Development of web-based e-LKPD to develop high school students' numeracy on geometry

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Abstract: This development is motivated by the importance of numeracy skills for secondary school students. It is necessary to have learning resources supported by technological developments. However, the facts in the field show that existing learning resources are still conventional and have yet to lead to the achievement of student numeracy. Based on this background, this development aims to develop web-based student worksheets in mathematics learning in secondary schools. This research was conducted at MAN 1 Serang City for grade XI students. The development model used is the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. The instruments used to measure the feasibility of this teaching material are expert validation questionnaires consisting of media experts and material experts, practicality questionnaires, and numeracy tests. Based on the results of processing the expert validation questionnaire, the results obtained are the assessment of media experts in the form of LKPD getting an average percentage score of 85% with very feasible criteria, the assessment of media experts in the form of a web getting an average percentage of 82% with feasible criteria and the assessment of material experts getting an average percentage score of 83% with very feasible criteria. Based on the analysis results, the learner worksheets developed are valid for developing the numeracy of secondary school students.

Keywords: Geometry, Numeracy, Student worksheet, Website learning


INTRODUCTION

Education as a vital sector in generational development must be responsive to pursue strategic initiatives that are in line with the times (Purwasiq & Kusumah, 2022). Learning in the 21st century constantly needs to adapt to changes over time. However, the learning process is still concentrated on the teacher. As a result, students become discouraged, repetitive, and bored. Therefore, Student Worksheet Innovation (E-LKPD) is very important to train 21st century skills known as 4C (critical thinking, creativity, communication, and collaboration) (Suryaningsih et al., 2021). Teachers’ involvement in setting learning strategies is crucial in supporting lifelong learning. Teachers in addition to their role as teachers also act as learning facilitators, inspiring, guiding and advising students, thus encouraging the transition to education that emphasizes the development of collaborative skills, the use of technology, and the development of multidisciplinary skills in students. Teaching strategies by utilizing learning strategies. Teachers must be innovative in order to reduce learning content. The learning media needed is of course by utilizing current technological developments. One of them is the use of Worksheets (LKPD). LKPD is a student activity sheet that allows students to engage in contextual tasks with the material and problems discussed. (Teresa et al., 2022). In other words, LKPD is a medium that helps students’ learning activities which contain material and questions.
However, most schools use LKPD learning media in the form of printed media and there are no guidelines for using it and the questions in LKPD do not support 21st century skills known as 4C (critical thinking, creativity, communication, and collaboration). Astuti & Sari (2017) LKPD is one of the instruments used to bridge the delivery of material by the teacher, even though the LKPD used is LKPD sold on the market, therefore worksheets on the market are not effective because they are just a collection of questions of various types. This is supported by facts in the field with interviews at MAN 1 Serang city school showing that curriculum changes affect learning, so MAN 1 Serang City is still considering using an independent curriculum. Furthermore, the learning media used are still LKS from publishers on the market so that the integrated problems are not numerate, the questions in the LKPD are still routine questions that do not support the skills needed in the era of society 5.0 Several studies on HOTS and 21st century skills have been conducted by various researchers, one of which (Pratama & Retnawati, 2018) analyzes the importance of including numeracy material in mathematics books to obtain these findings, numeracy must be trained and taught to students through LKPD. In addition, there is no E-LKPD media at MAN 1 Kota Serang. In line with this opinion, Lestari et al., (2019) the teaching materials most often used by schools in general are LKPDs purchased from publishers instead of worksheets designed directly by teachers, these LKPDs are less attractive in terms of aesthetics; In addition, the content and topics in LKPDs are not always relevant to the context of students' daily lives.

The role of a teacher is very important in packaging learning activities. Teachers need teaching materials to support the learning process. Teaching materials with learning media are an alternative to teachers in conveying knowledge or learning material, one of which is by using LKPD media. Of course, learning media must go hand in hand with current technological developments, such as the development or innovation of LKPD using web learning as a bridge in delivering material and supporting learning. Researchers use Google sites in developing LKPD because Google sites are easy to use and free and are more connected to teacher creativity. According to Adzkiya and Suryaman (2021), teachers can post learning materials, assignments, and syllabi on google sites. The instructional content offered may be in the form of text, graphics, or videos, allowing teachers to be creative. In addition, students only need a device/laptop connected to the internet network to open Google Sites.

One of the disciplines in education is mathematics. Mathematics is very important in everyday life and in dealing with advances in science and technology so it must be taught to every student. Learning math can help students develop critical, creative, and logical thinking skills (Novelia et al., 2017). Therefore, there is a need for a variety of LKPDs that are in accordance with current skills that need to be developed as guidelines for educators and students in carrying out the mathematics learning process, can help build concepts, practice finding, and improve process skills, in facing 21st century competencies, namely numeracy skills. Numeracy is one of the 21st century skills that must be developed. Darwanto and Putri (2021) numeracy is the ability to analyze numbers, known as “numerical literacy.” It can be concluded that numeracy literacy is the skill in managing symbols, calculating and analyzing problems in real life. Numeracy is considered to help a person become more sensitive to the presentation of data, patterns, and numerical sequences, as well as train thinking to solve problems and make decisions. One of the subjects related to numeracy is geometry transformation. geometry transformation is closely related to everyday life and can be integrated with numeracy.

Integrating numeracy in E-LKPD in the teaching and learning activities of mathematics students in senior high school grade XI is needed to improve the development of 21st century competencies that emphasize numeracy skills. The researcher focuses on the development of E-LKPD, so the objectives of this study are: (1) Knowing the feasibility of web-based Electronic Learner Worksheets (E-LKPD) to develop high school students’ numeracy on the topic of geometry; (2) Knowing the numeracy of high school students after using web-based E-LKPD on the topic of high school geometry. This research is expected to provide alternative learning
resources for teachers and schools in developing high school students’ numeracy skills and developing students’ numeracy skills in solving problems that exist in everyday life and are related to mathematics through web-based E-LKPD.

METHOD

The subject of the development research was grade XI students because it was adjusted to the implementation of AKM for high school grade levels, the researcher chose MAN 1 Kota Serang. This research includes Research and Development (R&D) research with the ADDIE research model (analyze, design, development, implementation, evaluation). Researchers chose this type of research because the ultimate goal is to produce a product and the stages carried out are systematic. The following are the stages carried out by researchers:

Analyze

Analysis data is obtained from the results of school observations, school teacher statements in the field and literature studies. The analysis stage consists of several, namely: (1) Curriculum analysis to find out the curriculum implemented at MAN 1 Kota Serang so that researchers will adjust the indicators of E-LKPD products to be developed based on the competency standards and basic competencies of students; (2) Analysis of student characters, to develop learning strategies according to what is needed in developing E-LKPD products; (3) Material analysis, researchers conducted a literature review.

Design

The design carried out by researchers is: (1) Material assessment, researchers determine the material that will be the focus of discussion in web-based E-LKPD development products. The material chosen by the researcher is geometric transformation because it is one of the components in numeracy, then the researcher determines the indicators that exist in the material as a barrier in the design of the product made; (2) The target product chosen is high school students in grade XI who are studying the topic of geometry; (3) Making storyboards, used to create a flow of content that will be poured into the visualization of E-LKPD.

Development

This activity is carried out to produce web-based E-LKPD development products on the topic of geometry, the development stages carried out by researchers, namely: (1) The preparation of the product, researchers develop LKPD adjusts to the results of the results of the analysis and design stages that will be combined to produce a complete product; (2) Product validation by 2 media experts, 2 material experts and 2 practitioners which resulted in suggestions, criticisms and input as a basis for revision; (3) Product review, researchers conduct a revision process in accordance with the suggestions, criticism and input from media experts, material experts, and practitioners. The results of the revision will be used at the implementation stage for students in grade XI SMA.

Implementation

At this stage, trials were conducted with students as research subjects in small group trials of 10 students of class XI IPA 3 at MAN 1 Kota Serang randomly and teachers who would use mathematics learning media. The implementation stages carried out are: (1) Small group test, conducted by representatives of students at MAN 1 Serang City who can represent the population of development products. Learners assessed the web-based E-LKPD development product; (2) Field test, conducted by XI IPA class students at MAN 1 Kota Serang, then students assessed the web-based E-LKPD development product that they had seen.

The data in this study were obtained through a questionnaire instrument containing questions modified from BSNP 2008, consisting of: 1) media feasibility questionnaire; 2) material feasibility questionnaire; 3) teacher and learner response questionnaire; 4) practicality questionnaire. Data analysis in this study used a Likert scale with a scale of 1 as the lowest
The scores obtained will be analyzed based on the Criterion Interpretation Scale.

1. **Expert Validation Questionnaire**

The data was obtained based on the results of the questionnaire that had been filled in by the validator, then the Likert scale assessment score (Asyhari & Silvia, 2016) was calculated and the value obtained was categorized with the Criteria Interpretation Scale in Table 1.

<table>
<thead>
<tr>
<th>Interval (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 &lt; p ≤ 20</td>
<td>Very less feasible</td>
</tr>
<tr>
<td>20 &lt; p ≤ 40</td>
<td>Less feasible</td>
</tr>
<tr>
<td>40 &lt; p ≤ 60</td>
<td>Feasible enough</td>
</tr>
<tr>
<td>60 &lt; p ≤ 80</td>
<td>Feasible</td>
</tr>
<tr>
<td>80 &lt; p ≤ 100</td>
<td>Very decent</td>
</tr>
</tbody>
</table>

2. **Teacher and Learner Response Questionnaire**

Teacher and learner response questionnaires are used to assess the practicality of the product. The results of the questionnaire are in the form of attitudes, views, and perceptions of a person or group of people which are then analyzed with the following steps (Norsanty & Chairani, 2016). The results of the practicality assessment by teachers and students through the provision of response questionnaires, can be categorized in Table 2.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>x̅ &gt; 4,2</td>
<td>Very good</td>
</tr>
<tr>
<td>3,4 &lt; x̅ ≤ 4,2</td>
<td>Good</td>
</tr>
<tr>
<td>2,6 &lt; x̅ ≤ 3,4</td>
<td>Fair</td>
</tr>
<tr>
<td>1,8 &lt; x̅ ≤ 2,6</td>
<td>Deficient</td>
</tr>
<tr>
<td>x̅ ≤ 1,8</td>
<td>Very less</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

This research seeks to actualize the design of the product design and research tools to be in line with the framework set at the planning stage (Adiyani & Berlianti, 2022). These stages include the product research stage and the validation stage. Draft I of the product that has been made is discussed with the supervisor, then there are suggestions and input for improvement on draft I then revised into draft II, then the product is verified by the validator to determine the feasibility of the product. The results of the validator's revision along with ideas and comments are draft III which will be tested in the field. The following is the assessment given by each validator; Table 3 below shows the results of the LKPD validation using the Criteria Interpretation Scale.

<table>
<thead>
<tr>
<th>No</th>
<th>Validator (LKPD)</th>
<th>Assessment Percentage</th>
<th>Rating Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Media Expert (LKPD)</td>
<td>85 %</td>
<td>Very Decent</td>
</tr>
<tr>
<td>2.</td>
<td>Material Expert</td>
<td>83 %</td>
<td>Very Decent</td>
</tr>
<tr>
<td>3.</td>
<td>Media Expert (Web)</td>
<td>82 %</td>
<td>Very Decent</td>
</tr>
</tbody>
</table>

The results of the validator's assessment show that the web-based electronic learner worksheet (LKPD) to develop students' numerical skills shows that the LKPD is very feasible in learning even though it still requires modifications for improvement. Related to the input from the validator, the indicators used are combined with numeracy indicators and the deepening
of geometric transformation material needs to be equipped with more varied evaluations so that the numeracy research objectives can be achieved. Furthermore, the products that have been validated will be revised in accordance with the suggestions and input provided by experts to determine the usability of the products developed. So that the web-based learner worksheets (LKPD) used have been assessed as valid in terms of media and material and suitable for testing (Arifin, 2010).

**Discussion**

**Analysis Stage**

Analysis is carried out on all aspects related to the preparation of product development. These aspects include needs analysis and curriculum analysis (Wahidah & Hasanuddin, 2018). Needs analysis was conducted through interviews with teachers and students of class XI MAN 1 Serang City. Based on the results of interviews with students, information was obtained that grade XI students of MAN 1 Kota Serang generally have the ability to use technology quite well, the technology that is often used is smartphones, laptops and computers. This is because the majority of students have gadgets and schools have computer laboratory facilities that are commonly used in learning. In addition, the majority of students' mathematical abilities are quite good but not optimal on the topic of transformation geometry, some students do not like math and are less excited when following the learning process in class. As for the numeracy skills of students in solving problems related to the topic of transformation is still lacking.

While the results of interviews with teachers, obtained information that teachers tend to have difficulty in conveying the concept of geometry transformation to students. Teachers have been conveying the concept of geometry transformation only rely on the help of images on power point or direct analogy by looking at examples of real objects around the school environment. In addition, teachers only rely on student books and worksheets provided by the publisher.

Figure 1. Flowchart of Prerequisite Materials

Therefore, an innovation is needed in the use of technology that is easily accessible to students both at school and outside of school, and students can review the material, the
technology in addition to providing convenience for students, of course also in helping students develop their numeracy skills. So that developers make web-based digital student worksheets as alternative learning media for teachers.

Curriculum Analysis is done by observing the epistemological material that is transformation geometry material at the secondary school level consisting of reflection, translation, rotation and dilation. These materials are introduced after students learn or master the prerequisite materials, namely functions, trigonometry and matrices. Details of the prerequisite material transformation material can be seen in Figure 1.

The flow diagram of the prerequisite material (Figure 1) shows that students must master the prerequisite material first because the material will be reused in solving geometry transformation problems. In developing E-LKPD products, researchers experience obstacles in organizing E-LKPD so that students can fill it in directly without having to upload documents on the results of E-LKPD work, while the challenges that will be faced in the future are 1) network constraints, the application of E-LKPD in the rainy season is very limited, 2) Because the screen on Android is very small, E-LKPD access is less effective.

**Design Stage**

At the design stage, researchers design the design of the product to be developed in the form of web-based LKPD. According to the opinion (Adilla, 2016; Gunawan et al, 2020; Ramli & Yohandri, 2020; Puspita & Dewi, 2021), that LKPD can help students understand and foster confidence in solving critical thinking problems. There are specifications for web-based LKPD products, namely determining the initial design with a storyboard, determining the manufacturing device, and planning instruments to assess the feasibility of web-based LKPD products. Based on the analysis stage, the material taken is transformation which consists of translation, reflection, rotation, dilation.

The features contained on the website consist of a home menu, competency analysis, learning videos, learning materials, learner worksheets, evaluation, bibliography and developer profile. Making web-based learner worksheets uses software and hardware devices. The software tools used in making this worksheet are google site, a tool on a google account that can be used to create web pages easily, flipbook for E-LKPD delivery, geogebra to demonstrate or visualize mathematical concepts and as a tool to construct mathematical concepts, and canva to design E-LKPD. While the hardware devices used are cellphones or gadgets and laptops. The instrument used is an assessment questionnaire designed to assess the validity and practicality of the student worksheet and a test to see the effectiveness of a product if it is used in classroom learning. The preparation of the instrument is carried out in accordance with the assessment indicators, the purpose of each instrument, and the design of the assessment instrument begins with making a grid arrangement which is then given to a team of experts to determine the quality of the product in the form of learner worksheets and learning websites developed.

**Development Stage**

The development stage includes material development in the form of subject matter, student worksheets and learning websites. This learning website in accordance with the initial design consists of a home menu, competency analysis, learning videos, learning materials, student worksheets, evaluation, bibliography and developer profile. The following is the appearance and explanation of each menu. The home menu in Figure 2 contains information about the topic that will be studied by students along with the display of the activity menu that can be accessed by students.
The competency analysis menu in Figure 3 consists of core competencies, basic competencies, indicators of competency achievement, and learning objectives. This menu serves to provide information on learning outcomes for students, so that students understand the competencies they will have after learning this material.

The learning video menu in Figure 4 consists of a collection of learning videos that discuss translation and reflection as well as rotation and dilation. This video is presented so that students can learn the material by observing interesting videos and also facilitate students with various learning styles.

The learning material menu consists of material about translation and reflection as well as dilation and rotation in Figure 5. This menu can be accessed by students according to the ongoing meeting.
The student worksheet menu consists of four student worksheets for translation, reflection, rotation and dilation material. LKPD is designed in the form of a flipbook, making it more attractive to students. Some E-LKPD displays can be seen in Figure 6.

The evaluation menu contains formative test questions that measure students’ understanding in solving problems related to the transformation material in Figure 7. In this menu, students are asked to solve several problems and then submit answers through the menu provided.

Another supporting menu is a bibliography containing and a development profile menu. Furthermore, the product validation process aims to obtain consideration and assessment from experts about the quality of products made in the form of web-based LKPD.
**Implementation Stage**

At the implementation stage, researchers conducted product trials in the form of web-based Electronic Student Worksheets (E-LKPD) in two stages to provide new learning experiences and support the competence of students in solving problems related to numeracy, namely the first stage of conducting small group trials of 10 students of class XI IPA 3 at MAN 1 Kota Serang randomly, and the second stage was conducting field trials involving all students of class XI IPA 3 MAN 1 Kota Serang. This is to assess the numeracy skills of students as they learn. The learning process this time was carried out with the research subjects, namely students of class XI IPA 3 as many as 40 people. Opening and welcoming followed by prayer and Asmaul Husna before starting the learning process with electronic learner worksheets. Then introduced with apperception, connecting the material to be learned with events in everyday life. In addition, researchers provide an overview to students about the benefits of learning geometry transformation material in everyday life.

In the core stage of learning, students take the pre-test provided in the Google site can be seen in Figure 8, after the researcher provides the URL or Google site connection that will be done. This aims to determine the initial ability of students. 

![Figure 8. Students fill in the pre-test](image)

After completing the pre-test, the researcher presented the material, namely the translation sub chapter on geometric transformation material. After the material was explained, the researcher divided the students into 8 groups of 5 members each. students are encouraged to solve problems in the LKPD and are directed to use GeoGebra available on electronic LKPD on their personal cell phones.

![Figure 9. Students discuss](image)

Based on Figure 9, students are eager to follow the learning process, understand the learning content offered, and are enthusiastic or involved in learning throughout the question and answer session, based on the student response questionnaire on the question "Using E-
LKPD based on Google site can make learning mathematics more fun" students gave scores of 3 and 4.

**Evaluation Stage**

The evaluation stage is carried out to determine the success of the development of web-based electronic LKPD to develop high school students' numeracy on the topic of geometry. Researchers provide a student response questionnaire to assess the response of students to the test instruments that have been given and learning using E-LKPD, so that it can be used as an evaluation material for educators and further research. The student response questionnaire was given to 40 students after a large-scale trial test consisting of 15 statement items. The results are presented in Table 4.

<table>
<thead>
<tr>
<th>Number of responses</th>
<th>Number of items</th>
<th>Percentage (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>15</td>
<td>79</td>
<td>Good</td>
</tr>
</tbody>
</table>

The results of the percentage assessment of students' answers to questions and the application of LKPD when learning takes place are classified as 'good' with an average percentage of 79. The numerical ability test instrument for geometric transformation material is in the form of four fill-in questions that have been adjusted to the numerical ability indicators by obtaining an N gain of 0.8287 with an effective category according to Hake, R.R, 1999 and through the ADDIE stage produces instruments that are declared valid and feasible to use to train students in developing numerical abilities and can be used as practice for students and can be developed again through further research.

**CONCLUSION**

Researchers can conclude that web-based electronic student worksheets are feasible to use in the learning process based on the results, analysis, and discussion. This is based on the assessment score obtained from the material expert of 83% with very feasible criteria, the assessment score obtained from the media expert in the form of LKPD of 85% with very feasible criteria, the assessment score obtained from the media expert in the form of a web of 82% with very feasible criteria, and the assessment score obtained from the practitioner of 91% with very practical criteria and E-LKPD is declared effective based on the effectiveness value of the pretest and posttest results obtained using the standard gain formula <g>, which is 0.8287 with a very good category. So that web-based E-LKPD to develop numeracy skills of class XI high school students can be used for learning geometry transformation chapter.

**Declarations**

**Author Contribution**: ASP: Conceptualization, Writing - Original Draft, Methodology, Editing and Visualization; EK: Writing - Review & Editing and Formal analysis, and Validation; TF: Writing - Review & Editing and Validation.

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