Development Of Project Based Learning (PjBL) Assistant Macromedia Flash Assistance To Improve Mathematic Problem Solving Ability And Student's Independence

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Abstract. The purpose of this study is to determine: (1) the validity, practicability, and efficacy of learning tools. (2)PjBL-based learning tools with macromedia flash can help pupils enhance their mathematical problem-solving abilities. (3)PjBL-based learning tools with macromedia flash can help pupils gain independence. This study is a development study that employs the 4-D Thiagaradjan development paradigm. (1) The learning aids produced were pronounced valid, practicable, and effective for use in improving students' mathematical problem solving abilities at SMPN 30 Medan. (2)Improving the mathematical problem-solving ability of students at SMPN 30 Medan who were taught utilising PjBL tools. It was reported via macromedia flash that there was an increase from Trial 1 to Trial 2, as seen by the N-gain in Trial 1 of 0.37, increasing to 0.56 in Trial 2. (3)Improving kids' ability to learn independently. The average student learning independence in the first trial was 80.13 with a standard deviation of 9.82, and in the second trial it was 85.31 with a standard deviation of 11.42.

Keywords: *PJBL Model, Learning Tools, Problem Solving Ability, Independent Learning*

1 . Introduction .

According to PERMENDIKNAS No. 22 of 2006, the mathematics topic taught in Junior High Schools (SMP)/Madrasah Tsanawiyah (MTs) aims to develop the following skills in students: (1) Using reasoning on patterns and properties, performing mathematical manipulations in making generalisations, assembling evidence, or explaining mathematical ideas and statements, (2) Using reasoning on patterns and properties, explaining the relationship between concepts, and (3) Applying concepts or algorithms in a flexible, accurate, and appropriate way when applying concepts or algorithms to problem solving [1] .

One of the mathematics skills that has to be improved is problem solving. Because it enables students to practise using their prior knowledge and abilities to solve non-routine problems both during the learning process and after it is complete, problem solving is an essential part of the mathematics curriculum [2] .

AISTEEL 2022, September 20, Medan, Indonesia

DOI 10.4108/eai.20-9-2022.2324700

Problem resolution, in the opinion of Surya and Harahap [3], is a high-level mental process requiring a more intricate reasoning process. Problem solving is one of the high-level cognitive abilities that enables pupils to gain knowledge and skills [4]. Because problem-solving abilities are the cornerstone of studying mathematics, students must possess them. Additionally, problem solving is a crucial skill in learning mathematics because mathematics is one of the components of issue solving.

The reality on the ground, however, contradicts these notions. When students are solving problems, they still struggle to understand the core of the problem, struggle to express what is known and asked when solving the problem, are careless when performing arithmetic operations, and fail to draw conclusions from the problem because they cannot comprehend the topic being asked in the question.[5] According to students, the challenging and frightening nature of mathematics can also contribute to their poor problem-solving abilities.[6] SMP Negeri 30 Medan also has a low problem-solving capacity. The researchers administered a diagnostic test to 16 pupils in class VIII-1 at SMP Negeri 30 Medan to determine the mathematical problem-solving skills of students. Four questions make up the test. Based on the outcomes of the test answers, the majority of the students were unable to work on the questions. Nobody is qualified to respond to the researcher's questions. despite the fact that the subject of the problem—namely, building space—has been studied. Only two of the sixteen students were able to offer a solution to the issue; however, a calculation error prevented 14 students from offering a workaround.

Along with the significance of mathematical problem-solving abilities, students' attitudes toward learning mathematics are also important. One such attitude is the independent learner, also regarded vital. Independent learning is a learning process in which anyone, with or without the assistance of others, can take the initiative in matters that determine learning activities such as developing learning objectives, educational resources (in the form of people or materials), diagnosing educational needs, and controlling the learning process. themselves [7] . Students require independent learning so that they can organise themselves and become self-disciplined [8]. Furthermore, Haryanti believes that independent learning is one of the affective skills that kids must possess [8]. As a result, even if they are pursuing distant learning, students must take responsibility for themselves. Independent learning is an educational activity carried out by individuals in their own time, without the assistance of others, as an increase in their knowledge, abilities, or development of their accomplishments; they determine and oversee their own teaching methods, schedules, and utilisation of various educational resources. [9]

The truth is that junior high school (SMP) mathematics teachers rarely give growing student numbers the attention they deserve learning independence in mathematics. Inability to study independently Mathematics for junior high students is a significant issue in mathematics education. According to allegations, student participation in learning and the learning environment are less conducive because the learning model used is less enjoyable.

According to the researcher's observations, mathematical problem solving skills and independent learning students are lacking because teacher-designed mathematics does not encourage student participation in interacting with teachers and other students. The teacher must arrange and plan good and mature preparations in order to improve math problem solving skills and independent learning students. One kind of gadget is a learning one preparation that must be prepared by the teacher. Learning tools are items that must be prepared by the teacher prior to learning.

As a result, we require a suitable learning activity to increase mathematical reasoning abilities and student autonomy in learning, including the use of study tools. Learning tools are essential for teachers because: (1) they provide recommendations on what a teacher should do in the classroom. Assist in the development of instructional strategies. (2) As a benchmark, learning tools must be evaluated by a trained instructor. To improve, professionals must analyse their learning tools. This is critical for increasing a teacher's professionalism. (3) Learning tools as a medium for increasing professionalism, namely, a teacher's professionalism can be improved with learning tools, implying that learning devices are not enhanced with learning tools, implying that learning tools are not only as administrative completeness, but as a medium for increasing professionalism.

Teacher difficulties discovered at SMP Negeri 30 Medan indicate that the mathematics teacher's preparation of learning instruments in the school is inadequate. The tools employed and how they were arranged did not actively engage students, hence the indicator of problem solving abilities was not achieved. This is evidenced by the teacher's failure to employ the learning model during the learning process. Teachers exclusively employ scientific methods. The teacher does not carry out all steps of utilising a scientific method while learning. For instance, students rarely ask questions while they are learning.

In addition to using learning tools, teachers must focus on using learning models in order to improve students' problem-solving abilities. One of the learning strategies developed to improve problem-solving abilities is the project-based learning (PjBL) model. Purnomo [11] claims that Pj BL is a cutting-edge teaching strategy that encourages contextual learning through challenging assignments. PjBL requires students to be able to select themes and presentation/product projects, create final products, and solve real-world problems while involving many disciplines. Students' learning motivation rose as a result of PBL [12] .

Aside from selecting a learning technique or learning model that is consistent with the mathematical learning process, selecting the appropriate supplementary media is also critical. One method is to use macromedia flash media. Macromedia flash is a tool used to make animated logos, movies, interactive menus, interactive icon fields, e-cards, screen servers, and site development websites, as well as developing other website applications [13]. Macromedia Flash, according to Masykur [14], is a multimedia platform and programme that may be used to view, play, and run Adobe Flash Player-compatible animation, games, and internet-enrichment applications. The use of macromedia flash as a media learning technique, beneficial to teachers in producing teaching materials and organising learning. This media can also stimulate students' minds so that they can alter concepts and discover the true form of abstract mathematical concepts.

However, throughout the learning process, teachers continue to underutilize technology in the mathematical learning process. In practise, the teacher does not create opportunities for pupils to construct their own mathematical concepts during the learning process; instead, they simply copy what the teacher does. Furthermore, pupils are not given the opportunity to articulate and create their own ideas when answering the teacher's practise questions [15]. Mayasari [16] emphasised that activities consistently carried out by teachers continue to use ordinary learning, resulting in pupils becoming increasingly passive. Furthermore, the provision of media in schools is limited, with only a few media and mathematical teaching tools available.

This also occurred at SMP Negeri 30 Medan, where the teacher did not build learning media by employing existing software on the computer while students were learning mathematics.

Whereas, in order to face the globalisation period and welcome the free market era, it is required to master the development of learning technology,particularly in the form of interactive CDs.

2. Research Method

This is a development study that departs from the Thiagarajan Paradigm (Thiagarajan, Semmel 1974) by creating a learning device based on the PjBL model and aided by macromedia flash. This study will take place at SMP Negeri 30 Medan during the academic year 2021–2022, the even semester. Class VIII students from SMP Negeri 30 Medan served as the study's subjects, while the study's research tool was a model-based learning tool built on the PjBL paradigm and supported by Macromedia Flash. In this work, learning tools are developed using the modified Thiagarajan 4-D development paradigm (define, design, develop, and disseminate). The research school's topic teachers' discussion forum serves as the distribution stage's sole audience. As learning aids, a Learning Implementation Plan (RPP), Student Books, LKPD, research instruments in the form of examinations of students' capacity to solve mathematical problems, student response sheets, and validation sheets were created.
Research methods and data collection techniques were put together to evaluate the validity, viability, and effectiveness of the creation of learning tools based on the PjBL paradigm and helped by macromedia flash. The validity of the instrument utilised in this study was evaluated using the learning device validity sheet, which also includes the RPP validation sheet, Student Book, LKPD, and student mathematical problem solving ability test sheets. The feasibility of the instrument utilised in this study was evaluated using the observation sheet on learning implementation. Four learning effectiveness indicators are used to evaluate the efficiency of teaching tools: (1) mastery of mathematical problem-solving abilities if at least 80% of students receive a score of 2.66 or at least a B on the mathematical problem-solving ability test; (2) efficient learning time; (3) positive student responses to learning.

3. Results and Discussion.

3.1. Development of Learning Tool Validation Results

Based on the validation results for each learning device component, "valid" is defined as having an average value of 3.59, 3.71, 3.65, 3.83, and 3.81. According to the expert team's notes, even though the components of the learning tools developed have met the validity criteria, there are still a number of issues that need to be fixed, including the use of language, writing or typing, and displaying images that must adhere to clearly defined conditions. As a result, with a small adjustment notice, this learning device has satisfied the requirements for validity in the "valid" category, according to the expert team's notes.

3.2. Development of Practical Results of Learning Devices

Validity is not the only requirement for good learning aids; practicality is also required. In this study, two practical indicators were determined: the reaction of a team of experts or validators stating that the learning device could be utilised with minor adjustments and the implementation of learning devices in the IO criteria = *3.86 good.*

3.3. Development of Learning Device Effectiveness Results

Effectiveness, in addition to practicality, is required for good learning tools. The success of student learning mastery, the teacher's ability to manage learning, and the teacher's capacity to manage learning all received an average of 4, 4 or in the "good" category in this study. and the average of student responses to learning was 84.38%.

a. **Problem Solving Ability Test Achievement**

It is possible to draw the conclusion that the learning tools have satisfied the effectiveness criteria, indicating that they are already effective for use in learning, based on the results of individual and classical student learning mastery. Table 1 displays the degree of classical completion of the second trial's final mathematical problem-solving test.

Table 1 . Results of Classical Completeness Analysis on Trial II

Category	**Mathematical Problem Solving Ability**	
	Total students	**Percentage**
Complete	14	87.5%
Not Complete	2	12.5%
Amount	1	100%

Table 1 shows that in the second trial, the conventional completeness of the final test of students' ability to solve mathematical problems was 87.5%. As a result, it can be concluded that in the second experiment, the development of learning aids based on the PjBL model and aided by macromedia flash met the criteria for gaining classical mastery.

b. **Ideal Time Achievement**

According to the findings of the analysis of the achievement of the ideal percentage of time for student activities at each meeting for the I and II trials in employing learning tools, there was a significant increase in activity. Table 2 shows a description of the average student observation outcomes in the second trial .

Table 2 . Analysis of the Percentage of Success in the Student's Ideal Period Activities Results

Meeting	**Percentage of Achievement of Student Activity Ideal Time for Indicator (%)**					
	1	**2**	**3**	**4**	**5**	**6**
I	20.5	27.6	25	15.3	8.33	2.78
II	23.4	26.4	27.8	12.5	6.94	2.78
III	22.3	26.4	27.8	13.9	8.33	1.39
Average	22.07	26.8	26.87	13.9	7.78	2.32

According to the findings of the analysis, the average percentage of students' desired time of achievement for three sessions in learning is 22.07%, 26.8%, 26.87%, 13.9%, 7.78%, and 2.32%. According to the results above, student activity has reached the percentage of achieving the ideal time. Based on the six indicators above, the percentage of student activity is still on the threshold of the percentage of achieving the ideal time or the tolerance interval of a predetermined time category.

c. **Student Response**

Student responses to learning and learning tools include both good and negative responses. Positive reactions are distinguished by expressions such as "glad," "new," and "engaged in the components of the problem-based learning device." Negative remarks include phrases like "not happy," "not new," and "not interested in using the components of the learning gadget." Analysis of the data revealed that the student replies to all areas, particularly learning tools, such as student opinions on learning components such as student books, student activity sheets, and student learning outcomes assessments, above 80%, or 84.38%. This implies that students respond positively to every component, and the learning device is changed based on student feedback.

3.4. Improved Troubleshooting Ability

The results of the first and second trials of the problem-solving ability test revealed an improvement in the students' ability to solve mathematical problems. It was found that students' spatial ability had increased based on the average normalised gain with the criteria of "medium" with a score of 0.37 (N-Gain 0,3) in the first trial and an increase in the average value of Gain with the criteria of "moderate" with a score of 0.56 (0.3 N-Gain 0,7) in the second trial. As a result, it is possible to conclude that this designed learning tool can increase students' problem-solving abilities .

3.5. Improving Student Learning Independence

Learning independence skills among students improved between the first and second trials, according to the questionnaire analysis results. In the first trial, the average student learning independence was 80.13, with a standard deviation of 9.82; in the second trial, it was 85.31, with a standard deviation of 11.42.

4. Conclusion

Students at SMP Negeri 30 Medan found that learning resources in the form of RPPs, Student Books, and LKPDs that were produced using Project-Based Learning and Macromedia Flash were legitimate, relevant, and effective for enhancing their mathematical problem-solving skills.

The N-gain in Trial 1 of 0.37 grew to 0.56 on Trial 2, demonstrating an improvement in the students' mathematical problem-solving skills at SMP Negeri 30 Medan who were taught utilising Project Based Learning-based learning tools with assistance from Adobe Flash.

enhancing children's capacity for autonomous learning. In the first trial, the average student learning independence was 80.13, with a standard deviation of 9.82; in the second trial, it was 85.31, with a standard deviation of 11.42.

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