Development of inquiry based learning model – based student worksheets through the 21st century science process skills approach to grade XI physics learning

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Abstract. Students in the learning process are still not optimal and active in learning activities. One of the contributing factors is that the available Student Worksheet is still in print and has not contained model steps and learning approaches that lead to student activities. The purpose of this research is to establish a learning model based on interactive student worksheet inquiry. The model has a comprehensive scientific literacy and scientific process skills method to conduct eleventh grade physics learning with effective and practical standards. This type of research is development research using ADDIE model consisting of analysis stage, design, development, implementation, evaluation. Research instruments include preliminary study questionnaires, validity questionnaires and practical questionnaires. Data analysis techniques for validity use Aiken’s V formula, for practicality using descriptive percentages and effectiveness using N-gain score The results of the analysis stage show the need for the development of interactive student worksheet Development results show student worksheet is on a valid criteria with a value of 0.87; Practicality scores are very high based on the response of students and teachers with average scores of 84.76% and 96.45% respectively. Thus, it can be concluded that the student worksheet inquiry based learning model with a process skills approach to grade XI high school physics learning meets valid, practical criteria.

1. Introduction

Learning in the 21st century is one of the challenges that education circles must foresee and face. Features of the 21st century that have an impact on the field of learning. First, the availability of information anytime, anywhere. Second, the characteristics of computing, namely the use of machines that make everything faster [1]. Third, it centers on students. Fourth, use information and literacy technology. It can be said that 21st century learning is required based on science and technology to get used to 21st century life skills.

Physics is one of the important sciences supporting the development of information technology. Physics and technology are two inseparable sides. Physics has provided a strong foundation of technological evolution[2]. Physics has a dominant contribution in today's technological advances, as physics can explain natural phenomena and symptoms empirically, systematically, and logically. The 2013 curriculum explains that physics must be implemented through activity-based learning of integrative scientific and thematic approaches[3]. Physics learning has two dimensions: learning science materials and how to do science activities[4].
But the reality based on the needs analysis and the analysis results of the students in physics learning is 1) student center learning that has not been maximized, 2) in terms of the development and use of student worksheets, 3) the availability of interactive student worksheets, 4) the use of laboratories and tools in the learning process that has not been maximized. 5) not yet optimal scientific literacy of students, and 6) Failure to develop student worksheets based on appropriate learning models and methods according to the requirements of the 2013 curriculum and based on physical learning methods.

The selection of this student worksheet is because physics learning is believed to be more practical and time efficient with the use of practicum tools. The use of tasks in the student worksheet will encourage activity and participation of students in learning. Students will be involved in constructing knowledge and improving learning skills. Students can still have 21st century learning skills with interactive student worksheets that allow students to be more independent. This interactive student worksheet is equipped with a controller that can be used by its users, so that when the user performs an action then the application responds to the actions of its users. Interactive students’ worksheets are implemented as self-taught materials that can assist students in improving their understanding and no longer rely on the only source of information.

Choosing a teaching model and method as a solution is a teaching model, which can be regarded as a systematic teaching model and a complete teaching guide for teachers to apply in teaching. The teaching model can be defined as a model or plan that can be used to shape courses or courses, select teaching materials and guide teachers’ actions. The other hand, an instructional model can be defined as instructional design, which describes the process of specifying and generating specific environmental conditions that cause students to interact to make specific changes in behavior. The function of the teaching model is to shape courses, design teaching materials, conduct teaching and create a teaching environment. Although the learning method is the approach taken by teachers and students to achieve the teaching goals of a specific teaching unit.

Inquiry Based Learning (IBL) model that suitable learning model in physics learning based on the demands of the 21st century. The IBL model is a flexible and open learning model involving multiple skills and learning resources that allows teachers and students to ask questions on a variety of topics. This means that this IBL model allows students to formulate learning problems through phenomena in daily life to find the right solution to existing problems. The ability to formulate and find solutions to these problems can be maximized using a process skills approach. Process skills approach is a skill approach used by scientists in conducting scientific research. The processing skills approach is very suitable for physics, which is a branch of science. Physics is one of the branches of science. It uses a series of scientific processes to understand nature and phenomena that occur in nature.

To solve this research problem, it is necessary to develop interactive student worksheets of IBL models through scientific process skills. In this case, this interactive student worksheet is very important for realizing science and technology-based and student-centered learning. Therefore, researchers are very interested in this research. The purpose of this research is: 1). Determine the validity of the interactive student worksheet and 2). Determine the practicality and effectiveness of implementing interactive student worksheets in physics learning in grade XI high school.

2. Research Method
The type of research done is Research and Development (R&D). The R&D method is a research method used to produce a specific product and test the effectiveness of the product. The product is used to solve learning problems in the classroom or laboratory instead of testing theories. The development model used in this study is the ADDIE model. The model represents the five stages of implementation, namely analysis, design, development, implementation and evaluation.

The analysis phase involves conducting preliminary research to discover physics learning opportunities and problems in the school. Activities in the analysis phase include needs analysis, student characteristics analysis and learning difficulty analysis. Through this analysis, it was
discovered that there were problems in using student worksheets in printed form, while the students’ ability was still low.

The design phase refers to planning activities to determine specific abilities, methods, teaching materials and learning strategies to solve the problems found. What to design at this stage is the interactive student worksheet of the IBL model generated by the scientific process skills method and the required research tools. At this stage, the design of student worksheets and research instrument is based on the results of the analysis stage. The design of a student worksheet is done by selecting a format that corresponds to the good and correct format of the student worksheet in accordance with the conditions of no shortage of construction and technical. The composition of this interactive student worksheet starts from cover, introduction, learning activities, training, evaluation, feedback and references[16].

The development stage aims to produce an interactive student worksheet IBL model through a science process skills approach to physics learning. This stage of development includes creating, self-studying interactive student worksheets created, revising based on the results of self-study, requesting an insert and criticism from experts to review interactive student worksheets that have been created and finally revising and modifying interactive student worksheets based on expert review results to achieve a pre-defined goal. Expert or practitioner assessment of learning instrument includes: format, language, illustration and content. This stage of development includes validation tests.

Valid means an instrument that can be used to measure what validation should measure done by experts and practical[11]. Then the validation results are analyzed for use as a basis for refinement or revision of the initial draft of interactive student worksheets. Validation activities in the form of filling out interactive student worksheet validation sheets and discussions until a valid interactive student worksheet is obtained according to experts and educators.

The implementation stage refers to the implementation of the design and method developed in the classroom based on the actual situation. In the implementation of the design process, educators and learners have been prepared to apply the developed equipment to actual conditions. Provide materials based on the developed interactive student worksheet. The test field was conducted in a high school in Padang City. The implementation phase includes practical testing. The practicality test is a test of the practicality of the developed interactive student worksheet.

The evaluation stage aims to measure the product and process quality before and after the implementation of the activity. There are two assessments, namely formative assessment and summary assessment. Formative evaluation is an evaluation conducted at each stage of the use of the developed equipment, while summative test is an evaluation conducted at the end of the interactive student worksheet, with the purpose of viewing the results on the interactive student worksheet. Effectiveness and practicality.

The data collection instrument is composed of three parts: the validity sheet and the practicality of the performance evaluation sheet. The effectiveness sheet is used to evaluate the effectiveness of the interactive student worksheet and its supporting system. Indicators of instrument validity include a) material substance feasibility, b) feasibility of learning design, c) visual feasibility, d) utilization eligibility. Validation is said to be complete when it is ready for trial. Practicality sheets are used to assess the practicality of implementing interactive student worksheets in physics learning. Indicators of the practicality of the instrument include the extent of the benefits, ease of use, convenience and efficiency of the use of interactive student worksheets.

3. Result and Discussion
The first result of this research is the validity of the interactive student worksheet. Three experts composed of UNP graduate physics lecturers evaluated the validity of the interactive student worksheet. The component of the assessment of the validity of interactive student worksheets consists of material substance feasibility, feasibility of learning design, visual feasibility and feasibility of software utilization. e) Determination of validity grades by using Aiken’s V formula. Interactive student worksheet validity assessment results can be viewed in Table 1.
Table 1. Interactive Student Worksheet Validity Results

| No  | Component                     | Expert Validator | Aiken’s V Value | Criteria |
|-----|-------------------------------|------------------|-----------------|----------|
| 1   | Substance Eligibility         |                  | 0.86            | Valid    |
| 2   | Visual Display Eligibility    |                  | 0.89            | Valid    |
| 3   | Learning Design Feasibility   |                  | 0.83            | Valid    |
| 4   | Software Benefit Eligibility  |                  | 0.89            | Valid    |

The value of the feasibility of the material substance that has been assessed by the Expert has a value of 0.86 which is in the valid category. This states that the substance contained in this interactive learner worksheet has had aspects of conformity with the curriculum, the truth of concept writing and meaning, the present because it takes the latest curriculum revision material and does not mean double. The visual feasibility value is also based on a valid category with a value of 0.89. It states that interactive student worksheets have instructions for use, animated videos and images that match the learning materials and can run properly. The grade of learning design feasibility shows that the composition of the learner worksheet is in accordance with the interactive teaching material creation rules where by a valid value of 0.83 is in the valid category. This means that none of the components are less than the worksheet components of the learner that have been created. The last feasibility of utilizing software at a value of 0.89 is in the valid category indicating that the student worksheet is indeed completely homemade and interactively integrated. All aspects of that validity have an average of 0.81 stating that a student's worksheet is eligible for use in classroom learning.

The results of the second study are based on the practicality of teachers and eleventh grade students in applying interactive student worksheets to IBL models through the scientific process skills method. The practicality of ibl model interactive student worksheets through skills through this science process approach was assessed by two teachers after trying to use the Through the scientific process skills method in the learning process, the interactive student worksheet of the IBL model is operated. The tool used to obtain the data sheet is an assessment of practicality. The evaluation part includes four indicators, which are available, easy to use, attractive and effective. Table 2 lists the results of the teacher’s practice assessment.

Table 2. Practicality of interactive student worksheets IBL model through science process skills approach on Field Tests based on Teacher Response

| Num. | Indicator       | Value (%) | Category    |
|------|-----------------|-----------|-------------|
| 1    | Useable         | 95.00     | Very High   |
| 2    | Easy to use     | 98.51     | Very High   |
| 3    | Appealing       | 98.44     | Very High   |
| 4    | Cost Effective  | 93.75     | Very High   |

| Average | 96.45 | Very High |

Data from these practical results analyzed using scoring All practicality indicators based on teacher responses showed practicality scores were in the very high category with a score of 96.45%. This is because interactive students' worksheets adapt to the needs of problems in the physics learning process. Teachers also have no significant difficulty in using IBL model interactive student worksheets through this science process skills approach because it can get students to study independently. So that the goal of learning centered on students is achieved.
Then the interactive student worksheet of the IBL model through the science process skills approach is also assessed practicality by the learner in the usable aspect, easy to use, appealing and cost effective. Table 3 shows the results of students' reaction to the practicality of the interactive student worksheet of the IBL model through the scientific process skills method.

Table 3. Practicality Interactive student worksheet IBL model through science process skills approach on Field Test based on Student Response

| Num | Indicator           | Value (%) | Category |
|-----|---------------------|-----------|----------|
| 1   | Usable              | 83.94     | Very High|
| 2   | Easy to Use         | 83.53     | Very High|
| 3   | Appealing           | 88.60     | Very High|
| 4   | Cost Effective      | 80.29     | Very High|
|     | Average             | 84.09     | Very High|

Practicality results based on the response of students have a value of 84.09 % being in a very high category. This shows that interactive student worksheets of IBL models through a science process skills approach can be used, easy to use, appealing and cost effective to used.

Based on the responses of teachers and learners seen interactive student worksheets IBL model through skill skills approach is able to make physics learning easier to understand, teach physics better, facilitate the presentation of learning materials, improve teaching activities, allow students to learn independently, and time to teach. In addition, both teachers and students consider it an interactive student worksheet of IBL models through an interesting approach to science process skills and a lot of videos and animations that make learning more exciting. Thus, this research results show, teachers and learners consider that interactive student sheets of IBL models through the approach of process science skills are easy to use and if in role models in physics learning.

The validity of IBL model interactive student worksheets through a science process skills approach can be classified into valid categories. This is because expert validity assessment instruments have been built on interactive teaching material indicators and can measure indicators that are ingi measured in the learning process. This shows that the implementation of interactive student worksheets of IBL models through a science process skills approach is useful, easy to use, engaging and efficient according to teachers and learners. An intervention is said to be practical if the user considers the intervention usable and easy to use[17]. Practicality refers to the extent that the user regards the intervention as interesting and can be used under normal conditions. Thus the interactive student worksheet of the IBL model through the science process skills approach can be used by teachers to improve the competence of students.

4. Conclusions
According to the research results, it is concluded that the use of inquiry based learning models and scientific process skills methods to develop high school physics grade XI interactive student worksheets has effective, practical and effective standards.

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