Validity of interactive student worksheets based on inquiry based learning models to improve knowledge competence

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Abstract. Physics learning activities have not been carried out optimally as seen from the low competency of students' knowledge. This is due to the lack of available teaching materials that fit the needs of students, the available teaching materials are very limited because they do not take advantage of technological developments and there is no model in them, so learning is not entirely student centered. Utilization of technology is one of the efforts to facilitate learning in accordance with the needs of students by developing non-printed teaching materials in the form of interactive student worksheet based on inquiry based learning models. The purpose of this research is to produce an interactive student worksheet based on a valid inquiry based learning model. This type of research is research and development using the ADDIE model. The method used in this research is descriptive statistics. The validity of the interactive student worksheet is assessed by three experts using a validity questionnaire. The validity of the interactive student worksheet is analyzed using the Aiken's V. formula. The validation results show that the material validity aspect is 0.87; visual display 0.89; and learning design 0.85. Based on the analysis of the validity of interactive student worksheets data, an average of 0.87 is in the valid category. Thus, Interactive Student Worksheets based on inquiry based learning model can be implemented in physics learning to increase knowledge competence.

1. Introduction

Education is an effort to develop competent and skilled human potential. Education always changes along with the development of science and technology. Every human being is required to be able to master science and technology to be able to adapt to a dynamic environment and be able to solve complex problems. The 21st century prepares human resources who have various skills in their fields. Competence and skills are needed to answer the challenges of the 21st century. Demands for human resources who are able to think creatively, critically, collaboratively and communicate [1].

The rapid development of technology in the 21st century requires students to be active and independent in learning. The use of technology makes it easy to access, find and use a wide variety of information [2]. Technology assisted learning can contribute to the attention of students relatively higher than ordinary learning [3]. The learning process should be carried out in an interactive, inspirational, and fun way. Thus, students are able to learn actively, independently, creatively, and innovatively in learning. The use of technological developments in learning is felt in a scientific discipline, one of which is learning Physics. Physics is the study of natural phenomena as a whole through scientific processes that are structured based on prevailing concepts, theories and principles [4]. Physics learning is used by students to understand natural phenomena and changes that occur. Physics is a field of study of natural phenomena using scientific methods [5].
Physics learning can be carried out optimally through the use of relevant teaching materials. Teaching materials are very important in the learning process to increase student activity. One form of teaching material in the form of worksheets is used to investigate the learning process [6]. Student worksheet is a material containing a summary of the material and instructions for carrying out tasks that will be carried out by students with reference to competence [7]. Student worksheet is a teaching material used to guide students in investigating and finding the concept of learning material.

Student worksheet as teaching materials should be developed by utilizing the technology used to present electronic-based teaching materials. Electronic teaching materials aim to make students learn independently and be more motivated to learn [8]. The use of technology can combine various types of media in the form of text, images, graphics, animation, and video which are operated using computers [9]. The development of technology-based teaching materials can make learning interactive. Interactive means that there is feedback between users and worksheets which is called interactive worksheets. Interactive worksheets are complex teaching materials with both real and virtual teaching aids. The use of technology becomes effective and efficient for practicum or investigation activities [10]. Thus, interactive worksheets can motivate students to learn independently and improve their learning outcomes.

Physics learning can be carried out effectively by using a learning model. The learning model is a systematic framework for implementing learning to achieve the expected goals [11]. The learning model should guide students to be actively involved in investigating and finding concepts independently. The application of the learning model is adjusted to the learning objectives to be achieved, the characteristics of students, learning materials, supporting facilities and infrastructure. One of the suitable models based on the specified criteria is the inquiry based learning model. The inquiry based learning model allows educators and students to ask questions on various learning topics [12]. The implementation of the inquiry based learning model in learning can stimulate students to conduct investigations and build new knowledge [13]. Thus, the application of the inquiry based learning model makes students think systematically in finding concepts.

The reality that occurs in the field of learning physics is not as expected. Based on observations made at SMAN 15 Padang, it was found that the learning process was not fully centered on students, they had not been able to independently find physics concepts, and the implementation of the learning model was not optimal. Furthermore, in the aspect of teaching materials used have not taken advantage of technological developments, teaching materials are not interactive, students are still low on interest and motivation to learn. Thus, resulting in low competence of students, especially in the aspect of knowledge.

The gap between the expected conditions and the conditions that occur in the field requires a solution to solve these problems. One effort that can be done is the development of interactive worksheets as teaching materials tailored to the needs of students. Interactive worksheets are developed with the structure and design of learning to follow technological developments. Interactive worksheets are non-printed teaching materials that can combine all relevant media elements with learning materials. The application of technology to learning can improve the learning abilities of students [14]. Interactive worksheets have an important role in learning if there is a relevant model in the form of inquiry based learning. The inquiry based learning model can involve students directly to investigate learning material. Therefore, it is necessary to develop interactive worksheets using the Inquiry Based Learning model.

Interactive worksheets used in learning can increase the knowledge competence of students. The developed interactive worksheets are said to have quality if they are in valid criteria. The validity of interactive worksheets can be done by presenting several experts in their fields to assess the interactive worksheets that have been designed [15]. The validity component of interactive worksheets consists of the feasibility of material substance, visual appearance, and learning design [16]. Thus, it is necessary to validate interactive worksheets based on the inquiry based learning model to determine the feasibility of interactive worksheets in improving knowledge competencies.
2. Research Method

This type of research is research and development with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model. The development model is chosen based on systematic development activities and based on learning design theory. Development is the process of realizing a design into a product that is suitable for use. The development stage of the ADDIE model is a validity test of the product that has been designed. The validity test is carried out by experts who act as validators. The purpose of the validity of the interactive worksheets is to determine the feasibility of the product that has been designed.

The stages to test the validity of interactive student worksheets by the validator are 1) Asking the expert's willingness to see the feasibility of interactive student worksheets and the correctness of the learning concepts that have been made, 2) Experts are asked to provide an assessment of the validity instruments and interactive student worksheets that have been made based on the validity test instrument, 3) After the product validity instrument is filled in, a revision is made in accordance with the suggestions given by the validator.

The data collection instrument for the validity test in this study was an instrument validation questionnaire and an interactive worksheet validation. Analysis of the validity test uses a Likert Scale by giving a score for each item with very good (4), good (3), sufficient (2), and less (1) alternative answers, then adding up the total score of each validator on all indicators, and processing the values validity based on the Aiken's V formula according to Equation 1.

\[
V = \frac{\sum \pi}{n(c-1)}
\]  

with the following information: \( s \) is \( r - lo \), \( lo \) is the lowest score on validity (in this case it is 1), \( c \) is the highest score on validity (in this case it is 4), and \( r \) is the number given by the validator. To find out the validity category of the developed interactive worksheets, it can be seen in Table 1.

| Table 1. Validity category |
|-----------------------------|
| Value | Category |
| ≥ 0.6 | Valid |
| < 0.6 | Invalid |

3. Results and Discussion

The validation includes the feasibility of the material substance aspects, visual appearance, and learning design. A product developed is said to be valid if the product can measure what it wants to measure [17]. The interactive worksheets that have been designed are tested for validity starting with the validity of the instruments to be used. Instrument validation and interactive worksheets were validated by three experts, namely FM, UM, and RM. The validation results are described as follows.

3.1 Instrument Validation Results

Prior to the validation of the product being developed, the expert validates the instrument first. The purpose of instrument validation is to measure what is being measured. So, valid instruments can produce valid data on products that have been developed. The results of instrument validation are shown in Table 2.

| Table 2. Result of instrument validation analysis |
|-----------------------------------------------|
| Indicator | V Value | Category |
| Level of validity of Interactive student worksheets | 1 | Valid |
| Instructions for use clear | 1 | Valid |
| Used in the assessment process | 0.89 | Valid |
| Eligibility of the contents of Interactive student worksheets | 1 | Valid |
| Feasibility of presenting | 1 | Valid |
| Interactive student worksheets | 0.89 | Valid |
Based on Table 2, it can be said that the results of the validation instrument assessment are in the valid category with an average value of 0.96. Where the V value is greater than 0.6. Therefore, this instrument can be used to measure the validity level of interactive student worksheets.

3.2 Student Worksheets Validation Results
The validity of the interactive worksheets was carried out after the validity of the instrument. The validity test of the interactive worksheets was carried out by three experts on each aspect of the feasibility of the material substance, visual appearance, and learning design. The results of the validation of the interactive worksheets for the feasibility aspect of the material substance with 9 indicators, the results can be seen in Table 3.

| Indicator | V Value | Category |
|-----------|---------|----------|
| Language eligibility | 0.89 | Valid |
| Graphic quality | 1 | Valid |
| Have feedback on the results of the assessment | 0.89 | Valid |
| Can be read clearly | 1 | Valid |
| Systematic | 0.89 | Valid |

Based on Table 3, it shows that the interactive worksheets developed are in the valid category of the material substance with an average value of 0.87. The product developed is said to be valid if each indicator gets a V value equal to 0.6. The validation results are used as a guide to see the feasibility of the material substance of the developed interactive worksheets, so that interactive worksheets can be used in learning.

Second, validation of interactive worksheets on the feasibility of visual appearance. In this aspect, there are 5 indicators that will be assessed by the validator. The results of the validation of the visual display aspects can be seen in Table 4.

| Indicator | V Value | Category |
|-----------|---------|----------|
| Interactive Student Worksheet design proportionally | 0.89 | Valid |
| Button layout accuracy | 0.78 | Valid |
| Has a good letter composition | 0.89 | Valid |
| Color composition | 0.89 | Valid |
| Interesting illustrations / pictures / animations / videos | 1 | Valid |

Based on Table 4, it shows that the developed interactive worksheets are valid in terms of the feasibility of visual displays with an average value of 0.89. Each indicator in the aspect of the feasibility of visual display has a large V value equal to 0.6. The results of validation are used as a guide to see the feasibility of the visual display of interactive worksheets, so that interactive worksheets can be used in the learning process.
Third, validation of interactive worksheets on the feasibility aspect of learning designs. In this aspect, there are 6 indicators assessed by the validator. The results of the validation of the learning design aspects can be seen in Table 5.

**Table 5. Result of interactive student worksheets validation on learning design aspects**

| Indicator | V Value | Category |
|-----------|---------|----------|
| Title     | 0.89    | Valid    |
| Learning Competence | 0.89    | Valid    |
| Suitability indicators with competency | 0.89    | Valid    |
| The conformity of supporting information with objectives | 0.89 | Valid |
| Tasks and work steps | 0.78    | Valid    |
| Evaluation | 0.78    | Valid    |

Based on Table 5, it shows that the interactive worksheets are valid in the feasibility of the learning design with an average value of 0.85. Each indicator in the feasibility aspect of the learning design obtained a large V value equal to 0.6. The results of the validation are used as a guide to see the feasibility of the interactive worksheets learning design, so that these interactive worksheets can be used in learning at school.

Based on the description above, it can be stated that the interactive student worksheets based on the inquiry based learning model developed are in the valid category of the material substance, visual appearance, and learning design with an average score of 0.87. Overall interactive worksheets are declared valid because in each aspect the V value is equal to 0.6. This means, interactive student worksheets based on the inquiry based learning model can be used in the learning process in schools.

After analyzing the validity of the product, it was found that the interactive worksheets that had been developed were in the valid category. However, there are some suggestions from the validator at the formative evaluation stage. Based on the suggestions given, revision of interactive worksheets was made. The suggestions given by the validator can be seen in Table 6.

**Table 6. Revised of interactive student worksheets according to validator suggestions**

| Before the Revision | After the Revision |
|---------------------|--------------------|
| Illustrations and animations are adapted to the learning material | Illustrations and animations have been adapted to the learning material |
| Reduce non-working free space | The non-working free space has been deleted |
| Interactive question display is less innovative | Display interesting and innovative interactive questions |

Based on Table 6. Shows the validation of interactive worksheets there are still some revisions that must be made in improving the interactive worksheets that have been designed. An example of the form of revision that is carried out is in the form of an interactive question display on an interactive worksheet. Examples of revisions to interactive worksheets are in Figure 1 and Figure 2.

![Figure 1. Display interactive questions before revision](image1)

![Figure 2. Display interactive questions after revision](image2)
4 Conclusion

The validity of interactive worksheets based on the inquiry based learning model obtained an average of 0.87 in the valid category. The results of each component of the validity of the development of interactive worksheets which include the feasibility of the material substance obtained a value of 0.87; the feasibility of the visual appearance obtained a value of 0.89; and the feasibility of the learning design obtained a value of 0.85. After the developed interactive worksheets are valid, the interactive worksheets should be used in physics learning activities.

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