24 (3), 2023, 556-570

Jurnal Pendidikan MIPA

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Implementation of the Connected Mathematics Project Learning Model on Students' Mathematical Problem Solving Abilities

Sinar Depi Harahap [1], Marzuki Ahmad [1*], Sabri[2] & Ilham Sahdi Lubis[3]

[1]Department of Mathematics Education, South Tapanuli Education Institute, Indonesia

[2]Department of Primary Teacher Education, South Tapanuli Education Institute, Indonesia

[3]Department of Indonesian Language and Literature Education, South Tapanuli Education Institute, Indonesia

Abstract: Low Mathematical Problem Solving Ability (MPSA) is a major problem in research. One learning model that supports increasing MPSA in learning is the Connected Mathematics Project (CMP) learning model. The aim of this research is to describe the implementation of the CMP learning model on students' MPSA. This type of research is quasi-experimental with a one group pretest posttest design. The research population was class VIII students' at MTsN 1 Padangsidimpuan consisting of 11 study groups. The research sample was students' from class VIII-11 with a total of 33 students'. The research instrument was the CMP learning management observation sheet and students' MPSA test. Analysis of data from observations was carried out descriptively and analysis of student MPSA data was carried out using inferential statistical tests using the paired t-test. The research results show that CMP learning management obtained an average score of 3.52 (good). Furthermore, analysis of the students' MPSA data shows a significance value of 0.00 which is smaller than the alpha level of 0.05 (there is a significant difference between the average pre-test and post-test scores). Furthermore, an n-gain value of 0.44 (Medium) was obtained. Thus it is concluded that the implementation of CMP learning on students' MPSA is effective.

Keywords: implementation, CMP, problem solving, mathematics.

Abstrak: *Rendahnya Kemampuan Pemecahan Masalah Matematika (MPSA) merupakan masalah utama dalam penelitian. Salah satu model pembelajaran yang mendukung peningkatan MPSA dalam pembelajaran adalah model pembelajaran Connected Mathematics Project (CMP). Tujuan penelitian ini adalah untuk mendeskripsikan implementasi model pembelajaran CMP terhadap MPSA siswa. Jenis penelitian adalah quasi eksperimen dengan rancangan one group pretest posttest design. Populasi penelitian adalah siswa kelas VIII MTsN 1 Padangsidimpuan yang terdiri dari 11 Rombongan belajar. Sampel Penelitian adalah siswa kelas VIII-11 dengan jumlah siswa 33 orang. Instrumen penelitian adalah lembar observasi pengelolaan pembelajaran CMP dan Tes MPSA siswa. Analisis data hasil observasi dilakukan dengan deskriptif dan analisis data MPSA siswa dilakukan dengan uji statistik inferensial uji paired t-test. Hasil penelitian menunjukkan pengelolaan pembelajaran CMP memperoleh nilai rata rata 3,52 (baik). Selanjutnya analisi data MPSA siswa menunjukkan nilai signifikansi 0,00 lebih kecil dari taraf alpha 0,05 (terdapat perbedaan signifikan dari nilai rata rata pretes dan postes). Selanjutnya diperoleh nilai n-gain 0,44 (Sedang). Dengan demikian disimpulkan bahwa Implementasi pembelajaran CMP terhadap MPSA siswa adalah efektif.*

Kata kunci: *implementation, CMP, pemecahan masalah, matematika.*

▪ INTRODUCTION

Advances in science and technology show the progress of a nation. As a scientific discipline, mathematics is a basic science that can be used in the development of science

Marzuki Ahmad
*Email: marzuki.ahmad45@yahoo.com

DOI: http://dx.doi.org/10.23960/jpmipa/v24i3.pp556-570
Received: 26 September 2023
Accepted: 20 October 2023
Published: 27 November 2023

and technology (Bhakti et al., 2018). Thus mathematics plays a very important role and it is necessary to develop various abilities in mathematics. Minister of Education and Culture Regulation Number 21 of 2016 states that the competency to be achieved in studying mathematics is showing an attitude of not giving up easily in solving problems and being able to provide estimates of problem solving (Kemendikbud, 2016). Problem solving is the main activity in developing mathematical understanding. For decades, problem solving has been a focus of elementary mathematics education reform (Hourigan & Leavy, 2022). This makes problem solving an integral part of all mathematics learning (Son et al., 2020). Problem solving is widely considered to be a cornerstone of educational curricula and a theoretical basis for assessing international student achievement (Vicente et al., 2022).

Mathematical problem solving is a complex cognitive activity, as a process to overcome a problem encountered and to solve it requires a number of strategies. Furthermore, according to Polya (Rambe & Afri, 2020) there are four steps that students' take in solving problems, namely: 1) understanding the problem, 2) planning a problem solving strategy, 3) implementing the problem solving strategy, and 4) checking again the solution obtained. Various information reveals that students' Mathematics problem solving abilities (MPSA) are still low. Based on the results of the 2018 Program International Student Assessment (PISA) study, Indonesia is ranked 73rd out of 79 in the mathematics category. The 2018 PISA results experienced a decline from 2015, where in 2015 the score was 386 while in 2018 it was 379 (OECD, 2019). The PISA results show that the problem solving abilities of students' in Indonesia are still lacking, because mathematics in PISA measures problem solving (Asdarina & Ridha, 2020).

Problem solving abilities are still considered ineffective. There are many reasons underlying this perception, but one of the main problems is a lack of awareness of the complexity and many factors involved in the problem solving process (Lester, 2013). Many students' hold traditional beliefs about mathematics that can hinder their learning in the discipline (Weldeana & Abraham, 2014). The results of initial observations carried out by researchers through interviews with one of the mathematics teachers in the city of Padangsidimpuan obtained information that students' MPSA tended to be less than satisfactory which could be observed from the symptoms of students' being less able to understand and solve problems as well as students' low mathematics learning outcomes. Furthermore, it was also revealed that the implementation of learning that occurred tended to be conventional, namely with the dominance of teacher activities in delivering lesson material. Student MPSA achievements are not as expected. Improving students' problem-solving skills continues to be a primary goal of educators in various fields of study (Lorenzo, 2005). They should be active and able to develop their thinking abilities well. An active learning process is generally found when in learning students' are active in solving problems, and students' actively try to build their own solution procedures from the problems presented with their abilities (Lithner, 2017).

A learning model that provides the widest opportunity to develop problem-solving abilities through giving assignments is the CMP model. In learning activities, students' in study groups are faced with various problems through student worksheets to be solved independently. These tasks require students' to collaborate without direct guidance from the teacher (Chan & Clarke, 2017; Langer-Osuna et al., 2020; Langer-Osuna, 2018; Yeo, 2017). Connected Mathematics Project (CMP) is a learning model that emphasizes giving

assignments related to mathematics which aims to help students' and teachers develop mathematical knowledge, understanding and skills, as well as awareness and appreciation of the enrichment of relationships between parts of mathematics and between mathematics. with other scientific disciplines (Lestari, 2017). Mathematical abilities will develop through giving relevant assignments, using various strategies, using virtual manipulatives, and asking questions in tutoring sessions (Hinojosa & Bonner, 2021). Furthermore, the CMP model expects student learning to have responsibility in completing projects according to the roles given in the group and focus on important material (Rohendi & Dulpaja, 2013). Through mathematical connections, students' will develop a comprehensive understanding of mathematics which is very useful in problem solving (Andriani et al., 2020). Mathematics learning activities are carried out by students' with the aim of discovering new things in the form of knowledge that students' have not previously understood (Ahmad, Siregar, Siregar, et al., 2018). The CMP learning model involves launching, exploring and summaring which aims to stimulate students' to understand complex problems by using certain forms of representation, discussing and evaluating problem solving in learning (Damaryanti et al., 2017).

Various previous studies in mathematics learning have revealed that through the application of the CMP learning model, the ability to understand mathematical concepts for class VIII SMP students' increases through classroom action research which is carried out in two cycles (Sari et al., 2020). The effectiveness of CMP learning on mathematical reasoning abilities and mathematics anxiety is relatively high in vocational school students' (Aprillia & Lestari, 2022). There is an influence of the CMP learning model on students' mathematical representation abilities (Harahap, 2020). The mathematical connection abilities of students' taught using the CMP learning model are better compared to conventional learning (Puteri & Riwayati, 2017). There is a significant influence of the application of the CMP learning model on MTs students' mathematical problem solving abilities (Agustinova & Granita, 2021).

From this description it can be observed that research implementing the CMP learning model which reviews its effectiveness in managing learning and students' problem solving abilities is still limited. Thus, researchers are implementing the CMP model towards MPSA. The aim of the research is to describe quantitatively the effectiveness of the implementation of the CMP model in learning and the effectiveness of students' MPSA through the CMP learning model in mathematics learning.

▪ METHOD

This research is quantitative research which aims to describe the Mathematical Problem Solving Ability (MPSA) of students' who are given mathematics learning using CMP learning model. The research location is MTsN 1 Padangsidimpuan Jl. Sutan Soripada Mulia No. 27 Padangsidimpuan, District. North Padangsidimpuan, Padangsidimpuan City Prov. North Sumatra. The research population was class VIII students, totaling 11 (eleven) rooms. Using the cluster random sampling technique, class VIII-11 was selected with a total of 33 people as the research sample. To achieve the research objectives, a quasi-experimental research was carried out with a one group pretest posttest design. The research design in question can be seen in Figure 1 (Sugiyono, 2016).

0_1	×	0_2

Figure 1. Research Design

Information:
0_1 = Prettest MPSA
0_2 = posttest MPSA
×= CMP Learning Model

The research was carried out in June-July 2023. The research mechanism was carried out by following the research design, starting from the research preparation stage, validation and testing of devices and instruments, research data collection and data analysis. Research preparation was carried out to design research instruments which included learning observation sheets and research instruments. Apart from that, learning tools were also designed which included learning implementation plans and student worksheets. Instruments and devices designed for class VIII junior high school students' with algebraic material. The results of the device and instrument design have been validated by 4 validators who have competence in student CMP and MPSA learning.

The research instrument involved the student MPSA test and Learning Management Observation Sheet. The MPSA test which includes MPSA pretest and posttest questions which are used as data collection tools has been validated by validators with valid criteria. Next, the MPSA test instrument was tested by analyzing the test results which met the valid and reliable criteria. Likewise, the observation sheet used has met the valid criteria by reviewing aspects of format, language and content by the validator. Data collection begins with the initial test (Pretest) which includes giving the student MPSA test to the research sample. After giving the pretest, learning was carried out using the CMP model in 4 meetings, with each meeting having a time allocation of 2×40 minutes. Learning activities involved observers to make observations on learning management. After the learning was carried out in 4 meetings, the students' MPSA posttest was then carried out.

Data analysis techniques use descriptive statistical data analysis and inferential statistics. The data obtained from observations of learning management were processed using quantitative descriptive statistics. The score obtained will be converted to the interpretation of the observation sheet assessment, namely $0 \leq$ Score ≤ 0.5 (very bad), $0.5 \leq$ Score < 1.5 (bad), $1.5 \leq$ Score < 2.5 (Enough), $2{,}5 \leq$ Score < 3.5 (Good), $3.5 \leq$ Score $<$ 4.0 (Very Good) (Ahmad, Siregar, & Siregar, 2018). The effectiveness of learning management is effective if it meets the criteria of good or very good. Inferential statistical analysis was carried out by analyzing the normality and homogeneity of data variants followed by the paired t-test. Analysis of the effectiveness level is determined based on the average value of Normalized N-Gain by consulting the effectiveness level criteria based on normalized N-gain (Hake, 1999) with Effectiveness Interpretations Ngain < 3 (Low), $3 \leq$ Ngain <7 (Medium), Ngain ≥ 7 (High).

▪ RESULT AND DISCUSSION

In accordance with the research design, tests and learning are carried out in research activities. The test is carried out in the form of pretest and posttest. The learning was carried out in 4 meetings, each meeting with a duration of 80 minutes. The learning carried out involves observers making direct observations at each meeting. The results of observations in learning activities can be observed in table 1.

Table 1. Results of observations on the management of the cmp learning model

No	Observed aspects	CMP learning				Average value Meeting I-IV
		Meeting I	Meeting II	Meeting III	Meeting IV	
1	Learning communication	3	3	3	4	3.25
2	Apperception of learning	3	3	4	4	3.5
3	Motivating students' in learning	4	4	3	3	3.5
4	CMP-*Launching*	3	4	4	4	3.75
5	CMP-*Exploring*	4	3	4	4	3.75
6	CMP-*Summarizing*	3	4	4	3	3.5
7	Mastery of Learning Materials	3	3	4	4	3.5
8	Suitability of material to students' cognitive level.	3	3	4	4	3.5
9	Learning Resources	4	3	4	3	3.5
10	Utilization of Learning Media	3	4	3	4	3.5
11	Use of Language	4	3	4	4	3.75
12	Closing Learning Activities	3	3	4	4	3.5
13	Time Management	3	3	4	4	3.5
14	Class atmosphere/Class Mastery	3	4	3	4	3.5
	Average value	3,29	3,36	3,71	3,79	3.54

From table 1 it can be seen that the learning management achievements in each meeting are in the good category. It can be seen that the last or 4 (four) meetings were the meetings that got the highest score and were the best of all the meetings held. Where the application of the learning carried out gets better and better. This is because students' increasingly understand and are increasingly interested in the learning activities carried out.

Furthermore, looking at the activities carried out by observation, there are 4 (four) score categories obtained. Where the highest average score is 3.75, namely this score is found in CMP-launching, CMP-Exploring activities and language use. The average score below is 3.5, namely this score is found in CMP-summarizing activities, learning apperception, mastery of learning material, suitability of material to students' cognitive level, learning resources, use of learning media, closing learning activities, time management, atmosphere class/class mastery. And the next average score is 3.25, namely in learning communication.

From the results of observations regarding management carried out in 4 meetings, the implementation of the CMP learning model in teaching MPSA was effective. The findings of this research are in line with the results of research Harahap & Nasution (2021) which revealed that through the application of the CMP learning model which was implemented with group discussions consisting of 2-3 people, it showed that student activity had increased from cycle I to cycle II. Research Daniel et al. (2021) revealed that through the CMP learning model students' learning in teaching MPSA went enthusiastically and was carried out optimally and was in the very good category. CMP learning affects students' mathematical problem solving abilities, namely making students' more enthusiastic and giving positive responses to learning mathematics because in CMP learning students' search and investigate problems, so that students' can express their own mathematical ideas (Agustinova & Granita, 2021).

Graphically, the results of observations of CMP learning activities in teaching students' MPSA can be observed in Figure 2.

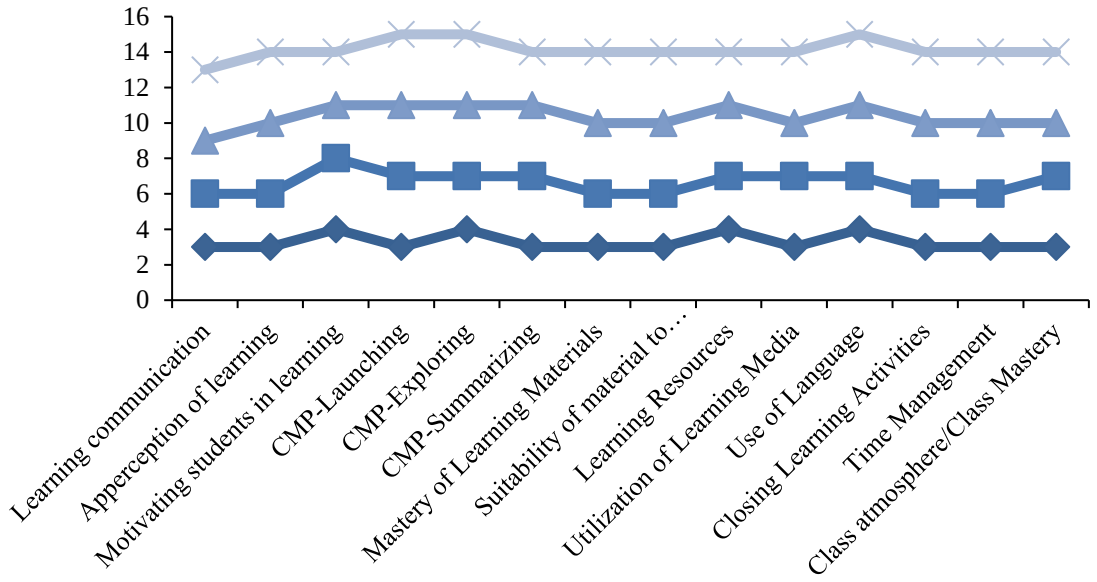

Figure 2. CMP learning model management graph

Apart from learning management results, MPSA test results were also obtained. This data is the result of scoring from the MPSA pretest and posttest on the research sample. In table 2 below, the results of descriptive analysis of MPSA data for sample group students' are presented.

Table 2. Obtaining descriptive student mpsa data

Test	Pretest MPSA	Posttest MPSA
N	33	33
Mean	38.73	50.09
Median	39.00	50.00
Modus	38.00	47.00
Standard Deviation	4.46	3.08
Minimum	26.00	45.00
Maximum	52.00	56.00

The results of the descriptive analysis show that the average post-test value data obtained is higher than the pre-test value. To see the significance of whether a realistic mathematics education approach has an effect on teaching students' ability to understand mathematical concepts, it was analyzed using the Paired Samples Test. For this test, it is first shown that the data variants are normally distributed and homogeneous. The data obtained from the pretest and posttest were analyzed for the level of normality using nonparametric tests with the help of SPSS 20. By proposing the hypothesis H_0 = normally distributed data variance and H_a = data variance not normally distributed. With the decision making criteria, accept H_0 and reject H_a if the significance is > 0.05 or vice versa. The SPSS output for normality analysis is in table 3.

Table 3. Normality test analysis results

Test	Pretest MPSA	Posttest MPSA
Asymp. Sig. (2-tailed)	0.55	0.70
Information	Sig. > 0.05	Sig. > 0.05
Decision	Accept H_0	Accept H_0

Obtaining the One-Sample Kolmogorov-Smirnov Test data shows that the 2-tailed significance is greater than the alpha level of 0.05, thus providing a decision that H0 is accepted. In other words, the data on students' ability to understand mathematical concepts from the pre-test and post-test has a normal distribution. Furthermore, data on students' ability to understand mathematical concepts was analyzed for data homogeneity using the Levene statistical test with the hypothesis H_0 = homogeneous data variance and Ha = non-homogeneous data variance. The decision making criteria are to accept H_0 and reject H_a if the significance is > 0.05 or vice versa. The SPSS output for normality analysis is in table 4 below.

Table 4. Obtaining the significance value of the homogeneity test

Test	Posttest-Pretest KPKM
Significance	0.27
Information	Significance > 0,05
Decision	Accept H_0

Obtaining data from the Test of Homogeneity of Variances test shows that the significance is greater than the alpha level of 0.05 which gives a decision that H0 is accepted. It is concluded that the variance of the pretest posttest data on students' ability to understand mathematical concepts is homogeneously distributed. Thus, to see the significance of the influence of the implementation of realistic mathematics education, it can be analyzed using the paired t-test inferential statistical test. Testing was carried out by proposing a hypothesis: H0 = there is no average difference between the pretest and posttest results and Ha = there is an average difference between the pretest and posttest results. With the decision making criteria, accept H0 and reject Ha if the significance is > 0.05 or t-count < t-table and vice versa. The SPSS output for the t-test analysis is in table 5 below.

Table 5. Obtaining significance values from the paired t-test

Test	Pretest-Posttest MPSA
Asymp. Sig. (2-tailed)	0.000
Category	< 0.05
df	65
t-count	53.97
t-table	2.00

Obtaining significance data (2-tailed) 0.000<0.05 and t-count>t-table (53.97>2.056) gave the decision to reject H0 and accept Ha. This means that there is a significant average difference between the pretest and posttest results. In other words,

there is a significant influence from the implementation of the CMP model in teaching student MPSA.

Furthermore, the normalized N-gain obtained from the creative thinking ability value involving four indicators obtained n-gain from indicators I – IV respectively, namely 0.48, 0.42, 0.49, 0.41 which were studied in the medium category. The N-gain graph in terms of the student MPSA indicators is as in Figure 3. Furthermore, from these achievements, the average N-gain Score is 0.44 (Medium). Obtaining this score means that the effectiveness of the student MPSA is in the medium category. The picture of the N-gain achievement of each student MPSA indicator can be seen in Figure 3.

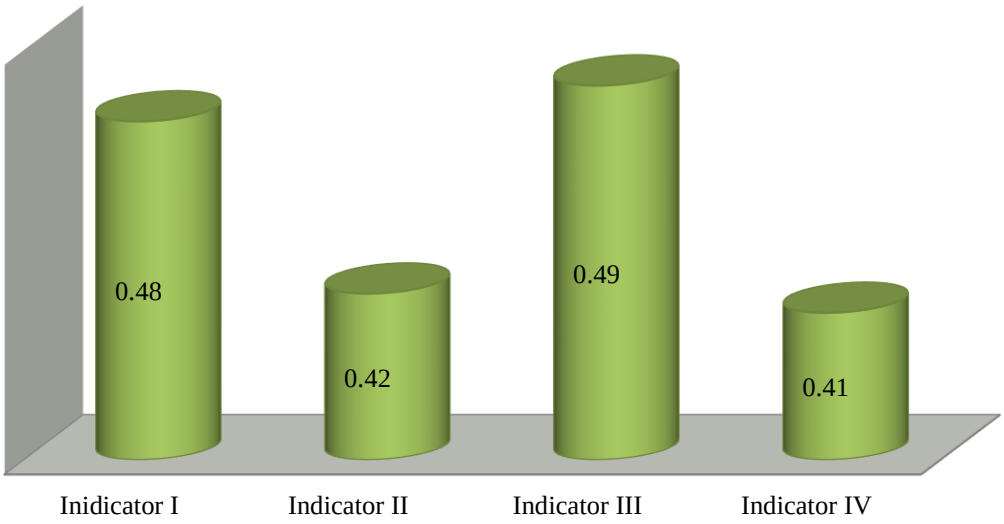

Figure 3. N-gain of each indicator mpsa

Based on the previous description, it can be concluded that the implementation of the CMP learning model for students' MPSA is effective. The results of research Fitriatien et al. (2021) also conveyed the same thing, showing that there is an influence of the CMP learning model on students' MPSA in the two variable linear equation system material and their mathematical reasoning abilities using the CMP model with a contextual approach are better than the direct learning model. Furthermore, the findings of this research are in line with the findings of research results Aprillia & Lestari (2022) showing that the average score achievement and effectiveness of mathematical reasoning abilities of students' who were given CMP learning was higher than students' who were given conventional learning. Likewise, research Lidwina et al. (2021) shows that students' mathematical reasoning abilities have reached the minimum completeness criteria for learning outcomes using the CMP learning model and are better than using the direct learning model. Likewise, research Susanti & Sulastri (2020) reveals that the improvement in mathematical problem solving abilities of students' who learn using the CMP learning model is better than students' who learn using the Discovery Learning model.

The implementation of the CMP learning model in teaching MTsN 1 Padangsidimpuan students' MPSA is implemented using collaborative learning stages as in general. The activities carried out in learning are fundamental to the success of

collaborative learning that is carried out (Wake et al., 2016). Students' carry out learning actively with the guidance and direction of the teacher as facilitator. Learning that is carried out requires the teacher's help to provide direction in problem solving and explore possible strategies to get the final result of problem solving (Doorman et al., 2019). In the CMP learning model, learning activities involve initial stages which include launching, exploring and summarizing.

Launching, in this stage, is the presentation of problems that students' will solve in learning. The teacher provides an understanding of the problem; reviewing old concepts and connecting them to problems and focusing on initial problems (Agustinova & Granita, 2021). In this stage the teacher distributes worksheets to individual students' in study groups (Wardhani, 2015). The worksheets distributed contain work instructions, instructions that guide students' in understanding the problem, questions or problems that are the students' task to solve and sheets to fill in the answers to solving the problem. The assignment items are designed to be interesting and appropriate to the students' level of ability. Designing assignments in mathematics lessons is a very important part that can bring about changes in students' (Coles & Brown, 2016). Learning activities are carried out in groups by solving problems on students' worksheets according to their respective skills.

Students' in learning utilize connections from concepts that students' already understand. To be able to solve the questions contained in the student worksheets, students' need to be able to connect relevant mathematical concepts with solutions to problems (de Koning et al., 2022). This stimulates students' to make varied answers. Encouraging flexibility in students' can be an efficient way to improve their performance in solving real context problems (Segura & Ferrando, 2023). The launch stage in this model is very important to provide students' with an understanding of the definition so that students' can solve problems well (Rupalestari et al., 2018). The mathematics learning materials used in CMP learning require the exchange of thoughts and information between students' (Daulay, 2022). The teacher will direct students' in filling out the student worksheet clearly. The problems given by students' will become the center of learning activities. Students' pay attention to and understand the problems given (Aprilia et al., 2014) and then work together to solve the problems found. The learning activities carried out involve teachers to support the cooperation of all students' and ensure the continuity of the collaborative process (Sormunen et al., 2020).

Exploring, in this stage students' are assessed through problem solving activities (Andriani et al., 2020). Students' are involved in data collection activities, seeing patterns, making estimates, sharing thoughts, developing strategies in solving problems, etc. In this case, students' are free to use various methods flexibly according to the problem solving techniques needed. The use of one method or methods that do not vary in learning will make it difficult for students' to solve problems (Peltenburg et al., 2012). Students' build relationships between the material taught in class and utilize it in completing assignments given to students' (Arthur et al., 2018). Exploring activities are carried out by students' individually in groups actively discussing their respective assignments.

Students' in the exploration stage are given the freedom to use their thinking activities in mathematics. This will allow students' to achieve some of the learning objectives that have been set (Tirpáková et al., 2023). In solving student problems, students' often encounter problems that require solutions in order to achieve certain goals

and objectives (Cifarelli & Sevim, 2015). In this case, discussion between fellow students' and assistance from the teacher as an educator is needed. The problem solving process carried out by student teachers needs to interact with students' by not providing solution methods and not eliminating students' opportunities to solve problems (Olsson & Granberg, 2022). Teachers facilitate lessons by introducing problems and connecting new content to previous understanding and investigations (Martin et al., 2012). In the CMP learning model, problems are used as the center of learning in which students' are required to understand problems, discuss, and find solutions to problems (Díez-Palomar et al., 2006).

Summary, In this stage students' convey their ideas, thoughts and solutions with the strategies used, organize data and find solutions and conclusions. This stage involves presenting or explaining the findings in learning. Students' can compare and discuss the answers obtained in their respective groups or in front of the class. Teachers guide students' to communicate and summarize the results of problem-solving discussions (Agustinova & Granita, 2021). In this case, the way to solve problems from various student findings in learning will be tested. Students' understanding of the problems they face will increase and their problem solving strategies will develop to become more effective and efficient (Wardhani, 2015). At the end of the CMP learning activities, students' are able to draw conclusions and interpret solutions from discussing problems well. A goal of CMP is for students' to be able to conclude material logically, explain material concepts and steps to answer them, and determine mathematical truth if there is a relationship between material concepts and the situation they face (Fitriatien et al., 2021).

Acknowledgement

The author would like to thank DRPM Kemenristekdikti for providing funds for the implementation of Beginner Lecturer Research in the Focus Area of Social Humanities-Arts and Culture Education in 2023 so that the research and publication of the results of this research can be carried out well.

▪ CONCLUSION

Based on the research results and discussion, it was concluded that the implementation of the Connected Mathematics Project (CMP) learning model on students' Mathematical Problem Solving Ability (MPSA) was effective in the medium effectiveness category. Furthermore, in learning, students' are actively involved in discussing to solve problems, students' are enthusiastic in searching for and finding solutions to problems and enthusiastic in presenting the results of their work in order to get the best conclusions from the problem solving carried out. CMP learning is very well applied in learning because it opens students' horizons to explore science and can develop a sense of responsibility for students' in solving problems well and correctly. The application of CMP requires research on the development of other mathematical abilities both quantitatively and qualitatively.

▪ REFERENCES

Agustinova, N., & Granita, G. (2021). *meningkatkan kemampuan pemecahan masalah matematis: eksperimen model pembelajaran connected mathematics project (cmp)*

pada siswa mts [improving mathematical problem solving abilities: experiments on the connected mathematics project (cmp) learning model for mts students]. *JURING (Journal for Research in Mathematics Learning)*, *4*(1), 81. https://doi.org/10.24014/juring.v4i1.11643

Ahmad, M., Siregar, Y. P., & Siregar, N. A. (2018). The effectiveness of realistic mathematics learning model based on mandailing culture in teaching of students' mathematical problem solving ability. *2nd International Conference on Mathematics and Mathematics Education 2018 (ICM2E 2018)*, *285*, 131–137. https://doi.org/10.2991/icm2e-18.2018.31

Ahmad, M., Siregar, Y. P., Siregar, N. A., & Effendi, H. (2018). Realistic math-based learning model based on mandailing culture. *IJSBAR*, *39*(1), 67–78. https://www.gssrr.org/index.php/JournalOfBasicAndApplied/article/view/8501

Andriani, D., Widada, W., Herawaty, D., Ardy, H., Nugroho, K. U. Z., Ma'rifah, N., Anggreni, D., & Anggoro, A. F. D. (2020). Understanding the number concepts through learning connected mathematics (CM): A local cultural approach. *Universal Journal of Educational Research*, *8*(3), 1055–1061. https://doi.org/10.13189/ujer.2020.080340

Aprilia, S. N., Wijaya, A. F., & Suryadi, S. (2014). *Efektivitas website sebagai media e-government dalam meningkatkan pelayanan elektronik pemerintah daerah (studi pada website pemerintah daerah kabupaten jombang)* [the effectiveness of websites as e-government media in improving regional government electronic services (study on jombang regency regional government websites)]. *Wacana (Jurnal Sosial Dan Humaniora)*, *17*(2), 126–135. https://www.neliti.com/publications/40110

Aprillia, E., & Lestari, K. E. (2022). *Efektivitas model connected mathematics project terhadap kemampuan penalaran matematis dan kecemasan matematika* [the effectiveness of the connected mathematics project model on mathematical reasoning ability and mathematics anxiety]. *Jurnal Educatio*, *8*(3), 873–882. https://doi.org/10.31949/educatio.v8i3.2305

Arthur, Y. D., Owusu, E. K., Asiedu-Addo, S., & Arhin, A. K. (2018). Connecting mathematics to real life problems: a teaching quality that improves students' mathematics interest. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, *8 Ver. II*(4), 65–71. https://doi.org/10.9790/7388-0804026571

Asdarina, O., & Ridha, M. (2020). *Analisis kemampuan penalaran matematis siswa dalam menyelesaikan soal setara pisa konten geometri* [analysis of students' mathematical reasoning ability in solving pisa equivalent questions on geometry content]. *Numeracy*, *7*(2). https://doi.org/10.46244/numeracy.v7i2.1167

Bhakti, Y. B., Astuti, I. A. D., & Agustina, I. (2018). The influence process of science skill and motivation learning with creativity learn. *Journal of Education and Learning*, *12*(1), 30–35. https://doi.org/10.11591/edulearn.v12i1.6912

Chan, M. C. E., & Clarke, D. (2017). Structured affordances in the use of open-ended tasks to facilitate collaborative problem solving. *ZDM Mathematics Education*, *49*, 951–963. https://doi.org/10.1007/s11858-017-0876-2

Cifarelli, V. V., & Sevim, V. (2015). Problem posing as reformulation and sense-making within problem solving. (pp.). . https://link.spr. In *In M. Singer, N. F. Ellerton, & J. Cai (Eds.), Mathematical problem posing: From research to effective practice*

(pp. 177–194). New York, NY: Springer. https://link.springer.com/chapter/10.1007/978-1-4614-6258-3_8

Coles, A., & Brown, L. (2016). Task design for ways of working: making distinctions in teaching and learning mathematics. *Journal of Mathematics Teacher Education*, *19*(2), 149–168. https://doi.org/10.1007/s10857-015-9337-4

Damaryanti, D. D., Mariani, S., & Mulyono. (2017). *Analisis kemampuan penalaran geometri ditinjau dari self-efficacy pada pembelajaran connectedmathematic project (cmp) berbasis etnomatematika* [analysis of geometry reasoning ability in view of self-efficacy in ethnomathematics-based connectedmathematic project (cmp) learning]. *UJME: Unnes Journal of Mathematics Education*, *6*(3), 325–332. https://doi.org/10.15294/ujme.v6i3.17126

Daniel, D., Siregar, E. Y., & Harahap, S. D. (2021). *Efektivitas penggunaan model pembelajaran connected mathematic project terhadap kemampuan pemecahan masalahmatematis siswa di smk negeri 1 lumut* [the effectiveness of using the connected mathematic project learning model on students' mathematical problem solving ability at smk negeri 1 lumut]. *JURNAL MathEdu (Mathematic Education Journal)*, *4*(1), 80–87. http://journal.ipts.ac.id/index.php/MathEdu

Daulay, L. A. (2022). *Peningkatan kemampuan penalaran matematis siswa dengan menggunakan pembelajaran connected mathematics project (cmp)* [increasing students' mathematical reasoning ability using connected mathematics project (cmp) learning]. *OMEGA: Jurnal Keilmuan Pendidikan Matematika*, *1*(2), 22–28. https://doi.org/10.47662/jkpm.v1i2.221

de Koning, B. B., Boonen, A. J. H., Jongerling, J., van Wesel, F., & van der Schoot, M. (2022). Model method drawing acts as a double-edged sword for solving inconsistent word problems. *Educational Studies in Mathematics*, *111*(1), 29–45. https://doi.org/10.1007/s10649-022-10150-8

Díez-Palomar, J., Simic, K., & Varley, M. (2006). "Math is everywhere": connecting mathematics to students' lives. *The Journal of Mathematics and Culture*, *VI*(2), 20–36.

Doorman, M., Bos, R., de Haan, D., Jonker, V., Mol, A., & Wijers, M. (2019). Making and implementing a mathematics day challenge as a makerspace for teams of students. *International Journal of Science and Mathematics Education*, *17*(1), 149–165. https://doi.org/10.1007/s10763-019-09995-y

Fitriatien, S. R., Leksono, I. P., & Prayogo. (2021). *Pengaruh model pembelajaran connected mathematics project (cmp) terhadap kemampuan pemecahan masalah matematis siswa smp* [the influence of the connected mathematics project (cmp) learning model on the mathematical problem solving ability of middle school students]. *PROXIMAL: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *4*(2), 48–55. https://e-journal.my.id/proximal/article/view/1243

Hake, R. R. (1999). Analyzing change/gain scores. *Dept. of Physics, Division D*, 1–4. https://web.physics.indiana.edu/sdi/AnalyzingChange-Gain.pdf

Harahap, T. H. (2020). *Pengaruh model pembelajaran connected mathematics project (cmp) terhadap kemampuan engaruh model pembelajaran connected mathematics project (cmp) terhadap kemampuan representasi matematis* [the influence of the connected mathematics project (cmp) learning model on ability the influence of the connected mathematics project (cmp) learning model on mathematical

representation ability]. *Jurnal MathEducation Nusantara*, *3*(1), 31–39. https://doi.org/10.54314/jmn.v3i1.98

Harahap, T. H., & Nasution, M. D. (2021). *Upaya meningkatkan pemahaman konsep matematika menggunakan model pembelajaran connected methematics project (cmp)* [efforts to improve understanding of mathematical concepts using the connected mathematics project (cmp) learning model]. *Journal Mathematics Education Sigma [JMES]*, *2*(1), 8–12. https://doi.org/10.30596/jmes.v2i1.6746

Hinojosa, D. M., & Bonner, E. P. (2021). The community mathematics project: using a parent tutoring program to develop sense-making skills in novice mathematics educators. *Mathematics Education Research Journal*, *35*(3), 497–524. https://doi.org/10.1007/s13394-021-00401-x

Hourigan, M., & Leavy, A. M. (2022). Elementary teachers' experience of engaging with teaching through problem solving using lesson study. *Mathematics Education Research Journal*, *0123456789*. https://doi.org/10.1007/s13394-022-00418-w

Kemendikbud. (2016). *Permendikbud nomor 21 tahun 2016 tentang standar isi pendidikan dasar dan menengah* [minister of education and culture regulation number 21 of 2016 concerning content standards for primary and secondary education].

Langer-Osuna, J. M. (2018). Exploring the central role of student authority relations in collaborative mathematics. *ZDM Mathematics Education*, *50*, 1077–1087. https://doi.org/10.1007/s11858-018-0965-x

Langer-Osuna, J., Munson, J., & Gargroetzi. (2020). "So what are we working on?": how student authority relations shift during collaborative mathematics activity. *Educ Stud Math*, *104*, 333–349. https://doi.org/10.1007/s10649-020-09962-3

Lestari, W. (2017). *Pengaruh model pembelajaran connected mathematic project terhadap kemampuan pemecahan masalah matematika* [the influence of the connected mathematics project learning model on mathematical problem solving ability]. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *02*(02), 245–253. https://journal.lppmunindra.ac.id/index.php/jkpm/article/view/2498

Lester, F. K. J. (2013). Thoughts about research on mathematical problem- solving instruction. *The Mathematics Enthusiast*, *10*(1), 245–278. https://doi.org/10.54870/1551-3440.1267

Lidwina, F. L., Citroresmi, N., Kontekstual, P., & Siswa, M. B. (2021). *Penerapan model pembelajaran connected mathematics project (cmp) dengan pendekatan kontekstual terhadap kemampuan penalaran* [application of the connected mathematics project (cmp) learning model with a contextual approach to reasoning ability]. *De Fermat : Jurnal Pendidikan Matematika*, *4*(2), 1–11. https://jurnal.pmat.uniba-bpn.ac.id/index.php/DEFERMAT/article/view/208

Lithner, J. (2017). Principles for designing mathematical tasks that enhance imitative and creative reasoning. *ZDM Mathematics Education*, *49*(6), 937–949. https://doi.org/10.1007/s1185 8-017-0867-3

Lorenzo, M. (2005). The development, implementation, and evaluation of a problem solving heuristic. *International Journal of Science and Mathematics Education*, *3*(2), 33–58. https://link.springer.com/article/10.1007/s10763-004-8359-7

Martin, T., Brasiel, S. J., Turner, H., & Wise, J. C. (2012). *Effects of the connected mathematics project 2 (cmp2) on the mathematics achievement of grade 6 students*

in the mid-atlantic region (Vol. 2). https://eric.ed.gov/?q="No+impact"+RCT&pr=on&id=ED530513

OECD. (2019). *Programme for international student asessessment (pisa) results from PISA 2018*.

Olsson, J., & Granberg, C. (2022). Teacher-student interaction supporting students' creative mathematical reasoning during problem solving using scratch. *Mathematical Thinking and Learning*, 1–28. https://doi.org/10.1080/10986065.2022.2105567

Peltenburg, M., van den Heuvel-Panhuizen, M., & Robitzsch, A. (2012). Special education students' use of indirect addition in solving subtraction problems up to 100-a proof of the didactical potential of an ignored procedure. *Educational Studies in Mathematics*, *79*(3), 351–369. https://doi.org/10.1007/s10649-011-9351-0

Puteri, J. W., & Riwayati, S. (2017). *Kemampuan koneksi matematis siswa pada model pembelajaran conneted mathematics project (cmp)* [students' mathematical connection abilities in the connected mathematics project (cmp) learning model]. *FIbonacci Jurnal Pendidikan Matematika Dan Matematika*, *3*(2), 161–168. https://doi.org/https://doi.org/10.24853/fbc.3.2.161-168

Rambe, A. Y. F., & Afri, L. D. (2020). *Analisis kemampuan pemecahan masalah matematis siswa dalam menyelesaikan soal materi barisan dan deret* [analysis of students' mathematical problem solving ability in solving problems on sequences and series material]. *AXIOM : Jurnal Pendidikan Dan Matematika*, *9*(2), 175. https://doi.org/10.30821/axiom.v9i2.8069

Rohendi, D., & Dulpaja, J. (2013). Connected mathematics project (cmp) model based on presentation media to the mathematical connection ability of junior high school student. *Journal of Education and Practice*, *4*(4), 17–22. https://doi.org/https://www.iiste.org/Journals/index.php/JEP/article/view/4512

Rupalestari, D., Hartono, Y., & Hapizah. (2018). *Hasil belajar siswa pada materi peluang melalui model connected mathematics project di kelas viii* [student learning results on opportunity material through the connected mathematics project model in class VIII]. *Jurnal Gantang*, *3*(2), 63–71. https://doi.org/10.31629/jg.v3i2.465

Sari, W. P., Haji, S., & Nirwana. (2020). *Peningkatan kemampuan pemahaman konsep siswa smp negeri 11 kota bengkulu melalui model pembelajaran connected mathematics project (cmp)* [increasing the ability to understand concepts of students at smp negeri 11 bengkulu city through the connected mathematics project (cmp) learning model]. *Jurnal Pendidikan Matematika Raflesia*, *05*(02), 75–83. https://ejournal.unib.ac.id/index.php/jpmr

Segura, C., & Ferrando, I. (2023). Pre-service teachers' flexibility and performance in solving fermi problems. *Educational Studies in Mathematics*, *113*(2), 207–227. https://doi.org/10.1007/s10649-023-10220-5

Son, A. L., Darhim, & Fatimah, S. (2020). Students' mathematical problem-solving ability based on teaching models intervention and cognitive style. *Journal on Mathematics Education*, *11*(2), 209–222. https://doi.org/10.22342/jme.11.2.10744.209-222

Sormunen, K., Juuti, K., & Lavonen, J. (2020). Maker-centered project-based learning in inclusive classes: supporting students' active participation with teacher-directed reflective discussions. *International Journal of Science and Mathematics*

Education, *18*(4), 691–712. https://doi.org/10.1007/s10763-019-09998-9

Sugiyono. (2016). *Metode penelitian kuantitatif, kualitatif dan r&d* [quantitative, qualitative and r&d research methods]. Bandung:Alfabeta.

Susanti, D., & Sulastri, Y. L. (2020). *Peningkatan kemampuan pemecahan masalah matematik peserta didik smp melalui model pembelajaran connected mathematics* [improving middle school students' mathematical problem solving abilities through the connected mathematics learning model]. *UJMES*, *05*(01), 55–64. https://doi.org/10.30999/ujmes.v5i1.922

Tirpáková, A., Gonda, D., Wiegerová, A., & Navrátilová, H. (2023). Developing the concept of task substitution and transformation by defining own equivalences. *Educational Studies in Mathematics*, *2004*, 1–20. https://doi.org/10.1007/s10649-023-10264-7

Vicente, S., Verschaffel, L., Sánchez, R., & Múñez, D. (2022). Arithmetic word problem solving. analysis of singaporean and spanish textbooks. *Educational Studies in Mathematics*, *111*(3), 375–397. https://doi.org/10.1007/s10649-022-10169-x

Wake, G., Swan, M., & Foster, C. (2016). Professional learning through the collaborative design of problem-solving lessons. *Journal of Mathematics Teacher Education*, *19*(2–3), 243–260. https://doi.org/10.1007/s10857-015-9332-9

Wardhani, I. S. (2015). *Menumbuhkan kemampuan berfikir geometri melalui pembelajaran connected mathematics project (cmp)* [developing geometry thinking ability through connected mathematics project (cmp) learning]. *PENA SD (Jurnal Pendidikan Dan Pembelajaran Anak Sekolah Dasar)*, *1*(1), 97–105. https://doi.org/10.29100/jpsd.v1i01.431

Weldeana, H. N., & Abraham, S. T. (2014). The effect of an historical perspective on prospective teachers' beliefs in learning mathematics. *Journal of Mathematics Teacher Education*, *17*(4), 303–330. https://doi.org/10.1007/s10857-013-9266-z

Yeo, J. B. (2017). Development of a framework to characterise the openness of mathematical tasks. *International Journal of Science and Mathematics Education*, *15*(1), 175–191. https://doi.org/10.1007/s10763-015-9675-9