International Conference on Education in Mathematics, Science and Technology

www.icemst.com March 24-27, 2022 Antalya, TURKEY www.istes.org

Students' Mathematical Problem-Solving Ability: Mathematics Teachers' Perception in Sumatra

Putri Wulansari

Universitas Pendidikan Indonesia, Indonesia, https://orcid.org/0000-0001-7424-9245

Al Jupri

Universitas Pendidikan Indonesia, Indonesia, https://orcid.org/0000-0002-0485-4332

Abstract: This study aims to obtain a picture of the perception of mathematics teachers related to students' mathematical problem-solving abilities. This research method is qualitative research with a case study approach. The subject of this research is a mathematics teacher in Sumatra. A total of 32 mathematics teachers were involved in this study. The data collected in this study used a questionnaire. The questionnaire used was validated by one mathematics education lecturer and three mathematics teachers. Then, the results of the questionnaire data were analyzed using Miles and Huberman analysis which consisted of data reduction, data presentation, and drawing conclusions. The results of this study indicate that the teacher's perception of the ability to solve mathematical problems as measured by the Polya stages ranges from 63% to 77%. In addition, there are differences in students' mathematical problem-solving abilities during online and offline learning. The impact of this research can add to existing references and be considered to improve and evaluate math problem-solving abilities in both public and private schools in Sumatra.

Keywords: Mathematical problem-solving, Polya stages, Teacher perception

Introduction

Problem-solving ability is an important point in learning mathematics. In mathematics, problem solving is essentially a high-level reasoning process (Sari et.al, 2019). Since its inception as a relatively new subject of inquiry, problem solving has been one of the key issues in mathematics education research (Carotenuto, 2021). NCTM (2000) states that there are 5 important components of mathematics, including problem-solving skills, mathematical connections, mathematical representation, reasoning, and communication. Supported by the opinion (Sitorus & Sutirna, 2021) that this problem-solving ability must be possessed by students. Because of this ability is one of the skills that must be possessed in the 21st century.

Wulansari, P., & Jupri, A. (2022). Students' Mathematical Problem-Solving Ability: Mathematics Teachers' Perception in Sumatera. In P. Dankers, M. Koc, & M.L. Ciddi (Eds.), *Proceedings of ICEMST 2022-- International Conference on Education in Mathematics, Science and Technology* (pp. 113-129), Antalya, TURKEY. ISTES Organization.

In addition, this problem-solving ability is a benchmark in assessing student abilities internationally (PISA) and national assessment (AKM). Several studies state that students' mathematical problem-solving abilities are low (Ardiana et.al, 2019). Reinforced based on the results of PISA, it is stated that the problem-solving and reasoning abilities of students in solving PISA questions are low. There are several studies related to students' mathematical problem-solving abilities in the last 5 years as follows: research by Apriani et al. (2017) regarding mathematical problem-solving abilities in terms of initial mathematical abilities and gender differences. Then, Buranda & Bernard's research (2018) with the article title analysis of mathematical problem-solving abilities in junior high school students' circle material based on gender. After that, the research of Saputri & Mampouw (2018), with the article title of problem-solving ability in solving fractional problems by junior high school students is viewed from the Polya stage.

Furthermore, Zakiyah et.al's (2019) research regarding the analysis of problem-solving abilities and responses to mathematical transitions from junior high school to high school on SPLTV material. Then Fitriani's research (2020), with the title of the article on the problem-solving abilities of junior high school students. After that, Darmawan & Ramlah's research (2021) with the article title analysis of students' mathematical problem-solving abilities in solving TIMSS questions based on Polya stages. Based on the research above, it can be concluded that research related to students' problem-solving abilities is often the object of research.

In this day and age, since the COVID-19 virus spread, learning in schools has changed. Learning is done through distance or online learning. In this phase, distance learning media can be developed by the government (Wijaya, 2020). Online learning is a new challenge for teachers and students because they have to replace their usual learning (Cao et al, 2021). So, this is certainly the process of learning and thinking of students, especially in solving mathematical problem-solving problems. However, there is still a lack of research related to the perceptions and views of teachers on students' mathematical problem-solving abilities, and also whether there are differences in students' mathematical problem-solving abilities before the pandemic and during the pandemic.

Therefore, the purpose of this study was to describe the mathematics teacher's perception of students' mathematical problem-solving abilities based on the teacher's experience. The mathematics teacher's perception of mathematical problem-solving abilities includes the teacher's knowledge and understanding of the types of questions given, students' difficulties in solving mathematical problem-solving problems, and mathematics topics that are often used. Furthermore, it describes the differences in students' mathematical problem-solving abilities before the pandemic and during the pandemic. The impact of this research is to add references or can be used as a consideration for teachers or the government in improving students' mathematical problem-solving skills through the important points discussed in this study. In Table 1, several variables of teacher perception criteria are as follows:

Table 1. Table of Teacher Perception Criteria

Variables		N
Teaching Level	SD	8
	SMP	11
	SMA/MA/SMK	13
School Origin	Public school	17
	Private school	15
Gender	F	20
	M	12
Total		32

Method

This research is qualitative research with a case study approach (Yin, 2009). The subjects in this study were mathematics teachers in Sumatra. A total of 32 mathematics teachers were involved in this study. The level of teaching mathematics teachers from elementary, junior high school, and high school (equivalent). The data collected in this study used a questionnaire. The questionnaire used was validated by one mathematics education lecturer and three mathematics teachers. Data analysis was carried out by analysis of Miles and Huberman (1994) which consisted of data reduction, data presentation, and conclusions.

Results

Mathematics teachers' perceptions of problem-solving abilities are viewed from the experience of teachers who teach in public schools or private schools. This result discusses 4 points, including the perception of mathematics teachers on knowledge and understanding related to students' mathematical problem-solving abilities, teachers' perceptions of students' mathematical problem-solving abilities, teachers' perceptions of students' difficulties in solving mathematics problems, and mathematics teachers' perceptions of mathematical problem-solving abilities of students before the pandemic and during the pandemic.

Teachers' perceptions of their knowledge related to students' mathematical problem solving

The teacher's perception of his knowledge related to matters relating to students' mathematical problem solving is described in Figure 1 which contains the teacher's perception of the difference between routine and non-routine questions, how often to give routine and non-routine questions, the teacher knows the level of the type of questions from Bloom's taxonomy, how often the teacher gives questions of types C4, C5 and C6 to students, as well as students' difficulties in solving math problems. Following is in Figure 1 the percentage of teachers' perceptions of their knowledge related to matters related to solving mathematical problems

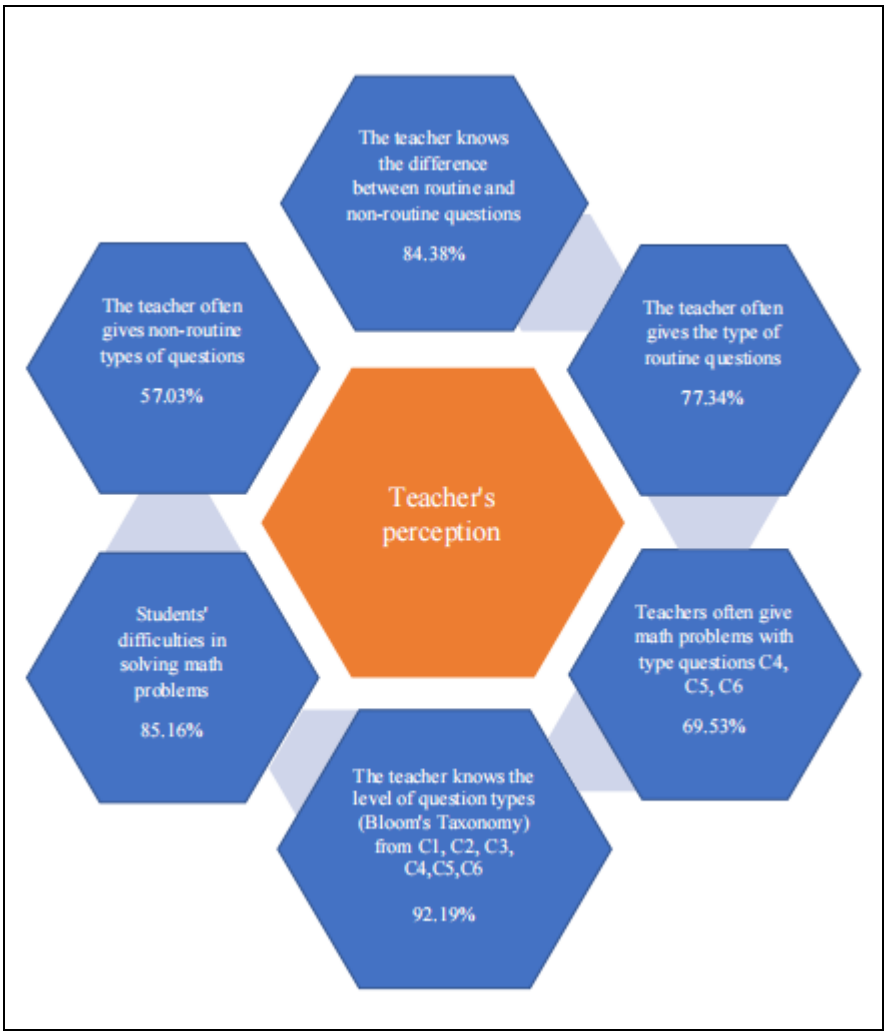

Figure 1. The teacher's perception of his knowledge regarding matters related to solving mathematical problems

Based on Figure 1, the teacher's perception of his knowledge related to matters related to solving mathematical problems, among others, the teacher knows the difference between routine and non-routine questions 84.38%, teachers often give questions to students with the type of routine questions 77.34%, teachers often give questions to students with non-routine types of questions 57.03%, teachers' perceptions of students who often have difficulty in solving math problems 85.16%, teachers know the level of question types (Bloom's Taxonomy) from C1, C2, C3, C4, C5, and C6 that is 92.19%, and the teacher often gives math problems to students with the type of questions C4, C5, C6 that is 69.53%.

In addition to the above aspects, the mathematics topics that are often used by teachers to give routine and non-routine questions to students are as follows in Table 2:

Table 2. Math Topics for Routine and Non-Routine Questions

Math topics	
Algebra	13
Number	6
Data and Uncertainty	3
Geometry	6
Others	6

Based on Table 2, shows that mathematics topics that are often given to students, both routine and non-routine questions consist of algebra, geometry, numbers, data and uncertainty, and others. In addition to discussing math topics that are often given, the teacher's perception of students' difficulties in solving math problems becomes important. In Table 3, the teacher's perception of the points of difficulty experienced by students in solving mathematical problems is discussed as follows:

Table 3. Students' Difficulties in Solving Students' Math Problems

Students' difficulties in solving students' math problems	
Understanding and analysis of basic concepts	❖ Do not understand the concept ❖ They are not used to the problems they face. So they do not know where to start and use any concept to solve the problem.
Understanding the problem & types of questions	❖ Understand and analyze the meaning of the question. ❖ Students are not careful in reading questions. ❖ Understand math story problems and fractional number material. ❖ Interpret and translate the mathematical language of the questions into their understanding to answer the questions.
Problem-solving procedures/steps, the student reasoning process	❖ Choose a problem-solving procedure, converting the problem into a mathematical representation. ❖ Development of existing formulas to solve different problems. ❖ Convert story problems to mathematical form and perform division operations. ❖ Students are less able to find methods of solving problems directly, there needs to be an inducement first.

Operation	❖ Students are still difficult in arithmetic operations. ❖ Multiplication of fractions in algebra. ❖ Basic operations on fractions and negative numbers.
Problem solving on story problems	❖ When dealing with story problems or questions related to everyday life. ❖ Troubleshooting story problems.
Math topics/materials	❖ Algebra and Numbers

Based on Table 3 above, there are six points of student difficulty in solving math problems, including understanding and analyzing basic concepts, understanding problems & types of questions, problem-solving procedures/steps & students' reasoning processes, operations, problem-solving on story problems, and topics/materials mathematics.

Teacher's Perception of Students' Mathematical Problem-Solving Ability

The teacher's perception of the ability to solve mathematical problems is measured based on Polya's stages, namely understanding, planning, implementing, and re-examining. The following is in Figure 2 regarding the percentage of teachers' perceptions of students' mathematical problem-solving abilities as follows:

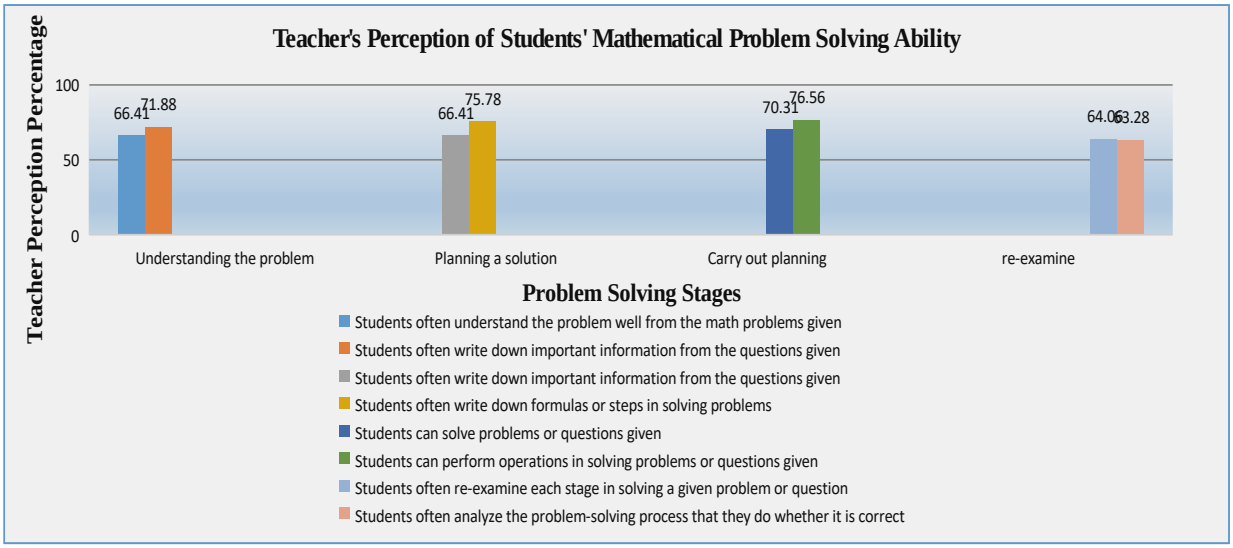

Figure 2. Teachers' Perceptions of Students' Mathematical Problem-Solving Abilities

Based on Figure 2, the teacher's perception of the ability to solve mathematical problems, namely:

1. Stages of understanding the problem: students often understand the problem well from the math problems given 66.41% and students often write down important information from the questions given 71.88%.
2. Stages of planning a solution: students can plan problem-solving well when given 66.41% of questions; students often write formulas or steps in solving problems 75.78%.
3. Stages of implementing the plan: students can solve problems or questions given 70.31% and students can perform operations in solving problems or questions given 76.56%.
4. Stages of re-checking: students often re-examine each stage in solving problems or questions given 64.06% and students often analyze the problem-solving process that they do whether it is correct 63.28%.

Teacher's Perception of Mathematical Problem-Solving Ability before the Pandemic and During the Pandemic

The table above has previously discussed the teacher's perception of mathematical problem-solving abilities. However, what is the teacher's perception of mathematical problem-solving skills before the pandemic and during the pandemic? In Figure 3 below, the percentage of teachers' perceptions of math problem-solving skills before the pandemic and during the pandemic.

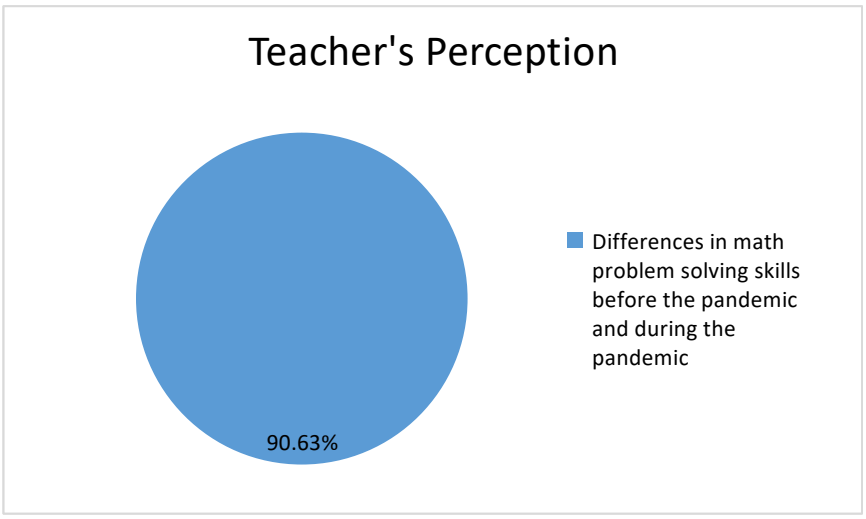

Figure 3. Teacher's Perception of Math Problem-Solving Ability

Based on Figure 3, the percentage of teachers' perceptions of differences in math problem-solving abilities before the pandemic and during the pandemic was 90.63%. The most significant differences between students' mathematical problem-solving abilities before the pandemic and when the pandemic occurred are described in Table 4, including:

Table 4. Significant Differences in Students' Mathematical Problem-Solving Abilities

The significant difference in students' mathematical problem-solving abilities before the pandemic and during the pandemic	
❖ Lack of student motivation. ❖ Students' thinking ability. ❖ Before the pandemic, students were able to solve math problems with good steps, but during the pandemic, students were less able to neatly write information about the math problem. ❖ Many students make mistakes, in addition, subtraction, multiplication, and division operations. ❖ Before the pandemic, students' problem-solving abilities were quite good, after the pandemic, students were more concerned with the answers available in applications such as Branly or the like so that the problem-solving abilities of students decreased. ❖ The ability to reason and think critically. ❖ The ability of students is not better. ❖ The difference is in analyzing the problem, before the pandemic, students in the analyzing stage could discuss with their friends or teachers, but during this pandemic, students were less enthusiastic in completing the tasks given, especially in analyzing the problems given. ❖ Very drastically decreased. ❖ The media used during the learning process. ❖ Before the pandemic, students' problem-solving abilities could be seen clearly because learning took place in the classroom so that the teacher knew	❖ Reasoning in solving problems. ❖ Able to understand the problem. ❖ Students are slow in arithmetic operations due to long online learning. ❖ During a pandemic, in solving problems, students often guess at different solutions. ❖ Students have more difficulty understanding material during the pandemic because they study online, whereas before the pandemic students were quite good at solving math problems. ❖ During the pandemic, students were not focused on learning and solving problems before the pandemic, on the contrary, students were more focused on learning and could solve math problems. ❖ Students do not understand how to solve a mathematical problem. ❖ If they are online they are not free to ask if there is something they have not understood, but it is different from in-class they can ask questions until they understand the desired solution to the problem to the teacher or friends who already understand. ❖ Less effective learning methods when BDR or online schools make understanding problem solving difficult for students to understand. ❖ Understanding of the questions given. After the pandemic, students studied

which students understood and which did not. Meanwhile, during the pandemic, students' abilities cannot be fully trusted because there is a possibility that their assignments will be done with their parents. It was concluded that before the pandemic the students' abilities were better than during the pandemic. ❖ Students have difficulty understanding the questions. ❖ It's quite different because, during a pandemic, students understand better in solving problems directly, learning offline, but during a pandemic, they learn online. Sometimes it is the signal that decides the student's focus so that the student's problem-solving ability is reduced. ❖ Students are lazy to read story problems. ❖ Study time. ❖ Students become less active. ❖ Availability of time to learn practice questions so that the material studied by students is more complex.	online so that the delivery of the material was often hampered by network constraints and others. ❖ It seems that the understanding of the matter is not good. Learning online during a pandemic must be admittedly ineffective, due to reduced study time and communication problems between students and teachers that some students may experience in various regions. So that the opportunity for students to study the material in depth is reduced, this also happens because there is a reduction in basic competencies as the minimum achievement of students during the pandemic based on the candy about learning during the pandemic. ❖ The level of understanding is decreasing and the understanding that has been previously obtained quickly fades. ❖ Students are lazy to think when given new questions and even the questions are the same as the daily test questions that are tested during PTS (Mid-semester assessment) and PAS (End of semester assessment).

In addition to the teacher's perception of the differences in students' mathematical problem-solving abilities before the pandemic and during the pandemic, the following is in Figure 4 regarding the teacher's perception of the media/tools used to improve students' mathematical problem-solving skills before the pandemic and during the pandemic.

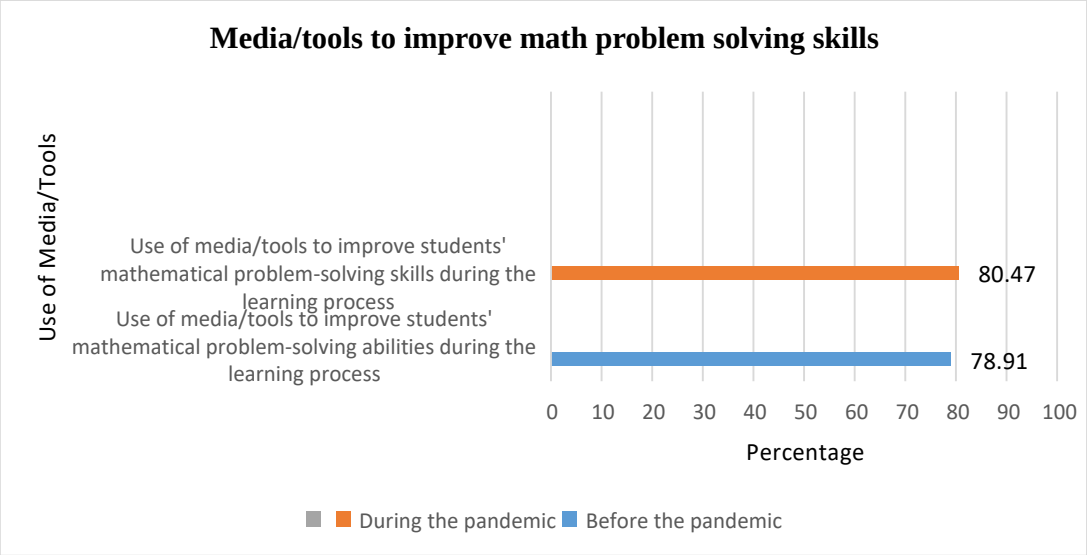

Figure 4. Teachers' Perceptions of The Use of Media/Tools to Improve Math Problem Solving Skills

In Figure 4, the percentage of teachers' perceptions of using media/tools to improve math problem-solving skills, namely before the pandemic period, teachers using media/tools to enhance students' math-solving abilities during the learning process were 78.91%, and during the pandemic period, teachers using media/tools to improve math problem-solving skills of the students during the learning process were 80.47%. The teacher's perception of the learning model or method used to improve students' mathematical problem-solving abilities before the pandemic is as follows in Table 5:

Table 5. Models Or Methods Used by Teachers to Improve Students' Mathematical Problem-Solving Skills Before the Pandemic

The model or method used by teachers to improve students' mathematical problem-solving skills before the pandemic	
❖ Problem-based learning ❖ Scientific ❖ Problem-solving method ❖ Props ❖ Cooperative learning and CTL ❖ Drill ❖ PMRI, RE ❖ Jigsaw ❖ Inquiry model ❖ Study in groups, using props on certain materials ❖ Quantum teaching	❖ Discovery learning ❖ Open-ended ❖ Question and answer ❖ A learning method that emphasizes a lot of practice questions in the school manual ❖ Direct learning model ❖ It can't be specific. The method used may be a more direct explanation from the teacher or class discussion. ❖ Lectures and discussions.

Based on Table 5, various models or learning methods are used to improve students' mathematical problem-solving skills, some of which are problem-solving methods, inquiry models, open-ended, question and answer, PMRI, jigsaw, CTL, cooperative, PBL, direct learning, and discovery learning.

Furthermore, the teacher's perception of the learning model or method used to improve students' mathematical problem-solving abilities during the pandemic is shown in Table 6 follows below:

Table 6. Models or methods used by teachers to improve students' mathematical problem-solving skills during a pandemic

Models or methods used by teachers to improve students' mathematical problem-solving skills during a pandemic	
❖ Learn online by giving assignments ❖ Online - learning videos ❖ Problem-solving ❖ Hybrid learning ❖ IT ❖ One of them is Blended learning using YouTube ❖ Scientific ❖ CTL ❖ Learning modules and learning videos, through one-way learning by watching videos that have been uploaded on personal YouTube ❖ Using Zoom including PowerPoint ❖ Scientific	❖ Independent study ❖ Problem-based learning ❖ Web-based Learning ❖ Discovery learning ❖ Lectures and discussions ❖ Project-Based Learning ❖ Learning methods that emphasize a lot of practice questions not only from school books but also from analyzing questions from the internet. ❖ Students learn online through Gmeet or WA (video or voice notes) so the methods or learning models used are often non-specific or even non-existent.

Based on Table 6, some teacher perceptions regarding the models or methods used to improve students' mathematical problem-solving skills during a pandemic include giving online assignments, making learning videos, zooming in with PowerPoint, blended learning using YouTube, hybrid learning, web-based learning, etc.

Teacher's Perception of Students' Difficulties in Solving Mathematical Problems

Many students have difficulty solving math problems. The following is in Table 7 the aspects that become difficulties for students based on teacher perceptions:

Table 7. Teachers' perceptions of students' difficulties in solving math problems

Students' difficulties in solving math problems	
❖ Determine what steps to use to solve the problem. ❖ The teacher uses too high a language when explaining. ❖ At the stage of working on the question. ❖ Quadratic equation material. ❖ The lack of literacy in students makes students less able to read the questions first. ❖ There are differences in the process of brain development of each child. ❖ Basic knowledge of mathematics.	❖ Students are difficult to understand the problems and lack of practicing math problems. ❖ Mastery of concepts or students' understanding of the problem. ❖ Students do not understand the context of the problem. ❖ Questions and answers and student self-discipline. ❖ Students are not familiar with problem-solving problems.

Based on Table 7, teacher perceptions related to students' difficulties in solving mathematical problems include problem understanding, concept mastery, planning and implementing problem-solving, students are not familiar with problem-solving problems, and others. Then, Table 8 also discusses the teacher's perception of the steps or actions that must be taken to improve student's problem-solving abilities during offline learning (before the pandemic) as follows:

Table 8. Teachers' Perceptions of the Efforts That Must Be Made to Improve Mathematical Problem-Solving Skills

Actions/steps that teachers must take to improve students' problem-solving skills during offline learning (before the pandemic)	
❖ Using a method or approach that invites students to find existing problems and be able to solve them. ❖ Approach students who do not understand. ❖ Provide a joint discussion of hard math problems. ❖ Focus on learning and how to learn. ❖ Teachers must change the way of teaching and motivate students to be more enthusiastic in doing math problems.	❖ The teacher gives many different types of questions. ❖ Teachers often give non-routine questions and use the guided discovery method. ❖ Re-checking their arithmetic operations. ❖ Take a certain approach to better know the students' problems first. ❖ Using a variety of learning methods that make students comfortable and happy to learn mathematics.

❖ Students must be taught to think for themselves and to solve problems based on context. ❖ Explain in simple language. ❖ Familiarize with problem solving problems using the PBL model in learning. ❖ By using simulations or by learning directly from real-world items. ❖ Understanding of concepts and lots of practice questions (case studies). ❖ Using the PMRI method. ❖ Creating interactive learning media. ❖ Varying media and teaching models ❖ The teacher increases the education of questions and their solutions.	❖ teachers use appropriate learning methods. ❖ Teachers should give more open-ended questions to students so they can think further so that there are many ways to solve math problems. ❖ The teacher participates in the MGMP regarding the discussion of HOTS questions. ❖ The teacher provides special skill-oriented learning. ❖ The teacher must use a prior approach to students, both an individual approach and the use of a learning approach. Apply the habit of reading (literacy) then do numeracy exercises.

Furthermore, Table 9 discusses the teacher's perception of the steps or actions that must be taken to improve student's problem-solving abilities during online learning (during a pandemic) as follows:

Table 9. Teachers' Perceptions of the Efforts That Must Be Made to Improve Mathematical Problem-Solving Skills

Teachers' perceptions of the efforts that must be made to improve mathematical problem-solving skills during the pandemic	
❖ The teacher gives assignments that can improve students' abilities. ❖ The teacher makes ICT-based learning media. ❖ The teacher explains through the video. ❖ Teachers make the learning process more meaningful and guided. ❖ Teachers must actively provide material in the form of soft files, give some practice questions, as well as motivate students to be more enthusiastic in working on math problems. ❖ The teacher gives a lot of quizzes.	❖ Adjusting student conditions, because students can only use group WA as a learning tool. This causes learning, especially mathematics, to be difficult to do. ❖ Using methods/models that are appropriate to the environment/conditions where students live. ❖ Conducting face-to-face learning is limited because students find it more difficult to solve math problems when studying online.

❖ The teacher often gives questions. ❖ Learn attractively with media/tools. ❖ The teacher gives non-routine questions for practice. ❖ Teachers must be able to use learning methods that support students in terms of improving problem-solving. ❖ The teacher gives examples of reasoning questions. ❖ Aiming at learning videos. ❖ Learning modules and question and answer media, which are adequate. ❖ Improving the ability of teachers in the IT field, especially the use of learning applications. ❖ Give a habit to students so that students will easily remember, such as reading habits (literacy) and numeracy. ❖ Provide learning videos on each material to be studied. ❖ The teacher often gives practice questions (case studies). ❖ The teacher uses interesting and relevant media.	❖ The teacher uses a method that is suitable for the student's condition. ❖ Immediately carry out offline learning. ❖ Take a webinar about Troubleshooting. ❖ Use of supportive media for online learning. ❖ Be more serious when learning so that students' understanding is maximized. ❖ Familiarize with problem-solving problems. Using problem-based learning in learning, and using interesting online learning media with learning resources that are easily accessible to students. ❖ Use as much as possible existing technology and use the environment as a learning medium. ❖ The teacher invites students to be creative by direct practice to real objects such as making cubes for lanterns. ❖ Understand the problem and its important points. ❖ Creative teachers in packaging learning to be easy to understand and not boring.

Discussion

Based on the results of the research that has been presented above, the teacher's perception of mathematical problem-solving abilities as measured by the Polya stages ranges from 63% to 77%. Polya's stages in this study include 4 stages, including understanding the problem, planning problem solving, implementing problem-solving, and re-examining (Polya, 1973). The research by Zakiyah et.al (2019) showed that students' mathematical problem-solving abilities ranged from 50.53% to 94.74%. In addition, Fitriani's research (2020) shows that the percentage of students' mathematical problem-solving abilities starting from the stage of

understanding the problem, planning, implementing, and re-examining is 56.72% to 90.44%. Furthermore, Afandi et.al's research (2020) shows that the percentage of mathematical problem-solving abilities based on the Polya stage is 5.36% - 76.79%. While the research by Sari et.al (2021) presented the results that the ability to solve mathematical problems according to the Polya stage was categorized into 5 levels, namely very good, good, quite good, not good, and bad. The percentages of these five categories in each stage of Polya in this study include the stages of understanding the problem which has a percentage ranging from 0% to 40.57% and the stages of problem-solving planning whose percentage ranges from 5.79% to 28.98%. Furthermore, at the stage of carrying out problem-solving, the percentage ranges from 5.79% to 42.02%. Then, the percentage at the re-examination (evaluation) stage is 2.89% - 62.31%. In addition, based on research that has been done, shows that there are differences in students' mathematical problem-solving abilities during online and offline learning. The difference lies in the media/tools used in the learning process, the methods or models used during the learning process, and the efforts or actions that must be taken by the teacher in improving students' mathematical problem-solving abilities before the pandemic and during the pandemic.

Conclusion

Based on research that has been done that teachers' perceptions of students' mathematical problem-solving abilities in schools in Sumatra are as follows: Stages of understanding the problem, students often understand the problem well from the math problems given 66.41% and students often write down important information from the questions given 71.88% ; Stages of planning completion, students can plan problem-solving well when given 66.41% of questions and students often write formulas or steps in solving problems 75.78% ; Stages of problem-solving, students can solve problems or questions given 70.31% and students can perform operations in solving problems or questions given 76.56% ; Stages of re-checking, students often re-examine each stage in solving problems or questions given 64.06% and students often analyze the problem-solving process that they do whether it is correct 63.28% ; The percentage of teachers' perceptions of differences in mathematical problem-solving abilities before the pandemic and during the pandemic was 90.63%, meaning that there was a significant change between students' mathematical problem-solving abilities before the pandemic and during the pandemic ; Furthermore, this research has limitations in certain cases such as the perception of teachers in Sumatra, so this research cannot generalize as a whole.

Recommendations

Based on the results of this study, more in-depth research can be conducted on similar research by adding variables such as age and gender factors. Then, other researchers can conduct the same research on the perception of mathematics teachers on students' mathematical problem-solving abilities in other areas such as Java, Kalimantan, Sulawesi, Papua, or even covering the whole of Indonesia.

Acknowledgments

We gratefully express our gratitude to LPDP (Indonesia Endowment Fund for Education) for funding this research and thanks to the mathematics teachers who have been involved in this research.

References

Afandi, I., Rosmaiyadi, & Husna, N. (2020). Kemampuan Pemecahan Masalah Matematis Siswa Pada Materi Pertidaksamaan Linear Satu Variabel Kelas VII SMP Negeri 3 Singkawang [Student's Mathematical Problem Solving Ability in One Variable Linear Inequality Material Class VII SMP Negeri 3 Singkawang]. *Jurnal Pendidikan Matematika Indonesia* , *5*, 87 - 91.

Apriani, E., Djadir, & Asdar. (2017). Kemampuan Pemecahan Masalah Matematika Ditinjau dari Kemampuan Awal Matematika dan Perbedaan Gender [Mathematical Problem Solving Ability in terms of Early Mathematics Ability and Gender Differences]. *Issues in Mathematics Education*, *1*, 7-11.

Ardiana, N.A., Arigiyati, T.A., & Nasroni. (2019). Analisis Kemampuan Pemecahan Masalah Matematika Siswa Kelas X SMK Muhammadiyah 1 Imogiri. *Prosiding Sendika*, 5 (1), 411-416.

Buranda, S.M., & Bernard, M., (2018). Analisis Kemampuan Pemecahan Masalah Matematik Materi Lingkaran Siswa Smp Berdasarkan Gender [Analysis of Mathematical Problem Solving Ability of Middle School Students' Circle Materials Based on Gender]. *JPMI – Jurnal Pembelajaran Matematika Inovatif*, *2*, 33-40.

Cao, Y., Zhang, S., Chan, M.C.E. *et al*. (2021). Post-pandemic reflection: lessons from Chinese mathematics teachers about online mathematics instruction. *Asia Pacific Educ. Rev*. 22, 157 – 168. https://doi.org/10.1007/s12564-021-09694-w.

Carotenuto, G., Martino, P.D., & Lemmi, M. (2021). Students' suspension of sense making in problem solving. *ZDM – Mathematics Education*, *53*, 817–830. https://doi.org/10.1007/s11858-020-01215-0.

Darmawan, S.M., & Ramlah. (2021). Analisis Kemampuan Pemecahan Masalah Matematis Siswa dalam Menyelesaikan Soal TIMSS Berdasarkan Tahapan Polya [Analysis of Students' Mathematical Problem-Solving Ability in Solving TIMSS Problems Based on Polya Stages]. *MAJU*, *8*, 283-292.

Fitriani. (2020). Kemampuan pemecahan masalah siswa SMP [Middle school students' problem-solving skills]. *JTMT : Jurnal Tadris Matematika*, *1*, 14-19.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage publication.

NCTM. (2000). *Principles and Standards for School Mathematics.* Reston, VA: The National Council of Teachers of Mathematics, Inc.

Polya, G. (1973). How To Solve It. Princeton, New Jersey: Princeton University Press.

Saputri, J.R., & Mampouw, H.L. (2018). Kemampuan pemecahan masalah dalam menyelesaikan soal materi pecahan oleh siswa SMP ditinjau dari tahapan Polya [Problem-solving ability in solving fractional

material problems by junior high school students in terms of the Polya stage]. *Math Didactic*: *Jurnal Pendidikan Matematika*, *4*, 146-154.

Sari, I.K., Nasriadi, A., Agustiani, R., Nursalim, R., & Jarudin. (2021). Analysis of Students' Mathematical Problem-Solving Skills. *Journal of Hunan University Natural Sciences*, *48*, 281 - 289.

Sari, N. M., Yaniawati, P., Darhim, & Kartasasmita, B. G. (2019). The Effect of Different Ways in Presenting Teaching Materials on Students' Mathematical Problem Solving Abilities. International Journal of Instruction, 12(4), 495-512. https://doi.org/10.29333/iji.2019.12432a.

Sitorus, Y. I., & Sutirna. (2021). Analisis Kesalahan Siswa SMA dalam Pemecahan Masalah Matematis pada Materi Program Linier [Analysis of High School Students' Errors in Solving Mathematical Problems on Linear Program Materials]. *Maju: Jurnal Ilmiah Pendidikan Indonesia*, *8*, 282–290.

Wijaya, T. T. (2021). Cómo los estudiantes chinos aprenden matemáticas durante la pandemia de coronavirusInternational Journal of Educational Research and Innovation (IJERI), 15, 1-16. https://doi.org/10.46661/ijeri.4950.

Yin, R. (2009). Case Study Research: Design and Methods. Beverly Hills, CA: Sage Publication.

Zakiyah, S., Hidayat, W., & Setiawan, W. (2019). Analisis Kemampuan Pemecahan Masalah dan Respon Peralihan Matematik dari SMP ke SMA pada Materi SPLTV [Analysis of Problem Solving Ability and Response to Mathematical Transition from Junior High School to Senior High School on SPLTV Materials]. *Mosharafa: Jurnal Pendidikan Matematika*, *8*, 227-238.