Development of Web-Based Mathematics Learning to Improve the Mathematical Power

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Abstract

This study aims to develop a mathematics learning web to improve the mathematical power of junior high school studentsthrough valid, practical, and effective development. This study uses development research methods with the ADDIE development model. The stages in this model include the steps of analysis, design, development, implementation, and evaluation. The product developed is a mathematics learning web to improve the mathematical ability of junior high school students. A valid learning web used for even semester math material for the 2020/2021 school year conducted with 30 research subjects on Class VIII of SMP Negeri 2 Sintang and SMP Swasta Nusantara Indah Sintang. In this study, product trials consist of expert validation, small-scale trials, and student questionnaires. The analysis technique measures student's mathematical power using the gain score calculation. The analysis phase starts from evaluating the expected results following the curriculum related to the material, study habits in the classroom, and the use of web media in learning mathematics. Then proceed to the web design stage and qualitative validation so that the web design, teaching materials, and test questions are valid. Furthermore, at the implementation stage, a web design is obtained that follows the curriculum and can measure students' ability to understand web content. The results of the study show (1) a mathematics learning web developed to increase valid mathematical power for junior high school students. (2) the mathematics learning web meets the practical criteria in its use from good student responses, and (3) there is an increase in student's mathematical power with moderate criteria after learning on the mathematics learning web.

Keywords: Web-Based Mathematics Learning; mathematical power; class VIII students

INTRODUCTION

Today's world of education has developed rapidly, marked by advanced technology, globalization, and vast competition. The quality of education reflects the advancement of a country. The more advanced education in a country results in a strong civilization. One of the factors that can make this happen is mathematics education in schools.

When learning mathematics in class, students need the power to think mathematically in solving new problems and learning new ideas that students will face in the future, not just counting skills(Janah et al., 2019). For junior high school students, the mathematics competition they must master is stated in the Standar Isi

Pendidikan Dasar dan Menengah Nomor 21 Tahun 2016, including 1) Demonstrate a logical, critical, analytical, careful, and thorough attitude, being responsible, responsive, and not giving up easily in solving problems. 2) Have a sense of belief in the benefits and uses of mathematics, which is formed through learning experiences, 3) Communicate mathematical ideas clearly. 4) Identify patterns and use them to understand general rules and make predictions.

NCTM (Chandra, 2015)states mathematical power process as the ability to explore, construct conjectures, make logical reasons, solve non-routine problems, communicate mathematically, use mathematics as a communication tool, and connect mathematical ideas and activities other intellectuals in learning mathematics. Mathematical power is the ability to make mathematical reasoning, problem-solving, mathematical communication, and mathematical connection in mathematics teaching. Mathematical power also includes the growth of confidence and spirit to seek, evaluate, and use quantitative and spatial information in solving problems and making decisions (Syaban, 2008).Students with mathematical power will master problem-solving, mathematical communication, reasoning, and mathematical connections.

Indonesian students haven't achieved mathematical expected proficiency and are still below international standards (Janah et al., 2019; Syaban, 2008b).Program for International Student Assessment (PISA) Report in 2012 and Trends In International Mathematics and Science Study (TIMSS) in 2015 depict the low mathematical power of Indonesian students. The results of the 2012 PISA study for seventh-grade junior high school students, the average score of the mathematics achievement was ranked 64 out of 65 countries. Indonesia accumulated a score of 375, which is still below the average score of 494. While the 2015 TIMSS study shows, Indonesia was ranked 44th out of 49 countries(Hadi & Novaliyosi, 2019).

To train mathematical power in the classroom, teachers should pay attention to the following aspects: (1) mathematical modeling, (2) problem solving, (3) develop analytical and logical thinking, (4) develop abstractions, (5) build context and correlation, (6) communication (Murtiyasa, 2015). hese points can be easier implemented face-to-face. However, Covid-19 Pandemic challenges learning activities due to face-to-face restrictions in class to suppress the spread of the pandemic. So schools must conduct online learning. The study results (Asmuni, 2020; Rifdan, 2018)reveal the problems of teachers in online learning, such as inefficient usage of media technologies, the passivity of students in online teaching, limited support facilities, and internet network access. Therefore, information technology-based learning innovations are crucial to meet the curriculum's competency demands related to mathematical power..

Munthoha, dkk (Persada, 2017)explained that educational technology had changed teaching techniques from lecture to learning media. Learning media has developed from books and audio-visuals to online materials on the internet. Websites (web blogs) are pages on a site/domain that contain information. Websites are built on many interconnected web pages. The relationship between one web page to another is called a hyperlink. Then the term hypertext is the text that becomes a connecting medium. The website is accessed through a browser on a

personal computer or other technological media, using software to access web pages, such as Mozilla Firefox, internet explorer, chrome, and more. Using the web for getting teaching materials is feasible be implemented.

One way to create exciting teaching materials is to display them on the web. Teaching materials displayed on the web can make students feel comfortable learning and accessing the web. Haiprilisya et al., (2020) suggest that the great potential of web-based teaching materials has three main characteristics, namely: (1) presenting multimedia, (2) storing, processing, and presenting information, and (3) hyperlinks. Another advantage of using online media makes it is easy for students to access various learning materials in videos, images, text, sound, animation, and others (Purmadi, 2016). Persada (2017); Arifin& Herman(2018), in their research, explains that the use of the web in learning mathematics can improve learning outcomes, conceptual understanding, and independence in learning.

The importance of mathematical power in junior high school students in achieving the objectives of the mathematics education curriculum is necessary to innovate teaching materials that are informative and easily accessible to develop mathematical power abilities. Learning using a practical and fun online learning web is a solution to improve these abilities. Fun learning web allows students to practice problem-solving in various situations, not just providing routine questions. The development of mathematical power abilities in students is essential to make students more flexible and effective in learning to solve mathematical problems, mathematical representation, mathematical communication, reason in mathematics learning, and problems in online learning. So it can be concluded that research in the development of a structured mathematics learning web of student's mathematical power abilities in junior high school needs to be carried out.

RESEARCH METHOD

This study uses development research methods with the ADDIE development model. Using a teaching development model that follows the theory will guarantee the quality of teaching materials (Cahyadi, 2019). The stages in this model include the steps of analysis, design, development, implementation, and evaluation. The product developed is a Web-Based Mathematics Learning to improve the mathematical ability of junior high school students. A valid learning web used for even semester math material for the 2020/2021 school year conducted with 30 research subjects on Class VIII of SMP Negeri 2 Sintang and SMP Swasta Nusantara Indah Sintang. The product trials in this study consisted of expert validation and revision and small-scale trials and product revisions. Expert validation consists of learning web design validation and material validation. Three validators were validated: two lecturers from the mathematics education study program and one computer education study program lecturer. Data collection techniques in this study include documentation, tests, and questionnaires.
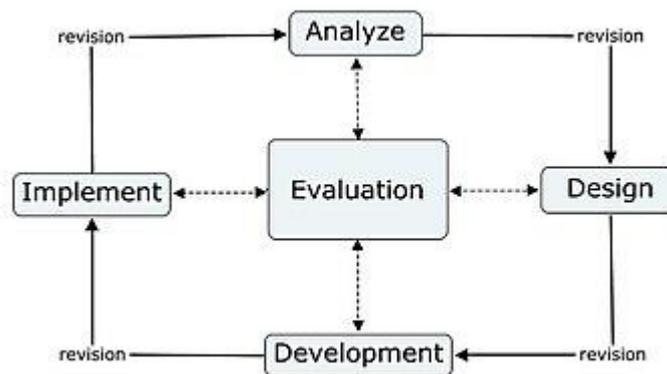
Picture 1. Design ADDIE development model

Data analysis techniques are used to measure the increase in student's mathematical power. The increase in ability was measured using a gain score calculation using the test scores for mathematical power, such as the pretest score before the learning web was implemented and the post-test score obtained after the learning web implementation. The results obtained are then processed using the following formula:

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$$g = \frac{X_2 - X_1}{X_{maks} - X_1}$$

Keterangan:
X_1 = pre-test score
X_2 = post-test score
X_{maks} = maximum score

Then, the results of the calculations are compared through the following table to acquire the criteria to increase student's mathematical power.

Table1.Criteria of*gain score*

Gain Score	**Kriteria**
$g \geq 0{,}7$	High
$0{,}3 \leq g < 0{,}7$	Moderate
$g < 0{,}3$	Low

RESULTS AND DISCUSSION

Here is the description of the development results based on the stages of the ADDIE development model on the Web-Based Mathematics Learning to improve student's mathematical power.

1. Analysis

The researchers communicated to the school regarding implementing the planned web development research procedures for mathematics teaching materials. This stage analyzed the expected outcome following curriculum related to the

material, learning habits in class, and use of web media in learning mathematics. Curriculum analysis was done by identifying mathematics learning materials for class VIII, developed on the mathematics learning web. The communication results to the mathematics subject teacher showed that the material's content to be published on the learning web was material for even semester learning, including the Pythagorean Theorem, Circles, Flat Side Spaces, Statistics, and Opportunities. Preliminary analysis related to student's mathematical power conducted on class VIII students as research subjects aimed to determine the initial ability before implementing the mathematics learning web. Researchers analyzed the initial ability of student's mathematical power by giving math pre-test questions. Based on the analysis obtained, 30 students have less mathematical power. Likewise, the researchers analyzed student's use of the mathematics learning web to explain the role of the developed mathematics learning web and how it was used in mathematics teaching on student's mathematical power.

2. Design

   At this stage, the researchers designed the web, including: (1) Web display; (2) teaching materials based on the ability of mathematical power; (3) test questions to measure student's mathematical power. The following shows the form of the developed Mathematical Power Structured Web-Based Mathematics Learning design:
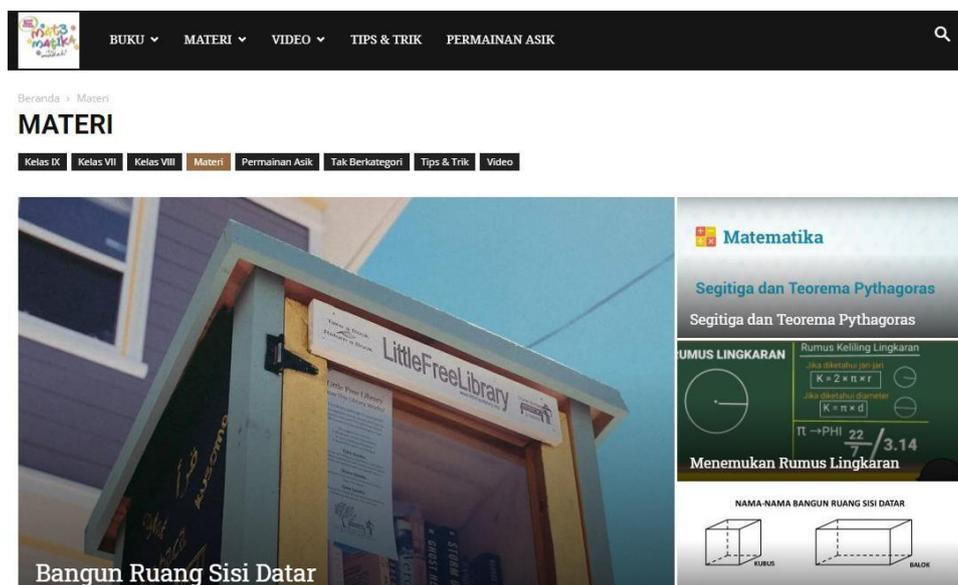
Picture 2. Web-Based Mathematics Learning of Class VIII Middle School Mathematics

3. Development

   This stage conducted qualitative validation for Web-Based Mathematics Learning, teaching materials, and test questions. Based on the validation results, several suggestions were obtained as follows:

Table 1. Validator Comments and Suggestions on the Mathematical Power Structured Web-Based Mathematics Learning

No	Type	Validator	Comment/Suggestion
1	Web Design	1	Add links/videos related to learning materials
			The color degradation must be consistent, and the pictures must use more specific descriptions regarding the description and type of the picture
			Add learning concept maps and links related to the previously studied material
2	Teaching Material	2	It's acceptable and feasible to be applied
			The teaching materials arranged are appropriate and have a mathematical power structure
		3	Examples of questions and discussions should be reconsidered related to solving everyday problems
3	Mathematical PowerTest Questions	2	Eligible and applicable
			The preparation of the questions is acceptable, and following the learning objectives
		3	The questions that have been made are appropriate and eligible for use

4. Implementation

The implementation stage was conducted after experts and content had validated the mathematics learning web, and material improvements were based on the results of the validation assessment. Then, the web was implemented to research subjects. At this stage, web-based mathematics learning teaching materials are enforced strictly around research topics. Students were asked to open the mathematics learning web on each of the links provided. A question of mathematical power accompanies each teaching material. After studying materials through the learning web, students work on the questions that have been provided and then submit them online through the web.

5. Evaluation

In the final stage, the researchers assessed the development results of the web design stage and student's mathematical abilities. The results of this evaluation were conducted with the final design stage. The design obtained used the same design stage because it follows the curriculum and student's power to understand the web content. The following are the results of the evaluation of the use of the mathematics learning web:

Table2. Analysis of Web-Based Mathematics Learning Development

No	Web Development Aspect	Average Score	Keterangan
1	Web media display	3,64	Very Good
2	Web usability	3,20	Good
3	Web setup	3,38	Good
4	Web benefits	3,82	Very Good
5	Learning material content	3,46	Good
6	Web language and communication	3,72	Very Good

The student's mathematical ability evaluation results were obtained through pretest and post-test scores. Student's mathematical power were increased by calculating a gain score of 0.62 with moderate criteria. Based on the analysis results, the Web-Based Mathematics Learning can improve student's mathematical power.

Web-Based Mathematics Learning which was developed as a series of mathematics learning designed in such a way that students' mathematical power can be involved in learning. Abdurrahman (2015) in his research revealed that mathematics learning we that have met the valid, practical, and effective criteria can be effective in developing students' mathematics learning achievement. Suanah (2019) explains that the integration of technology in learning Mathematics has several positive impacts, including technology can improve learning outcomes, can increase teaching effectiveness and can develop conceptual understanding, so that it can provide many benefits and conveniences in learning activities. Shearer (Munir, 2017) reveals that digital learning actually contributes quantitatively to teaching and learning interactions.

CONCLUSION

The conclusions from the research are as follows (1) A Web-Based Mathematics Learning developed to increase valid mathematical power for junior high school students. The validator states that the learning web is feasible and meets the valid criteria of content, construct, and language; (2) Web-Based Mathematics Learning meets the practical criteria in its usefulness by achieving good responses from the student; and (3) there is an increase in student's mathematical ability with moderate criteria after learning on the Web-Based Mathematics Learning.

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