Validity of student worksheet inquiry based learning model with multi-representation approach integrated scientific literacy for grade XI physics learning on 21st century

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Abstract. Student worksheet is a learning resource that guides student during investigations or problem solving. Learning activities will be successful if they are carried out with the right learning model and learning approach as well as supporting literacy skills. Based on the analysis of the needs and characteristics of student, and the limitation of previous validation studies, student worksheet based on the inquiry-based learning model with an integrated multi-representation approach to scientific literacy can be a problem solution. The purpose of this study was to produce a worksheet based on an inquiry based learning model with an integrated multi-representation approach to scientific literacy in valid category. This research method uses descriptive statistics. The instrument was used a validation sheet filled out by experts. The validity of student worksheet obtains on the feasibility of content, presentation, language and graphic components. The average of the four components of student worksheet validation was 0.81 by development experts. In this way, it can be said that student worksheet inquiry-based learning model with an integrated multi-representation approach of scientific literacy is in valid category.

1. Introduction

The development of the 21st century brings changes to human life. In the 21st century, everyone should have a variety of skills to be able to compete in facing the changing times that are increasingly fast. The demands for these skills can be fulfilled if the implementation of education prepares students to master the various skills needed. Skills are important for students to achieve success in their learning, daily life and future in the 21st century (Asrizal, Amran, Ananda, Festiyed, et al., 2018). This indicates that education has an important role in preparing the nation’s progress in the future.

The role of literacy is also very much needed to answer the challenges of 21st century education. Literacy makes humans sensitive to the environment and can keep up with the times. Humans can understand and explore the relationship between one another. Literacy is an effort that can be used to prepare better and easier Human Resources competencies in the learning acceptance process. The learning process does not only have a limited concept of knowledge, but plays a role in the process of inquiry and discovery. In physics learning, concept discovery can be done through discussion or experimentation. The learning process requires appropriate teaching materials, models and learning
approaches. Good learning tools must be in accordance with the demands of the 2013 Curriculum and make students to achieve learning goals.

The facts that occur in schools indicate that learning activities are not in accordance with the 2013 curriculum. This is known from the results of interviews with several physics teachers at SMA N 9, SMA N 15 and SMA N 16 Padang. Based on the results of the interview, it was found that: (1) the use of Student Worksheets (student worksheet) in learning has not been optimally carried out; (2) student worksheet in the school has not included steps in the model and learning approach according to the demands of the curriculum; (3) the teacher has difficulty directing students to be active as a whole in the learning process; (4) teachers explain the material more often than experiment and discussion activities.

Observation of the physics learning process was also carried out directly at SMA N 9 Padang, SMA N 15 Padang and SMA N 16 Padang. The initial study conducted was the observation of the analysis of the student needs and characteristics. Needs analysis is seen from the analysis of performance, graduation standards, and learning difficulties. The results of the analysis are expressed in terms of the average percentage of the three schools that were observed.

Performance analysis which consists of identifying teachers and completeness of infrastructure can be categorized as lacking. This is reflected in the percentage of performance analysis and infrastructure, which is 52.33% and 50%. The teacher has used a learning model but it has not been implemented optimally. The teaching materials used by the teacher, especially student worksheet, are not in accordance with the structure of the teaching materials in the 2013 curriculum. The facilities and infrastructure at school are quite complete but have not been used optimally in learning activities.

The results of the analysis of the passing standards from the aspects of spiritual, social, knowledge and skills of students were 72.20%, 63.89%, 55.50%, and 53.13%. These values indicate that the achievement of students in the aspects of attitudes, knowledge, and skills is still categorized as sufficient. The percentage of attainment of competence attitudes of students is higher than knowledge and skills. This indicates that the competence of knowledge and skills of students needs to be improved and in accordance with the demands of the 21st century.

Learning difficulties of students can be seen from the factors that affect the success of the learning process. The results of the analysis of learning difficulties are still in the poor category. This can be seen from the percentage of student worksheet usage which is only 60.42%. The student worksheet used did not arouse the curiosity of students in discovering the concept of physics so that learning using the existing student worksheet in schools was not optimal. In addition, the application of learning models and approaches has a percentage of 48.33% and 51.67%. Learning models and approaches used in schools are difficult to increase the activeness of students and do not develop students' physics concepts in the learning process.

The next analysis is the analysis of the characteristics of students. The results of the analysis of students were in the sufficient category. Analysis of the characteristics of students consisting of interests, learning motivation, learning styles, attitudes, knowledge and skills, namely 62.29%, 68.95%, 70.66%, 71.69%, 65.83%, and 65.61%. First, students are generally already interested and have high curiosity about learning physics, but many are still inactive during the problem solving process. Second, the learning style that students like is to interact directly with the learning environment, including interactions between students and teachers. Students find it easier to master learning material through practicum and discussion because they can be directly involved in the process of investigation and concept discovery. Third, the social and spiritual attitudes of students need to be improved. Fourth, students’ knowledge is still lacking. This is because physics material is not represented in several forms so that students who have different learning styles have difficulty understanding the concepts of physics in depth.

The preliminary study illustrates that it is necessary to take appropriate action to overcome the problems of education in facing the industrial revolution of the 21st century. One of the right solutions is to practice learning Physics directly in the form of practicum. Physics learning is believed to be more practical and time efficient by using practicum tools as support (Yulkifli et al., 2018). So, it is
necessary to develop student worksheet to be able to improve the competence of students in learning physics.

The core activities in the learning process must use models, methods, and learning resources that are tailored to the characteristics of students and subjects. The use of student worksheet in the learning process is included in the core activities. Student worksheet should be accompanied by syntax into the model so that the learning process remains focused on achieving learning objectives. Learning model can be viewed as a systematic and complete teaching guide for teachers to be applied in their teaching (Asrizal, Amran, Ananda, & Festiyed, 2018). The learning model that can help active students in investigative or problem-solving activities according to the demands of the 21st century is the Inquiry Based Learning (IBL) model. The IBL model affects understanding, knowledge development on a topic, scientific process skills, attitudes towards science learning, motivation in learning, and communication skills of students (Bayram et al., 2013). IBL can create more meaningful and permanent knowledge in students. Students are accustomed to acquiring knowledge and problem solving through the process of discovery and investigation.

The IBL model has several advantages (Ramnarain, Umesh, 2014). First, it can provoke students' interest in science learning. Second, it can improve students' conceptual understanding. Third, it leads to an understanding of the nature of scientific knowledge. Fourth, facilitate collaboration between students. Fifth, help develop students' experimental skills. This shows that the use of the IBL model is in accordance with the 2013 Curriculum, which involves active participation of students in learning and can improve the competence of attitudes, knowledge, and skills of students.

The right approach used to maximize the IBL model is a multi-representation approach. Representative ability is needed in the IBL model to abstract the analysis data into concepts (Maliah, 2012). The application of multi-representations in the learning process plays an important role in the learning process so that it leads to the realization of meaningful learning (Lusiyana et al., 2019). The multi-representation approach helps students to be able to present physics concepts in various forms such as verbally, mathematically, diagrams, and pictures (Suhandi & Wibowo, 2012).

Based on the background described, student worksheet with the right model and approach is needed to help improve the abilities of students. In addition, integrating literacy in student worksheet can help students to answer the challenges of 21st century skills. Therefore, the solution to this problem is the development of the IBL model student worksheet with an integrated multi-representation approach to scientific literacy for learning Physics class XI in the 21st century.

2. Research Methods

This research method uses descriptive statistics. Descriptive research is not intended to test specific hypotheses. Descriptive research is conducted to describe, interpret and describe or explain variables or status. This study will explain the results of the validation of the student worksheet development stage. The data collection instrument used a validation sheet filled in by 3 expert validators for student worksheet validation. The validation sheet used has been validated first by the validator expert. The validation sheet can assess the four components of presentation, content feasibility, grammar and student worksheet language. The validity analysis uses a Likert scale which has four scales with very good criteria (4), good (3), sufficient (2), and lacking (1). The total score for each validator for all indicators is summarized and the validity value is given using the Aiken V formula:

\[ V_l = \frac{\sum r}{n(c-1)} \]  

Information:

- s = r - lo
- lo = the lowest number of validity assessments (in this case = 1)
- c = the highest number of validity assessments (in this case = 4)
- r = Number given by the validator

The validity category of the developed student worksheet can be seen in Table 6.
Table 1. Validity Category (Saifuddin, 2015).

| No | Value | Criteria |
|----|-------|----------|
| 1  | $V_i \geq 0.667$ | Valid    |
| 2  | $V_i < 0.667$   | Not Valid|

The validity assessment is determined based on the interpretation of the scores obtained. The valid value classification used in this study is equal to 0.667-1.

3. Result and Discussion

3.1. Result

3.1.1 Design

The design stage begins with making a product design and validity instruments. The design is adjusted to the results of preliminary research. Based on the results of the analysis of the needs, characteristics of students, materials, and assignments, the student worksheet design was carried out using the IBL model with a science process skills approach to learning SMA class XI physics. The student worksheet structure compiled refers to the 2008 instructional material development guide. The description of the student worksheet design that has been carried out is as follows.

3.1.1.1 Title

The title is on the cover of the student worksheet. The cover design is based on material analysis represented by images of phenomena in everyday life regarding physics material for class XI. The student worksheet cover design is shown in Figure 1.

![Figure 1](image1.jpg)

Figure 1. Student Worksheet Cover Design

3.1.1.2. Study Instructions

Study guides are useful for providing guidance in using student worksheet. In this student worksheet there are learning instructions for students, discussion instructions, and instructions for teachers. The study guide design that has been designed can be seen in Figure 2.

![Figure 2](image2.jpg)

Figure 2. Design of Study Instructions
This study guide is also completed with a prayer before starting the lesson. Before learning, students are asked to pray first, being guided through student worksheet. This is to get used to the religious character in students.

3.1.1.3 Learning Competencies

Learning competencies include core competencies, basic competencies, competency achievement indicators, and learning objectives. These four parts are designed to be interrelated. Core competencies consist of KI 1 regarding spiritual attitudes, KI 2 regarding social attitudes, KI 3 regarding knowledge, and KI 4 regarding skills. The core competency design can be seen in Figure 3.

![Figure 3. Core Competency Design](image)

Subsequent learning competencies are basic competencies. Basic competence refers to core competencies. Parts contained in basic competencies include spiritual attitudes, social attitudes, knowledge, and skills. Competence in spiritual attitudes (KD 1.1) and social attitudes (KD 2.1) is achieved through indirect teaching in the learning of knowledge competencies (KD 3.8) and skills (KD 4.8). The basic competency design can be seen in Figure 4.

![Figure 4. Basic Competency Design](image)

Referring to basic competencies, indicators of competency achievement are formulated. Competency achievement indicators are formulated using operational verbs. After that, the learning objectives were formulated. Learning objectives refer to indicators that have been formulated previously. The design of competency attainment indicators and learning objectives can be seen in Figure 5.
In this student worksheet the competencies that will be achieved by students after participating in the learning are clearly explained. The goal is to make it easier for teachers and students to know the indicators that must be mastered and the goals that must be achieved after studying the material.

3.1.1.4. Learning materials
The learning material is presented briefly and clearly. The scope of the substance to be studied is in the learning material. The learning material design can be seen in Figure 6.

![Learning Material Design](image6)

**Figure 6. Learning Material Design**

3.1.1.5. Tasks and work steps
Tasks and work steps are activities that students carry out during the learning process. In this student worksheet, tasks and work steps are designed clearly and systematically using the five syntax of the IBL model with a multi-representation integrated approach to scientific literacy. The initial design of activities and work steps is shown in Figure 7.

![Design of Tasks and Work Steps](image7)

**Figure 7. Design of Tasks and Work Steps**

Students work in accordance with the tasks and work steps that have been designed. Every task and work step in the student worksheet has a section filled out by students. This aims to make students active in building knowledge and developing attitudes and skills through direct activities they do.

3.1.1.6. Assessment
The assessment included in this student worksheet is only on the knowledge aspect, while for the attitude and skills aspects, it is a separate observation sheet. Assessment is carried out for each step of the activities carried out by students. The assessment of the knowledge aspect in student worksheet is shown in Figure 8.
3.1.2. Formative Evaluation
3.1.2.1 Self Evaluation
Self-evaluation aims to review all components contained in student worksheet. This stage is carried out by the researcher himself using a check list. Several things that need to be revised are errors in typing and reconciling the syntax of the IBL model and indicators of the science process skills approach for each step in the student worksheet. The revision results are then discussed and asked for expert judgment.

3.1.2.2 Expert Review
Expert review is useful for assessing the validity of the product that has been designed. The product is said to be valid if it meets the specified criteria. Before doing product validity, first the validity of the instrument to be used is tested. The student worksheet that has been designed is validated by three experts. Expert review of student worksheet uses the IBL model with an integrated multirepresentation approach to scientific literacy including the feasibility of content, presentation, language, and graphics. The results of the validator's assessment for each component of the student worksheet validity are presented in Table 2.

Table 2. Student Worksheet Validity Result

| No | Validity Components                  | Expert Validator | Aiken's V | Criteria |
|----|--------------------------------------|------------------|-----------|----------|
| 1  | Feasibility of student worksheet     | 0,83             |           | Valid    |
|    | Contents                             |                  |           |          |
| 2  | Presentation                         | 0,86             |           | Valid    |
| 3  | Language                             | 0,72             |           | Valid    |
| 4  | Graphics                             | 0,83             |           | Valid    |

Rata-rata 0,81 Valid

Based on Table 2, it can be seen that the average validity value of the student worksheet of the expert validators is greater than 0.6. This means that student worksheet uses the IBL model with an integrated multirepresentation approach to scientific literacy for class XI high school physics learning in the valid category. In full the results of the validity of the student worksheet are presented.

3.2. Discussion
The problems obtained are based on the results of preliminary research analysis which has been published in the 2nd ICRLP 2019 (Septiani et al., 2020), and are used as a basis in designing student worksheet according to the needs, characteristics of students, and materials so that the expected learning objectives are achieved. Needs analysis includes analysis of performance, passing standards,
and learning difficulties (Abidin, 2014). Teaching materials are needed by teachers to master effective learning and to improve student performance in the learning process (Asrizal et al., 2019).

Student worksheet design is made in such a way. Student worksheet covers are made in color to make it attractive and display the characteristics of the student worksheet that are designed. After that, the student worksheet is equipped with learning instructions for students and teachers to make it easier to use. In student worksheet there are also learning competencies in the form of KI, KD, indicators of competency achievement, and these are broken down into instructional goals that must be achieved after the learning takes place. Then, student worksheet is equipped with learning materials. At work steps, students are required to do tasks that can develop their potential. Furthermore, student worksheet is also equipped with an assessment that makes it easier for teachers to assess student worksheet.

The next step is to conduct a self-assessment and revise the parts that need to be revised. Next, test the validity of student worksheet to experts. The instrument for testing the validity of the product is first validated by an expert. After the instrument is categorized as valid, then it is used to test the validity of student worksheet. The evaluation of the validity of the student worksheet is based on its suitability with the compilation components, the steps in the student worksheet are in accordance with the syntax of the IBL model and contains an integrated multi-representation approach to scientific literacy.

The student worksheet validity test is to assess the content, presentation, language, and graphics. Based on the results of the analysis, the validity of the student worksheet is valid and can be used. This research is also supported by other research on the development of student worksheet based on the IBL model, the development of integrated scientific literacy teaching materials and the development of multi-representation based modules which are categorized as valid and suitable for use in physics learning (Yulkifli et al., 2019), (G. Dwiyanti, 2017), (Yuli et al., 2020).

4. Conclusion
Based on the results of the study, it was concluded that the development of student worksheet using an inquiry based learning model with an integrated multi-representation approach to scientific literacy has valid criteria and can be used in class XI physics learning.

Acknowledgments
This research is part of the “Penelitian Tesis Magister” (PTM) 2020, No. Contract: 901/ UN35.13 / LT / 2020 entitled "Development of student worksheet Based on Inquiry Based Learning Model with Multi-Representation Approach to Improve Collaborative Ability in 21st Century Physics Learning". This research is inseparable from the help of various parties. Therefore, the authors would like to thank Mr. and Mrs. lecturers who have provided motivate and suggestions for the perfection of this article and to the large families of SMAN 15 Padang, SMAN 9 Padang and SMAN 16 Padang, who have given permission and help during the study.

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