International Journal of Educational Dynamics
Vol. 2 No. 1 (pp. 199-208) Desember 2019
p_ISSN 2655-4852
e_ISSN 2655-5093
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

THE DEVELOPMENT OF PROBLEM BASED LEARNING DEVICE FOR JUNIOR HIGH SCHOOL NATURAL SCIENCE CLASS FOR LEARNING SUBSTANCE PRESSURE AND ITS DAILY USE MATERIAL

*** Efrida Welni[1], A Fauzi[2] Usmeldi[3]**
[1]Student of Physics Education of Master Program in Universitas Negeri Padang, Indonesia
[2] Lecture of Physics Education of Master Program in Universitas Negeri Padang, Indonesia
[3]Lecture of Physics Education of Master Program in Universitas Negeri Padang, Indonesia
Email: efridawelni@gmail.com

*Corresponding Author, Received: November 12, 2019, Revised: December 10, 2019, Accepted: December 21, 2019

ABSTRACT

This research was purpoted to develop a valid, practical and effective learning devices based on problem-based learning model especially for substance pressure materials. The development model used was 4-D model from Sivasailam Thiagarajan. The research data are validity data, practicality data, and effectiveness data. The research instruments were validation sheets, practicality sheets, and effectiveness sheets. The data analysis technique used is a descriptive analysis. The results of the study are the science learning tools of SMP based on the learning model of problem-based learning on material pressure and its application in everyday life that is valid, practical and effective.

Keywords : Problem-Based Learning, Learning Device, Natural Scince.

INTRODUCTION

Developing learning device must meet the criteria of good quality learning devices. The quality of learning tools is determined by valid, practical and effective criteria. The learning tools developed must be in accordance with the 2013 curriculum.

International Journal of Educational Dynamics
Vol. 2 No. 1 (pp. 199-208) Desember 2019
p_ISSN 2655-4852
e_ISSN 2655-5093
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

The ideal learning design and expected by the 2013 curriculum is the learning process design that balances soft skills and hard skills.

Substance pressure an its use in daily life is one of he materials taught in Natural Science classes at Junior high school. Substance pressure is commonly found in daily life. Various problems in the daily lives of students can be explained by the concept of pressure, for example the cause of ear pain when diving deep. This material is very important for students to understand scientifically through learning either through experimental activities or through the investigation of literature on the phenomena contained in the material. Therefore teachers need a good learning plan with teaching materials that are in accordance with the demands of the curriculum.

The results of the observation carried out in July 2018 found that the science learning devices at SMPN 1 Mapat Tunggul had been prepared in accordance with the demands of the 2013 curriculum. The RPP that was prepared had organized students in group activities and discussions with fellow students. Learning design has followed the syntax of certain learning models. However, after observing the steps in the main activities, student activities are more focused on the activity of recording all information about the material pressure of solids, liquids and gases from the textbook. In addition to the lesson plans, teachers must also prepare teaching materials to support classroom learning. Through observations, it was found that teaching materials used at SMPN 1 Mapat Tunggul are national text books, so students are less interested in science lessons and more silent while learning, the teacher complains of the difficulty of activating students in learning activities. Information obtained through observation and interviews with science teachers showed the same conclusions as the results of student analysis conducted at school. Based on the results of student analysis that has been done, it is obtained that 77% of students do not actively participate in class discussion activities, 86% of students are bored studying science with the lecture method and 74% of students are happy if science lessons are associated with daily natural phenomena.

The conclusion of these problems is that teachers need to develop learning devices that meet valid, practical and effective criteria in accordance with the demands of the 2013 curriculum. The learning tools developed must be based on scientific learning models so that they are more motivating for students to learn and be able to

International Journal of Educational Dynamics
Vol. 2 No. 1 (pp. 199-208) Desember 2019
p_ISSN 2655-4852
e_ISSN 2655-5093
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

increase students' understanding, activeness and skills during learning. The learning model that is suitable and in accordance with Permendikbud number 22 of 2016 is the Problem Based Learning model. Through the PBL model, students are expected to be more familiar with the science material. This is in accordance with research conducted by I Wayan Gunada and his friends that problem-based learning arouses students' interests and is suitable for building intellectual abilities.

The Ministry of Education and Culture (2014) stated that problem-based learning is a learning model that presents contextual problems that stimulate students to learn in groups to solve problems from real-world problems. Oon-Seng Tan (in Abidin 2014) argues that PBL is student-centered where unstructured problems (real world problems or complex problem simulations) are used as starting points and anchors for the learning process.

Based on the description, this study produces a science learning device for junior high school learning model of problem-based learning that is valid, practical and effective on material pressure and its application in everyday life

METHOD

The design model used in this research was 4D model which was developed by Sivasailam Thiagarajan (1974). Thiagarajan (in Trianto, 2009) called it 4D because the model development process is divided into 4 stages: *define*, *design*, *develop*, and *disseminate*.

In this research the instruments used were validity sheet, practicality sheet and effectiveness sheet.The techniques of analysis were product validity analysis, practicality analysis, and effectiveness analysis. To calculate the devices' validity and practicality, the researcher percentage wise analysed the obtained score of categories from validity testing. A device was considered valid if the score was above 60 %. The validity tested in the development of learning tools is content validity, construct validity, language validity, and graphic validity. Content validity relates to the content and format of the learning tools developed. Construct validity is concerned with the construction or structure and presentation of the developed learning tools. The validity of the language regarding the language and writing used and the validity of the graphics related to the printout, for example, the layout of the cover, the arrangement of letters,

International Journal of Educational Dynamics
Vol. 2 No. 1 (pp. 199-208) Desember 2019
p_ISSN 2655-4852
e_ISSN 2655-5093
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

type letters and others. The device developed in development research is said to be practical if we can apply the device in the field and the level of implementation is in a good category. They say a product to be practical if people can use the product. According to Aida Fariroh's research (2015), practicality based on student responses of 81.81 and teacher responses of 100 got very practical criteria. According to N Za'ba and S Prabawanto (2019), modules developed based on PBL that are practical can facilitate students learning mathematics. Device practicality was also analysed in percentage as presented in Table 1.

Table 1. Catergories of Learning Device Practicality

Interval	Categories
0 – 20	Very impractical
21 – 40	Impractical
41 – 60	Less Practical
61 – 80	Practical
81 – 100	Very Practical

(Adapted from Riduwan, 2009:89)

Effectiveness shows the level of success in achieving a goal. The effectiveness tools are determined by the competency assessment of attitudes, knowledge, and skills carried out at each meeting. Device effectiveness was also analysed in the same manner. A device was considered effective if 85% students classically completed attitude, knowledge and skill competencies.

RESULTS AND DISCUSSION

3.1. The Result of Validity Testing

In the validation activity, experts and practitioners are asked to assess the learning tools that have been made. Assessment includes content validity, construct validity, Language validity and graphic validity. The validator is asked to provide an assessment and suggestions for improvements to the syllabus, lesson plans, modules and assessments that have been designed. Based on the assessment conducted by the validator, the results obtained in Table 2.

Table 2. Device Validity

Devices	Validator Score (%)		Category
	Experts	Practitioners	
Syllabus	86,6	95,1	Valid
Lesson Plan	84,5	96,3	Valid
Modul	86,0	95,0	Valid
Attitude Evaluation	93,3	93,8	Valid

Knowladge Evaluation	87,5	77,8	Valid
Skills Evaluation	92,1	89,1	Valid

Based on the data in Table 2, we get the results that the learning device is in the valid category. We can conclude it that the devices that have been developed are appropriate and meet the valid criteria and are suitable for testing.

3.2.The Result of Practicality Testing

Data on the practicality of learning tools are obtained based on assessment during the learning process using the lesson plans that have been designed, teacher's assessment of learning tools that are developed, and students' assessment of the modules they use during learning activities. The results of the practicality of the developed learning tools can be seen in the following table 3.

Table 3. Device Practicality

Devices	Practicality Score (%)			Category
	Teacher Response Questionnaire	Lesson Plan Implementation	Student Response Questionnaire	
Syllabus	100,00	-	-	Very Practical
Lesson Plan	93,8	93,06	-	Very Practical
Modul	95,00	-	86,9	Very Practical
Evaluation	100,00	-	-	Very Practical

Based on Table 3 we can conclude it that the learning device based on the problem-based learning model of learning on material pressure substances and its application in daily life that is developed is very practical to be used in the learning process.

3.3.The Result of Effectiveness Testing

Data on the effectiveness of learning tools are obtained based on student learning outcomes which include attitudes, knowledge and skills competencies. The results of the effectiveness of the learning kit at the trial stage can be seen in Table 4.

Table 4. Device Effectiveness at the Trial Stage

Competency	Score (%)	Category
Attitude Competency	87,19	Effective
Knowledge Competency	84,06	Effective
Skil Competency	85,78	Effective

Based on Table 4 we can conclude it that the learning tools based on the problem-based learning model on the pressure of substances and we use their application in daily life that are developed in the learning process. Data on the effectiveness of learning tools are also obtained based on student learning outcomes in the class deployment. The results of the effectiveness of learning tools in the deployment class can be seen in Table 5.

Table 5. Device Effectiveness at the Disseminate Stage

Competency	Score (%)	Category
titude Competency	88,31	Effective
ıowledge Competency	85,88	Effective
Skill Competency	85,14	Effective

Based on Table 5 we can conclude it that the learning tools developed already meet the effective criteria for the learning process.

3.4.Discussion

The results of the validation of learning tools got from experts are between values of 84.5% to 93.3%. This value shows that the learning tools developed are under the theory of both the content and format used. The language and writing used in learning tools are under EYD and graphics related to cover layouts, the arrangement of letters and others is appropriate.

The results of validation provided by experts are in line with the results of validation provided by practitioners or users of the learning tools from the teacher. Practitioners gave validation values between 77.8% to 96.3%. Practitioners give validation values also show that the learning tools developed are under aspects of measuring validity (content validity, construction, language, and graphics).

According to Riduwan (2009) if the validity value is over 60%, then the learning tools developed are in the valid category. Therefore, it can be concluded that the science-based learning tools based on problem-based learning on material pressure and its application in daily life that have been developed are in the valid category.

The results of the practicality of learning tools based on teacher responses to the syllabus, lesson plans, modules, and assessments are between 93.8% to 100%. According to Riduwan (2009) if the practicality value is over 80% then the category of learning tools developed is very practical. Therefore, based on the teacher's response questionnaire, the learning tools developed are very practical.

International Journal of Educational Dynamics
Vol. 2 No. 1 (pp. 199-208) Desember 2019
p_ISSN 2655-4852
e_ISSN 2655-5093
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

The practicality value of the RPP based on the teacher's response questionnaire was 93.8%. According to Riduwan (2009) the value of practicality is in a very practical category. When observing the implementation of the RPP in class through the observation sheet, the practicality value of the RPP 93.06% was obtained. Based on the teacher's questionnaire responses and observations of implementing the lesson plans in class, the conclusion was that the lesson plans developed were very practical for the study of substance pressures and their application in daily life. The practicality of the module based on the teacher's questionnaire response was 95.00%. According to the teacher's assessment, the module makes it easy to guide students to implement problem-based learning, makes it easy to convey facts, concepts, principles, and procedures and the pictures in the module to help the teacher make it easier for students to remember the material.

Besides the teacher's response questionnaire, we got the practicality of the module through the students' questionnaire responses as module users. Based on the questionnaire responses of students got module practicality of 86.9%. According to students, the module makes it easy to understand the relationship between the concept of pressure and its application in daily life and the problems presented in the module are simple and interesting to learn. According to Riduwan (2009), if the practicality value is over 81% then the category is very practical. Therefore, it is concluded that the module developed is very practical for the study of substance pressure and its application in everyday life. Based on these reviews, we conclude that the learning tools based on problem-based learning on substance pressure and its application in daily life are very practical in junior high school science learning.

We see the effective tools in this study from the acquisition of the value of student learning outcomes from aspects of competence in attitudes, knowledge, and skills. The value of learning outcomes got at the stage of the trial and distribution stage each of 3 meetings. At the trial stage, the average classical completeness results of students for attitude competency aspects were 94.67%, knowledge competency aspects were 93.33% and skills aspects were 94.67%. At the stage of the deployment got average classical completeness of students for the aspect of attitude by 93.93%, the aspect of knowledge by 96.97% and the aspect of skills by 95.12%. According to the

International Journal of Educational Dynamics
Vol. 2 No. 1 (pp. 199-208) Desember 2019
p_ISSN 2655-4852
e_ISSN 2655-5093
http://ijeds.ppj.unp.ac.id/index.php/IJEDS

Ministry of Education and Culture (2013) if classical completeness is over 85% then learning is said to be effective. Therefore, it is concluded that science-based learning tools based on problem-based learning are effective in material pressure and its application in everyday life.

The effectiveness of learning tools developed based on learning outcomes data on attitudes, knowledge and skills competencies can be stated that the learning tools developed are effective. The device developed is effective for attitude competency. These results concur with R Isna, et al (2018) through his research also produced effective PBL-based modules for student attitude competency. The opinion of Yona Fauzana, et al (2019) also states that learning physics using PBL models that are integrated with local wisdom turns out to be effective in increasing students' attitude competency. Rina Rahayu, et al (2015) state that PBL-based tools are more effective for students' scientific attitudes than using conventional devices. Classroom action research conducted by Yosico Indagiarmi and Abd Hakim (2016) also resulted in an increase in the value of student attitudes after applying problem-based learning.

The device developed is effective for knowledge competence. The results of this study are in line with research conducted by K D P Meke, et al (2018) using the problem based learning model of learning mathematics effectively on cognitive competence. Research conducted by R Isna, et al (2018) relating to the implementation of problem based learning based physics modules obtained by the results of the study that the average student learning outcomes have reached KKM after applying the problem based physics learning module. Research conducted by Heru Edi Kurniawan (2016) produced PBL-based SMP IPA devices that were effective in achieving student cognitive learning outcomes. Classroom action research conducted by Syaiful Prayogi and Muhammad Asy'ari (2013), Ira Sawitri, et al (2016) resulted that the implementation of the PBL model could improve student learning outcomes.

The device developed is effective for skills competence. The results of this study are in line with the results of research conducted by Syamsidah (2018) that PBL-based learning tools are effective for improving student skills. F E Wulandaria and N Shofiyah (2018) through their research stated that PBL learning is feasible to be implemented because it can improve students' reasoning skills. Research conducted by

R Isna, et al (2018) states that the implementation of PBL-based modules can train students' speaking skills through presentation activities. Heru Edi Kurniawan (2016) through research into the development of PBL-based devices can also improve students' psychomotor abilities. Ratna Ningsih, et al (2016) also resulted in PBL-based learning tools effectively improving the performance of high school students in preparing reports. Classroom action research conducted by Yosico Indagiarmi and Abd Hakim (2016) also resulted in an increase in the value of student skills after applying problem-based learning.

CONCLUSION

Based on the description above it can be concluded that the learning device developed has been valid based on the validator's assessment consisting of 3 expert validators and 2 validator practitioners. The valid learning tools are syllabus, lesson plans, modules and assessment tools consisting of attitude, knowledge and skills assessment. The learning tools developed are very practical. Practicality of the device (Syllabus, lesson plans, modules and assessment tools) is obtained through the teacher's response questionnaire. The practicality of the lesson plan is also obtained through observing the implementation of the lesson plan in class and the practicality of the module is also obtained through student questionnaire responses after using the module. Learning tools developed effectively. The effectiveness of the use of the device is based on student learning outcomes for attitudes, knowledge and skills competencies acquired at the testing and dissemination stages

REFERENCES

Abidin, Yunus. (2014). *Desain Sistem Pembelajaran Dalam Konteks Kurikulum 2013*. Bandung : PT Refika Aditama

Aida Fariroh dan Yustinus Ulung Anggraito. (2015). Pengembangan Perangkat Pembelajaran Berbasis Problem Based Learning Pada Materi Virus Kelas X SMA. *Unnes Journal of Biology Education*, 4(2), 149-155.

F E Wulandari and N Shofiyah. (2018). Problem-based learning: effects on student's scientific reasoning skills in science. International Conference on Science Education (ICoSEd). Journal of Physics: Conf. Series 1006 (2018) 012029 doi :10.1088/1742-6596/1006/1/012029

I Wayan Gunada, Hairunnisyah Sahidu, Sutrio. (2015). Pengembangan perangkat pembelajaran fisika berbasis masalah untuk meningkatkan hasil belajar dan sikap ilmiah mahasiswa. *Jurnal Pendidikan Fisika dan Teknologi*, 1(1), 38-46.

Ira Sawitri, Suparmi dan Nonoh Siti Aminah. (2016). Pembelajaran Fisika Berbasis Problem Based Learning (Pbl) Menggunakan Metode Eksperimen Dan Demonstrasi Ditinjau Dari Kemampuan Berpikir Kritis Terhadap Prestasi Belajar Dan Keterampilan Metakognitif. *Jurnal inkuiri,* 5(2), 79-86.

Joi Merritt, Mi Yeon Lee, Peter Rillero, and Barbara M. Kinach. (2017). Problem-Based Learning in K–8 Mathematics and Science Education: A Literature Review. *IJPBL*, 11(2),

K D P Meke, D U Wutsqa and H D Alfi. (2018). The Effectiveness of Problem-based Learning Using Manipulative Materials Approach on Cognitive Ability in Mathematics Learning. ICRIEMS 5.Journal of Physics: Conf. Series 1097 (2018) 012135 doi :10.1088/1742-6596/1097/1/012135

Kurniawan, Dwi Agus. (2013). *Pengembangan buku siswa untuk meningkatkan proses dan hasil belajar Kompetensi dasar cornflake cookies pada siswa Tunagrahita SMA-LB Negeri Gedangan, Sidoarjo*. E-journal boga. Volume 2 no. 1 tahun 2013.

Kurniawan, H. E. (2016). Pengembangan Perangkat Pembelajaran IPA SMP Berbasis Problem Based Learning pada Materi Getaran dan Gelombang. *Jurnal Pendidikan Fisika dan Keilmuan (JPFK), 2(1), 16-28.http://dx.doi.org/10.29303/jpft.v1i1.233*

N Za'ba' and S Prabawanto. (2019). The development of the problem-based learning module to facilitate students' mathematical reasoning. International Conference on Mathematics and Science Education (ICMScE 2018). Series: Journal of Physics: Conf. Series 1157 (2019) 032107. doi:10.1088/1742-6596/1157/3/032107

R Isna, M Masykuri and Sukarmin. (2018). Achievement of learning outcome after implemented physical modules based on problem based learning. International Conference on Mathematics, Science and Education 2017 (ICMSE2017). Journal of Physics: Conf. Series 983 (2018) 012026 doi :10.1088/1742-6596/983/1/012026

Ratna Ningsih, Andi Ichrar Asbar, Muh. Amir Masruhim. (2016). Pengembangan Perangkat Pembelajaran Berbasis Problem Based Learning Untuk Meningkatkan Kinerja Dalam Menyusun Laporan Siswa SMA. *Jurnal Kependidikan, 1(11), 2172-2177.*

Syamsidah. (2018). Development of Learning Tools of Problem-based Learning to Enhance Scientific Thinking Skills. 2nd International Conference on Statistics, Mathematics, Teaching, and Research. Journal of Physics: Conf. Series 1028 (2018) 012086 doi :10.1088/1742-6596/1028/1/012086

Trianto. (2009). *Mendesain model pembelajaran inovatif-progresif*. Surabaya: Kencana

Yona Fauzana, Ratnawulan and Usmeldi. (2019). The effectiveness of physics learning materials using problembased learning model integrated with local wisdom. The 2018 International Conference on Research and Learning of Physics. Series: Journal of Physics: Conf. Series 1185 (2019) 012087. doi:10.1088/1742-6596/1185/1/012087

Yosico Indagiarmi dan Abd Hakim. (2016). Pengaruh Model Pembelajaran *Problem based learning* (Pbl) Terhadap Hasil Belajar Siswa Kelas XI Semester II Pada Materi Pokok Fluida Dinamik Di SMA. *Jurnal Pendidikan Fisika, 5(1), 26-31.*