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Enhancing Problem-Solving Skills in Mathematics: Applying LDMAT and SRL for Students with Learning Difficulties

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Abstract

This study examines the effectiveness of the LDMAT and SRL models in improving problem-solving skills in students with learning difficulties in mathematics. The research involved 18 junior high school students and employed a mixed research design. The assessment of problem-solving skills was conducted through pre-test and post-test measurements, consisting of 10 essay-based tests and weekly assignments. Furthermore, problem-solving understanding was assessed based on the strategies utilized by students in the post-test. Data analysis involved using paired t-tests to compare pre-test and post-test results. The findings indicate that applying the LDMAT and SRL models significantly enhanced problem-solving skills in students with learning difficulties in mathematics, particularly among female students. Moreover, the students exhibited an improved understanding of problem-solving procedures. This study underscores the efficacy of the LDMAT and SRL models in enhancing problem-solving abilities and promoting deeper comprehension of problem-solving strategies among students with learning difficulties in mathematics.

Keywords: learning difficulties; LDMAT model; problem-solving; SRL model

I. Introduction

Problem-solving is an important thing that needs attention in learning mathematics (Pambudi et al., 2020). The importance of solving mathematical problems encourages that mathematics must be able to prepare students to face contemporary problems and contribute to the growth and resolution of societal problems in everyday life (Lan et al., 2021; Majeed et al., 2021). Thus, it is unsurprising that problem-solving is the essence of learning mathematics and must become an integral activity in learning mathematics in the classroom.

Mathematical problems are questions that meet the criteria: provide challenges, are solved with non-routine procedures, and are related to everyday contexts. Challenging conditions depend on the abilities of each individual. Solving problems by using non-routine procedures is the main feature of Problem-Solving. Some of the problem-solving strategies used are algebraic manipulation (AM), Making Systematic Lists (MSL), Guessing and Checking (GC), Making Models or Diagrams (MD), Looking for Patterns (LP), Working Backward (WB), Making Tables (MT), Eliminating Possible Situations (EPS), Simplifying Problems (SP), and Logical Reasoning (LR) (Kurniawan et al., 2022).

Problem-solving skills refer to a series of higher-order thinking cognitive activities

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(requiring creative thinking, critical thinking, and decision-making) in which a person tries to find or develop practical solutions to real-life problems by applying the solutions correctly and evaluating the reasonableness of the answers (Simanjuntak et al., 2021; Wanya, 2016). However, the ability of Indonesian students to solve problems still needs improvement (Nur Hasanah & Ilma Indra Putri, 2022). One of the indicators is the low ranking of students' mathematics results from PISA which is shown by Indonesian students only being able to solve questions related to knowledge, understanding, and even application (Meryansumayeka et al., 2021). Mathematical literacy as an indicator of understanding and process in high school students was in the low category (Sari & Wijaya, 2017). The ability to solve questions related to knowledge, understanding, and using formulas is a low-level mathematical ability that needs to be improved to reach the problem-solving skills requiring advanced thinking skills.

Referring to the importance of problem-solving in the mathematics curriculum and the low ability of students towards it, it is very important to focus on learning practices to provide experience and problem-solving skills to all students, including students with learning difficulties. Disability to learning mathematics can be said to be a condition indicated by weak or declining mathematical competence despite having received appropriate mathematics education services (Szucs & Goswami, 2013). One of the mathematical concepts that are often used as an indication of learning disabilities is logical reasoning which is below standard or lower than students in general (Jitendra et al., 2009; Yip et al., 2020). Often, students with learning difficulties in mathematics display difficult-to-calculate behavior, inefficient calculation strategies, and difficulty carrying out several steps to solve problems (Nelson et al., 2022).

Most of the school curricula for students with learning disabilities have been developed to train convergent thinking (Jaben, 1986) due to students' low level of logical reasoning. Therefore, when teachers can provide efficient, well-designed, problem-focused, and beneficial interventions in appropriate learning to overcome obstacles, there will be a proportional increase in understanding and reasoning concepts (Kunwar et al., 2021). Thus, the role of the teacher is to present and choose the right learning strategy needed, significantly to help students with learning difficulties.

Optimizing the teacher's role in helping students in problem-solving activities by applying appropriate learning strategies has been extensively researched before. These studies address the topic: a) learning models or strategies to improve mathematical problem-solving, such as: the application of the REACT model (Nurhasanah & Luritawaty, 2021), the Creative Problem-solving model (Sulaeman et al., 2021), the Problem Posing (Iswara & Sundayana, 2021), or the CORE model (Irawan & Iasha, 2021); b) development of educational products to improve mathematical problem-solving, such as: interactive learning media (Sattriawan et al., 2020), android application-based media (Mahuda et al., 2021), comic media (Gumilang et al., 2019), or multimedia from Macromedia flash (Hodiyanto et al., 2020); and c) thinking analysis of solving mathematical problems through the Newmann procedure (Kania & Arifin, 2018) or Bransford and Stein procedure (Yanti & Syazali, 2016).

In contrast to the research topics above, this study will seek to provide support to students with learning difficulties in mathematics through modification of the Learning Difficulties in Mathematics (LDMAT) model (Žakelj, 2014) and Self-Regulated Learners (Johnson et al., 2021) to help improve mathematical problem-solving. The LDMAT model is considered capable of helping improve students' problem-solving skills because it makes a very positive and significant contribution to improving teaching practice in overcoming students' learning difficulties in mathematics (Žakelj, 2014). Other research shows that students with better self-learning skills tend to have higher academic achievement (Biwer et al., 2021). The SRL approach presents a

promising learning procedure for addressing the comprehensive needs of students with learning difficulties (Johnson et al., 2021). Referring to the findings of these studies, it is quite reasonable to apply LDMAT and SRL in helping students with learning difficulties to improve their problem-solving skills.

The LDMAT model (Žakelj, 2014) was developed based on several principles: a) recognizing the importance of acquiring essential mathematical concepts and procedures for all students, while addressing any difficulties they may encounter and adapting instructional approaches accordingly; b) emphasizing that instruction is a collaborative effort between students and teachers, with shared responsibility; and c) promoting participation as a means to collectively construct education and mathematics, while respecting students' cognitive, social, and emotional needs. Practically, the collaborative creation of mathematics involves expressing mathematical ideas and demonstrating knowledge and comprehension of mathematical concepts, procedures, and their interrelationships. Additionally, this collaborative process also takes into account students' social and emotional requirements. The LDMAT model encompasses two primary pillars: The first focuses on establishing a supportive and safe learning environment. In contrast, the second involves systematic steps for implementing adjustments for students with learning difficulties in mathematics. A stimulating and safe learning environment is fostered through collaborative efforts among students, educators, and parents, providing equal opportunities for all students to contribute to math lessons. Professionals who possess in-depth knowledge of students' cognitive, social, and emotional characteristics, as well as expertise in supporting students with learning difficulties and implementing necessary adaptations, play a key role in creating this environment. Guided by the principle of participation, all students are actively engaged in the learning process, ensuring a meaningful educational experience.

The self-regulated learner model presented by Johnson et al (2021) in their paper was still conceptual. So far, there is no empirical data related to its application, so it is worth trying in this study.

Table 1.
Self-regulated learner conceptual

Component	**Definition**	**Strategies Approach**
Connected	*Connected* is when learners: 1. Feel safe and that they belong; 2. Feels supported to be themselves and are socially aware; 3. Can take the perspective of others; 4. Can develop, manage, and maintain relationships that are healthy and helpful.	a. Intentional planned feedback b. Building in interests c. Communicate routines/ expectations d. Responsive to student needs e. Frequent opportunities to respond
Self-aware	Self-aware students: 1. Understand their strengths and needs as learners; 2. Can self-monitor during the learning task; 3. Understand how their emotions and actions affect themselves and those around them;	a. Rating scales b. Tools to explain emotions c. Video self-reflection d. Models of proficient performance e. Noticing feedback
Self-determined	Self-determined learners: 1. Are self-directed; 2. Make plans and commit to reaching goals; 3. Monitor their progress toward goals; 4. Understand the relationship between short-term and long-term goals.	a. Goal setting/tracking tools b. Choice-making opportunities c. Promoting advocacy
Strategic	Strategic learners: 1. Know how to select and effectively use the appropriate	a. Word problem-solving strategies (schema instruction) b. Use of manipulatives to support

Component	Definition	Strategies Approach
	strategies to reach their learning goals; 2. Create an environment that helps them accomplish their goals.	problem-solving c. Step-by-step guides to monitor work
Resilient	Resilient learners: 1. Are able to recover from disappointment; 2. Can adapt to sources of stress or adversity; 3. Persevere through challenges and setbacks.	a. If-then planning b. Positive emotion building c. Opportunities for success d. Celebratory feedback

The combined theoretical framework of LDMAT (Žakelj, A., 2014) and SRL model (Johnson, E. S., Clohessy, A. B., & Chakravarthy, P., 2021) emphasizes the following principles:a) Supportive and Encouraging Learning Environment: Creating a safe, inclusive, and collaborative learning environment for students, teachers, and parents, with a focus on providing appropriate support for students with learning difficulties in mathematics; b) Participation-Based Learning: Encouraging active participation of all students in the mathematics learning process, allowing them to contribute, express their mathematical thoughts, and share their understanding and strategies; c) Self-Regulation in Learning: Incorporating self-regulation strategies to assist students with learning disabilities and math anxiety, promoting the development of self-regulation skills such as goal setting, progress monitoring, effective learning strategies, and overcoming obstacles; d) Adaptation and Differentiation of Learning: Recognizing the importance of adapting and differentiating learning for students with learning difficulties in mathematics, by identifying individual needs and providing tailored strategies and approaches, and e) Supportive Emotional Environment: Promoting the creation of a supportive emotional environment, understanding the cognitive, social, and emotional characteristics of students with learning difficulties, and providing appropriate support based on their needs.This comprehensive theoretical framework aims to enhance learning experiences and outcomes for students with learning difficulties in mathematics, by fostering an inclusive and supportive learning environment, promoting active participation, developing self-regulation skills, and adapting instruction to meet individual needs.

The procedures or syntax of learning resulting from the integration of the theoretical framework that combines the principles of LDMAT and SRL models can involve the following steps:

Table 2.
Theoretical framework combines the LDMAT model and SRL

Component	Learning Strategies
Creating a Safe and Supportive Learning Environment:	a. Building an inclusive environment that supports collaboration among students, teachers, and parents. b. Providing relevant and diverse resources to support student understanding. c. Implementing a participatory approach where all students have the opportunity to contribute and share their mathematical thoughts.
Adopting a Self-Regulated Learning Approach:	a. Assisting students in developing self-regulation skills by teaching them how to set specific and measurable learning goals. b. Teaching students to monitor their progress and reflect on strengths and areas for improvement. b. Providing effective learning strategies to help students overcome obstacles such as math anxiety.
Adaptation and Differentiation of Learning:	a. Identifying individual student needs and providing appropriate learning adaptations, such as additional materials, more detailed explanations, or alternative learning approaches. b. Providing differentiated instruction based on students' understanding and abilities.
Building a Supportive	a. Understanding the cognitive, social, and emotional characteristics of students with learning difficulties and providing appropriate emotional support.

Component	Learning Strategies
Emotional Environment:	b. Creating a safe and open classroom atmosphere where students feel comfortable sharing their thoughts and asking questions.
Evaluation and Feedback:	a. Conducting regular formative assessments to monitor students' understanding of mathematics and self-regulation. b. Providing constructive and supportive feedback to help students improve their understanding and skills.

Learning objectives related to problem-solving are essential, considering that currently, learning interventions applied to students with learning difficulties in mathematics target more low-level skills, such as remembering facts or only competency with procedures (Marita & Hord, 2017). The ability to remember and solve problems procedurally is categorized as low-order thinking skills because these skills primarily involve recalling and applying factual information or the execution of predetermined steps with little analysis or synthesis of information. Procedural problem-solving skills need more transferability to new situations, limit alternative problem-solving strategies, result in shallow understanding, and hinder real-world application, limiting students' adaptability, critical thinking, and effective problem-solving in complex and non-routine scenarios. On the one hand, learning to solve mathematics for students with learning difficulties in mathematics is also rarely done.

The results of this study seek to close research gaps regarding forms of assistance that teachers can provide to students with learning difficulties in mathematics in problem-solving activities. Based on these problems, the research question is whether the LDMAT and Self-Regulated Learning models can help students with learning difficulties improve their problem-solving abilities.

II. Research Method

Research design

This study is mixed research by combining quantitative and qualitative approaches. Quantitative aspects are carried out using a pre and post-test design to assess the effectiveness and significance of using the LDMAT (Learning Difficulties in Mathematics) & SRL (Self-Regulated Learner) models to improve problem-solving skills in students who have difficulty learning mathematics, both overall students as well as in terms of the gender of students. Improvement in problem-solving skills is also seen in the results of student work on weekly assignments. Meanwhile, the qualitative aspect seeks to examine the description of the results of assignments and Students' Problem-Solving Performance as a result of implementing the LDMAT & SRL model.

This research was conducted in 5 weeks. During this treatment, students are taught about material concepts related to arithmetic. Moreover, their application in mathematical problems while applying the LDMAT and SLR models. Students are given problem-solving strategies: making pictures/diagrams/tables, working backward, guessing, simplifying problems, and logical reasoning, along with examples of questions and exercises to work on independently. Planned delivery of problem-solving strategies is given on a schedule: Week 1: Make pictures/diagrams/tables, week 2: Make pictures/diagrams/tables and work backward; Week 3: Work backward and guess; Week 4: Guess and simplify the problem, and week 5: logical reasoning.

Population and sample

The population in this study were class VII students of SMP N 20 Surakarta and SMP N 15 Purworejo, who were categorized as students with learning difficulties. The population was determined based on the results of numeracy tests (10 items), geometry (10 items), and arithmetic (10 items). Students with scores below the average minus the standard deviation ($\mu - sd$) are categorized as students with learning difficulties.

Based on the scoring results, 8 students (5 boys and 3 girls) were selected from SMP N 20 Surakarta and 10 students (6 boys and 4 girls) from SMPN 15 Purworejo as research samples. The learning treatment is only imposed on these students according to the schedule set by the school.

Research instruments

The pre-test and post-test utilized 10 different essay test items each. This differentiation was implemented to ensure that the post-test outcomes do not merely reflect a repetition of the pre-test, thereby showcasing only mechanistic abilities. Both assessments were equipped with identical indicators, rendering them equivalent instruments. Additionally, the post-test instrument was employed to assess the student's performance in problem-solving skills. Five assignment test items were given every week to ascertain any improvements in problem-solving abilities.

Analytical assessment is used to carry out quantitative studies to obtain and determine test scores for each student. The final test of arithmetic ability has been tested on subjects outside the population. The assessment of 3 experts through an expert judging panel declared the test valid and had a reliability index of $r_{11} = 0.836$.

Holistic assessment is used for qualitative assessment. The holistic assessment of the final test is based on 3 criteria, namely: conceptual understanding (CU), understanding of implementation procedures (PU), and skills in selecting problem-solving strategies (PSS). Each criterion is divided into high, medium, and low categories. The high category is fulfilled if students display an understanding of concepts, an understanding of applying procedures, and select good strategies so that the questions given are correctly resolved. The category is fulfilled if students display an understanding of concepts, an understanding of applying procedures, and select good strategies so that the questions given are correctly resolved. The low category is fulfilled if students display conceptual understanding and understanding of applying procedures and choose poor strategies so that the questions given are not appropriately resolved. Each criterion will be given a score of 1 – 5 in the category of low – low to moderate – moderate – moderate to high – high.

Data Analysis Technique

Using an analytical assessment, quantitative data were obtained from the final arithmetic ability test results. Furthermore, the data were analyzed using paired t-tests. Qualitative data were obtained from the results of 5 assignments, a holistic assessment of the final test of arithmetic abilities, observations, and interviews. The value of the assignment and holistic assessment is presented as descriptive data, which will be strengthened by analyzing observations and interviews conducted on the sample.

III. Results and Discussion

Improved Problem Solving Skills: Arithmetic ability final test results

This study aims to determine whether applying the LDMAT and SRL models can improve the ability to solve mathematical problems in students with learning difficulties. To see this, a pre-test and post-test are given, which will be analyzed further with the t-test. The statistical hypothesis (H0) tested was that there was no increase in mathematical problem-solving abilities after the LDMAT and SLR models were known for students with learning difficulties in mathematics. The results are shown in Table 3.

Tabel 3.
Paired t-test for pre-test and post-test

Descriptive Statistics	Post- test	Pre-test
Mean	50,833	42,222
Variance	150,735	127,124
Observations	18	18
Pearson Correlation	0,836	
Df	17	
t Stat	5,358	
t Critical one-tail	1,740	

Table 3 shows that the value of t_{stat} = 5.358 with t_{tab} = 1.740. These results indicate that H0 is rejected, so it is concluded that there is an increase in mathematical problem-solving

abilities after the LDMAT and SLR models are known for students with learning difficulties in mathematics.

These results show that applying the LDMAT and SRL models is effective in helping students with learning difficulties in mathematics to improve their problem-solving skills. However, the average post-test score (50.833) could be an ideal average score. This study's pre-test and post-test results highlight the positive impact of implementing the LDMAT and SRL models on students' problem-solving abilities. Before the intervention, students exhibited limited problem-solving skills, as indicated by the pre-test scores. However, following the application of the LDMAT and SRL models, a significant improvement was observed in the post-test results. Students demonstrated a higher level of proficiency in solving mathematical problems, indicating the effectiveness of the LDMAT and SRL approaches in enhancing their problem-solving skills. These findings suggest that using these models can be instrumental in supporting students with learning difficulties in mathematics and promoting their overall academic growth.

The LDMAT and SRL models significantly impact improving problem-solving skills in students with learning difficulties in mathematics. The LDMAT model focuses on helping students make sense of mathematical knowledge and understand which concepts and procedures are necessary for their learning. The LDMAT model helps students overcome barriers and acquire essential mathematical skills by providing targeted support and addressing individual student needs. On the other hand, the SRL model emphasizes self-regulation in learning. It equips students with strategies to set goals, monitor their progress, use effective learning techniques, and overcome challenges such as math anxiety. By developing self-regulation skills, students gain greater control over their learning process and are better equipped to tackle problem-solving tasks. When these two models are combined, they create a powerful framework for improving problem-solving skills in students with learning difficulties in mathematics. The LDMAT model ensures that students receive the necessary support and instruction tailored to their needs.

In contrast, the SRL model empowers them to take ownership of their learning and apply effective problem-solving strategies. Through applying the LDMAT and SRL models, students with learning difficulties in mathematics can develop a deeper understanding of mathematical concepts, enhance their problem-solving abilities, and experience increased confidence and engagement in their mathematical learning. This combined approach fosters a supportive and inclusive learning environment that enables students to overcome challenges and reach their full potential in problem-solving.

Students with learning difficulties must also understand that they need help solving complex mathematical problems. With the help of this model, students can gradually be helped and begin to show problem-solving skills. Therefore, the application of this model must be consistently applied to students. Changes in the application of models to help students with learning difficulties align with research findings which show that changes in learning that are oriented towards conceptual inculcation that leads to a deeper understanding will minimize misunderstandings rather than learning that emphasizes memorization (Tortajada-Genaro, 2014). LDMAT and SRL are based on conceptual reinforcement so that basic conceptual errors can be avoided. This is the key to the success of this model in helping students with learning difficulties in mathematics. This is also in line with the finding that the teacher has an extensive role in helping to increase students' mathematical knowledge by understanding the location of learning difficulties so that they can provide appropriate strategies and feedback (Khanal, 2022).

Then an independent t-test was conducted to compare the mean test scores for male and female students. The results are shown in Table 4.

Table 4.
Independent t-test differs in the mean scores of male and female students

Descriptive Statistics	Girls	Boys
Mean	59,286	45,454
Variance	45,238	147,273
Observations	7	11
Pooled Variance	109,010	
Df	16	
t Stat	2,740	
t Critical one-tail	1,746	

Table 4 shows that t_{stat} = 2.740 with t_{tab} = 1.746. This shows that H0 is rejected, so it is concluded that the average problem-solving score of female students is better than that of male students.

Male and female students differ in their interest in mathematics. The school environment influences this difference, as teachers' attitudes and beliefs, learning approaches, and parents' views (Elmedina Nikoçeviq-Kurti, 2022). Although it seems that female students are better than male students, this study cannot explain what factors cause it in detail. If ideally, every individual student has the same self-concept, then it should be no difference in perceptions between male and female students (Peteros et al., 2019). However, it can be assumed that differences may occur due to students' different interests and learning methods. On the other hand, female students show better extrinsic motivation and mastery orientation than male students (D'Lima et al., 2014).

The learning process in the classroom needs to be strengthened by the habit of independent learning by SRL principles. Independent learning allows students to work hard to have their own learning experience. This will impact his proficiency in using the appropriate problem-solving strategies taught in class when completing assignments. Students need to study hard using the practical study skills they have learned and have good analytical thinking skills to perform well in math class (Khanal, 2022).

These results indicate that applying LDMAT in the classroom provides practical assistance to students to reduce their learning difficulties. Thus, learning strategies provide a crucial role in providing support to students with learning difficulties.

Improved Problem-Solving Skills: The Weekly assessment results of the assignment

Assignment questions are given to students 5 times every weekend. Giving assignments aims to enable students with SRL principles to study independently at home. The assignment also aims to give students a learning experience according to their stage of development in understanding the problem-solving strategies they have received in each week of learning. The results of the assignment score can be seen in Table 5.

Table 5.
Result of assessment assignment

Indicator	Week -				
	1st	2nd	3rd	4th	5th
Mean Score	36,45	41,04	51,83	54,72	60,52
Average number of questions answered correctly	3,25	3,53	4,02	4,17	4,32
Accuracy of Collecting Assigment	75%	76%	82%	86%	87%

Table 5 shows that the assignment results increase weekly in terms of the average score, the average number of questions answered correctly, and the number of students who submit assignments on time An increase in the average score and the average number of questions answered correctly indicates an improvement in students' learning difficulties. In other words, students can understand the problem-solving strategies studied and apply them to complete tasks given by the teacher.

The main impact of SRL in assignment activities is to provide full support so that students connect previous learning experiences with the assignments given by applying the problem-

solving strategies taught by the teacher. Students with learning difficulties often need support to set goals and monitor their learning progress because sometimes such students find it challenging to do so (Rogers & Tannock, 2018). Students become concerned with themselves about their learning assignments, what they have learned, what difficulties they face, and how to find solutions. Teachers need to support children in managing emotions and talking about their feelings and reactions so that they understand their duties (Nolan et al., 2014).

Furthermore, students can determine their learning goals, when to do assignments, when to submit assignments, and when to ask if they encounter difficulties. Awareness and regulation of emotion and task management have positively impacted academic achievement (Arguedas et al., 2016). At the end of the session, feedback on assignment corrections positively impacts students regarding what has been done. Students can detect their mistakes, be emotionally motivated to work harder, and not give up easily. When students with learning difficulties are not supported to obtain feedback, their accumulation of failures to succeed in class can lead to negative characteristics (Rogers & Tannock, 2018).

SRL also emphasizes that students work and practice with discipline according to a set schedule. SRL will encourage students to practice using their learned knowledge to complete their assignments consistently. SRL encourages students to know their capacity and is expected to increase their fighting power so they do not give up easily. This effect is beneficial for reducing the impact of student learning difficulties. The role of the teacher in giving structured assignments is one way to improve student discipline in learning. School discipline policies can impact academic success and educational attainment (Weisburst, 2019).

Description of students' problem-solving performance

Problem-solving skills in students are shown by applying problem-solving strategies to the 10 final test items of arithmetic ability. The following shows some of the analysis of the student's answers to the questions: "Kevin read a novel for 4 days. On the first day, he read 1/3 part. On the second day, he read the remaining half. On the third day, he read the remaining part. On the fourth day, he read 44 pages. What is the total page of the book? " The following is an alternative problem solving presented by students.

Solution 1 is displayed in Figure 1. The settlement uses the making picture/ diagram. Next, the trunk box is manipulated according to the facts presented in the problem. Furthermore, the facts are combined to obtain the results of the settlement. Problem-solving steps in this way are usually done by students accustomed to applying ideas in the form of pictures/graphics. This settlement step requires accuracy or carefulness to divide the box into several boxes according to the facts known in the problem. However, this step is enough to help students get the answers correctly.

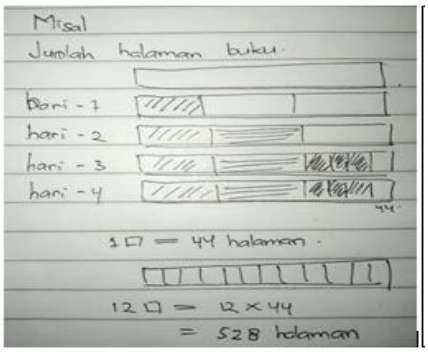

Figure 1. Solution 1

Solution 2 is presented in Figure 3. The settlement uses a working backward, which is completed by counting the pages of the book from day 4 then counting the number of pages on day 3, day 2, and the results obtained on the calculation of many pages on day-to-day 1 This step back can also be one alternative to solving problems. However, a step back usually requires a high level of accuracy.

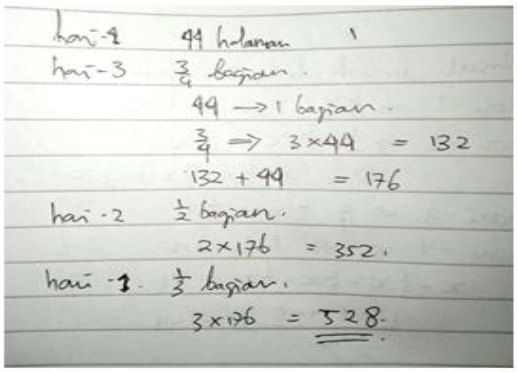

Figure 2. Solution 2

In the treatment given during learning, there are 5 problem-solving strategies taught by the teacher, namely: making pictures/ diagrams/ tables (MP), working backward (BW), guessing (GC), simplifying problems (SP), and logical reasoning (LR). The results of a holistic assessment of the 3 criteria: conceptual understanding (CU), understanding of implementation procedures (PU), and skills in selecting problem-solving strategies (PSS) are shown in Table 6.

Table 6.
Students' problem-solving performance

Subject Number	Criteria	Mean Score	Average	Category	Subject Number	Criteria	Mean Score	Average	Category
S1	CU	1,243	1,534	low	S10	CU	2,093	2,446	low/ moderate
	PU	1,012				PU	2,897		
	PSS	2,348				PSS	2,348		
S2	CU	1,573	1,789	low	S11	CU	1,765	1,780	Low
	PU	1,923				PU	1,874		
	PSS	1,872				PSS	1,702		
S3	CU	2,123	2,055	low/moderate	S12	CU	2,934	2,672	Moderate
	PU	1,056				PU	2,884		
	PSS	2,987				PSS	2,198		
S4	CU	1,972	2,107	low/moderate	S13	CU	1,092	1,896	Low
	PU	2,001				PU	2,099		
	PSS	2,348				PSS	2,496		
S5	CU	1,452	1,489	low	S14	CU	1,452	1,480	Low
	PU	1,923				PU	1,984		
	PSS	1,093				PSS	1,005		
S6	CU	2,536	2,699	moderate	S15	CU	2,536	2,768	moderate
	PU	2,645				PU	2,786		
	PSS	2,915				PSS	2,983		
S7	CU	2,093	2,209	low/moderate	S16	CU	2,123	2,275	low/ moderate
	PU	2,098				PU	2,714		
	PSS	2,435				PSS	1,987		
S8	CU	1,256	1,305	low	S17	CU	1,234	2,037	low/ moderate
	PU	1,223				PU	1,893		
	PSS	1,436				PSS	2,983		
S9	CU	1,987	2,056	low/moderate	S18	CU	2,684	2,514	moderate
	PU	1,293				PU	2,092		
	PSS	2,887				PSS	2,765		

Table 6 also shows information that 7 students (39%) are in the low category, 7 students (39%) are in the low to moderate category, and 4 students (22%) are in the moderate category based on the average value of the 3 criteria that have been determined. This said that 11 students (61%) were no longer in the low category. This shows that implementing the LDMAT and SRL models can improve the understanding of problem-solving in students with learning difficulties.

Table 6 also shows that the average conceptual understanding is 1,900. The average understanding of implementation procedures is 2.022, and the average problem-solving strategy selection is 2.266. This result also informs that the criterion for selecting a problem-solving strategy is the highest criterion score. This means that students can use and choose the appropriate solving strategy for the given problem. Thus, the LDMAT and SRL models can indirectly help students overcome learning difficulties in solving mathematical problems by selecting appropriate problem-solving strategies. These results also conclude that students' understanding of concepts still needs to be improved. This is to the results of other studies that show that students' learning difficulties are heavily influenced by their shared understanding of concepts.

Improving problem-solving skills in students with learning difficulties is also strengthened by the results of interviews and observations. The results of interviews and observations during learning show the following findings: a) students feel enthusiastic about their learning, b) students feel they are getting more attention during learning, c) students feel they can reduce learning anxiety due to difficulties encountered, d) students feel more confident when doing assignments or tests, e) students feel that the teacher understands the difficulties they face, f) students feel they are getting proper assistance during learning and doing assignments, g) students feel actively involved in learning and h) students get feedback to improve their learning performance.

IV. Conclusion

The results indicate that implementing the LDMAT and SRL models effectively enhances problem-solving skills in students with learning difficulties in mathematics. The data reveal significant improvements in problem-solving abilities after the intervention, demonstrating the efficacy of the LDMAT and SRL approaches in supporting these students. Furthermore, it is noteworthy that the LDMAT and SRL models have a particularly positive impact on female students compared to male students. This suggests that these models cater to female students' specific needs and learning styles, contributing to their enhanced problem-solving skills in mathematics. Additionally, applying the LDMAT and SRL models contributes to an increased understanding of problem-solving procedures among the students. By implementing these models, students gain a deeper comprehension of approaching and navigating mathematical problem-solving tasks, resulting in improved procedural knowledge. Overall, the research underscores the effectiveness of the LDMAT and SRL models in improving problem-solving skills in students with learning difficulties in mathematics. It highlights the importance of implementing these models to address the specific needs of students, particularly females, and emphasizes the significance of enhancing students' understanding of problem-solving procedures.

Thus, teachers should focus on increasing awareness of how their knowledge, practices, and beliefs about learning difficulties in mathematics can affect the improvement of the learning process for students (Hamukwaya & Haser, 2021). The self-regulated learner setting, initially in the form of a conceptual framework, has been empirically proven through this study to help students with learning difficulties. On the one hand, this study also strengthens the effectiveness of the LDMAT model principles.

Furthermore, researchers need to pay attention to the subject of students with learning difficulties in their follow-up studies.

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