IJORER : International Journal of Recent Educational Research
Homepage : https://journal.ia-education.com/index.php/ijorer
Email : ijorer@ia-education.com

p-ISSN : 2721-852X ; e-ISSN : 2721-7965
IJORER, Vol. 3, No. 4, July 2022
Page 464-477


# Science Learning Materials in Integrated PBL Scientific Literacy Model to Improve Problem Solving Ability of Junior High School Students

**Eko Puji Lestari[1], Wasis[2], Tarzan Purnomo[3]**
[1,2,3] Universiatas Negeri Surabaya, Surabaya, Indonesia

**DOI :** https://doi.org/10.46245/ijorer.v3i4.230

**Sections Info**

***Article history:***
Submitted: June 14, 2022
Final Revised: July 16, 2022
Accepted: July 22, 2022
Published: July 30, 2022

***Keywords:***
PBL
Problem Solving Ability
Scientific Literacy
Validity

**ABSTRACT**

This research is motivated by the low ability of students to solve problems. This research aims to produce the validity of the Problem Based Learning (PBL) model of science learning tools integrated with scientific literacy to improve the problem solving skills of class VIII junior high school students. The research method used is the development method with Four-D (4D) stages.The subjects of this study were validated learning tools including the syllabus, lesson plans (RPP), Student Worksheets, and problem-solving ability tests. While the object of this research is the level of validity of the learning device. The data analysis technique was carried out in a qualitative descriptive manner based on the assessment of three validators. The results of the validation by three validators concluded that the syllabus had an average score of 3.97 with valid criteria, the Learning Implementation Plan (RPP) had an average score of 3.84 with a valid category, Student Worksheet with an average score 3.70 in the valid category and the problem-solving ability test assessment instrument gets an average score of 3.60 in the valid category. Based on the results of this validity analysis, the learning materials developed was declared valid for use in learning. Thus the learning materials developed can be used as an alternative in improving the problem solving ability of students in their learning.

## INTRODUCTION

In the era of the 21st century, the demands are even greater to provide education that is able to produce reliable human resources so that they are able to answer the challenges of the times with all their problems. Knowledge is an important aspect that needs to be possessed by everyone who knows, through his work humans gain knowledge that is constructed from experience, the formation process runs dynamically and every new understanding causes reconstruction (Rizal, et al 2016). Piaget (in Slavin, 1994:145) states that students need to be encouraged to discover their own knowledge through direct interaction with their environment. Because building interactions with each other is very possible for knowledge transfer, collaboration is established which results in easier and lighter learning tasks (Ardianto & Rubini, 2016). So that teachers are required to prepare learning with various activities that involve students directly with the real world. Because as a mediator, the teacher should be able to generate positive energy for students with various active, innovative, creative, effective and fun learning activities such as practicum activities or demonstrations of real problems so that students' creativity in solving problems is explored. Presentation of problems from real phenomena can be packaged in the form of activities that exist in worksheet (Gestarini, et al., 2018). For this reason, it is very important for teachers to understand the potential and expertise of different students with varying levels of understanding and knowledge in managing information so that teachers need to know their thinking styles and construct their knowledge (Rahman & Setiawan, 2013). Applying Piaget's theory means

learning that is designed using multiple investigations. By doing this process continuously in learning will create new experiences that students get in solving research problems. Students who are accustomed to being active in constructing and applying the knowledge that they have previously resulted in increased ability to solve problems related to various fields of daily life (Ahmad & Nasution, 2019). When students have been able to apply their knowledge in real situations in everyday life, they are said to have been able to solve problems. The importance of problem solving skills is in line with the 2013 science curriculum for junior high school science subjects which can be seen in the basic competencies of science learning which states that "students are expected to understand science concepts and principles as well as their interrelationships and be applied in solving problems in life" (Permendikbud No. 21 of 2016). The 2013 curriculum is a solution to the question of developing aspects of 21st century skills in students (Redhana, 2019). One of them solves the problem.

The existence of a curriculum is very important to support the educational goals held. Because the curriculum is a structure that limits not only the activities carried out by teachers and students but rather on efforts to design the curriculum to achieve the desired goals (Young, 2014b). In addition, basically the curriculum is systematic knowledge to be transmitted from one generation to the next because it can be taught and learned by students according to their stage and age development (Young, 2014a). Curriculum development is very necessary to meet the needs of students in an effort to prepare themselves to face the challenges ahead which are increasingly complex in the 21st century with various skills and competencies that need to be taught. Therefore, learning designed by teachers in this century should be able to arouse the desire and interest of students to dig deeper and motivate them to be confident in applying the various knowledge and skills that have been learned. Through project-based learning and problem-based learning, teachers must change their functions and roles from being the only source of learning to becoming a mentor and mediator for students to gain knowledge. This condition may cause discomfort for some teachers because the new paradigm of teacher-centered learning has changed to student-centered (Woods, 2014). The government has made changes to the 2013 curriculum at the lower secondary school level (Rawung, et al., 2021). Learning that guides students to be able to solve problems in everyday life must be trained and taught. But in fact, the problem-solving ability of students is still low.

Based on the results of discussions and interviews with colleagues and observations during learning, it shows that students' problem-solving abilities are still far from expectations. The tendency to things that are practical and fast is the basic reason that activities that emphasize long processes are not liked. This shows that the learning that has been implemented has not been able to deliver students to the correct understanding of the importance of applying the steps in solving problems. So that resulted in the problem solving ability of students is still low. The habit of being taught lessons instead of finding and solving them independently (Prastiwi, 2018) also tends to be preferred. This has an impact on their literacy skills which are not well honed. Meanwhile, students live in the globalization era of the 21st century, where scientific literacy is one of the skills that are indispensable in this century which makes scientific knowledge the foundation of everyday life (Gultepe & Kilic, 2015). Scientific literacy is an individual's ability to solve and analyze issues in society scientifically (Nurjanah et al., 2019). However, a study conducted by PISA (2018) shows that the scientific

competence obtained by Indonesian children is only 389, while the OECD average score is 489. More than 60% of Indonesian students have a science literacy competency level below level 2. Indonesian students are only able to answer or solve problems of a general nature with supporting information, the ability to identify information still requires explicit direction, and is only able to take action if given a clear stimulus (Wasis, 2015). This condition is reinforced by Angraini (2014) and Putra (2016) who state that the low level of scientific literacy is a tendency that the learning process does not support students in developing scientific literacy skills. Scientific literacy competence has resulted in the ability to solve problems. This relationship is seen in Bond's (1989) statement that students who have the knowledge to understand scientific facts and the relationship between science, technology and society, and are able to apply their knowledge to solve real-life problems are called scientifically literate people. According to Belfali (2018) as Head of The Early Childhood and School Division, Directorate of Education and Skills, OECD said that teachers in Indonesia have high enthusiasm but have not been able to understand the needs of each individual student. Of course this is an opportunity and a challenge for teachers to be able to facilitate it. Designing learning according to the characteristics and needs of students so that they are able to deal with all the problems of their time, teachers need to do so that students' problem solving abilities increase.

To improve the problem solving ability of students, it is necessary to be supported by the right learning model. Teachers as mediators in learning must be able to choose learning models according to the needs or characteristics of the basic competencies (KD) being taught (Directorate of High School Development, 2017). Problem Based Learning (PBL) Model Learning has an essential role in efforts to improve students' problem solving abilities (Harapit, 2018). Problem-based learning (PBL is a learning model that uses everyday contextual problems as a medium for students to learn about critical thinking as well as hone problem-solving skills, and acquire essential things, namely concepts and knowledge (Cahyani and Setyawati, 2016 ). Problem-based learning is a learning model that presents real problems that require collaboration among students in solving agreed problems (Trianto (2014). Furthermore, problem-based learning is able to facilitate successful problem solving, communication, group work, and interpersonal skills with better than other approaches (Rusman, 2014).

Based on the opinions above, the Problem Based Learning (PBL) model is suitable for improving problem solving skills. Issues related to scientific phenomena need to be presented in learning so that a scientific literate society is formed. The concept of learning the PBL model is able to support the characteristics of a scientific literate, because students benefit from problem-solving skills and scientific process skills related to issues related to natural and environmental phenomena (Nurhaliza & Hazifah, 2021). The ability to solve problems can be trained intensively on students by presenting real phenomena in everyday life (Santhalia, 2019). Because the ability to solve problems is an important aspect of every individual who often finds everyday problems that require creative solutions and solutions to deal with them (Permatasari, 2014). With this linkage, the researchers focused on research by analyzing the validity of the Science Learning Model Problem Based Learning (PBL) integrated scientific literacy to improve problem-solving skills in junior high school students on additive and addictive substances. This material was chosen because the phenomena are close to the daily lives of students who need alternative solutions to deal with them. The problem-based

learning model (PBL) developed in the learning process as a support can use material that uses problem-solving-based concepts so that the learning process takes place effectively and efficiently (Bahri, et al., 2018).

## RESEARCH METHOD

### General Background

This research is a type of development research because it aims to produce science learning materials with an integrated Problem Based Learning (PBL) model of scientific literacy to improve problem solving skills in junior high school students which refers to the research design of Research and Development (R&D) development. The development method used is the Four-D (4D) stage which includes the definition stage, the design stage, the develop stage and the dissemination stage. The dissemination stage was not carried out because the research results were not disseminated in other schools.

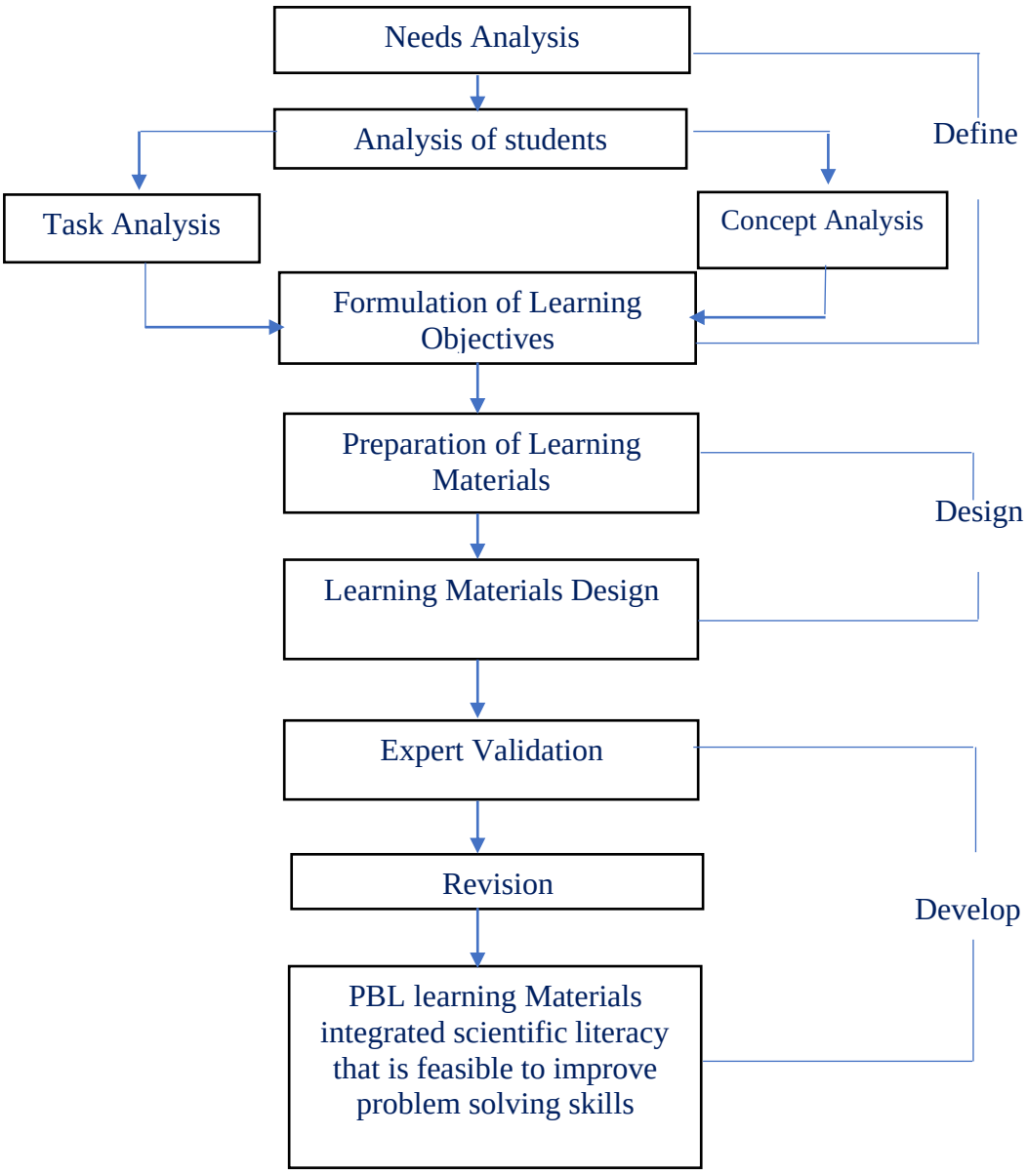


**Figure 1.** Model Diagram of 4D Model Learning Device Development (Adapted from Thiagarajan, Semmel, and Semmel, 1974)

**Instrument and Procedures**

Instrument is a measuring tool used for research data collection purposes. The research instrument made refers to the objectives to be achieved so that appropriate and accurate data are obtained. The instrument used in this research was a learning materials validation sheet. This validation sheet functions to determine the feasibility and criteria for product suitability that have been designed by researchers (Febrianti and Putra, 2020). The validated learning materials include the syllabus, lesson plans (RPP), Student Worksheets, and problem-solving ability tests. The instrument that has been developed was validated by three validators consisting of two expert lecturers and one expert teacher. An instrument is declared content valid depending on the expert. As an indicator, the instrument is said to be valid if the expert has accepted both the content and the format without any further improvements (Yusup, 2018). The validator has the right to give opinions, perceptions or express attitudes on the instruments made by researchers which refers to the Likert scale assessment (Sugiyono, 2016).

**Data Analysis**

The validation data obtained from the validator was then analyzed using qualitative descriptive, namely by calculating the average score of the validator's assessment. The validation data obtained from 3 (three) validators are then taken on average with the following scoring rules:

$$Average = \frac{V_1 + V_2 + V_3}{3}$$

Description:
V1 : Validator score 1
V2 : Validator score 2
V3 : Validator score 3

The average score is converted using conditions such as Table 1.

**Table 1.** Interval score, category and description

| Interval score | Category | Description |
|---|---|---|
| 3,6 ≤ SV≤ 4,0 | Completely valid | Can be used without revision |
| 2,6 ≤ SV ≤ 3,5 | Valid | Can be used with revisions |
| 1,6 ≤ SV ≤ 2,5 | Less valid | Can be used with many revisions |
| 1 ≤ SV ≤ 1,5 | Not valid | Can be used yet and still need consultation |

(Adapted from Ratumanan & Laurens, 2011)

The assessment data from the validator can be seen from the reliability value of the instrument. The level of reliability is calculated using the following formula:

$$R = \left(1 - \frac{A - B}{A + B}\right) x\ 100\%$$

Description:
R = Percentage of instrument reliability
A = The average score is higher than the validator
B = The average number of scores lower than the validator

The results of instrument validation are said to be suitable if the results of the percentage of agreement are 75% (Borich, 1994).

## RESULTS AND DISCUSSION

This research has produced an integrated Problem Based Learning (PBL) model of scientific literacy to improve the problem solving ability of students in the valid category. The learning materials developed include the syllabus, lesson plans, worksheet and problem-solving ability test instruments. In the early stages of the study, an analysis of the needs of students was carried out according to the conditions found, preparing the initial design of the learning materials which was reviewed by the supervisor as the initial draft of the research. Furthermore, review and validation by the three validators to obtain input and suggestions so that the learning materials developed produce valid categories. The validity of learning materialas is the value obtained from the results of the study of learning devices given by the validators in the form of scores between 1 to 4 (Hendratmoko et al., 2016). The expert/validator assessment is in the form of a checklist (√) in the score column using a Likert scale in the range 1-4. For criteria 4 is very good, 3 is good, 2 is not good and 1 is not good. The purpose of validation of learning tools is to assess whether or not several aspects will be implemented before being used in learning, then revise learning materials s according to suggestions and input from the validator (Naila & Sadida, 2020). The validation results of the validators are then processed and the following analysis is obtained:

**a. Syllabus validation results**

The syllabus was developed referring to Permendikbud (2016) presenting short learning activities with the Problem Based Learning learning model integrated scientific literacy that has been validated by three validators with the results of the syllabus validation can be seen in table 2.

**Table 2.** Results of syllabus validation recapitulation

| No. | Aspect of Assesment | Score | | | Average | Category |
|---|---|---|---|---|---|---|
| | | V1 | V2 | V3 | | |
| 1. | Conformity between the syllabus format and the format of Permendikbud no 22 of 2016 | 4 | 4 | 4 | 4 | SV |
| 2. | Completeness of syllabus identity | 4 | 4 | 4 | 4 | SV |
| 3. | Conformity between the subject matter with KI and KD | 4 | 4 | 4 | 4 | SV |
| 4. | Conformity between learning activities and the achievement of KI and KD | 4 | 4 | 4 | 4 | SV |
| 5. | The suitability of the learning steps with the syntax of the integrated PBL model of scientific literacy | 3 | 4 | 4 | 3,7 | SV |
| 6. | Contains three types of assessment (attitude, knowledge and skills) | 4 | 4 | 4 | 4 | SV |
| 7. | Conformity between the assessment instrument with KI and KD | 4 | 4 | 4 | 4 | SV |
| 8. | The suitability of the time allocation with KD, indicators, and learning objectives | 4 | 4 | 4 | 4 | SV |
| 9. | Loading various learning resources | 4 | 4 | 4 | 4 | SV |
| | **Average** | | | | **3,97** | **SV** |
| | **Validity Percentage** | | | | **99,08** | **Very valid** |
| | **Reliability (%)** | | | | **98,41** | **Reliabel** |

Based on the validation results in Table 2, it can be seen that the syllabus developed has an average score of 3.97 with very valid criteria and 98.41% reliability (reliable) so it is feasible to use in learning. The syllabus which was developed as needed uses the 2013 curriculum on additive and addictive materials for class VIII SMP where the preparation of the learning framework refers to the components of the Minister of Education and Culture (2016). A well-structured syllabus will be a reference in the preparation of the learning framework (Supeno, 2016). The syllabus is the basis for the development of other tools so that it must be categorized as valid (Sofyan et al., 2017). Other learning tools in question are Learning Implementation Plans (RPP), Student Worksheets, and assessment test instruments to measure problem solving abilities. Thus the syllabus developed can be useful as a guide in the development of further learning, the main source in preparing lesson plans, guidelines for managing learning activities and developing an assessment system (Ratumanan & Rosmiati, 2019).

**b. RPP validation results**

The Learning Implementation Plan (RPP) developed by the researcher was scenariod in three meetings with each meeting 3 hours of learning so that the total learning was 9 hours of learning. Learning activities are developed using the Problem Based Learning syntax which is integrated with scientific literacy. The developed lesson plans were validated by three validators and three validators with the validation results can be seen in Table 3.

**Table 3.** Results of RPP validation recapitulation.

| No. | Aspect of Assesment | Score | | | Average | Category |
|---|---|---|---|---|---|---|
| | | V1 | V2 | V3 | | |
| 1. | Conformity between the RPP format and the format of Permendikbud no 22 of 2016 | 4 | 4 | 4 | 4 | SV |
| 2. | Completeness of RPP identity | 4 | 4 | 4 | 4 | SV |
| 3. | Conformity between RPP with KI and KD | 4 | 4 | 4 | 4 | SV |
| 4. | Conformity between learning objectives and indicators. | 4 | 4 | 4 | 4 | SV |
| 5. | The suitability of learning materials with KD and learning indicators. | 3 | 4 | 4 | 3,7 | SV |
| 6. | The suitability of learning resources with learning objectives and learning materials | 3 | 4 | 4 | 3,7 | SV |
| 7. | The suitability of the learning model with the subject matter of learning | 3 | 4 | 4 | 3,7 | SV |
| 8. | The suitability of learning activities with integrated PBL syntax of scientific literacy | 2 | 4 | 4 | 3,3 | SV |
| 9. | The suitability of learning activities with integrated PBL syntax of scientific literacy | 3 | 4 | 4 | 3,7 | SV |
| 10. | The suitability of the time allocation with KD, indicators, and learning objectives | 4 | 4 | 4 | 4 | SV |
| 11. | Conformity between the assessment instrument with KI and KD. | 4 | 4 | 4 | 4 | SV |

| No. | Aspect of Assesment | Score V1 | Score V2 | Score V3 | Average | Category |
|---|---|---|---|---|---|---|
| 12. | Coverage of learning indicators with the achievement of problem solving aspects | 4 | 4 | 4 | 4 | SV |
| | **Average** | | | | **3,84** | **SV** |
| | **Validity Percentage** | | | | **95,84** | **Very valid** |
| | **Reliability** | | | | **92,45** | **Reliabel** |

Based on the validation results in Table 3, it can be seen that the RPP developed has an average score of 3.84 very valid criteria. With a reliability of 92.45% (reliable), so it is feasible to use it in learning. After going through revisions based on suggestions and input from the three validators, the lesson plans developed based on the 2013 curriculum can be used in learning to measure problem-solving skills. The RPP which contains the planning process for implementing learning adapts to the existing provisions in the 2013 curriculum so that it has learning objectives that are in accordance with the needs and achievement of the demands of the applicable curriculum (Rahmiati et al., 2017: Widya et al., 2017). RPP as a reference for teachers in implementing science learning using the syntax of the Problem Based Learning model which is integrated with scientific literacy is arranged in the form of an easy-to-use scenario. The Learning Implementation Plan (RPP) contains teacher planning in carrying out each stage of learning to achieve predetermined and student-centered basic competencies so that a more meaningful understanding is obtained during the learning process (Djumingin et al., 2016). The lesson plans implemented should be able to show an essential picture of an appropriate learning planning process (Fahmi & Sitompul, 2022). Every teacher has the obligation to prepare lesson plans (Ratumanan & Rosmiati, 2019). Based on the Regulation of the Minister of Education and Culture Number 22 of 2016 concerning Process Standards, what is meant by the Learning Implementation Plan (RPP) is a face-to-face learning activity plan for one or more meetings.

This research in the scenario in lesson plans using PBL syntax which is integrated with scientific literacy competence is divided into three meetings. At the first meeting, students are actively involved in authentic problems that exist around everyday life, identify the problem, explain the analysis of possible problem solving by providing ideas/solutions in the form of an investigation design. The second meeting in groups carried out the results of the research design with experiments or literature studies and then interpreted the data and evidence scientifically. While the last third meeting, the activity of students developing ideas/solutions based on the results of the investigation by making written works to be presented in front of the class, obtaining comments from other groups and evaluating the problem-solving process carried out.

**c. Student worksheets validation results**

Student worksheets are activity sheets that contain instructions for activities that must be carried out by students during learning. Student activities are based on Problem Based Learning syntax that is integrated with scientific literacy. worksheet is equipped with reading materials to support literacy activities. This worksheet was validated by three validators with the validation results which can be seen in table 4.

**Table 4.** Results of worksheet validation recapitulation

| No. | Aspect of Assesment | Score V1 | Score V2 | Score V3 | Average | Category |
|---|---|---|---|---|---|---|
| 1. | The suitability of learning activities with KI and KD. | 3 | 4 | 4 | 3,7 | SV |
| 2. | Suitability of learning activities with learning objectives and materials. | 3 | 4 | 4 | 3,7 | SV |
| 3. | Clarity of learning steps used. | 3 | 4 | 4 | 3,7 | SV |
| 4. | The inclusion of character values (honesty, cooperation, and curiosity) developed in learning activities | 3 | 4 | 4 | 3,7 | SV |
| 5. | Coverage of learning indicators with the achievement of problem-solving ability aspects | 3 | 4 | 4 | 3,7 | SV |
| 6. | Clarity of the components that make up the worksheet in the form of pictures, tables, units and quantities. | 3 | 4 | 4 | 3,7 | SV |
| 7. | Clarity of language, numbers and writing used. | 3 | 4 | 4 | 3,7 | SV |
| | **Average** | | | | **3,70** | **SV** |
| | **Validity Percentage** | | | | **91,7** | **Very valid** |
| | **Reliability** | | | | **85,7** | **Reliabel** |

Based on the validation results in Table 4, it can be seen that the worksheet developed has an average score of 3.70 so that it is declared very valid. With a reliability of 85.70% so it is feasible when used in learning. After revisions were made based on suggestions and input from the three validators, the developed worksheets could be used in learning to improve problem-solving skills. The activities of students during learning are summarized in various activities in worksheet. The prepared worksheet can be designed and developed according to the conditions and situations of the learning activities that will be faced (Putriana, et al., 2020). According to research by Sumiantri, et al. (2019), the worksheets developed by the PBL model should be adapted to the content and context of the learning materials. The PBL model is proven to be able to develop all indicators of problem solving ability. By using an activity sheet in the form of instructions, as well as the steps needed to complete the task, it will be useful for educators in carrying out learning (Ratumanan & Rosmiati, 2019). So that the learning objectives carried out using PBL syntaxes can be achieved.

**d. Assessment Instrument validation results**

The assessment instrument developed by the researcher includes an assessment of aspects of character, skills and problem-solving abilities. In accordance with the research objectives, test questions were given to determine whether or not aspects of problem solving ability were improved. The instrument has been validated by three validators with the validation results can be seen in Table 5.

**Table 5.** Results of the recapitulation of the assessment instrument validation

| No. | Aspect of Assesment | Score V1 | Score V2 | Score V3 | Average | Category |
|---|---|---|---|---|---|---|
| 1. | The suitability of the assessment grid with KI, KD, and learning objectives. | 3 | 4 | 4 | 3,7 | SV |
| 2. | The use of good and correct language, in | 3 | 4 | 3 | 3,3 | SV |

| | | | | | | |
|---|---|---|---|---|---|---|
| | accordance with the variety of languages in the EYD. | | | | | |
| 3. | Clarity of scoring guidelines on the observation sheet. | 3 | 4 | 4 | 3,7 | SV |
| 4. | The scope of the assessment of the developed character values. | 3 | 4 | 4 | 3,7 | SV |
| 5. | Scope of assessment of skills aspects during investigation activities. | 3 | 4 | 4 | 3,7 | SV |
| 6. | Scope of assessment on aspects of problem solving ability | 3 | 4 | 4 | 3,7 | SV |
| 7. | The suitability of the questions with indicators of learning achievement, learning objectives, and answer keys. | 3 | 4 | 4 | 3,7 | SV |
| 8. | Clarity and suitability of questions with answers and rubrics for assessment guidelines. | 1 | 4 | 4 | 3 | V |
| | **Average** | | | | **3,60** | **SV** |
| | **Validity Percentage** | | | | **88,56** | **Very valid** |
| | **Reliability** | | | | **79,98** | **Reliabel** |

Based on the validation results in Table 5, it can be seen that the assessment instrument has an average score of 3.60 very valid criteria. With a reliability of 79.98% so it is suitable for use in learning. Based on the opinion of Luthfi, et al (2019) which states that before being used as an evaluation tool, an assessment instrument needs to be tested for validity and reliability with the aim of knowing the level of feasibility of the instrument. So that after revisions were made based on suggestions and input from the three validators, the test instrument developed could be used in learning to measure the improvement of students' problem-solving abilities. This instrument was developed as an evaluation tool for the achievement of learning objectives, because not many schools have presented tests that link everyday phenomena only focusing on the knowledge and conceptual dimensions so they have not been able to measure scientific literacy competence (Pratiwi, et al., 2019). Moreover, measuring the ability to solve problems. Therefore, an assessment instrument is needed that refers to indicators of problem-solving abilities which include defining and analyzing problems, collecting information/data, implementing solutions, and evaluating solutions (Chao Yu et al., 2017). According to research by Sumiantri, et al. (2019), it is stated that making question instruments with problem-solving indicators should at least use the stages of analyzing, then choosing material not only on mathematical calculations but with a wider and open scope so that students are able to answer questions optimally.

Based on the overall results of the validity analysis, the learning materials developed by the researchers were stated to be very valid and suitable for use in learning. The learning materials developed were tested for construction validity through expert judgment (Sugiyono, 2013). Learning materials that have been validated receive an assessment in the form of corrections, suggestions and comments that can be used as a basis for making improvements and improvements to learning tools (Ahmad et al., 2018).

## CONCLUSION

Base on the results of the research, it can be concluded that the learning tools developed with the integrated Problem Based Learning model of scientific literacy are said to be valid and suitable for use in learning to improve students' problem solving skills. Summarizing the results of the validation by three validators, it is concluded that the syllabus has a valid category, Learning Implementation Plan (RPP) a valid category, Student Worksheet is in the valid category and the problem-solving ability test assessment instrument gets the valid category. The research conducted is limited to the validity aspect of this science learning materials, however, it can be used as an example and alternative for developing teaching material devices with other topics at the same level. However, sustainability is needed for a wider scale so that the PBL model of science learning materials is proven to be able to improve students' solving abilities.

## ACKNOWLEDGEMENTS

The researcher would like to thank the expert lecturers: Prof. Endang Susantini, M.Pd., Dr. Raharjo, M.Sc., and expert teacher Wiji Agustin, S.Pd. as a validator who has provided corrections, suggestions and comments on the developed science learning tools.

## REFERENCES

Abdurrozak Rizal.,dkk. (2016). "Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kreatif Siswa". Jurnal Pena Ilmiah.

Ahmad, M., & Nasution, D. P. (2019). Peningkatan Kemampuan Literasi Matematika Siswa Sekolah Menengah Pertama melalui Pendekatan Kontekstual. Jurnal Education and Development, 7(2), 103–112. http://journal.ipts.ac.id/index.php/ED/article/view/883/395

Angraini, Gustia. 2014. Analisis Kemampuan Literasi Sains Siswa SMA Kelas X di Kota Solok. Jurnal Prosiding mathematics and Science Forum 2014 Jurusan Biologi FPMIPA: Universitas Pendidikan Indonesia

Ardianto, D., & Rubini, B. (2016). Literasi Sains dan Aktivitas Siswa pada Pembelajaran IPA Terpadu Tipe Shared. Unnes Science Education Journal, 5 (1). http://journal.unnes.ac.id/sju/index.php/usej

Bahri, A., Putriana, D., & Idris, I.S. (2018). Peran PBL dalam Meningkatkan Pemecahan Masalah Biologi. Jurnal Sainsmat,7(2),114-124. http://ojs.unm.ac.id/index.php/sainsmat

Belfali, Y. (2018). Hasil PISA Indonesia 2018: Akses Makin Meluasi, Tingkatkan Kualitas. Jakarta: Kemdikbud

Bond, D. 1989. In pursuit of chemical literacy: A place for chemical reactions. Journal of Chemical Education, 66(2), 157. http://doi. org/10.1021/ed066p157

Cahyani, H., & Setyawati, R. W. (2017). Pentingnya Peningkatan Kemampuan Pemecahan Masalah melalui PBL untuk Mempersiapkan Generasi Unggul Menghadapi MEA. PRISMA, Prosiding Seminar Nasional Matematika,151-160. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/21635

Chao, Tzeng, dan Hsin. (2017). "The Study of Problem Solving Process of E-book PBL Course of Atayal Senior High School Students in Taiwan". EURASIA Journal of Mathematics Science and Technology Education, 13(3):1001-1012

Dinantia, A., & Amran, E. Y. (2017). Pengembangan Lembar Kegiatan Peserta Didik (LKPD) Berbasis Hierarki Konsep pada Pokok Bahasan Kelarutan dan Hasil Kali Kelarutan. *Jurnal Online Mahasiswa (JOM) Bidang Keguruan dan Ilmu Pendidikan*, 4(2), 1-10

Direktorat Pembinaan Sekolah Menengah Atas. 2017. Model-Model Pembelajaran. Jakarta: Kementerian Pendidikan dan Kebudayaan Republik Indonesia

Fahmi, A., & Sitompul, S.S. (2022). Analisis Perangkat Pembelajaran IPA Terpadu Berbasis Daring Yang Digunakan Guru SMP Negeri Pontianak. Jurnal Inovasi Penelitian dan Pembelajaran Fisika, 3(1) http://doi. org/10.26418/jippf.v3i1.49771

Febrianti, D & Putra, Z.H. (2020). Developing 3-D Snake And Ladder Game: The Implementation At The Second Grade Students Of SDN 37 Pekanbaru. Jurnal PAJAR (Pendidikan dan Pengajaran), 4(6) http://dx.doi.org/10.33578/pjr.v4i6.8107

Gestarini, E.K., Santyasa, I.W., & Kirna, I.M. (2018). Pengaruh Model Pembelajaran Sains Teknologi Masyarakat (STM) Terhadap Kemampuan Pemecahan Masalah dan Sikap Ilmiah Siswa. Jurnal Teknologi Pembelajaran Indonesia, 8(2).

Gultepe, N., & Kilic, Z. 2015. Effect of scientific argumentation on the development of scientific process skills in the context of teaching chemistry. International Journal of Environmental and Science Education, 10(1), 111–132. http://doi.org/10.12973/ijese.2015.234a

Haripit, S. (2018). Peranan Problem Based Learning (PBL) terhadap Kemampuan Pemecahan Masalah dan Motivasi Belajar Peserta Didik. Jurnal Pendidikan Tambusai. 2(2). 912-917 https://doi.org/10.31004/jptam.v2i4.41

Hendratmoko, A.F., Wasis., & Susantini, E. (2016). Development Of Physics Learning Matertials Based On Guided Inquiry Model Integrated With Virtual Laboratory To Facilitate Student's Scientific Argumentation Ability. Jurnal Imiah Pendidikan Fisika "Lensa", 4(1).

Ibrahim, M. (2010). Dasar-dasar Proses Belajar Mengajar. Surabaya: Unesa: University Press.

Luthfi, I.A., Muharomah, D.R., Ristanto, H.D., & Miasyah, M. (2019). Pengembangan Tes Kemampuan Masalah Pada Isu Pencemaran Lingkungan. *Jurnal Program Studi Pendidikan Biologi*, 9(2).

Naila, I., & Sadida, Q. (2020). Validitas Perangkat Pembelajaran Matematika Berbasis Scaffolding untuk Siswa Sekolah Dasar. Procedings Conference of Elementary Studies : Literasi Dalam Pendidikan Di Era Digital Untuk Generasi Milenial, 229–246. http://journal.um- surabaya.ac.id/index.php/Pro/article/view/4829

Nurhaliza, S & Hazifah, E. (2021). Implementasi Problem Based Learning (PBL) Terhadap Kemampuan Literasi Sains Peserta Didik. Jurnal Inovasi Pendidikan Sains, 12 (1). 1-11

Nurjannah, A., Sudin, A., & Sujana, A. (2017). Literasi sains dalam pembelajaran berbasis

masalah (penelitian pre-experimental terhadap siswa kelompok atas, tengah, dan bawah sdn waringin ii dan sdn palasah i di kecamatan palasah kabupaten majalengka pada materi energi panas). Jurnal Pena Ilmiah, 2(1), 581-590. https://doi.org/10.17509/jpi.v2i1.10036

Permendikbud No 21. (2016). Standar Isi Pendidikan Dasar dan Menengah. Jakarta

Permatasari, N Y. 2014. Meningkatkan Kemampuan Siswa dalam Memecahkan masalah Matematika dengan Model Pembelajaran Treffinger. Jurnal Pendidikan Matematika, 3(1): 31.

Prastiwi. (2018). Kemampuan Pemecahan Masalah Pada Siswa Kelas VII SMP. e-journal -pensa. 6(2). 98-103

Pratiwi, Cari, & Aminah. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. Jurnal Materi dan Pembelajaran Fisika (JMPF). 9(1). ISSN : 2089-6158

Putra, Hadi Hamzah. 2016. Analisis Kemampuan Literasi Sains SMP Kelas VII Kurikulum 2013 di Kota Padang. Skripsi. Padang: Universitas Negeri Padang

Putriana, A.R., dkk. (2020). Socio Scientific Issue (SSI) Based LKPD Development In Learning Natural Scince SMP Class VII. Jurnal PAJAR (Pendidikan dan Pengajaran), 4, 1. (30 Agustus 2020)

Rahman, A., & Setyawan, D. (2013). Eksplorasi Proses Konstruksi Pengetahuan Matematika Berdasarkan Gaya Berpikir. Jurnal Sainsmat. II(2). 140-152 http://ojs.unm.ac.id/ index.php/sainsmat

Rahmiati, Musdi, E., & Fauzi, A. (2017). Pengembangan Perangkat Pembelajaran Matematika Berbasis Discovery Learning untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa Kelas VIII SMP. Mosharaf (Jurnal Pendidikan Matematika), 6(2), 267–272. https://doi.org/10.30998/jkpm.v3i1.2540.

Ratumanan. dan Laurens. (2011). Penilaian Hasil Belajar pada Tingkat Satuan Pendidikan. Surabaya: Unesa University Press.

Ratumanan & Rosmiati, I. (2019). Perencanaan Pembelajaran. Depok: RajaGrafindo Persada.

Rawung, W.H., Katuuk, D.A., Rotty, V.N.J., & Lengkong, J.S.J. (2021). Kurikulum dan Tantangan Abad 21. Jurnal Bahana Manajemen Pendidikan, Vol 10 (1): pp.29-34, DOI: https://doi.org/10.24036/jbmp.v10i1

Redhana, I.W. (2019). Mengembangkan Keterampilan Abad Ke-21 Dalam Pembelajaran Kimia. Jurnal Inovasi Pendidikan Kimia, 13(1)

Rusman. (2014). Model-model Pembelajaran (Mengembangkan Profesionalisme Guru). Jakarta: Raja Grafindo Persada

Safaruddin, Degeng, I. N. S., Setyosari, P., & Murtadho, N. (2020). The effect of PJBL with WBL media and cognitive style on students' understanding and science-integrated concept application. Jurnal Pendidikan IPA Indonesia, 9(3). https://doi.org/10.15294/jpii.v9i3.24628

Santhalia, Yuliati & Wisodo. (2019). Kemampuan Pemecahan Masalah Siswa pada Materi Suhu dan Kalor melalui Experiential Learning Berbasis Fenomena. Jurnal Pendidikan. 4(2). 164-171. http://journal.um.ac.id/index.php/jptpp/

Sumiantari, N.L.E., Suardana, I.N., & Selamet, K. (2019). Pengaruh Model Problem Based Learning Terhadap Kemampuan Memecahkan Masalah IPA Kelas VIII SMP. Jurnal Pendidikan dan Pembelajaran Sains Indonesia, 2(1).

Sugiyono. (2013). Metode penelitian kuantitatif, kualitatif dan R&D. Bandung: Alfabeta CV.

Sugiyono. (2016). Metode Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: PT Alfabet.

Supeno. (2016). Model Pembelajaran Penyelesaian Masalah Argumentatif untuk Meningkatkan Hasil Belajar Fisika Kognitif Produk, Ketrampilan Proses Sains, & Argumentasi Ilmiah Siswa SMK. (Disertasi Doktor Pendidikan tidak dipublikasikan).Universitas Negeri Surabaya.

Sofyan, M.A., Wasis & Ibrahim, M. (2017). Pengembangan Perangkat Pembelajaran Berbasis Edutainment Untuk Melatihkan Kreativitas Siswa SMK Jurusan Otomotif Pada Materi Fluida Statis. Pendidikan Sains Pascasarjana Universitas Negeri Surabaya, 7(1).

Trianto. (2014). Mendesain model pembelajaran inovatif, progresif, dan kontekstual: konsep, landasan, dan implementasinya pada kurikulum 2013, kurikulum tematik integrative/TKI. Jakarta: Kencana Prenada Media Group

Wasis (2015). Pembelajaran dan Penilaian Sains Sesuai Tuntutan Kurikulum 2013. Prosiding Seminar Nasional Tahun 2015. Surabaya.

Widya, Hamdi, & Fauzi, A. (2017). Kualitas Perangkat Pembelajaran Fisika Berbasis Model Creative Problem Solving Dengan Pendekatan Open-Ended Pada Materi Usaha Dan Energi Terintegrasi Energi Biomassa. Gravity : Jurnal Ilmiah Penelitian dan Pembelajaran Fisika, 3(2), 158–171. https://doi.org/10.30870/gravity.v3i2.2600

Woods, D. 2014. Problem-Based Learning (PBL) (online). McMaster University. http://chemeng.mcmaster.ca/problembased-learning

Yusup, F. (2018). Uji Validitas dan Reliabilitas Instrumen Penelitian Kuantitatif. Jurnal Ilmiah Kependidikan, 7(1), 17-23

Young, M. (2014a). Teoria do currículo: O que é e por que é importante. Cadernos de Pesquisa, 44(151),191–201. https://doi.org/10.1590/198053142851

Young, M. (2014b). What is a curriculum and what can it do? Curriculum Journal, 25(1), 7–13.https://doi.org/10.1080/09585176.2014.902526

Zubaidah, Siti (2016). Keterampilan Abad Ke-21: Keterampilan yang Diajarkan Melalui Pembelajaran. Universitas Negeri Malang. tersedia [online] : https://www.researchgate.net/publication/318013627

***Eko Puji Lestari (Corresponding Author)**
Universitas Negeri Surabaya,
Postgraduate Programme, Science Education Study Program
Continuing Program Development, Jl. Unesa Lidah Wetan, Surabaya, East Java,Indonesia.
Email: eko.19006@mhs.unesa.ac.id

**Prof. Dr. Wasis, M.Si.**
Universitas Negeri Surabaya,
Postgraduate Programme, Science Education Study Program
Continuing Program Development, Jl. Unesa Lidah Wetan, Surabaya, East Java,Indonesia.
Email: wasis@unesa.ac.id

**Dr. Tarzan Purnomo, M.Si.**
Universitas Negeri Surabaya,
Postgraduate Programme, Science Education Study Program
Continuing Program Development, Jl. Unesa Lidah Wetan, Surabaya, East Java,Indonesia.
Email: tarzanpurnomo@unesa.ac.id