

DEVELOPMENT OF LKPD WITH STEM APPROACH BASED ON E-LEARNING ON THE MATERIAL OF QUANTITIES AND UNITS

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ABSTRACT

This study aims to design teaching materials in the form of LKPD that are valid, effective and feasible, by implementing an e-learning-based STEM approach to the material of quantities and units. This research was conducted using the R&D method and the ADDIE model. To determine the validity of the product at the development stage involved 3 validators, namely material experts, media experts and teachers. To determine the effectiveness of the product, the normalized gain (N-Gain) test was conducted. And to find out the practicality of the product based on student responses. The product test consisted of a small-scale test involving 10 students and a large-scale test involving 20 students. The instruments used were an expert validity questionnaire and a student response questionnaire. The validation test, effectiveness test and practicality test on the product show that the LKPD developed is very valid, effective and very practical as teaching material in learning activities.

Keywords: LKPD, STEM, Magnitude and Unit.

INTRODUCTION

Education is an activity of a group of individuals to pass on skills, knowledge and habits from one generation to the next by learning, training and research so that humans can continue to develop towards a better direction (Dewey, 2001). However, all the benefits of education depend on the quality of education itself. Looking at the data published by the Organization for Economic Co-operation and Development (PISA, 2018), the quality of education in Indonesia is far when compared to other countries, this is due to the many educational problems that exist in Indonesia. The government continues to strive to improve the quality of education in Indonesia, one of which is by designing an independent learning curriculum that adopts the 2013 curriculum. This curriculum is very suitable to be applied in the midst of the massive use and development of information technology today.

Entering the year 2000, the rapid progress of science and technology resulted in innovations in the field of education, one of the innovations in the field of education is the e-learning system. E-learning is a teaching and learning activity that uses computers or the internet (Effendi & Zhuang, 2005). In addition to choosing a learning system, sorting out teaching materials and developing them is also needed as a guide for students and teachers as well as an evaluation tool for learning outcomes. Teaching materials are all things used by educators or students that aim to facilitate teaching and learning activities (Kosasih, 2021). The development of teaching materials certainly has the right purpose, namely to complement the needs, as well as the vehicle available at school. LKPD is a type of teaching material that is easy to make, very practical and also economical. LKPD is an acronym for learner worksheets whose contents include guidance for students

in carrying out an activity program.

According to the results of research conducted by Trends in International Mathematics and Science Study (TIMSS) in 2015 showed that the achievement of learning outcomes of primary school students in Indonesia in mathematics and natural science (Science) has not shown satisfactory results. In math, Indonesia was in the 44th position out of 49 countries with a total score of 397. As for natural science materials, Indonesia is in 44th position out of 47 countries with a total score of 397. these results are below the standard average results with a value of 500 (TIMSS | IEA.NI, 2015.).

According to the results of the 2018 Program for International Student Assessment (PISA) study published on December 3, 2019, the results obtained in the 2018 PISA test decreased compared to 2015. The 2018 PISA study assessed 600,000 15-year-old children in 79 countries. The tests tested were to compare reading, math and science performance. The results obtained from this test are that Indonesia's reading ability is ranked 74th with a score of 371, then for Indonesia's math ability is ranked 73rd with a score of 379, then for Indonesia's science performance ability is ranked 71st with an average score of 396. This shows that the ability of the three aspects tested including reading, math and science performance is still very low compared to other countries (Publications - PISA, 2018.).

Reflecting on the results of TIMSS and PISA above which show the low achievement of the ability and learning outcomes of students in Indonesia, the government needs to improve the education system by improving infrastructure in the education sector and the quality of teachers. With the rapid development of technology and information, superior human resources are needed who can analyze any information so that they do not easily accept false information or news (hoaxes), therefore a suitable learning approach is needed and can help students to foster great curiosity so that students can apply lessons to real life. Currently, the development in the field of education is accelerating, this is seen from the increasing number of learning methods and approaches used in teaching and learning activities by teachers. One approach that is effective in improving learning outcomes and science literacy is the STEM approach. based on the results of research from (Amir, 2019) states that the STEM learning approach is effective in increasing student scores.

STEM is an acronym used to express a learning approach that uses various fields of knowledge such as science, technology, engineering and mathematics to help learners conduct research, discuss and work together and increase the responsiveness of learners. STEM stands for Science, Technology, Engineering and Mathematics. (Rachim, 2019) In the STEM approach, students are directly involved in achieving learning competencies in the form of real work. (Hadinugrahaningsih, 2017).

Looking at the various problems that have been described previously and analyzed in order to solve existing problems. It is necessary to develop teaching materials and determine a suitable learning approach to the conditions of the education system in Indonesia and the high use and development of information technology today. Reflecting on the explanation that has been explained previously, the researcher wants to develop LKPD with an e-learning-based STEM

approach on the material of quantities and units.

METHODS

The type of research conducted uses the Research and Development method or in English called Research and Development (R&D). According to Sugiyono in his book Quantitative Qualitative and R&D Research Methods explains that this research method is used to produce a product and test how effective the product has been made (Sugiono, 2013).

The design of teaching material development in the form of LKPD with the implementation of the STEM approach in this study uses the ADDIE development model. This model consists of 5 stages, namely Analysis (analysis), Design (planning), Development (development), Implementation (application) and Evaluation (evaluation). The stages in the ADDIE development model can be seen in the figure below.

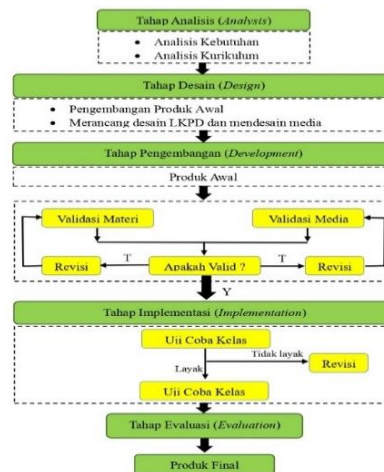


Figure 1: Stages of ADDIE Development Model

The data collected will be analyzed to determine the assessment and opinions of the products produced.

1. Product Development Process Data

Product development process data is descriptive data. Data on the product development process is obtained from material experts, media experts and teachers in the form of criticism, suggestions and input which are used as a reference for product revision.

2. Data on Product validation Assessment by Experts

Product quality assessment data is obtained from the results of questionnaire filling by material experts, media experts and learning practices for size and units. The data will then be analyzed by converting qualitative research into quantitative according to the Likert scale type. Likert scale is a scale designed by Likert, on this scale four assessment items are used which are combined to form a value that represents individual characteristics (Syofian, 2015). Likert scale value provisions can be seen in the following table:

Categori	Skor
SS (Strongly Agree)	4
S (Agree)	3
TS (Disagree)	2
STS (Trongly Disagree)	1

Table 1. Likert scale score conditions

The results of data calculations presented in the distribution of scores and percentages against categories are identified with the provisions of product quality assessment in the table below:

Percentage Rating	Classification
76 - 100%	Very valid
50 - 75%	Valid
26 - 50%	Moderately valid
<26%	Less valid

Table 2: Evaluation of validity

The indicator of the validity of the developed product is if the percentage of assessment results $\geq 50\%$ can be said to be valid.

3. Normalized Gain (N-Gain)

The normalized gain test (N-Gain) was conducted to determine the increase in students' cognitive learning outcomes after being given treatment. This increase is taken from the pretest and posttest scores obtained by students after treatment. Normalized gain or abbreviated as N-Gain is a comparison of the actual gain score with the maximum gain score. The actual gain score is the gain score obtained by students while the maximum gain score is the highest possible gain score obtained by students. The calculation of the normalized gain score (N-Gain) can be expressed in the following formula:

$$NGain = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Description:

N Gain = Gain normality test value

S_post = Posttest score

S_pre = Pretest score

The effectiveness criteria interpreted from the normality gain value according to Meltzer can be seen in the following table.

Value N-Gain	Categori
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

Table-3. effectiveness criteria

The indicator of learning effectiveness used in research is if the N-Gain value ≥ 0.3 can be said to be effective.

4. Practicality test from student responses

To measure the quality of the developed media products that are practical or not, the researchers used student response questionnaire assessment data. The data will then be analyzed by converting qualitative research into quantitative according to the Likert scale type. the provisions of the Likert scale value can be seen in Table 1.

The results of the calculation presented in the distribution and percentage against the category are identified with the provisions of the product quality assessment in the table below:

Percentage Rating	Classification
0 - 20%	Not Practical
21 - 40%	Less Practical
41 - 60%	Practical Enough
61 - 80%	Practical
81 - 100%	Very Practical

Table 4. Feasibility assessment

The indicator of the practicality of the developed product is if the percentage of assessment results $\geq 61\%$ can be said to be practical.

RESULT & DISCUSSION

Research Results

1. Validation results

a. Material Expert Validation

One type of validation to determine the material feasibility of the LKPD that has been made is material validation, the results obtained from this validation are assessments, suggestions and also comments on the products produced which are useful for improving the quality and feasibility of the product. The results of the validation can be seen in the picture below.

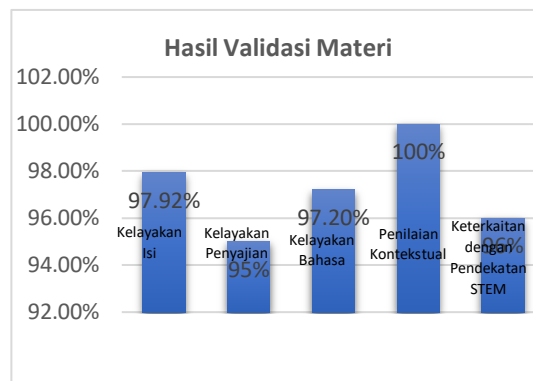


Figure 2. Material Expert Validation Results

Material validation consists of several aspects, namely aspects of content feasibility, presentation feasibility, language feasibility, contextual assessment and linkage to the STEM approach. From the validation results obtained, this STEM-based LKPD received a score with a percentage of content feasibility of 97.92%, a percentage of presentation feasibility of 95%, a percentage of language feasibility of 97.20%, a percentage of contextual assessment of the STEM approach.

Aspect	Before Revision	After Revision
Cover	The cover illustration does not illustrate the material contained in the LKPD	Using several pictures of measuring instruments that are in accordance with the material of quantities and units
	Less attractive design	The design is made with red and white wallpaper and logos of Unimed and the independent campus.
Content of LKPD	Pictures are not numbered and captioned	Pictures are numbered and captioned

Table 5. Material expert suggestions

The percentage of contextualization is 100% and the percentage of linkage with the STEM approach is 96%. The suggestions given by the material validators can be seen in the table below.

By looking at the results obtained from material validation, it can be concluded that the developed LKPD can be continued at the product trial stage.

b. Media Expert Validation

One type of validation to determine the media validity of the LKPD that has been made is media validation, the results obtained from this validation are assessments, suggestions and also comments on the products produced which are useful for improving the quality and feasibility of the product.

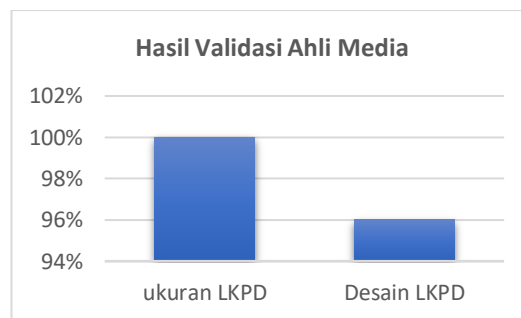


Figure 3: Media Expert Validation Results

Media validation only consists of one aspect, namely the graphic aspect. From the validation results obtained, this STEM-based LKPD received a score with a percentage of grammatical feasibility of 96% which was categorized as very valid with revisions. By looking at the results obtained from material validation, it can be concluded that the developed LKPD can be continued at the product trial stage. Some suggestions given by media validators can be seen in the table below. Table-6. Media expert suggestions.

Aspect	Before Revision	After Revision
Isi LKPD	Picture is too big	Image scale adjusted
	Some of the line spacing in the theoretical review section is too wide	Spacing is adjusted to 1.5
	Pictures are not numbered and captioned	Pictures are numbered and captioned

Tabel6. Media expert suggestions

c. Teacher Validation Questionnaire

After validation by material experts and media experts, validation is carried out by physics teachers to obtain assessments, suggestions and comments so that they can find out the shortcomings of the LKPD that have been developed. The results of the validation conducted by the teacher can be seen in the figure below.

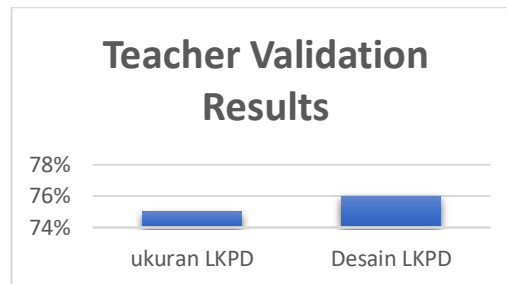


Figure 4. Teacher Validation Results

The results of the validation by the physics teacher showed that the developed LKPD received a 76% grammatical feasibility score. From this value it can be concluded that the LKPD developed is very valid without revision and LKPD can be continued at the product trial stage.

2. Implementation Phase Results

a. Small Group Student Responses

Small group trials were conducted to determine the feasibility of the developed LKPD, this trial involved 10 students who were randomly selected. In this trial, the revised LKPD was distributed, then students used the LKPD. After students finished using the LKPD, students were given a student response questionnaire consisting of 15 assessment items. The results of student responses can be seen in the figure below.

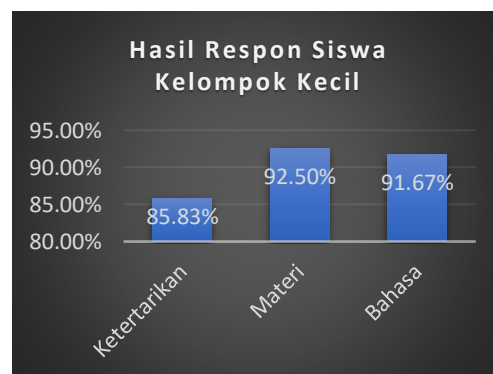


Figure 5. Small Group Student Response Results

The student response questionnaire in the small group consisted of three aspects, namely interest, material and language. The results obtained from the questionnaire received a fairly high score, including the aspect of Interest 85.83%, the material aspect 92.50%, and in the language aspect, 91.67%. The average percentage on the results of small group student responses scored 90.00% so that the LKPD can be classified into very practical.

b. Product Implementation

1. Pretest-posttest results

From the results of the data that has been obtained through pretest and posttest tests, it can be seen that the use of LKPD with an e-learning-based STEM approach can improve student learning outcomes. So that the effectiveness of LKPD in learning is very high. Data on the results of the N-Gain calculation can be seen in the table below.

Large Scale (20 students)	Learning Outcome Score	
	Maximum score 100/student	
	Pretest	Posttest
Total Score	1020	1920
Average Score	51	96
N-Gain Score	0,94	
Percent N-Gain Score	93,89%	
N-Gain Interpretation	Tinggi	

Table7. Large group Pretest-Posttest result data

Based on the above, it shows that student learning outcomes after using LKPD have increased. It can be seen in the N-Gain score value of 0.94. Based on table 3.6 the value of 0.94 can be categorized as high effectiveness value.

2. Large Group Student Responses

The student response questionnaire in the large group consisted of three aspects, namely interest, material and language. The results obtained from the questionnaire received a fairly high score, including the interest aspect of 90.42%, the material aspect of 93.75%, and the language aspect of 95.83%. The average percentage on the results of small group student responses scored 93.33% so that the LKPD can be classified into very practical. The results of student responses can be seen in the figure below.

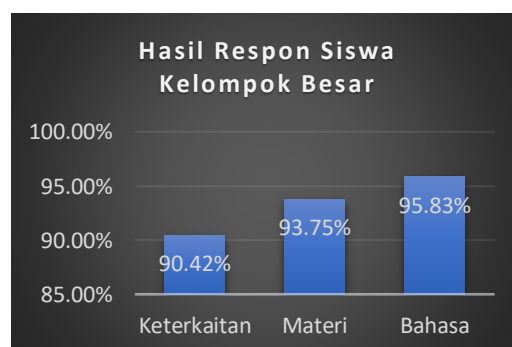


Figure 6. Large Group Student Response Results

Discussion

This research has produced an LKPD with an e-learning-based STEM approach to class X quantities and units. This study aims to determine how valid, effective and feasible the developed product is. The validity of the product is seen based on the validation questionnaire filled in by material experts, media and teachers. The effectiveness of the product is seen from the results of the student pretest-posttest, and the feasibility of the product is seen based on the student response questionnaire.

1. Steps for Developing LKPD with ADDIE Research Model

To develop an LKPD with an E-Learning-based STEM approach on the material of quantities and units, an ADDIE research model is used, namely 1) Analysis, 2) Design, 3) Development, 4) Implementation, 5) Evaluation. The initial stage is to analyze or observe, what researchers get from this stage is information about the application of learning that is applied to the material of quantities and units, especially in the measurement sub-material that uses measurement instruments in the form of a push-pull and screw micrometer. Learning that is carried out is only limited to an explanation of measuring instruments and how to read measuring instruments.

The next step is design or Design, what is done at this stage is to design the LKPD and cover so that the LKPD display becomes more attractive and the next step is to compile a practicum using the vernier caliper application and adobe flash player to visualize the vernier caliper, screw micrometer and ohaus balance. LKPDs are compiled based on KD, Indicators and objectives contained in the lesson plan along with materials based on the learning handbook at MAN 2 Medan Model. The next step is development or Developer by conducting validation by experts such as material experts, media experts and teachers. After the LKPD is valid, the application or Implementation stage can be carried out. This step is done by testing the LKPD to students to determine the effectiveness and feasibility through pretest-posttest and student response questionnaire. At each stage in this model, an evaluation stage is always carried out to find out the shortcomings and make improvements to the LKPD.

2. Analysis of product validity by experts

The results of the validity test analysis by experts on LKPD consisting of material validation, media validation and practitioners (teachers), this is done to find out how feasible the LKPD that has been developed so that LKPD can be used in learning. In the validation test conducted by material experts, it shows that the LKPD that has been developed can be used as teaching material. This can be seen from the final score that has been filled in by the material validator with a very satisfying average score of 97% with a very valid category with several revisions. The aspects assessed are aspects of content feasibility, presentation, language, contextual, and linkage to the STEM approach.

The validation test conducted by media experts also showed very satisfying results with a score of 96% so that it was categorized as very valid with revisions. The aspect that was assessed was the graphic aspect. Then the validation test conducted by the teacher received a score of 76% and was categorized as very valid without revision. The aspect that was assessed was the graphic aspect. This is

in line with previous research that developed effective STEM-based LKPD and tested valid with the achievement of KPS and KPS which were obtained very well when used during learning (Mahjatia, Nanda, Eko Susilowati, & Sarah Miriam, 2020).

3. Analysis of product effectiveness by students

Analysis of product effectiveness is carried out using the normalized gain test (N-Gain) so that it can be seen the increase in students' cognitive learning outcomes after being treated. By looking at the N-Gain value, it can be seen the effectiveness of the LKPD that has been developed. This test was only conducted in large classes with a result of 0.94 with a high interpretation. Previous research states that the STEM integrated approach based on guided inquiry on temperature and heat material is effectively used as teaching material (Arinillah, 2016).

4. Analysis of product practicality based on student responses

Product feasibility is obtained from the results of student response questionnaires. It was conducted twice, namely in small classes and large classes. The small class involved five students from class X-L who were randomly selected from 38 people. The large class involved ten students from class X-O who were randomly selected from 36 people.

The results of the practicality test conducted in small and large classes showed a fairly high average percentage, which was 90.00% and 93.33%. This shows that the LKPD developed is very practical to use. This is in line with previous research which states that STEM-based modules are very practical in helping students to understand the concept of energy (Zulaiha & Kusuma, 2020).

CONCLUSION

From the results of research and development that has been carried out by researchers, it can be concluded several things, namely 1. LKPD teaching materials with an e-learning-based STEM approach to the material of quantities and units are designed using Microsoft Word and Photoshop for the cover. With the vernier caliper application and adobe flash player to help visualize measurement instruments. 2. The results of validation conducted by material experts get a score of 97% which is categorized as very valid with revision, then the results of validation from media experts get a score of 96% which is categorized as very valid with revision, and the results of validation from teachers get a score of 76% which is categorized as very valid without revision. From the validation results, it shows that the LKPD that has been developed can be tested in learning. 3. The results of the pretest-posttest conducted in the large class showed an increase, with an N-Gain value of 0.94. This shows that the LKPD developed is high as teaching material in learning activities. 4. The results of student responses to determine the feasibility of LKPD given to small groups and large groups received scores of 90.00% and 93.33%. So it can be concluded that the developed LKPD is interesting and practical to be used as teaching materials in learning.

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