Development of Electronic Student Worksheets Based on Live-Worksheets with Problem Based Learning Models on Three-Dimensional Shape Materials

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Abstract. Rapid technological developments can cause a great influence on life in society, one of which is in the education sector. Educators are required to be able to find the right learning strategy in order to achieve good learning outcomes. One way is to innovate learning tools in order to achieve optimal learning outcomes. Reflecting on the impact of the Covid-19 pandemic, which requires all activities to be carried out online, there is a need for flexible teaching materials that can be used online or offline. One alternative is to create interactive electronic student worksheets based on Live-worksheets. This study aims to produce electronic student worksheets based on Live-worksheets with Problem Based Learning model on three-dimensional shape materials that meet the valid and practical categories. This research is a research and development of a 4-D Thiagarajan model, namely define, design, development, and disseminate. This research instrument consists of a sheet of validity and practicality. The results showed that the development of electronic student worksheets based on Live-worksheets with the Problem Based Learning model on three-dimensional shape materials was included in the categories: (1) very valid based on 48 aspects of assessment consisting of 12 aspects of material assessment, 14 aspects of construction assessment, 7 aspects of language assessment, and 15 aspect of media assessment with a tendency to strongly agree on aspects of electronic student worksheets validity assessment, and (2) very practical based on 8 aspects of assessment with a tendency to strongly agree on aspects of practicality assessment.

Keywords: Organizational Commitment · School Culture · Teacher Performance

1 Introduction

Education is the process of developing one's own abilities and individual strengths [1]. Education plays an important role in increasing and expanding global insight in order to understand global problems [2]. Education is able to develop individual potential optimally. One of the fields in education is mathematics. Mathematics is one of the

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subjects in school that has an important role in life. At every level of education, from elementary, junior high, high school, even up to college, the curriculum in Indonesia contains mathematics. However, many students find this subject quite difficult. So, some students do not like this subject. One of the factors is because the learning is considered monotonous. One way to overcome these problems is to improve learning strategies by conducting learning by using strategies, methods that involve students so that they can help students understand clear content or concepts [3]. The right learning strategy can affect the process and learning outcomes of students.

Educators are required to be able to create and find appropriate learning strategies in order to achieve good learning outcomes. Based on research conducted by Firmansyah, there is a significant influence between learning strategies on mathematics learning outcomes [4]. Therefore, educators must create appropriate learning strategies in order to achieve optimal learning objectives. One of the things that can be done is by developing learning tools. Teaching materials need to be developed to suit the characteristics and needs of students [5]. Learning device is a plan that is used in the learning process. One form of learning tool is the Student Worksheet. The success of implementing the 2013 curriculum is driven by the selection or use of teaching materials, one of which is student worksheets [6].

The use of printed worksheets that we usually encounter in face-to-face learning seems less relevant to current conditions. In the current pandemic conditions, there are several educational institutions implementing a fully online learning system and there are several educational institutions implementing a semi-online learning system and offline. Therefore, student worksheets with a more flexible form are needed that can be used by teachers and students in online or offline mode learning. One alternative is to make student worksheets in online form or commonly called electronic student worksheets.

Based on the results of observations made by researchers during Internship activities from October to December 2021, the teaching materials used at the school are still based on textbooks and worksheets sold by agents to schools. The learning system used is also still using conventional methods. The worksheets sold by agents to schools is still ineffective because it only contains a summary of the material, multiple choice questions and short entries. With the worksheets with a specific model, it can guide students to solve problems.

In terms of technology, SMP Negeri 18 Bengkulu City has started to implement a learning system that applies technology. The school has a school website that can be accessed by educators and students. This can be seen during the semester exams that the school has conducted a CBT-based exam system. Students continue to take exams in the classroom and are supervised by educators, but exam work is carried out through the school's website which can be accessed on smartphones or laptops. Therefore, we can also optimize the use of this technology during the learning process, such as the use of electronic student worksheets. However, to create electronic student worksheets, an efficient supporting website is needed so that it can be easily reached by students. One of the electronic student worksheets supporting websites is Live-Worksheets. Live-Worksheets is one of the electronic media-assisted media in which it can contain text, images, animations, and videos. Based on research conducted by Prabowo, the use of live-worksheets with web-based applications can improve student learning outcomes.

The choice of learning model also affects the achievement of optimal learning objectives. One of the learning models is Problem Based Learning (PBL). Electronic student worksheets supporting the problem based learning model is considered necessary because it is able to train students to be independent, active and able to think creatively so that student learning outcomes will also increase. [7]. The implementation of Web live-worksheets based on Problem Based Learning (PBL) is considered to be able to increase students' activities in learning mathematics online [8]. Therefore, electronic student worksheets with a Problem Based Learning model based on Live-worksheets can be an alternative teaching material in the learning process in schools, one of which is the three-dimensional shape materials.

2 Methods

The type of research carried out in this is research and development, the product being developed is electronic student worksheets with a Problem Based Learning model based on Live-worksheets on the flat-sided building material. The development model used is the Thiagarajan 4D development model. The stages in this model are defining, designing, developing, and distributing.

The subjects in this study were at the stage of testing the validity of the material aspect, namely one lecturer of mathematics education and one mathematics teacher at school, on construct validity, namely one lecturer of mathematics education, on language validity, namely one lecturer of Indonesian language and literature, and in media validity, namely ICT teachers who understand electronic media. The subjects of the practicality test were 31 students of class VIII-8 of SMPN 18 Bengkulu City and the subject of the effectiveness test were 31 students of class VIII-10 of SMPN 18 Bengkulu City.

4D development model, namely the definition stage which aims to determine and define the learning requirements. In the design stage, the electronic student worksheets will be designed according to the results at the definition stage. The development stage is the realization stage of electronic student worksheets in other words, electronic student worksheets development is carried out according to the plan that has been made at the design stage. At this stage, validity and practicality tests were conducted. The dissemination stage is the dissemination stage on a larger scale. This study uses the instrument validation test sheet and practicality test sheet.

Data collection techniques are methods used to collect data about the validity, practicality and effectiveness of the teaching materials developed. The data collection techniques for this study are data on the validity of the developed electronic student worksheets obtained from a validation sheet filled out by experts (validators) for reference for revision or improvement of the developed electronic student worksheets. And the data for the practicality of the electronic student worksheets is obtained from the practicality sheet filled out by students during the practicality test. The data analysis technique used in this study is as follows.

To analyze the validation data, descriptive analysis will be used by revising the electronic student worksheets based on suggestions and notes from the validator. The stages to analyze the validation level of the electronic student worksheets are to add up all the scores given by the validators for each aspect contained in the electronic student

worksheets validation sheet, to analyze the trend of the validator's assessment of the electronic student worksheets based on the total score obtained. Adjusted according to the criteria. Electronic student worksheets can be said to be valid if the validator tends to strongly agree or agree on the validity of electronic student worksheets.

The analysis of the practicality of the electronic student worksheets was carried out using a practicality sheet that was assessed by students. The stages of practicality analysis are adding up all the scores given by students for each aspect contained in the electronic student worksheets validation sheet, analyzing the tendency of students' assessment of the electronic student worksheets based on the total score obtained, based on the trend of practicality assessment obtained will be adjusted to the criteria. Electronic student worksheets can be said to be practical if students tend to strongly agree or agree on the practicality of electronic student worksheets.

3 Results and Discussion

The definition stage consists of preliminary and final analysis, student analysis, concept analysis, task analysis, and goal specification. Based on the analysis stage, it was found that it was necessary to develop an electronic student worksheet with a Problem Based Learning model based on Live-worksheets on the flat-sided building material. The selected Basic Competencies (KD) are (3.9) Distinguishing and determining the surface area and volume of flat-sided shapes (cubes, blocks, prisms, and pyramids) and (4.9) Solving problems related to the surface area and volume of flat-sided shapes (cubes, blocks, prisms, and pyramids), and their combinations. So that we get 1st electronic student worksheets with the title of cube and cuboid surface area, 2nd electronic student worksheets with the title prism and pyramid surface area, 3rd electronic student worksheets with the title of volume of cubes and blocks, and 4th electronic student worksheets with the title prism and pyramid volume.

The design stage is prepared based on the initial final analysis, student analysis, concept analysis, task analysis, and analysis of the specification of objectives that have been obtained from the definition stage. This design stage consists of three main steps, namely media selection, format selection, and the preparation of tests. In media selection, the author determines the right media and in accordance with the learning material researched. The selected teaching materials to be developed are: electronic student worksheets and the tools or media supporting the selected teaching materials are using a smartphone or computer. In format selection, the choice of format is adjusted to the factors described in the objectives learning. In the preparation of test, the tests are arranged based on the results of the formulation of specific learning objectives. This test is a tool to measure the occurrence of changes in behavior in oneself students after teaching and learning activities using the electronic student worksheets in this case in the form of Learning Outcomes Test (Fig. 1).

The planning stage is prepared based on the analysis at the definition stage and the design stage. After analyzing and planning, product development will be carried out. This development stage consists of three main steps, namely validity test of electronic student worksheets and practicality test of electronic student worksheets. This stage will result in the final electronic student worksheets product being developed. The validity

Fig. 1. Sample display of electronic student worksheet

test consists of four aspects, namely material, construct, language, and media. In general, from the four categories of material validity, construction, language, and media were obtained:

Based on Table 1. it can be seen that the validators tend to strongly agree on the validity of the electronic student worksheets. However, there are some improvements during the validity testing process. Electronic student worksheets that have been categorized as valid will be tested for practicality. The following are the results of the electronic student worksheets practicality test.

Based on the analysis of material validation, the validity of the material in each aspect tends to be very valid. This is in accordance with the purpose of material validity, namely as a reference to measure the scope to be measured so that the product developed is in accordance with the Basic Competence (KD) and the indicators to be achieved [9]. Based on the analysis of construction validity, validators tend to strongly agree regarding the construction aspects contained in the electronic student worksheets. The accuracy of the construction used in a medium can affect learning. The function of learning media in the aspect of attention is to attract and direct the attention of students to concentrate

Table 1. Validity

worksheets	Trend				Category
	Material	Construct	Media	Language	
1	Agree	Strongly agree	Strongly agree	Strongly agree	Very Valid
2	Agree	Strongly agree	Strongly agree	Strongly agree	Very Valid
3	Agree	Strongly agree	Strongly agree	Strongly agree	Very Valid
4	Strongly agree	Strongly agree	Strongly agree	Strongly agree	Very Valid
conclusion	agree	Strongly agree	Strongly agree	Strongly agree	Very Valid

on learning content related to the visual meaning displayed or accompanying the text of the subject matter [10].

Based on the analysis of the validity of the language, the validator considers that the one used in the electronic student worksheets is very feasible to use and very valid. The proper use of Indonesian is an important component, because one of the functions of language is as a medium of communication. In simple terms, a communication medium is an intermediary in conveying information from a communicator to a communicant that aims to be efficient in disseminating information or messages [11].

Based on the analysis of the validity of the media, the validator considered that the media used was very feasible and very valid. This is in accordance with the media selection criteria, namely conformity to the objectives to be achieved, appropriately supports the content of the lesson, practical in use, does not require expensive costs, is flexible, can last a long time or is durable, does not require a long time in operation and manufacture, and good technical and visual quality [10].

Based on the assessment that has been given by the validator regarding the validity of the material, construct, and language, the validator tends to strongly agree if the material, construction, and language aspects used in the electronic student worksheets are in accordance with the assessment aspects and are very feasible to use. Thus, the validity of the electronic student worksheets developed in the four electronic student worksheets in the aspects of material, construction, language, and media has been categorized as very valid.

Based on Table 2, it is found that students tend to strongly agree if the electronic student worksheets developed is practicality. This means that the second draft of the electronic student worksheets is feasible or and can be used properly.

Based on the assessments that have been given by students regarding the practicality of the electronic student worksheets, students tend to strongly agree if the practicality of the electronic student worksheets is in accordance with the aspects of the assessment and is very feasible to use. This is in accordance with the practicality indicators. The indicators of an instrument are practical, namely: the costs used are not too high, easy to administer, easy to score, easy to interpret, and the time used is right and not too long [12]. Thus, the practicality of the electronic student worksheets developed in the four electronic student worksheets has been categorized as very practical.

Table 2. Practicality

Worksheets	Results					Trend	Category
	SS	S	KS	TS	STS		
1	117	116	6	0	0	Strongly agree	Very Practicality
2	119	110	10	0	0	Strongly agree	Very Practicality
3	121	113	6	0	0	Strongly agree	Very Practicality
4	123	109	9	0	0	Strongly agree	Very Practicality
Conclusion						Strongly agree	Very Practicality

The dissemination stage in this study was carried out by distributing electronic student worksheets which had been declared valid and practical. The dissemination was carried out by providing a manual for operating the electronic student worksheets in the form of a softfile. Electronic student worksheets given to mathematics teachers for class VIII SMP Negeri 18 Bengkulu City and on the Live-worksheets page.

4 Conclusion

Based on the results of the research on the development of electronic student worksheets with a Problem Based Learning model based on Live-worksheets on the flat-sided space building material, the following conclusions were obtained: 1) The development of electronic student worksheets with a Problem Based Learning model based on Live-worksheets on the flat side space building material including in the very valid category. This is shown from the electronic student worksheets pointing to the correctness and suitability of the sequence on the electronic student worksheets in accordance with the Problem Based Learning stages of material validation. The construction aspect shows the writing, pictures, and appearance on the electronic student worksheets that are attractive and legible. The language aspect shows that the use of simple, clear, and easy to understand sentences and the use of appropriate punctuation marks. 2) The development of electronic student worksheets with a Problem Based Learning model based on Live-worksheets on the flat-sided building material is included in the very practical category. This is shown from the working instructions, steps, pictures, and problems on the electronic student worksheets which are easy to understand and easy to use for students. Thus, there are no obstacles for students in using electronic student worksheets in the learning process.

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