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Development of Learning Tools Based on the Think Pair Share Learning Model to Improve Metacognition Abilities of Junior High School 4 Panyabungan.

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ABSTRACT

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This study aims to describe the validity, usability, and efficacy of learning tools based on the Think-Pair-Share learning model, the improvement of students' mathematical metacognition and mathematical communication skills through the use of the developed learning tools, and the process of students' answers to questions pertaining to mathematical metacognition and communication skills. Based on the findings of the research's analysis and discussion, the following conclusions are drawn: (1) Experts gave the Think Pair Share learning device model an average rating of validity: The Mathematical Metacognition Ability Test (TKMM) is valid for each item with a reliability value of 0.818 (very high) for the pretest and 0.830 (very high) for the post-test, and the Mathematical Communication Skills Test (TKKM) is valid for each item with reliability values of 0.825 and 0.861, respectively. (2) The Think Pair Share learning gadget model passes practicality criteria based on observational outcomes of learning implementation. Trial I's "poorly implemented" score of 2.93 did not meet research success requirements. After multiple changes, trial II's learning implementation observation score reached 3.62 (the "well implemented" category). (3) The Think Pair Share learning model device met effectiveness criteria, including: (1) 66.67% (20 students) in trial I and 86.67% (26 students) in trial II; (2) 53.33% (16 students) in trial I and 90.00% (27 students) in trial II; (3) 91.33% and 97.50 average student responses in trials I and II (criteria a). (4) Students' mathematical metacognitive abilities improve in all aspects. The normalized gain index revealed a 0.42 rise in value for "medium" criterion in trial I and 0.52 in trial II ($0.3 < \text{N-Gain} \leq 0.7$). Thus, the Think Pair Share-based learning tool improves students' mathematical metacognition.

A. INTRODUCTION

Education enables all individuals to realize their full potential. A national curriculum is mandated by Article 1 of Chapter I of Law No. 20 of 2003 on the National Education System of Indonesia. Education is a learning environment and process in which students actively cultivate religious and spiritual fortitude, self-control, personality, intelligence, noble morals, and skills necessary for themselves, society, nation, and state. Education is the most important aspect of human existence, according to Alpian et al. at 2019, so every Indonesian has the right to receive it and is expected to continue developing in it. Education never ends and enhances an individual's capacity to live and live life. One of the sciences associated to national advancement is mathematics. Mathematics is a universal science that underpins modern technology, is crucial in many fields, and improves human reasoning, according to Hasratuddin Math is required from primary to college (Hasratuddin, 2014).

Due to the intricacy of its learning objectives, mathematics is studied over a very long and continuous period of time, and its function in the world of education appears to be of considerable relevance. Therefore, efforts must be made to enhance the quality and efficacy of education, particularly mathematics. The quality of instruction falls short. The findings of international tests of student achievement, notably in mathematics, show that the standard of education in Indonesia is generally poor. This shows that Indonesian kids continue to face problems with maths. According to Abdurrahman at 2012, mathematics is the most difficult subject for all children, including those with cognitive challenges. Numerous hurdles that have a detrimental impact on student progress are typically brought about by the vast number of pupils at all educational levels who find mathematics tough (Ma'atus Sholekah et al., 2017).

Teachers are a profession that requires professionalism in their instruction in order to facilitate learning. Article 20 letter (a) of Law No. 14 of 2005 concerning instructors and Lecturers requires instructors to organize learning, implement a high-quality learning process, and measure and evaluate learning outcomes. Professionalism is required for an effective and productive educational environment. In addition to serving as examples or role models for students, instructors play a significant role in the learning process as administrators of learning. The success of a learning process is dependant on the teaching skills of the teacher, who seeks to reinvent learning in order to ensure its success. Implementation and assessment follow planning. In the classroom, learning aids are utilised to facilitate instruction and learning activities. According to Trianto at 2009 Learning implementation plans, student workbooks, evaluation instruments or learning outcome assessments, learning media, and student handbooks are essential classroom management tools. The most fundamental elements that must be employed in the classroom are learning aids (Trisandi, 2021).

The significance of learning tools is to support the implementation of effective and efficient learning in order to create an environment/atmosphere conducive to student learning in order to improve student learning outcomes, generate student interest in learning, provide students with opportunities for practise, and assist students with problem-solving. Instruments for learning are one of the variables that determine the efficacy of education, as well as one of the variables that instructors must consider and possess. Examples of mathematics study instruments include RPP, LKPD, and student volumes.

According to Minister of National Education Regulation No. 41 of 2007, a Learning Implementation Plan (RPP) is a learning plan established utilising the curriculum to direct students' learning activities in order to attain essential skills. The RPP describes the instructor's plans for promoting learning activities. Therefore, the instructor can maintain the setting, allowing pupils to focus on self-directed learning. As a guide for an educator to implement the learning process, the RPP must be complete and able to describe the prevailing conditions. However, many SMP Negeri 4 Paneri teachers continue to suffer with the creation of lesson plans. According to the results of interviews with mathematics instructors, he still had difficulties designing lesson plans that would improve students' interest in and motivation to learn mathematics since they did not correlate to the personalities of the students.

To accomplish the specified learning results, instructional materials must be designed. According to Chonga (Fitriani et al., 2016), the application of context-specific LKPD can boost students' comprehension of linked concepts. Student Worksheets (LKPD) are defined as printed teaching resources in the form of paper pages that provide information, summaries, and instructions for implementing learning tasks that students are required to complete in relation to the required Basic Competencies (KD). Student Worksheets (LKPD) are a factor that influences educational attainment and should be required by all instructors.

When LKPD is used as a learning medium with more practise questions, students will have more opportunity to be imaginative and interested in the learning process. This can assist kids in growing habituated to exercising their independent learning talents. The LKPD also aids educators with the teaching and learning process, which may need detailed explanations of the subject to be delivered.

The following are the educational texts for students. In regulation number 11 of 2005 (Isga, 2016)published by the Ministry of National Education, it is stipulated that textbooks must incorporate information geared to cultivate students' religiosity, character, and individuality. In accordance with this, Trianto (Trisandi, 2021) states that student books serve as a guide for students' learning activities, which comprise lesson material, investigative activities based on concepts and activities, information, and daily application examples of lessons. The qualities for an excellent textbook are dependability and correctness. According to Akbar (2013: 34), a good textbook is: (1) accurate, (2) relevant, (3) communicative, (4) complete and systematic, (5) student-centered, (6) aligned with the nation's and state's ideology, (7) language rules are correct, and (8) readable; textbooks with high readability contain sentence length and structure based on the reader's comprehension. In actuality, however, the outcomes of field observations by researchers are not yet fully fulfilled. Because they continue to focus mostly on content summaries and routine queries, present books cannot provide a full comprehension of the subject. The accompanying explanation reveals that Panyabungan State Middle School has inadequate instructional resources.

In accordance with the Graduate Competency Standards for primary and secondary education levels specified in Regulation No. 54 of 2013 issued by the Minister of Education and Culture, mathematics majors are expected to possess graduate competency skills including factual, conceptual, procedural, and metacognitive knowledge. This demonstrates that metacognitive knowledge is a curriculum requirement for SMP/MTS in 2013.

Metacognition refers to a person's knowledge, awareness, and control over their mental processes and consequences. Metacognition is one factor that can influence a person's mathematical problem-solving ability. Consequently, attempts to introduce metacognition to students in the context of solving mathematical problems are either extremely limited or largely ignored. Metacognition is a facet of knowledge and skills that warrants further study, particularly in the context of mathematics learning. A student's capacity to solve mathematical problems may depend on his awareness of his prior knowledge and metacognitive skills.

Livingston at 1997 (Aliyah & Sugiarto, 2016) defines metacognition as an advanced level of cognition characterised by the active regulation of cognitive processes during learning. Metacognitive problem-solving abilities, especially in mathematics, impact both the learning process and student achievement. Utilising metacognition during the learning process will aid students in retaining information for memory and comprehension. According to Schonfeld and De Corte (Kaune, 2006: 350), metacognition is necessary for enhancing mathematical thought and learning. In addition, Wang et al. in Kaune, 2006 (Fitria et al., 2016) state that "metacognition ranks highly in terms of its influence on learning achievement," indicating that metacognition plays an essential role in achieving student learning outcomes. In addition, Lucangeli and Cornoldi in Desoete et al., 2001, p. 435 (Fitria et al., 2016) asserted that metacognition is essential for gaining a deeper comprehension of mathematics performance.

If they possess metacognitive skills, students will be able to control their actions. Concentration improves the outcomes of cognitive tasks. When students can regulate their cognitive processes, they will seek out appropriate problem-solving strategies, thereby enhancing their learning's effectiveness and efficiency. Metacognition, the process of reflecting on one's own cognitive processes, is essential to the development of problem-solving strategies. Teachers must be able to maximize their students' mathematical learning potential by utilizing their metacognitive skills. Flavell (Iwai, 2011) states that "Metacognition is active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive object or data on which they bear, usually in the service of some concrete goal or objective" . Students will be able to regulate their behavior if they possess metacognitive skills.

Yanty Putri Nasution et al., (Tabitha Wulansari et al., 2022) conducted a study titled "Students' Metacognitive Analysis in Solving Integral Problems"; the study's findings indicated that the metacognition of class XII multimedia students remained in the middle range. Zulfikar's research shows that the four metacognitive aspects, namely the awareness aspect, the cognitive strategy aspect, the planning aspect, and the checking aspect, received average student responses of 2.90, 2.74, 2.95, and 2.90, respectively, and were supported by the results of the questions and interviews. In solving mathematics problems, eighth-grade students at SMP N 16 Kupang demonstrate competent metacognitive strategy skills (Zulfikar, 2019).

According to data from the field, the mathematical metacognitive skills of students remains inadequate. The SMP Negeri 4 Panabungan observations support this conclusion. Develop an area with level sides. The following metacognitive topics are discussed: A gold business has a secret chamber where all of the gold for sale is stored. A cube-shaped storage cabinet measuring 1.2 by 0.8 by 2 metres is concealed in the chamber. The cabinet will be filled with 20-centimeter-long, 10-centimeter-wide, and 5-centimeter-tall gold ingots. The store's proprietor will stock the complete cabinet with gold bars.

How many gold bullion ingots must the merchant stock?
What is understood and researched about the topic?
What method is utilised to resolve the issue?
What is the procedure for locating a solution, and what are the outcomes?
How many gold bullion ingots must the merchant stock?
This is an example of a student's response to a question on a diagnostic test for mathematical metacognition.
It is impossible to monitor the resolution of a problem.
not reviewing and interpreting received responses
Compositional defects in the query that are readily apparent

The responses of the students suggest that they were incapable of answering the presented mathematical metacognitive ability queries. Students are incapable of documenting their knowledge and posing pertinent queries; consequently, they are unable to formulate suitable problem-solving strategies. Students do not control and monitor their metacognitive processes when responding to the provided queries; as a result, they are unaware of the structures associated with procedural issues. Consequently, students cannot solve the provided problems. On the basis of diagnostic tests administered to 32 students, it appeared that only 14 students (40%) understood the problem, 3 students (9.38%) were capable of planning problem solving, 2 students (6.25%) were capable of executing problem solving, and only 1 student (3.13%) could verify again. According to the aforementioned results, there is still a substantial number of students who are unable to comprehend the problems of the inquiries, such as what is known and what is being addressed. Students have a tendency to formulate a solution plan and execute calculations/settlements without double-checking their work, resulting in numerous errors. To solve the problem presented above, students must first demonstrate an understanding of it by documenting their knowledge and posing queries within the problem, which will facilitate the next phase of problem solving. In order to accurately solve the metacognition problem, the student must comprehend and investigate the relationship between one procedure and another. According to the conclusion, students continue to lack adequate mathematical metacognitive abilities.

This is consistent with Wellman's (Chairani, 2015) claim that metacognition is a type of cognition, namely a high-level cognitive process involving the active control of cognitive activities. Metacognition is a person's awareness of their own awareness. This is consistent with Khun's (Nugroho & Dwijayanti, 2016) definition of metacognition as the awareness and administration of a person's cognitive processes and outcomes, or the simple act of thinking about thinking.

In addition to metacognition, students must be able to verbally and in writing communicate mathematical concepts. In the United States, the National Council of Teachers of Mathematics or NCTM (Hasratuddin, 2014) recommends mathematical communication skills as one of the five fundamental skills for acquiring mathematics. (1) problem-solving skills, (2) communication skills, (3) connection skills, (4) reasoning and evidence skills (reason and proof), and (5) the capacity to represent ideas. The 2006 mathematics curriculum of the Ministry of National Education includes the following learning objectives: (1) connections between mathematical concepts and their application to problem solving; (2) reasoning; (3) problem solving; (4) communication and representation; and (5) affective factors. Both documents highlight mathematical communication abilities as a strategic talent.

Communication expected during the learning process is effective communication that facilitates instruction and learning. Effective communication consists of shared meaning and comprehension. The keys to effective communication are transparency, active listening, and a comprehensive understanding. Students will lack the ability to communicate mathematical concepts if they are not actively engaged in mathematics learning. In addition to imparting information (transmitting knowledge), It is the responsibility of the teacher to motivate students to learn so they can construct their own knowledge. Essential for assisting students in establishing relationships between abstract language and mathematical symbols is the early growth of mathematical communication skills.

Students at SMP Negeri 4 Panyabungan do not develop mathematical communication skills and lack the self-assurance to articulate their own problem-solving comprehension. Students' inability to apply and communicate concepts to real-world problems is hindered by their tendency to memorise them without understanding them. Hariyanto (Deswita et al., 2018) indicated that "students' Mathematical communication skills among students are still inadequate, as they are unable to express a situation or problem using symbols, diagrams, or mathematical models."

Significant numbers of students at SMP Negeri 4 Panyabungan were inactive during the learning process, resulting in an ineffectual environment for teaching and learning. This instructional strategy appears to cultivate a less-than-ideal environment for learning. Consequently, students are ineffective of communicating mathematical concepts. Students are not required to communicate their conclusions verbally and/or in writing for the vast majority of mathematics content. One of them is building a parallel-walled chamber. According to Sumarmo (Turmuzi et al., 2021), with slight modifications becomes: (1)Explaining ideas mathematics into the form of images and expressing everyday events in mathematical symbols and finish it. (2). Explain ideas, situations in written form. (3). Connect images into mathematical ideas. (4). Reading with understanding of a mathematical representation written.

Initial observations at SMP Negeri 4 Panyabungan indicate that students' mathematical communication remains at a low level, based on indicators such as explaining ideas or situations from an image or graph given in their own words in written form (writing), stating a situation with pictures or graphs (drawing), and expressing the situation using mathematical models (Mathematical Expressions). Many eighth-grade students at SMP Negeri 4 Paneribungan had difficulty accomplishing their homework, according to the study's findings.

Recognizing the significance of a learning paradigm in nurturing the development of students' metacognition and mathematical communication skills, it is necessary to engage students actively in the mathematics learning process. This can be achieved by employing an instructional method that encourages students to actively respond to their metacognitive awareness and mathematical communication skills. Based on the antecedent description, the researcher hypothesizes that the Think-Pair-Share (TPS) cooperative learning model can improve students' metacognition and mathematical communication skills during the mathematics learning process.

According to Isjoni Think-Pair Square was developed by Spencer Kagan. This learning model is a development of Think-Pair Share which was developed by Frank Lyman. This technique gives students the opportunity to work alone and collaborate with others. This technique can be used in all subjects and for all age levels of students (Silviriyanti, 2019). Think-Pair-Share is a teaching method that was developed as a result of research on cooperative learning and leisure time. This technique, which was first described by Frank Lyman and his colleagues at the University of Maryland in 1985, is an effective method for modifying pupil behavior in the classroom. According to Arend Think-Pair-Share is an effective technique for altering classroom discussion patterns. Assuming that all recitations and discussions require organization to maintain class order, Consider-Pair-Share procedures can give students more time to consider, respond, answer, and help one another. This Think-Pair-Share model replaces whole-class question-and-answer sessions (Alfahmi, 2014). It is anticipated that through the Think phase of this Think-Pair-Share cooperative learning model, students' metacognitive abilities will develop and improve. The instructor provides students time to reflect and formulate answers based on prior knowledge during the ponder stage. At this point, students consider the provided material and how to devise suitable plans and strategies to solve the presented problems.

"Development of Mathematics Teaching Materials through Think-Pair-Share (TPS) Learning" ((Astriani & Al Dhana, 2020)) This study focuses on Think-Pair-Share (TPS) instructional materials for eighth-grade mathematics. Expert validation results and the accomplishment of valid criteria by five validators determine the validity of instructional materials. The practicability of the product is evaluated based on the results of the instructor's practicality evaluation and observations of learning implementation. This research produces valid and trustworthy mathematics instructional materials and assessment instruments. And research conducted by Nopianty(2018) titled "Development of Teaching Materials Based on a Metacognitive Approach to Improve Mathematical Communication Skills and Learning Independence of Students at SMP Negeri 30 Medan." According to the results of trial one, the devised instructional materials increased mathematical communication skills.

In light of this, Kurnasih and Sani at 2016 (Rivai & Mohamad, 2021) provided the following description of the advantages of the Think-Pair-Share cooperative learning model: This model has many benefits: (1) more chances for students to think, answer, and help one another; (2) the potential to increase student participation in the learning process; (3) more chances for each group member to contribute; (4) simpler and faster group formation; (5) more opportunities for students to interact with one another; and (6) greater student engagement. Because it calls for students to first practice on their own, then collaborate with a partner, and then present their findings to the class, Think-Pair-Share is an active learning paradigm. The Think-Pair-Share paradigm of cooperative learning has been suggested by experts as a means of enhancing students' metacognitive skills.

It is anticipated that employing the Think-Pair-Share model of cooperative learning will increase student engagement and participation in the learning process, thereby increasing student activity, which may lead to enhanced metacognition and mathematical communication skills.

The researcher deems it essential to conduct research titled "Development of Learning Tools Based on the Think-Pair-Share Learning Model to Improve Mathematical Metacognition and Communication Skills of Students at SMP Negeri 4 Panyabungan."

B. RESEARCH METHODS

This study will be of the developmental study variety. Thiagarajan's 4-Dimensional Development Model will be used in this study. This framework includes four distinct phases: definition, design, development, and dissemination. The students of eighth grade during the even semester of the 2022–2023 school year at SMP Negeri 4 Panyabungan completed this study. Students in eighth grade at SMP Negeri 4 Panyabungan in the 2022–2023 school year served as the study's participants, while the study's objects included a set of Teacher's Books (BG), Shiva Books (BS), Sheets Student Activities (LKPD), and a metacognitive ability test based on the think–pair–share learning model.

This research was conducted in two phases, the first of which involved the creation of learning tools based on the think-pair-share learning model. The development of learning tools, including the validity of the learning implementation plan (RPP), the validity of the Student Activity Sheet (LKPD), the validity of the Student Book (BS), the validity of the metacognition ability test, and the validity of the mathematical communication ability test, is accomplished via: (a) Planning and review by experts; (b) Simulation. This is done to assess the viability of the developing learning instruments. The second phase is the implementation of learning aids deemed suitable based on the results of class VIII trials at SMP Negeri 4 Panyabungan.

This study employs Thiagarajan's (4-D) model for learning tool development (Trianto, 2011:190) to examine the evolution of educational resources. The 4-D model was selected because it is systematic and well-suited to the creation of educational resources. The 4D model consists of four stages: definition (Define), design, development, and dissemination (Disseminate). This study's development model is depicted in a nutshell in the next image:

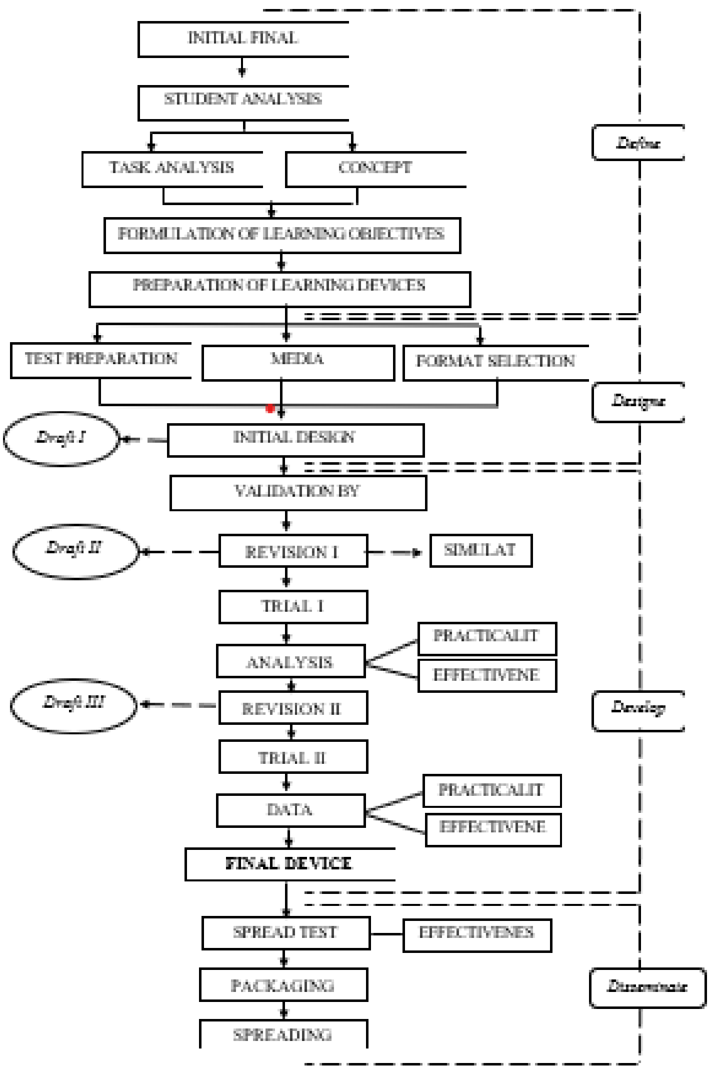

Figure 1.4-D Model Teaching Material Development Chart (Thiagarajan. 1974)

This research employs the following instruments to evaluate the developed learning tools: (1) The learning tool validation document is used to collect information about the quality of the learning tools based on expert evaluations. Validation sheets for Learning Implementation Plans (RPP), Student Books (BS), and Student Activity Sheets (LKPD); (2) the given ability test instrument is a structured description test; and (3) the Mathematical Communication Ability Test Instrument. A description test is used to acquire data to determine the mathematical communication ability of students. The purpose of the mathematical communication ability test is to determine whether or not students have mastered the topic of flat-sided geometric shapes after receiving instructional materials based on the think-pair-share learning model. This research is deemed successful if the instruments and instructional materials developed meet the criteria of validity, usability, and efficacy for encounter-based research. Validity is met when the content and construct validity of the developed teaching materials are satisfactory. Practicality is met if the instructional materials created are straightforward. Effectiveness is achieved when the outcomes of students' lectures after receiving learning materials are based on a problem-solving learning strategy. Developed problem-based learning instructional materials are considered effective if they ≥ 80% Positively consumes 65% of the presented material and satisfies individual learning completion of all test-takers.

This development research makes use of the following instruments: (1) a validation sheet; (2) a sheet for experts and practitioners to assess the usefulness and efficiency of the tool; (3) an observation sheet; (4) a questionnaire for students and teachers; and (5) tests of learning outcomes.

C. RESULTS AND DISCUSSION

Whether or not the problem statement or research question given in the previous section has been answered can be deduced from the information gleaned from the study results. According to the findings of the data analysis:

(1) The developed learning tools are legitimate; The validity test was conducted to identify the flaws in the initial draft of the learning tools, which were created in response to problems in Class 8 of SMP Negeri 4 Panabungan pertaining to fundamental competencies, content, sample questions, and practice questions. Five experts comprise the expert team (validators) involved in developing this instrument. The validation results from the five validators indicated that the learning aids, such as Student Books and Student Worksheets (LKPD), were valid and usable with minor modifications. In addition, the five validators determined that the students' mathematical metacognitive ability test and mathematical communication ability test were valid, with the LKPD's total validity averaging 4.33 and the Student Book's total validity averaging 4.33. The results of testing the mathematical metacognitive ability test instrument on pretest and posttest questions administered to classes not included in the sample demonstrated the validity of the test. The same was discovered during the instrument's reliability test. The test's reliability was 0.818 (very high) and the post-test's was 0.830 (very high) for mathematical metacognitive ability. The mathematical communication aptitude test's reliability results were also 0.94 (very high category). Based on the results of the preceding analysis, it can be concluded that the think-pair-share-based learning tools devised met the validity criteria established by expert/practitioner evaluations.

(2) the developed learning tools are useful; (3) the implementation of learning with the developed learning tools is evaluated from three different vantage points: (a) implementation of learning steps, (b) implementation of the social system, and (c) implementation of management reaction principles with the provided support system. Using the learning tools created in trial I, the average score for observing learning implementation was low. The class met for a total of three times, and the average score for learning implementation was 2.93 ("not well implemented"). This means that the class did not fulfill the success requirements for the usefulness of learning tools. Trial I's learning device fell short of the predetermined usability standards. The next step is to conduct a second trial, known as trial II, this time paying close attention to indicators of unfulfilled practical considerations. Trial 2's implementation of learning was observed and given an average score of 3.62 (category "well implemented"), meaning it successfully met the success criterion for the usability of learning tools.

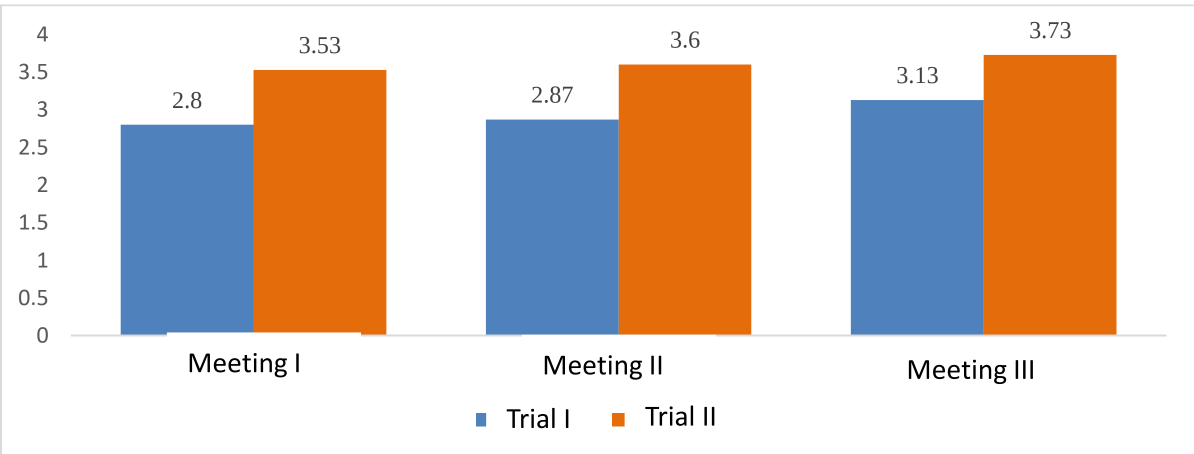

Figure 2.Average learning implementation per meeting

This study's findings suggest that the educational gadget lives up to its promise as a useful tool for education. The resulting educational resources will be useful for both instructors and students.

(3) the developed learning aids are effective; The effectiveness of the devised learning tools is evaluated based on two factors:
(i) Completion of classical education, it was determined, based on the results of posttest analyses of trials I and II, that the mathematical metacognitive abilities of trial I did not satisfy the criteria for classical completion. Mathematical metacognitive abilities are evaluated using essay-formatted evaluations to determine whether or not students' mathematical learning is complete. Trial I's post-test results revealed that the average problem-solving ability of students was 79.17%, while trial II's post-test results revealed that it was 87.50%, meeting the criteria for completeness of classical student learning outcomes.

Figure 3.Classical student learning completeness

According to the traditional criteria for fullness of learning outcomes stated by Trianto (2011), at least 80% of students taking the problem-solving ability test will be able to get a score above basic competence ≥75. This means that pupils' problem-solving skills have reached a level of classical completeness after being tested;

(ii) student responses. This student response data aims to see the extent of interest, feelings of enjoyment, up-to-dateness, and ease of students in understanding the learning tools being developed. After carrying out the post-test, students fill out a student response questionnaire regarding the use of learning tools and the implementation of learning. Student response data was obtained from a questionnaire which was analyzed based on percentages. Data analysis of trials I and II showed that roughly the same percentage of students gave favorable feedback during both. This suggests that students respond favorably to the incorporation of pedagogical aids into their educational experiences. Positive responses to learning (listening, reading, writing, discussing/asking) and negative responses (other unrelated behaviors) can be categorized as the actions/responses carried out by pupils in response to the stimuli in the form of teaching as an activity. Students' willingness to engage in the learning process is reflected in their answers. After completing classroom activities, students responded positively because they were met with feedback and reinforcement tailored to their own traits and preferences.

Figure 4.Student Response to the device

(4) Students' mathematical metacognition improved after being exposed to the designed learning tools. The findings of the pre- and post-tests indicate that the students' use of the learning aids has resulted in an improvement in their mathematical metacognition. Trial I had an average N-Gain of 0.42, putting it in the medium group, and Trial II had an N-Gain of 0.52, again placing it in the middle of the pack.

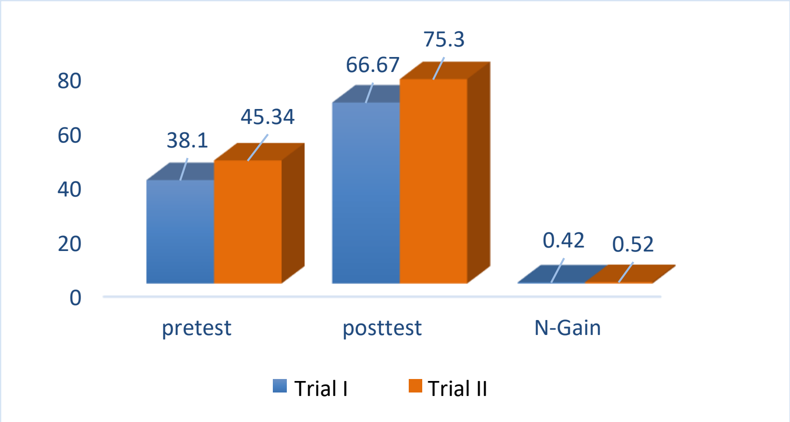

Figure 4. Average Increase in Mathematical Metacognition Ability to Students

The increase in students' mathematical metacognitive abilities can be seen in trials I and II, where the average problem-solving ability on trial I's post-test was 66% and increased to 75% in trial II. In trials I and II, it is evident that students' metacognition of problems has increased.

D. CONCLUSION AND SUGGESTIONS

Based on the findings of the research's analysis and discussion, the following conclusions are drawn: (1) Experts gave the Think Pair Share learning device model an average rating of validity: The Mathematical Metacognition Ability Test (TKMM) is valid for each item with a reliability value of 0.818 (very high) for the pretest and 0.830 (very high) for the post-test, and the Mathematical Communication Skills Test (TKKM) is valid for each item with reliability values of 0.825 and 0.861, respectively. (2) The Think Pair Share learning gadget model passes practicality criteria based on observational outcomes of learning implementation. Trial I's "poorly implemented" score of 2.93 did not meet research success requirements. After multiple changes, trial II's learning implementation observation score reached 3.62 (the "well implemented" category). (3) The Think Pair Share learning model device met effectiveness criteria, including: (1) 66.67% (20 students) in trial I and 86.67% (26 students) in trial II; (2) 53.33% (16 students) in trial I and 90.00% (27 students) in trial II; (3) 91.33% and 97.50 average student responses in trials I and II (criteria a). (4) Students' mathematical metacognitive abilities improve in all aspects. The normalized gain index revealed a 0.42 rise in value for "medium" criterion in trial I and 0.52 in trial II ($0.3 < \text{N-Gain} \leq 0.7$). Thus, the Think Pair Share-based learning tool improves students' mathematical metacognition.

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REFERENCES

Alfahmi, A. M. (2014). PENERAPAN MODEL PEMBELAJARAN KOOPERATIF TIPE TPS (THINK PAIR SHARE) UNTUK MENINGKATKAN HASIL BELAJAR SISWA PADA MATA PELAJARAN IPS DI SEKOLAH DASAR. Jurnal Pendidikan Guru Sekolah Dasar (JPGSD), 01(02), 1–11.

Aliyah, H., & Sugiarto, B. (2016). KETERAMPILAN METAKOGNITIF SISWA DALAM MEMECAHKAN PERMASALAHAN KIMIA MATERI POKOK LAJU REAKSI PADA DOMAIN MENGEVALUASI. Unesa Journal of Chemical Education, 5(2), 212–222.

Astriani, N., & Al Dhana, M. B. (2020). PENGEMBANGAN BAHAN AJAR MATEMATIKA MELALUI PEMBELAJARAN THINK-PAIR-SHARE (TPS). Prosiding Seminar Nasional Multidisiplin Ilmu Universitas Asahan Ke-4 Tahun 2020, 87–93.

Amri, S. dan Ahmadi I. K. 2010. Konstruksi Pengembangan Pembelajaran Penagruhnya Terhadap Mekanisme dan Praktik Kurikulum. Jakarta : Prestasi Pustaka

Chairani, Z. (2015). PERILAKU METAKOGNISI SISWA DALAM PEMECAHAN MASALAH MATEMATIKA. Math Didactic: Jurnal Pendidikan Matematika, 1(3), 200–210.

Deswita, R., Kusumah, Y. S., & Dahlan, J. A. (2018). Peningkatan Kemampuan Komunikasi Matematis Siswa Melalui Model Pembelajaran CORE dengan Pendekatan Scientific. ©Edumatika Jurnal Riset Pendidikan Matematika, 1(1).

Fitria, C., Sujadi, I., & Subanti, S. (2016). ANALISIS KESULITAN METAKOGNISI SISWA DALAM MEMECAHKAN MASALAH SISTEM PERTIDAKSAMAAN LINEAR DUA VARIABEL DITINJAU DARI TIPE KEPRIBADIAN GUARDIAN, ARTISAN, RATIONAL, DAN IDEALIST KELAS X SMKN I JOMBANG. Jurnal Elektronik Pembelajaran Matematika, 4(9), 824–835.

Fitriani, Hasan, M., & Musri. (2016). PENGEMBANGAN LEMBAR KEGIATAN PESERTA DIDIK (LKPD) BERBASIS MASALAH UNTUK MENINGKATKAN PEMAHAMAN KONSEP DAN AKTIVITAS BELAJAR PESERTA DIDIK PADA MATERI LARUTAN PENYANGGA. Jurnal Pendidikan Sains Indonesia, 04(01), 26–42. http://jurnal.unsyiah.ac.id/jpsi

Hasratuddin. (2014). Pembelajaran Matematika Sekarang dan yang akan Datang Berbasis Karakter. Jurnal Didaktik Matematika, 1(2), 30–42.

Isga, S. A. (2016). EFEKTIVITAS PENGELOLAAN BUKU ACUAN PEMBELAJARAN KTSP DI SEKOLAH DASAR NEGERI KECAMATAN SEWON. Jurnal Hanata Widya, 5(8), 58–64.

Iwai, Y. (2011). The Effects of Metacognitive Reading Strategies: Pedagogical Implications for EFL/ESL Teachers. The Reading Matrix, 11(2), 150–159.

Ma'atus Sholekah, L., Anggreini, D., & Waluyo, A. (2017). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Matematika Ditinjau Dari Koneksi Matematis Materi Limit Fungsi. Wacana Akademika Volume, 1(2), 151–164.

Nugroho, A. A., & Dwijayanti, I. (2016). PROSES BERPIKIR MAHASISWA DITINJAU DARI KEMAMPUAN METAKOGNITIF AWAL DALAM PEMECAHAN MASALAH MATEMATIS. JPPM (Jurnal Pendidikan Dan Pemberdayaan Masyarakat), 25–32.

Permendikbud. 2014. Pengembangan Kurikulum 2013. Jakarta: Kemdikbud

Rivai, S., & Mohamad, F. D. (2021). Pengaruh Penggunaan Model Pembelajaran Think Pair Share Pada Terhadap Hasil Belajar Siswa Pada Materi Penyajian Data Kelas IV Sekolah Dasar. Aksara: Jurnal Ilmu Pendidikan Nonformal, 7(2), 695–712. https://doi.org/10.37905/aksara.7.2.685-712.2021

Silviriyanti, D. (2019). Diterbitkan oleh UNITRI PRESS Penerapan Pembelajaran Kooperatif Model Think-Pair-Square (TPS) Untuk Meningkatkan Aktivitas dan Prestasi Belajar Siswa Kelas VIII D Semester II SMP Negeri 20 Malang. INTELIGENSI: Jurnal Ilmu Pendidikan, 1(2), 16–27.

Tabitha Wulansari, K., Rohana, & Marhamah. (2022). Metakognisi Dalam Pemecahan Masalah Matematika Pada Siswa Kelas VIII SMP. MATHEMA JOURNAL E-ISSN, 4(2), 107–117.

Trisandi, Y. P. (2021). Semarang, 11 Agustus 2021 Pengembangan perangkat pembelajaran dengan penemuan terbimbing pada pokok bahasan fungsi kelas VIII. SEMINAR NASIONAL MATEMATIKA DAN PENDIDIKAN MATEMATIKA (6 Th SENATIK) PROGRAM STUDI PENDIDIKAN MATEMATIKA FPMIPATI-UNIVERSITAS PGRI SEMARANG, 187–195.

Turmuzi, M., Wahidaturrahmi, & Kurniawan, E. (2021). Analisis Kemampuan Komunikasi Matematis Mahasiswa pada Materi Geometri. Edumatica Jurnal Pendidikan Matematika, 11(1), 50–61.

Zulfikar, R. N. (2019). Analisis Strategi Metakognitif Siswa Dalam Memecahkan Masalah Matematika. Jurnal Ilmiah Iqra, 13(1), 64–71.