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Development of A Digital Learning Platform to Improve Math Problem Solving Skills

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Abstract: Mathematical problem solving skills are not only limited to the ability to work on routine or algorithmic problems, but also include the ability to solve non-routine problems, which require creativity, logic, and more complex thinking strategies. The researcher's findings that students' mathematical problem solving skills are very low can be seen from learning documents and the use of learning media that tends to be conventional. This research aims to develop a digital learning platform to improve students' math problem solving at MTsN 1 Pesawaran. This research is a development research using the ADDIE approach model, the research sample used amounted to 30 students who will be observed using 20 items of assessment instruments to determine the problem solving ability of students. Data analysis in this study used the N-Gain formula to determine the effectiveness of the development of digital learning platforms. The results of the study can be concluded that the digital learning platform obtained 100% significant results with very effective interpretation on students' math problem solving at MTsN 1 Pesawaran. The development and selection of mathematics learning instructional design to improve students' mathematical problem solving is achieved very effectively.

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Introduction

Problem solving ability is one of the learning objectives of mathematics that must be achieved by students found in the Regulation of the Minister of National Education No. 22 of 2006 (Utami & Wutsqa, 2017). Problem solving ability refers to a person's effort to achieve a goal because they do not have an automatic solution that can immediately solve the problem. A problem has a goal, which is what the problem solver is trying to get to achieve the goal. (Burton, 1980) says that problem solving is an individual or small group activity that is most efficient when done cooperatively with free opportunities for discussion.

Problem solving ability is a skill or potential in students so that they can solve problems and can apply them in everyday life (Gunantara, Suarjana, & Riastini, 2014). Problem solving ability is a basic ability in the learning process (Suryani, 2020). This means that problem-solving ability is the key for students to improve higher-level thinking skills. Problem-solving skills are indeed very important for students to improve higher-order thinking skills. According to Bloom's Taxonomy, this high-level thinking ability is related to the three main categories in the higher taxonomy, namely analysis, synthesis and creation.

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Problem solving in mathematics is a high-level mental process that involves cognitive abilities to solve complex problems. Where by learning problem solving in the learning process, it will allow students to think more critically in investigating problems, thus making students better at responding to and solving a problem. Then learners can apply this mathematical problem solving ability in solving problems in mathematics learning, other learning, and in solving problems in everyday life. (Nunung Khafidotul Layali, 2020). However, many problems occur regarding students' mathematical solution skills. As seen in the achievement of students' mathematics learning achievement in Indonesia which is still low. The ability of Indonesian students is still dominant in the low level (Alamsyah, 2018). In learning mathematics, basically someone is inseparable from problems because the success or failure of a person in mathematics is marked by the ability to solve the problems he faces.

The mathematical ability of Indonesian students is still far below the international median, no Indonesian students reach the advanced standard, for high levels only achieved by 2%, while the intermediate level is 15% and cumulatively the mathematical ability of Indonesian students reaches a low level as much as 43% of grade 8 students. One of the factors causing this is the inappropriate orientation of mathematics learning in schools (Nurrahman, 2016).

Mathematical problem solving skills are important for students to do in order to provide positive value to students' intellectuals in developing mathematical problem solving skills which are basic demands that must be mastered by students. This means that students need to be trained and accustomed to solving mathematical problem solving problems. (Darmawan Harefa, 2021). The way that can be done to improve students' problem solving skills is by practicing problems regularly with varied problems, understanding basic concepts, improving problem analysis skills, and applying problem solving strategies.

Mathematics education has a very important role in equipping students with critical and analytical thinking skills, as well as the ability to solve problems. Mathematical problem-solving skills are not only useful in academic contexts, but also in everyday life that requires logic and structured thinking skills. However, reality shows that many learners still experience difficulties in mastering these skills, one of which is caused by the lack of effective and interesting learning methods. In agreement with this statement Suryani, (2020) suggests that the low mathematical problem solving ability of students causes students to be less able to solve non-routine problems and students still lack the ability to develop their ideas and abilities. This means that problem solving ability is an important agenda for teachers to develop ideas, creativity and high-level thinking in students.

Mathematical problem solving skills are not only limited to the ability to work on routine or algorithmic problems, but also include the ability to solve non-routine problems, which require creativity, logic, and more complex thinking strategies. However, the reality shows that many students have difficulty in dealing with these non-routine problems. This is due to a lack of idea development and critical thinking skills, as well as a reliance on familiar solution patterns. As a result, many learners find it difficult when faced with problems that do not follow the patterns they have learned.

This low problem-solving ability is a serious challenge in the world of mathematics education. In addition, this also affects the ability of students to develop mathematical concepts that are more abstract and applicable. One of the factors that contribute to this low ability is the learning approach that tends to be conventional, where most of the time is spent

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working on routine problems and does not provide opportunities for students to think more creatively.

Based on the results of interviews with mathematics teachers at MTsN 1 Pesawaran, it was found that there were still many students who had difficulty in solving math problems. This is caused by a lack of understanding of basic mathematical concepts, namely there are still many students who make mistakes in performing basic arithmetic operations such as addition, subtraction, multiplication and division which can hinder understanding of social arithmetic material.

In response, educational technologies such as online learning platforms are being used as one of the solutions. These platforms offer various types of materials and practice problems that are more interactive, and provide opportunities for learners to practice independently at a pace that can be adjusted to their abilities. However, although online platforms can offer various advantages, their effectiveness in improving mathematics problem solving skills, especially non-routine problems, still needs to be further evaluated. Thus, it is important to know whether these platforms can help learners develop their problem-solving skills, especially in the context of problems that require creativity and deeper thinking strategies.

The emergence of online learning platforms is a promising alternative in improving the quality of education, especially in mathematics learning. Research conducted by Muna, (2015) suggests that the use of information technology in education is an extraordinary breakthrough and technology-based learning systems can increase innovation in learning in the current era of globalization.

Online learning platforms provide flexibility in time and place, and can provide various types of learning resources that are interactive and easily accessible. However, despite their widespread use, the efficacy of these platforms in improving mathematical problem-solving skills remains questionable. There are various factors that influence its effectiveness, ranging from the quality of the materials provided, interactivity, to the way of delivery that can be tailored to the individual needs of learners. Previous studies have shown that the use of online learning platforms has the potential to increase learners' motivation to learn, but not necessarily to directly improve math problem-solving skills. Factors such as instructional design, content quality, level of learner engagement, and the way these platforms teach math problem-solving strategies strongly influence the results achieved.

In accordance with the results of research conducted by Aziz (2021) Technology plays an important role for students in participating in online learning, various platforms are used in online learning. Various positive responses were conveyed by students regarding online learning. besides that, teachers and parents are also no less instrumental in providing support and guidance to children's learning efforts. Teachers' competencies and skills must continue to be enriched, supported by school policies that encourage teachers to continue learning. Related parties also need to evaluate the online learning so that learning objectives can be achieved optimally. Based on this description, this research aims to develop problem-solving products using online media platforms as a solution to the problems faced by students at MTsN 1 Pesawaran.

Methods

This research is a research and development study, the approach used in this study is to use the ADDIE approach developed by Dick and Carry to design learning systems

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(Endang, 2012). The research was conducted at MTsN 1 Pesawaran involving 30 class VIII students and involving 3 experts to validate the product, namely material experts, design experts, and media experts. Data collection techniques researchers use pretest and posttest observation techniques, and interviews. To determine the effectiveness of the development of researchers analyzing data using the N-Gain formula.

Research Results And Discussion

Research Results

The ADDIE approach design used by researchers in solving students' math problem solving problems is carried out in accordance with the ADDIE development stages, namely as follows: Analysis, at the initial stage the researcher analyzes the initial needs of students' mathematical problem solving learning problems, the initial analysis shows that students have low problem solving skills, the main issue found in most students is the low problem solving skills Many students still have difficulty identifying the right steps to solve problems, or even feel inhibited in understanding the basic concepts needed to solve these problems. They tend to rely on patterns or formulas that have been taught without being able to develop more flexible problem-solving strategies. Lack of development of higher-order thinking skills. Based on Bloom's Taxonomy, mathematical problem solving requires learners to not only remember formulas or procedures, but also to be able to think critically, analyze problems in depth, and come up with creative solutions. However, most learners show limited higher-order thinking skills, both in terms of problem analysis and in the ability to make decisions or evaluate existing solutions. Lack of practice in creative and analytical problem solving is a major barrier to the development of these skills. Reliance on conventional learning models where the focus of learning is only on memorizing formulas and mechanistic procedures that cause this approach does not encourage students to think independently, creatively and critically. Based on the needs analysis pattern, researchers design learning by utilizing media as a platform for students' mathematical problem solving.

The Design Stage, is the determination of learning objectives that will be addressed at this stage researchers design development products in the form of digital-based teaching modules that direct the entire learning process and ensure all activities carried out have measurable goals. The appearance of the development product is as follows:

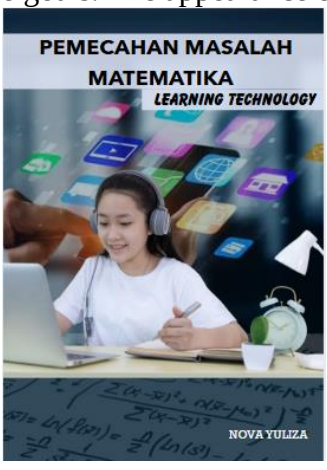

Figure 1. Front Cover Picture & Back Cover

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The development stage of the development stage is the product testing stage carried out by the validation experts involved in this study, namely material experts, media experts and design experts, as for the recapitulation of the results of expert assessments based on expert assessment indicators, as follows:

Table 1 recapitulation of expert assessment

No	Validation Expert	Assessment Score	Criteria Validation
1	Material Expert	94,0	Very Valid
2	Media Expert	82,3	Very Valid
3	Design Expert	77,3	Valid
Total		**253,6**	
Average		**84,5**	**Very Valid**

Source: data processed 2025

Based on the validation expert assessment, it was found that the average overall assessment of the expert obtained the validation criteria "Very Valid" with a score of 84.5% with input and suggestions for improvement provided by the corrected expert, so it can be concluded that the digital learning platform can be used to be implemented in the research sample.

Furthermore, the Implementation stage. At this stage the researchers carried out the implementation activities at MTsN 1 Pesawaran by involving 30 respondents as research samples. The implementation stage was carried out to find out the sample response before and after using the digital learning platform to find out the problem solving ability of students. At this stage the researcher used an observation sheet with a scale of very good (5), good (4), sufficient (3), less good (2) and very poor (1). On the observation sheet the researcher used 20 question items. At the implementation stage, researchers implemented the scheme 4 times a meeting. Namely as follows:

Meeting I

At the first meeting, the researcher analyzed the needs of students by applying conventional learning methods using mathematics textbooks, then at the first meeting the researcher made observations (pretest) to students to determine the problem solving abilities of students.

Meeting II

In the second meeting, the researcher introduced and used the math digital learning platform. In the implementation of learning, students are required to use and interpret during the learning process.

Meeting III

In the third meeting, students explore math problem solving using the digital learning platform.

Meeting IV

On the fourth meeting, students present the results of their exploration of mathematical problem solving using the digital learning platform module, along with the teacher observing students using an observation sheet (posttest). Furthermore, to determine the effectiveness of digital learning platforms to improve students' problem solving, the following are the results of the development effectiveness test results

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Table 2 effectiveness test results

No	Learners	Pretest	Posttest	Ngain Persen	Criteria
1	Learners 1	38	89	82.26	Highly Effective
2	Learners 2	37	95	92.06	Highly Effective
3	Learners 3	40	90	83.33	Highly Effective
4	Learners 4	42	90	82.76	Highly Effective
5	Learners 5	51	92	83.67	Highly Effective
6	Learners 6	38	90	83.87	Highly Effective
7	Learners 7	43	89	80.70	Highly Effective
8	Learners 8	39	98	96.72	Highly Effective
9	Learners 9	38	93	88.71	Highly Effective
10	Learners 10	41	92	86.44	Highly Effective
11	Learners 11	49	87	74.51	Highly Effective
12	Learners 12	41	93	88.14	Highly Effective
13	Learners 13	37	95	92.06	Highly Effective
14	Learners 14	39	95	91.80	Highly Effective
15	Learners 15	37	98	96.83	Highly Effective
16	Learners 16	38	90	83.87	Highly Effective
17	Learners 17	40	92	86.67	Highly Effective
18	Learners 18	39	88	80.33	Highly Effective
19	Learners 19	39	92	86.89	Highly Effective
20	Learners 20	39	96	93.44	Highly Effective
21	Learners 21	37	94	90.48	Highly Effective
22	Learners 22	40	94	90.00	Highly Effective
23	Learners 23	39	91	85.25	Highly Effective
24	Learners 24	40	93	88.33	Highly Effective
25	Learners 25	47	92	84.91	Highly Effective
26	Learners 26	40	93	88.33	Highly Effective
27	Learners 27	42	98	96.55	Highly Effective
28	Learners 28	38	91	85.48	Highly Effective
29	Learners 29	35	91	86.15	Highly Effective
30	Learners 30	38	96	93.55	Highly Effective

Source: implementation activity document (attached)

Based on the observation assessment conducted by the researcher, it is known that 30 students have a very significant problem solving ability with a score of 100% indicating that the digital learning platform has a significant impact on the mathematical problem solving ability of students at MTsN 1 Pesawaran.

The last stage of development is the evaluation stage, at the evaluation stage researchers make improvements to development products in accordance with the suggestions and input from material experts, media experts and design experts, suggestions such as using observation sheets in assessment techniques have been implemented, then bringing up

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HOTS-based problem solving problems is also applied by researchers to development products.

Discussion

The 21st century is referred to as the century of knowledge, the century of knowledge-based economy, the century of information technology, globalization, industrial revolution 4.0, and so on (Redhana, 2019). The century that everyone knows as the century of knowledge is the main foundation for various aspects of life (Kurnia, 2015). Various organizations try to formulate various kinds of competencies and skills needed in facing the 21st century (Zubaidah, 2016). Sugiyarti, (2018) stated that in formal schools, learning has been required to apply 4C (Critical Thinking, Communication, Collaboration, Creativity) abilities. Critical thinking is the ability of students to think critically in the form of reasoning, expressing, analyzing, and solving problems. (Palennari, 2021) As the massive advancement in the 21st century, the role of education is to prepare generations in mastering the skills they need to face challenges arising in their era (Husamah, 2018).

Mathematics has an important role in all aspects of life, especially in improving human thinking, so that mathematics is one of the subjects required at every school level starting from the elementary level to the university level. According to Abdurrahman (2003) and Sumartini (2016) "Mathematics is a symbolic language whose practical function is to express quantitative and spatial relationships while its function is to facilitate thinking".

The National council of teachers og mathematics (NTCM, 2000) suggests that the implementation of mathematics learning in schools, teachers must pay attention to five mathematical abilities, namely: connection, reasoning, communication, problem solving, and representation. Therefore, teachers have a very important role in fostering mathematical problem solving skills in students both in the form of learning methods used, as well as in evaluation in the form of making supporting questions.

In the implementation of learning, teachers not only apply the methods used to support students' mathematical problem solving skills, teachers must also be able to consider what media or learning tools are used. Learner characteristics must be considered in great detail in conceptualizing learning and learning so that learning objectives can be achieved completely, especially with regard to the goal of achieving problem solving in mathematics learning.

Linking learning methods and tools is very relevant especially with the development of information and communication technology today. Especially linking digital media in the learning process will have a significant impact on achieving learning objectives. as stated by Bates, (2005); Jewwit, (2006); Buckingham, (2013); Lin & Hwang, (2019) and Fanny, (2019). Utilizing technology can be an effective way to deliver material in the learning process.

Furthermore, the use of online learning platforms makes it easier for students to achieve the desired goals, the results of the study prove that the digital learning platform obtained significant results with very effective interpretation on students' mathematical problem solving at MTsN 1 Pesawaran. This means that the development and selection of instructional design for mathematics learning to improve students' mathematical problem solving is achieved very effectively. The development results also highlight the objectives of developing a digital learning platform to improve mathematical problem solving skills for learners, namely improving problem solving skills by providing learners with the opportunity

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to practice and develop abilities in solving various types of mathematical problems systematically and effectively, the provision of interactive and interesting learning materials helps learners understand mathematical concepts in a more interesting way. The platform also provides immediate feedback on learners' answers, so they can understand the mistakes they make and correct them to improve their understanding.

As stated by Via (2015). Learners' problem solving skills can be improved through intensive practice. Furthermore, learning activities with online learning allow students to learn more relaxed in addition to fostering responsibility and learning independence. In line with Sutisna's opinion (2016) online learning can increase learning independence.

Conclusions

The results of the study can be concluded that the digital learning platform obtained significant results with very effective interpretation on students' math problem solving at MTsN 1 Pesawaran. This means that the development and selection of instructional design for mathematics learning to improve students' mathematical problem solving is achieved very effectively.

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