category and statistical tests of the relationship and influence with the SPS value get sig < 0.05, the obstacles that accompanied by a solution. (3) Effective learning tools are assessed from the N-gain that reaches the medium and high categories with an average of > 0.80, the item sensitivity value is > 0.75, and the student's response shows an average of > 81% with a very good category. Based on the results of data analysis, it can be concluded that PBL-based learning tools on environmental pollution materials to train junior high school science process skills are valid, practical and effective to use learning activities in class.

Keywords
Problem Based Learning (PBL); Science Process Skills (SPS); science learning

I. Introduction

Education is an effort that must be carried out in the intellectual life of the nation so that the quality of human resources will increase. The National Education System Law Number 20 of 2003 stipulates: "Education is a planned and conscious learning environment in which students are proactive in terms of religious spirit, personality, self-control, a sense of intellectual development (planned work), noble personality, and the necessary skills. Help develop their potential, society, nation and state." Education is a long-term strategic program

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where in its implementation it is required to be able to respond to challenges and needs globally and nationally.

Education is considered to have a very important role in promoting the civilization of a nation. Good quality education can encourage the creation of a quality society, creative and productive until finally able to achieve welfare. Through this national education system, the government should be able to ensure equal distribution of educational opportunities, as well as the relevance and efficiency of education management to face challenges in line with the changing demands of local, national and global life. The budget allocation system for education in Indonesia is heavily influenced by government policies. (Saputra, A. 2018)

The success of a national education goal cannot be separated from the role of an educator or teacher who is responsible for organizing learning in the national education system, and of course curriculum-based. Therefore, teachers need to have appropriate personal, social and professional teaching skills. The current curriculum is the 2013 curriculum which focuses on student activities (student centered), this curriculum is also integrated and allows the integration of topics, skills, disciplines and concepts in the form of individual disciplines from various disciplines (Poerwati, et al., 2013). The aims and objectives of this curriculum are expected to be implemented in a good learning tool.

Zuhdan (2011:16) explains that equipment is a device or tool, while learning is a way or process for people to learn. Article 65 of the 2013 Basic and Secondary Education Process Standards in the Permendikbud stipulates that "preparation of teaching resources is part of the learning plan, including: lesson plans (RPP), syllabus, media, learning scenarios, learning resources and assessment tools,". This means that learning tools have a very important role to make the teaching and learning process successful.

The results of observations of class VII science learning at SMP Negeri 2 Gondang Mojokerto during the even semester of the 2019/2020 academic year show that there are still many inappropriate learning tools used in their preparation. The inaccuracy of the preparation referred to in this case is the link between the syllabus request and the RPP, WORKSHEET and others that are not appropriate. There are still many discrepancies between the elaboration of Basic Competencies (KD), Indicators and Learning Objectives. The learning tools used also have not been able to train science process skills, namely skills that represent one of the scientific dimensions of students and are still carried out by transfer of knowledge so that it limits students' learning experience.

One way to overcome the lack of scientific process skills is to use PBL (Problem Based Learning) or problem-oriented learning. PBL is a learning model that provides contextual challenges, which can stimulate students to learn and think (Tasoglu & Bakar, 2010: 2410). The emphasis on problems in PBL is the problems that exist in real life (Draghicescu, et al, 2014: 299). In relation to preparing for future needs, it is necessary to interpret concepts that can make students' minds open to the surrounding environment. Examples of things that really support PBL are through concept discovery, such as the science concept through problem solving through the use of the surrounding environment. PBL can also be used to encourage students' science process skills. M. Taufiq Amir (2009:22) explains, PBL involves students in dealing with a problem by going through a number of stages of the scientific method that allows students to understand the knowledge related to the problem as well as gain skills in dealing with problems.

The teacher's role in PBL is to facilitate learning through fostering learning conditions and giving students the opportunity to seek, apply ideas, consciously use their own strategies in learning.Draghicescu, et al, 2014). Through PBL with multiple perspectives and underlining student independence, it is able to encourage students to be active in learning and

express their ideas which can encourage process skills (Saputro, 2019: 498). One way to facilitate student learning is to provide problem-oriented worksheets to practice science process skills (Serevina, et al, 2018: 31). The material chosen by the researcher is Environmental Pollution. The selection of this material is based on SPS elements (scientific process skills) that can be trained in it, which include: observing problems, classifying, predicting, interpreting, hypothesizing, asking questions, using tools and materials, planning experiments, and communicating. So that in training the above skills, a learning model that has a perspective that is almost the same as the objectives of the science process skills is needed, namely a problem-based learning model. Familiarize students to think scientifically. In problem solving, helping students make decisions in life both in the everyday world and at work. With the above considerations, the researcher took a study entitled "Development of Problem Based Learning (PBL) Science Learning Devices to Practice Science Process Skills (SPS) on Environmental Pollution Materials" help students make decisions in life both in the everyday world and in the workplace.

II. Research Methods

Research is exploratory. As part of this research, PBL-based environmental pollution learning tools will be developed to equip students with skills in the scientific process. The syllabus, learning implementation plan (RPP), student activity sheets (WORKSHEET), student activity tools, scientific process skills assessment tools, and learning disability tools are the development of learning tools in this study. Because when developing this learning tool according to the problem based learning (PBL) method, the learning syntax is carried out according to the PBL syntax, namely: focusing on problems, organizing participating students, helping independent or group-related research, development and presentation of work, analysis and evaluation problem solving results. Students are taught to ask questions, then determine strategies or methods to respond, analyze, and finally find student answers. The problem is that students who passively acquire knowledge become active learners and create knowledge, which also reflects thinking processes that can be applied to different situations and research areas (Johnson, 2010).

III. Results and Discussion

3.1 Science Process Skills Analysis (SPS)

The instrument used in measuring the Science Process Skills (SPS) of students is through a test description consisting of 4 questions. The results of the Science Process Skills (SPS) test as measured through the pretest and posttest can be shown in Table 1

Table 1. Science Process Skills Test Results

PD	*Pretest*				Σ	K	*Posttest*				Σ	K
	Completeness Score Indicator (Question) (%)						Completeness Score Indicator (Question) (%)					
	1	2	3	4			1	2	3	4		
PD 1	50	50	50	50	200	ST	75	75	100	75	325	T
WW2	75	50	50	25	200	ST	100	100	75	75	350	T
WW3	50	50	25	50	175	ST	75	75	100	100	350	T
PD 4	50	50	50	25	175	ST	75	75	100	75	325	T
PD 5	50	50	50	25	175	ST	75	75	100	75	325	T
PD 6	75	50	50	50	225	ST	100	100	75	75	350	T
WW7	50	50	50	50	200	ST	75	75	75	100	325	T
PD 8	50	75	50	25	200	ST	75	100	100	75	350	T
PD 9	50	50	25	50	175	ST	100	75	75	75	325	T
PD 10	50	50	50	50	200	ST	75	100	75	75	325	T
WW11	50	50	50	25	175	ST	75	100	100	75	350	T
PD 12	50	50	25	50	175	ST	100	100	75	100	375	T
PD 13	50	50	50	25	175	ST	100	75	75	100	350	T
PD 14	75	50	25	50	200	ST	75	75	100	100	350	T
PD 15	50	50	25	50	175	ST	100	75	100	75	350	T
Average	**55.0**	**51.7**	**41.7**	**40.0**	**188.3**	**ST**	**85.0**	**83.3**	**88.3**	**83.3**	**343.3**	**T**

Information : PD : Students; K: Completeness; TT: Unfinished; Q: Done

From the data in Table 1, it can be seen that all students did not get the pretest indicator completeness. The mean score of students' pretest completeness is 188.3 so it can be interpreted that the average pretest score of students is 47.5 (Table 4.13) with less predicates. While the posttest results obtained an average score of 343.3 so that it can be interpreted that the average posttest score of students is 86.3.

The mean score of students' pretest completeness is 188.3 so it can be interpreted that the average pretest score of students is 47.5 with less predicates. While the posttest results obtained an average score of 343.3 so that it can be interpreted that the average posttest score of students is 86.3. Based on the data presented, it shows that the effectiveness of the Problem Based Learning learning model on improving the Science Process Skills (SPS) of students can be seen based on the data from the pretest and posttest using the normalized gain formula (N-gain). Based on the results of the calculation of the increase score (N-gain) shows that the N-gain ranges from 0.71 to 1.00 in the high category. The average score of increasing the Science Process Skills (SPS) of students is 0.84. The sensitivity of the Science Process Skills (SPS) test questions that this study developed also needs to be known. This is used to determine whether the questions developed are good or not.

The results show that as many as 4 Science Process Skills (SPS) test items that were tested are sensitive to the learning process with an average sensitivity index of 0.78 so it can

be stated that the Science Process Skills (SPS) test is suitable to be used as an instrument to measure Science Process Skills (SPS) learners.

The existence of a mutually influencing relationship between the Problem Based Learning (PBL) learning tools that this study developed by researchers with the acquisition of Science Process Skills (SPS) test results can be seen in the following statistical table:

Table 2. The Relationship and Effect of PBL Learning Tools on the Value of Students' Science Process Skills (SPS)

Group	N	mean	Std. Deviation	t	df	Signs. (2 tails)
Pemb Device. PBL	5	92.57	1.74	4.18	19	**0.001**
SPS Test	15	86.27	3.49	5.49	17.68	**0.000**

Note: Value of Sig. (2-tailed) 0.001 < 0.05, this means that PBL learning tools have a significant effect on the results of the SPS test.

From the table above, it is known that the presentation of learning must be attempted as attractively as possible starting from the learning materials, appearance, legibility, language and learning activities carried out in order to be able to foster the enthusiasm of students in receiving learning stimulation which has implications for good assessment results or as expected.

3.2. Relationship and Influence of Student Activities in PBL Tools on SPS Value Score

The existence of a relationship between student activities in the implementation of PBL learning developed by researchers and the acquisition of SPS test results can be observed through statistical tests in the following table:

Table 3. The Relationship between Student Activities in PBL with SPS Grade VIIBPS

Correlations

			Aktivitas Peserta Didik	Nilai KPS
Spearman's rho	Aktivitas Peserta Didik	Correlation Coefficient	1,000	,535*
		Sig. (2-tailed)	.	,040
		N	15	15
	Nilai KPS	Correlation Coefficient	,535*	1,000
		Sig. (2-tailed)	,040	.
		N	15	15

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4. The Relationship of Student Activities in PBL with Grade VIIC K SPS Scores

Correlations

			Aktivitas Peserta Didik	Nilai KPS
Spearman's rho	Aktivitas Peserta Didik	Correlation Coefficient	1,000	,834**
		Sig. (2-tailed)	.	,000
		N	15	15
	Nilai KPS	Correlation Coefficient	,834**	1,000
		Sig. (2-tailed)	,000	.
		N	15	15

**. Correlation is significant at the 0.01 level (2-tailed).

Based on Tables 3 and 4 above, it is known that the presentation of learning must be sought as attractive as possible and in accordance with the sequence of planned activities in order to be able to foster student enthusiasm to receive learning stimulations that have implications for good assessment results or as expected, because such as which are listed in Tables 3 and 4 that the PBL learning activities developed have a relationship with students' SPS scores.

The influence between student activities in PBL learning and the SPS scores of class VIIB and VIIC students can be observed in Table 5 and Table 6

Table 5. The Influence of Student Activities in PBL with Grade VIIB K SPS Scores

Group	N	mean	Std. Deviation	t	df	Signs. (2 tails)
Student Activities - SPS Score	15	-5.06000	8.87314	-2.209	14	.044

Note: Value of Sig. (2-tailed) 0.044 < 0.05, sign (1-talied) 0.022 < 0.025: this means that there is an effect of student activities in PBL learning on the SPS score.

Table 6. The Influence of Student Activities in PBL with Grade VIIC K SPS Scores

Group	N	mean	Std. Deviation	t	df	Signs. (2 tails)
Student Activities - SPS Score	15	-4.60000	8.70746	-2.130	14	.042

Note: Value of Sig. (2-tailed) 0.042 < 0.05, sign (1-tailed) 0.021 < 0.025: this means that there is an effect of student activities in PBL learning on the SPS score.

Based on Tables 5 and 6 it can be seen that the activities of students in PBL developed by researchers in grades VIIB and VIIC have an effect on the value of students' Science Process Skills, so this strengthens us that PBL tools are feasible for us to use in develop students' science process skills.

3.2. Student Response to Learning

The distribution of response questionnaires to students will be carried out at the end of the lesson, after the learning process is complete. The answer that you want to know is related to the learning process and the device developed. The questions asked in the questionnaire have 5 aspects: material, appearance, legibility, linguistics and learning activities. Analysis of student responses to scientific learning about environmental pollution using a question-based learning model and device-based learning found that an average of 91.98% of all respondents chose "yes". It shows that tools and learning are very useful for students. While 8.02% chose “No” which indicates that there are several points from the criteria that have not been met.

IV. Conclusion

Based on the results of research that applies the PBL (Problem-Based Learning) learning model conducted in SMP (Junior High School), it was found that PBL can improve students' skills and learning tools in the scientific process (SPS). Learning tools and learning-based learning (PBL) can foster positive feedback. The conclusion is that the PBL tools used for environmental pollution materials are effective in improving students' scientific skills.

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