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Development of PBL-Based Worksheets with the Alef Education Platform to Improve Mathematical Reasoning and Independent Learning Skills in Islamic Junior High School Students

Nurhasana. A. L. Sirait[1], KMS Muhammad Amin Fauzi[2], Hasratuddin[3]

[1,2,3] Postgraduate Mathematics Education Study Program, Medan State University
Jl. William Iskandar Ps. V, Kenangan Baru, Deli Serdang, Sumatera Utara, Indonesia

[*] nurhasanasirait@gmail.com

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Abstrak

Tujuan penelitian ini untuk menentukan kevalidan, kepraktisan, dan keefektifan lembar kerja peserta didik (LKPD) berbasis PBL berbantuan platform alef education, peningkatan kemampuan penalaran matematis siswa, dan peningkatan kemandirian belajar siswa. Jenis penelitian yang digunakan adalah research and development, model pengembangan yang digunakan adalah model pembelajaran Thiagarajan, Semmel yaitu model 4-D. Penelitian dilakukan di kelas VII MTsN Toba Samosir, sampel penelitian sebanyak 30 siswa. Hasil penelitian diperoleh bahwa LKPD yang dikembangkan dinyatakan valid, praktis dan efektif, peningkatan kemampuan penalaran dan kemandirian belajar siswa yang belajar menggunakan LKPD yang dikembangkan dengan model PBL berbantuan Platform Alef Education dilihat dari n-gain dinyatakan meningkat. Untuk itu, PBL dengan menggunakan LKPD dengan berbantuan platform alef education dapat menjadi alternatif pembelajaran matematika pada siswa kelas VII.

***Kata Kunci**: Kemampuan Penalaran Matematis, Kemandirian Belajar, Platform Pendidikan Alef, Problem Based Learning*

Abstract

The purpose of this study was to determine the validity, practicality, and effectiveness of student worksheets (LKPD) based on PBL assisted by the Alef Education platform, improving students' mathematical reasoning skills, and improving students' learning independence. The type of research used is research and development, the development model used is the Thiagarajan, Semmel learning model, namely the 4-D model. The study was conducted in class VII MTsN Toba Samosir, the research sample was 30 students. The results of the study showed that the LKPD developed was declared valid, practical and effective, the increase in reasoning skills and learning independence of students who learned using LKPD developed with the PBL model assisted by the Alef Education Platform seen from the n-gain was stated to have increased. For this reason, PBL using LKPD assisted by the Alef Education platform can be an alternative for learning mathematics for class VII students.

Keywords: Mathematical Reasoning Ability, Learning Independence, Alef Education Platform, Problem Based Learning.

A. Introduction

Mathematics emphasizes more on the world of ratios or reasoning, not emphasizing the results of experiments or observation results, mathematics is also formed because of human thought related to ideas, processes, and reasoning. The National Council of Teacher Mathematics (NCTM, 2020) states that learning mathematics is a process of teaching students to have the ability to think mathematically and have basic mathematical knowledge and skills, where the process includes problem solving, reasoning and proof, communication, connections, and representation. Reasoning is a process of thinking to draw conclusions. Mathematics learning has five reasoning, namely problem solving, reasoning and proof, communication, connection, and representation. According to (Khoerunnisa, Putri, 2020), mathematical reasoning skills are important for students to have because with these abilities, students can analyze every problem that arises, can solve problems correctly, can assess something critically and objectively, and can express their opinions and ideas sequentially and logically in mathematics learning.

The average accomplishment results of Indonesian participants in TIMSS 2011 (Rosnawati, 2018) showed that 17% of Indonesian pupils scored poorly in the cognitive domain at the reasoning level. Jihad and Haris describe students' mathematical reasoning abilities as being able to submit conjectures, perform mathematical manipulations, draw conclusions, compile evidence, provide reasons or evidence for the solution, draw conclusions from statements, check the validity of an argument, and find patterns or properties of mathematical phenomena. Mathematical aptitude helps pupils comprehend that learning is not only memorizing but also comprehension so they can better grasp the subject matter. Indonesian students are still poor mathematicians. (Hewi, La., Shaleh, 2020) reported that Indonesian students scored 375 in the 2012 PISA maths test. Indonesia had an average maths score of 386 in 2015 and 379 in 2018. A lack of knowledge and pupils' remarkable capacity to work on topics by applying mathematics to daily life lowered Indonesia's PISA score.

(Rosalina, 2018) noted that contextual reasoning in PISA questions on change and relationships requires students to think about different concepts to solve difficulties. Thus, each student solves problems differently. (Hendriana, 2018) found that many pupils still answer level 1 PISA questions incorrectly. Student capacity to tackle PISA questions on change and relationships is still poor, and they are not accustomed to addressing real-world issues. According to this research, MTS students' thinking ability is poor. MTS is junior high school-level formal education. Official education is organized by the government. The particular MTS objectives—(1) educating students to utilize reasoning to solve reasoning problems—led to the choice of MTS research. (2) connecting academic learning to real-life situations via questions.

Mathematics should be taught in schools because of daily life issues and curriculum changes in Indonesia. Indonesia has changed its curriculum. The current curriculum balances spiritual

and social perspectives, and schools in Indonesia organize learning activities to promote students' attitudes, knowledge, and abilities. Education is intended to foster independence. Independence is doing something and being responsible (Dewi, 2018). Learning independence is one approach to using independence. Learning independence is a crucial student attitude. According to (Rahayu, I. F., & Aini, 2021), learning independence is an active and constructive process in which learners set learning goals and try to monitor, regulate, and control their cognition, motivation, and behavior, which are guided and limited by their goals and environmental context. According to (Islahiyah et al., 2021), learning independence is when someone chooses their own instructional materials, time, location, and learning resources. Someone with high learning independence can prepare, implement, and evaluate their own learning activities. In fact, most students do not like autonomous study. (Lubis, S.D., Surya, E., dan Minarni, 2015) stated that a learning system that does not encourage students to actively seek knowledge can lead to low learning independence. According to (Kotto, M. A., Babys, U., dan Gella, 2022), low student activity is caused by the use of information discussion learning methods, where the teacher delivers the material and students only receive it. The results of observations at MTSN Toba Samosir show that student reasoning and independence still need to be improved. The following observation questions are used.

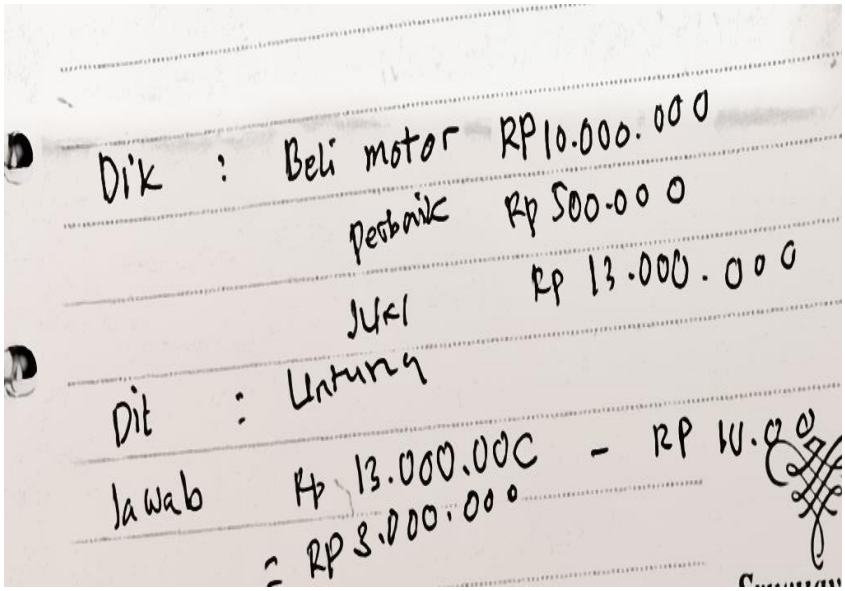

Figure 1. Example of Student Errors

Based on Figure 1, the observation test of students' reasoning ability shows that out of a total of 28 students who took the test, only 2 students (7.14%) had achieved learning completion, while 26 students (92.86%) had not achieved learning completion. This shows that the class has not achieved the target of student completion classically, even though one of the goals of current mathematics learning is to improve students' reasoning in solving problems.

Lack of learning freedom contributes to inferior reasoning. Thus, this issue must be resolved. Creating a Student Worksheet may help students improve their thinking. The created LKPD must work. Actively arranging and finding information and knowledge improves learning. (Clara, Aldila, 2017) found that mathematics LKPD in schools has not maximized kids' capacity and creativity in math. (Fitri, 2020) say 21st-century learning must be flexible. However, teacher-centered learning persists. Students become docile, monotonous, and bored because of this. Student Worksheet (LKPD) innovation is needed. The results of observations showed that some students in the class did not pay attention to the teacher while learning, were late in collecting assignments, did not complete practice assignments at home, made excuses to go to the toilet, and used the maximum amount of c. These conditions suggest poor student learning motivation and independence. Learning involves more than just mathematical thinking. Student attitudes are also important. (Slameto., 2010) defines independence as doing anything without being told. Student independence without parental or instructor pressure to focus on questions. Independent means doing something without being forced to.

Interviews with mathematics instructors at MTS Toba Samosir showed that pupils' reasoning and independent skills required development. This was because pupils were passive, didn't grasp the questions, and professors utilized standard approaches and less innovative LKPD utilizing the Alef Education Platform. The only learning medium instructors utilized were school textbooks. Based on these issues, instructors must design learning activities. Innovations include a Student Worksheet (LKPD).

Teachers and the government must work together to enhance Indonesian education. Teachers must plan and execute appropriate learning. Developing a more relevant, entertaining, and science- and technology-based learning approach. Teachers may promote student reasoning and independence by creating a Student Worksheet (LKPD) and using the correct learning model. The Problem-Based Learning (PBL) Model meets government curricular requirements. According to (Syamsidah, 2018), Problem-Based Learning is an innovative learning model that is new and different from conservative, conventional, and all student-based learning models. It requires student active learning. Students only copy instructors in the traditional learning approach because they think teachers must teach the complete content. PBL also concentrates pupils on genuine issues that must be solved in groups using methodical and scientific methods.

Technology may be utilized to give mathematics learning resources to increase students' mathematical reasoning instead of PBL. Technology has made PBL easier by increasing access to learning materials, facilitating online student communication, and documenting learning results. The fast evolution of mathematics learning must match pupils' rising capacity to detect links, patterns, and qualities. To grasp excellent mathematics problems by seeing evidence from each This is logic. According to (Turmudi., 2010), reasoning ability is a brain habit, as is

employing context, reasoning, and evidence in basic mathematics. The fast growth of Science and Technology (IPTEK) requires people resources who can endure, overcome, and confront this. If more human resources gave up and thought it tough, that would be highly concerning. Researchers will employ learning media to assist pupils improve science, technology, and problem-solving abilities.

According to the opinion of (Arsyad, 2015) states that learning media selection is founded on the idea that it is part of the instructional system. Alef Education Platform is a manipulative learning tool. Alef Education Platform is a technology-based learning material that students may access anytime, anywhere. (Nurzazili., Irma, A., Rahmi, 2018) found that this platform increases learning. The Alef Education Platform is supposed to aid classroom learning as an interactive learning platform that enhances students' thinking. Alef Education Platform is a learning medium in this study to apply LKPD learning. According to the description, the researcher wants to investigate "Development of PBL-based LKPD assisted by the Alef Education Platform to Improve Reasoning Skills and Learning Independence of MTSN Toba Samosir Students".

B. Research Method

Research and development is the sort of research that is used, and the development model that is utilized is the Thiagarajan and Semmel learning model, specifically the 4-D model (which stands for define, design, develop, and disseminate) (Sugiyono, 2018). MTsN Toba Samosir, which can be found in Jalan Aek Batu, Saribu Village, Raja Janji Maria Tampubolon District, Toba Samosir Regency, North Sumatra Province, was the location where this study was carried out. It was during the odd semester of the 2024/2025 school year that this study was finally carried out. The participants in this research were students who were enrolled in the eighth grade at MTsN Toba Samosir during the academic year 2024/2025. There are thirty pupils in each of the classes that are being taught. At the same time, the purpose of this study is to evaluate the extent to which the PBL model, with the assistance of the Alef Education platform, has contributed to an improvement in students' ability to reason and their level of independence in learning social arithmetic content. RPP, LKPD, reasoning ability exams, and student learning independence are the tools that are used in the study methodology. Following is a list of the phases that may be noticed in the development of Thiagarajan:

Define

A requirements analysis is performed at the step known as "define." In the context of the creation of the LKPD utilizing the Alef Education Platform, the term "needs analysis" refers to the process of producing, analyzing, and collecting information about the model that is required for its development.

Design

The purpose of this design stage is to design the development of the PBL model with the assistance of the Alef Education Platform in order to create a prototype, which is an example of learning devices. During this stage of the design process, the outcomes are referred to as draft 1. Among the educational resources that will be developed are the Learning Implementation Plan (RPP), Student Worksheets, and Student Learning Independence Questionnaires.

Develop

As part of the development stage, the goal is to create high-quality final gadgets that may be used in educational endeavours. During the first draft, the learning devices and research instruments are evaluated by professionals. Following this, the mathematical reasoning test instruments and learning independence surveys are tested on sample classes.

Disseminate

This is the last step, which is the dissemination stage. At this point, the stage is considered to be the stage of extensive distribution. At this point, the researcher will, on a restricted basis, discuss the findings of the creation of LKPD with the PBL learning model that was aided by the Alef Education platform with students who are enrolled in MTsN Toba Samosir.

C. Result and Discussion

Data analysis and research results obtained at each stage of development are presented as follows:

Define

According to observations of the learning model at MTsN Toba Samosir, instructors' learning devices had various shortcomings, which indirectly caused inadequate mathematical reasoning abilities and student learning independence. Teacher-centred learning resulted in less active student learning due to learning technologies. Judging by the RPP, its preparation did not meet student demands, resulting in a suboptimal learning design. Teachers utilized LKPD to assist teaching and learning activities, but they primarily used textbook questions, which did not engage students.

Design

From this stage is designing learning devices, so that a prototype (example of learning devices) is obtained for PBL-based social arithmetic that is developed. Activities at this stage are compiling tests, selecting data, selecting media, selecting formats and initial design of learning devices. There are images of the development product which can be seen in the image below:

Figure 2. Student Worksheet

Development

The validators who validated the developed learning devices consisted of 5 people, including 3 UNIMED mathematics education lecturers, 2 teachers.

Table 1. Recapitulation of Learning Device Validation Results by Experts

No	Objects assessed	Average total validation value	Validation Level
1.	Learning Implementation Plan	4,37	Valid
2.	Student Book	4,33	Valid
3.	Student Worksheet (LKPD)	4,32	Valid
4.	Reasoning Ability Test	4,20	Valid
5.	Students' Mathematical Independence	4,40	Valid

Based on Table 1, the average total validity of the learning device is in the interval: $3 \leq Va < 4$. Based on the validity criteria, it can be said that the learning device developed is "Valid". Based on the learning implementation criteria, it can be concluded that the implementation of the learning device at the first meeting has a learning implementation level at the IO = 4.5, high criteria ($4 \leq IP < 5$). In general, in this Trial, it has a learning implementation level of IO = 4.5, high. Thus, the learning device has met the empirical practical criteria.

The critical thinking ability test is carried out once at the beginning before the learning activity begins, which is called the Pre-Test and once at the end of learning after carrying out two teaching and learning meetings, which is called the Post-Test. The purpose of the Pre-Test and Post-Test is to determine the increase in students' reasoning abilities obtained by students after being given social arithmetic learning treatment. The trial data can be seen in Table 2. Below.

Table 2. Level of Completion of Pre-Test and Post-Test of Students' Mathematical Reasoning Thinking Ability in Trial II

No	Interval	Mathematical Reasoning Ability				Description
		Number of Students		Percentage		
		Pretest	*Posttest*	*PreTest*	*PostTest*	
1	$TKPM < 55$	25	1	96%	*4%*	Less
2.	$55 \leq TKPM < 70$	0	1	0%	4%	Enough
3.	$70 \leq TKPM < 85$	1	22	4%	85%	Good
4.	$85 \leq TKPM \leq 100$	0	2	0%	8%	Very Good

Based on Table 2 above, it is obtained that there are still students who get scores in the less category, namely 25 students (96%) in the pretest and there are students who get scores in the good category in the pretest 1 student (4%), there are no students who get scores in the sufficient and very good categories. In the posttest it becomes 1 student (4%). While for the less category, there are 1 person in the sufficient category (4%), as many as 22 (85%) in the good category, and 2 students (8%) in the very good category.

Analysis of Student Learning Completion Results in a Classical Way Student Learning Independence

If categorized based on the level of student mastery, then the level of mastery of student learning independence in the pretest and posttest results of trial II can be seen in the following table:

Table 3. Level of Mastery of Student Learning Independence Pretest and Posttest Results

No	Value Interval	Number of Students	Percentage	Number of Students	Percentage	Category Value
1	85<SKBS≤100	0	0%	0	0%	High
2	70<SKBS≤85	0	0%	25	96%	Medium
3	55<SKBS≤70	16	62%	1	4%	Fair
4	0<SKBS≤55	10	38%	0	0%	Low

In table 3, it is obtained that in the pretest there were 10 students (62%) who got the low category, 16 students (62%) got the sufficient category, and there were no medium and high categories. However, in the posttest there were no low and high categories, 1 student (4%) got the sufficient category, and 25 students (96%) got the moderate category.

Diseminate

During the course of the trial, the final device is acquired after the requirements for validity and effectiveness have been satisfied. The next step is to carry out limited distribution, which will be done in the form of distributing the final device to the MGMP forum at MTSN Samosir. This will be marked by the submission of learning devices to the MGMP forum. The hope is that mathematics teachers who are members of the forum will be able to use the learning device in subsequent learning. Immediately after the delivery of the completed product, the most

important stage is to provide the findings of the development to the full population that is participating in this research.

Discussion

Research shows that students' improved reasoning ability and learning independence at MTsN Toba Samosir, TOBA Regency, are closely linked to their thoroughness in solving mathematical problems in the Student Worksheets (LKPD). Students' mathematical reasoning ability is affected by internal and external elements, including their own volition and learning independence. A previous study shows that learning independence impacts accomplishment; hence, student performance affects math learning. To master math, students must be self-motivated and practice often. LKPD and the Problem-Based Learning learning approach improve students' mathematical thinking and learning independence in this research.

The proposed LKPD includes practice questions, contextual issues stated progressively and concisely at each step based on the Problem-Based Learning approach, and mathematical reasoning indicators. (Fitri, 2020) found that PBL improves mathematical thinking, supporting this LKPD. The designed LKPD motivates pupils to solve arithmetic problems successfully. In this research, students' mathematical reasoning abilities and learning independence increased. The Problem-Based Learning model and learning independence are related in the learning process. Problem-based learning works best when students have solid reasoning abilities that make arithmetic problems easy to solve. (Winandyaz, 2021) lists three PBL model features. Students don't just listen and take notes in the PBL model; they solve issues and use scientific thinking to solve them. Thinking, reasoning, and working mathematically include student-teacher collaboration in a learning setting.

D. Conclusion

We present several conclusions based on the analysis and discussion in this study. Student Worksheets (LKPD) developed with the Problem-Based Learning learning model assisted by the Alef Education Platform are declared valid, practical, and effective and can be used to improve students' reasoning skills and learning independence at MTsN Toba Samosir, Toba Samosir Regency. Student Worksheets (LKPD) developed with the Problem-Based Learning learning model assisted by the Alef Education Platform are declared practical and can be used to improve students' reasoning skills and learning independence at MTsN Toba Samosir, Toba Samosir Regency. The increase in students' reasoning skills and learning independence at MTsN Toba Samosir, Toba Samosir Regency, which is taught using the Student Worksheets (LKPD) developed with the Problem-Based Learning model assisted by the Alef Education Platform, seen from the n-gain, is stated to have increased from trial I to trial II.

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