The CORE Learning Model in Improving Mathematical Communication and Learning Outcomes of Junior High School Students

Edy Setiyo Utomo(✉), Nurwiani, and Esty Saraswati Nur Hartiningrum

STKIP PGRI Jombang, Jombang, Indonesia
edystkipjb@gmail.com

Abstract. This study aims to improve the mathematical communication and learning outcomes of junior high school students by implementing the CORE (Connecting, Organizing, Reflecting, and Extending) learning model. Mathematical communication refers to five aspects: representation, listening, reading, discussion and writing. This type of research is a classroom action research conducted at SMP Negeri 1 Jombang in class VIII and carried out in 2 cycles. The results showed that the mathematical communication in the first cycle, the percentage of the representation aspect was 57.81% in the medium category, while the second cycle was 82.81% in the high category. The listening aspect in the first cycle was 56,25% in the medium category, and in the second cycle, it was 78,13% in the high category. The reading aspect in the first cycle is 50% in the medium category, and in the second cycle, it is 87.5% in the high category. The discussion aspect in the first cycle was 48.38% in the low category, and in the second cycle, it was 84.38% in the medium category. The writing aspect in the first cycle was 62.5% in the medium category, and in the second cycle, it was 92.19% in the high category. The average learning outcome in the first cycle is 68.69 and in the second cycle is 86. Therefore, the application of the CORE model is very effective in improving mathematical communication skills and learning outcomes. Teachers are expected to modify and integrate the CORE model with STEM and think critically and creatively.

Keywords: CORE · mathematical communication · learning outcomes

1 Introduction

The transformation of mathematics learning is very dynamic and developing. The current teaching process prioritizes student interaction and activity [1, 2]. Students are given a more contextual stimulus and demand to think more critically and creatively. The development of the learning model also adjusts to the object and learning objectives. Teachers are expected to be able to design the right model during learning so that students can become a priority and become the centre of teaching goals [3–5].

The importance of building students' mindsets to convey ideas during the process and problem-solving. It aims so that students can independently explore their abilities.

J. Handhika et al. (Eds.): ICETECH 2022, ASSEHR 745, pp. 425–435, 2023.
https://doi.org/10.2991/978-2-38476-056-5_44

Each student has different characteristics and abilities, especially during the learning process. Mathematical communication is one of the abilities possessed by every student. Mathematical communication skills are related to student's ability to convey ideas in the form of others in the classroom.

In [6, 7] that the indicators of students' mathematical communication in learning consist of 1) students' ability to express mathematical ideas in writing, orally and able to represent visually; 2) the ability to understand, analyze, interpret, and evaluate mathematical ideas in writing, verbally and visually; 3) the ability to use terms, symbols, and mathematical notation to describe ideas and represent the relationship between mathematical concepts embodied in mathematical models.

Mathematical communication skills are important when learning is carried out in groups or in discussions. Where students will be required to convey, explain, describe, listen, write and work together so that students gain a good understanding. According to [8, 9], mathematical communication has several indicators, including 1) stating mathematical statements related to everyday life events; 2) stating the mathematical model in writing and orally in the form of pictures and tables as well as algebraic expressions; 3) explain the mathematical model or mathematical pattern that has been made in writing and orally; and 4) ask questions about the conditions given along with the reasons. Therefore, mathematical communication is closely related to the CORE learning model, especially the Organizing stage, where each student is required to interact with other students when conveying ideas and presenting the results of the answers.

Based on the initial observations made at SMPN 1 Jombang in class VIII-C, teachers still dominate learning. There is still no active interaction between teachers and students in the learning process. The lack of students who answer the questions given by the teacher means that only certain students respond. Students have not been able to provide verbal feedback on questions given by the teacher. Students are more likely to pay less attention to the explanations given by the teacher, and students are less likely to write notes on the blackboard. The teacher does not provide an innovative learning model during the learning process. Teachers tend to apply conventional lecture or learning methods. In addition, based on the results of the document regarding the mathematics learning outcomes of class VIII students, the learning mastery is still around 45.2% in the material tangent to the outer and inner circles. Students still have many difficulties and tend not to understand the material tangent to a circle.

Referring to the problems above, students' mathematical communication becomes the main priority that is solved during learning. The application of the CORE learning model can be an alternative learning model that can improve mathematical communication and mathematics learning outcomes. The CORE (Connecting, Organizing, Reflecting, and Extending) learning model is a learning model that can increase student activity, especially mathematical communication activities. The stages of the CORE learning model emphasize more on the ability of students to interact personally and in groups, the ability of students to organize ideas in writing and orally, the ability to understand information, carry out reflection activities on what has been done and strengthen the knowledge gained and integrated with prior knowledge [10–12].

According to [13, 14] the CORE learning model consists of several steps, including 1) the teacher asks students questions about the material to be studied, which is related

to everyday life; 2) the teacher guides the students to organize the ideas they have previously; 3) the teacher facilitates students to reflect on the material and review the results of the discussion during the learning process, and 4) the teacher guides the students to expand the material according to the ability of each student.

This study aimed to improve mathematics communication skills and learning outcomes through the CORE (Connecting, Organizing, Reflecting, and Extending) learning model for junior high school students. The aspects of mathematical communication in this study consist of aspects of representation, listening, writing, discussion, and reading.

2 Research Method

This research is a classroom action research. Characteristics of classroom action research are more on research conducted to overcome problems and improve the learning process to improve the teaching quality in the classroom. Thus, classroom action research begins with problem identification, giving action, observing, and reflecting. According to [15] This research was conducted on class VIII-C students at SMPN 1 Jombang, with 16 students consisting of 10 female and six male students.

This research has four stages in each cycle, namely the stages of planning, implementation, observation, and reflection. However, before the pre-cycle, get an initial picture to identify problems that occur in the learning process. This research was carried out in 2 cycles adopted from Kemmis and Taggart.

The research instrument consisted of a mathematical communication observation sheet and a test sheet for learning mathematics results while applying the CORE learning model. The aspects of mathematical communication seen in this study consist of representation, listening, reading, discussion, and writing. While the results of learning mathematics seen from the test on the material tangent to a circle.

Data collection techniques in this study include: observation methods, interview methods, tests and documentation. The data analysis technique refers to the indicators of the success of this study seen from the ability of mathematical communication and mathematics learning outcomes through the application of the CORE learning model. In this study, students' mathematical communication skills in every aspect of representation, listening, reading, discussion, and writing were at a high level. Namely, the average mathematical communication was 75%. Mathematical communication skills are divided into three levels: high, medium, and low. Determination of the level of students' mathematical communication skills is based on the score of each aspect. The assessment score is shown in Table 1.

This study's learning outcomes were the circle material's cognitive aspects using the CORE learning model. The completeness of mathematics learning outcomes refers to the Minimum Completeness Criteria determined by the school, namely student scores $\geq$80 and class average, namely class average $\geq$85.

3 Result

Classroom action research has been conducted at SMPN 1 Jombang in class VIII to improve mathematical communication and mathematics learning outcomes through applying the CORE learning model. Mathematical communication refers to several

Table 1. Mathematical Communication Score in the application of the CORE Learning Model

Skor	Representation	Listening	Reading	Discussion	Writing
1	Does not show pictures, tables, or diagrams in the answers	Students do not respond when there are questions	I cannot understand the meaning of the question	Not following the discussion that the group has done	Do not make notes of the results of the answers or group discussions
2	Just give a few pictures, tables, and diagrams in the answers	Giving a response but not following the question given	Only a little can be understood from the content of readings and questions	Only slightly involved in group discussion	Just make a few notes of the meeting and the results of group discussions
3	Provide pictures, tables, and diagrams in the answers but not yet correct	Respond correctly but takes a long time	Able to understand most of the meaning of the question	Participate in group discussions but tend to be less active	Make notes from the results of meetings and group discussions but not systematically
4	Provide pictures, tables, and diagrams on answers entirely and correctly	Give a fast response, and the answer is correct	Able to understand all the meaning of the question and able to convey ideas	Actively participate in the group discussion process	Make notes systematically about the results of meetings and discussions.

aspects, namely, representation, listening, reading, discussion, and writing in the 2021–2022 school year.

While applying the CORE learning model, the researcher provided material on the tangent lines of the outer and inner circles. Students are given several examples of contextual problems to connect their experiences to the material (Connecting stage). Furthermore, students were formed into four groups, where each group consisted of 4 students who were heterogeneous in terms of mathematical ability. Each group is given a contextual problem that needs to be solved as a group (organizing stage). The results of group discussions are presented alternately in front of the class, and other groups respond to the results given by the presenter (Reflection stage). Furthermore, finally, each student is allowed to convey the results of the summary of the material they have with a conclusion (Extending stage).

During the discussion and presentation, the researcher made observations about students' mathematical communication skills which were viewed from several aspects, namely representation, listening, reading, discussion and writing. The researcher gave a

score to each student following the guidelines for assessing mathematical communication skills. In addition, the researcher also conducted several questions and answers to several students who presented the results of group answers to get a descriptive description of mathematical communication skills.

3.1 Class VIII Students' Mathematical Communication Skills Through the Application of the CORE Learning Model

The improvement of mathematical communication skills of class VIII students as many as 16 people through the application of the Connecting, Organizing, Reflecting and Extending (CORE) learning model by comparing the results in cycle one and cycle two on the representation aspect shown in Fig. 1.

Based on Fig. 1, the percentage of each score on the representation aspect of students' mathematical abilities from cycles 1 and 2 has increased. In cycle 1, many students got a score of 1 of 12.5%, many got a score of 2 of 56.25%, many got a score of 3 of 18.75%, and many got a score of 4 of 12.5%. While in cycle 2, many students got a score of 1 of 0%, and many got a score of 2 of 12.5%. Many got a score of 3 of 43.75%, and many got a score of 4 of 43%. This shows that applying the CORE learning model can improve students' mathematical communication skills in the representation aspect very well because, in the second cycle, there are no students who get a score of 1.

Mathematical communication skills in the listening aspect through the CORE model from cycles 1 and 2 are shown in Fig. 2.

Based on Fig. 2, the percentage of each score on the listening aspect of students' mathematical abilities from cycles 1 and 2 has increased. In cycle 1, many students got a score of 1 of 18.75%, many got a score of 2 of 50%, many got a score of 3 of 18.75%, and many got a score of 4 of 12.5%. While in cycle 2, many students got a score of 1 of 6.25%, many got a score of 2 of 18.75%, many got a score of 3 of 31.25%, and many got a score of 4 of 43.75%. This shows that applying the CORE learning model can improve

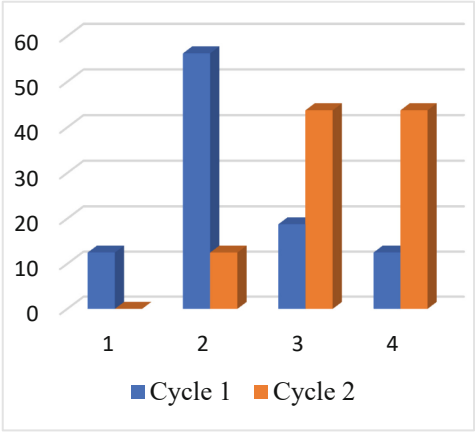

Fig. 1. Improved Mathematical Communication Ability Aspects of Representation in Cycles 1 and 2

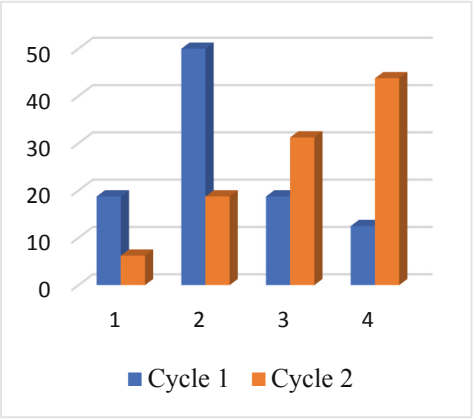

Fig. 2. Improving Listening Aspects of Mathematical Communication Skills in Cycles 1 and 2

students' mathematical communication skills in the listening aspect quite well because there are still students who get a score of 1 as much as 1.

Mathematical communication skills in the reading aspect through the CORE model from cycles one and two are shown in Fig. 3.

Based on Fig. 3, the percentage of each score on the reading aspect of students' mathematical communication skills from cycles 1 and 2 has increased. In cycle 1, many students got a score of 1 of 43.75%, many got a score of 2 of 18.75%, many got a score of 3 of 31.25%, and many got a score of 4 of 6.25%. While in cycle 2, many students got a score of 1 of 0%, many got a score of 2 of 6.25%, many got a score of 3 of 37.50%, and many got a score of 4 of 56.25%. This shows that the application of the CORE learning model can improve students' mathematical communication skills in the representation aspect very well because, in the second cycle, there are no students who get a score of 1, and a significant increase in the number of students who get a score of 4 in cycle 2.

In the discussion aspect, mathematical communication skills through the CORE learning model from cycles 1 and 2 are shown in Fig. 3.

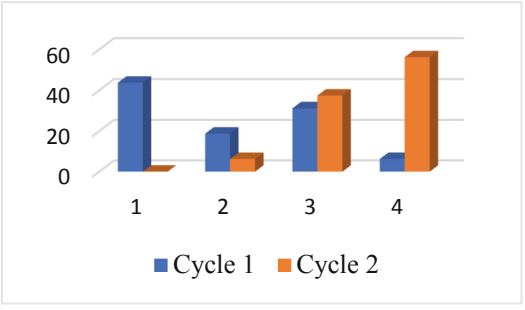

Fig. 3. Improved Mathematical Communication Ability Reading Aspects in Cycles 1 and 2

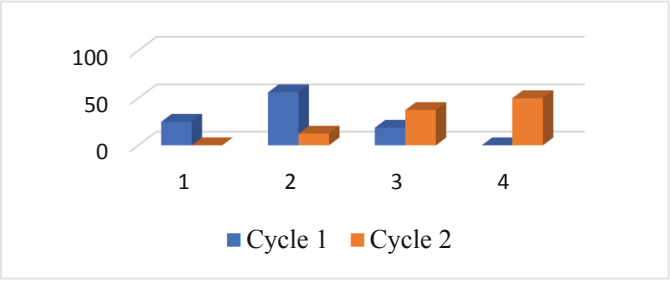

Fig. 4. Improved Mathematical Communication Ability Discussion Aspects in Cycles 1 and 2

Based on Fig. 4, the percentage of each score on the discussion aspect of students' mathematical communication skills from cycles 1 and 2 has increased. In cycle 1, many students got a score of 1 at 25%, a score of 2 at 56.25%, a score of 3 at 18.75%, and many students got a score of 4 at 0%. While in cycle 2, many students got a score of 1 of 0%, many got a score of 2 of 12.5%, many got a score of 3 of 37.50%, and many got a score of 4 of 50%. This shows that the application of the CORE learning model can improve students' mathematical communication skills in the discussion aspect very well because, in the second cycle, there are no students who get a score of 1, and a significant increase in the number of students who get a score of 4 in cycle 2.

Finally, mathematical communication skills in the writing aspect through the CORE learning model from cycles 1 and 2 are shown in Fig. 5.

Based on Fig. 4, the percentage of each score on the writing aspect of students' mathematical communication skills from cycles 1 and 2 has increased. In cycle 1, many students got a score of 1 of 0%, a score of 2 of 50%, a score of 3 of 50%, and a score of 4 of 0%. While in cycle 2, many students got a score of 1 of 0%, many got a score of 2 of 0%, many got a score of 3 of 31.25%, and many got a score of 4 of 68.75%. This shows that the application of the CORE learning model can improve students' mathematical communication skills in the writing aspect very well because, in the second cycle, there are no students who get a score of 1, and a significant increase in the number of students who get a score of 4 in cycle two which exceeds 50%.

The overall improvement in mathematical communication skills compared between cycle one and cycle 2 in each aspect of each category is shown in Fig. 6.

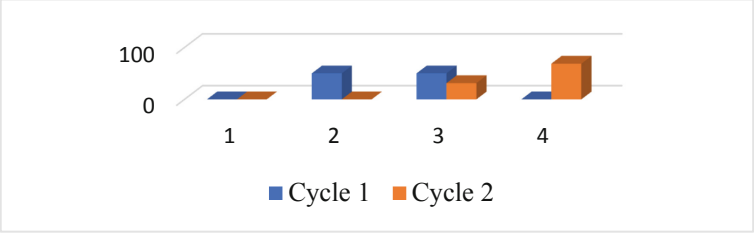

Fig. 5. Improved Mathematical Communication Ability Writing Aspects in Cycles 1 and 2

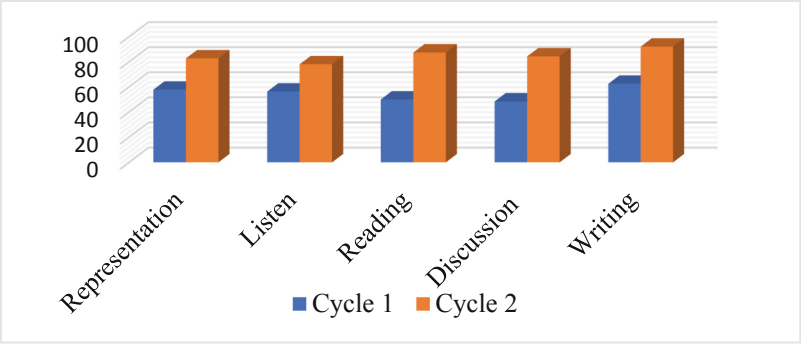

Fig. 6. Improving Mathematical Communication Skills through the CORE Learning Model

Based on Fig. 6, the mathematical communication ability, which refers to the representation aspect, has increased from cycles 1 to 2. Where in cycle one, the students' representation results are 57.81% or moderate category, while in cycle two, it is 82.81% or category tall. This indicates an increase of 25%. This means that applying the CORE learning model is very good in improving students' representational abilities.

The students' mathematical communication ability, which refers to the listening aspect through the application of the CORE model, shows that in the first cycle, the percentage is 56.25% or the medium category, and in the second cycle, it is 78.13% or the high category. This shows that students' listening ability has increased by 21.88% during the application of the CORE learning model.

Mathematical communication ability refers to the reading aspect through the application of the CORE model that in cycle one, it is 50% or in the medium category, and in cycle two, it is 87.50%. This shows that applying the CORE model can increase students' reading ability by 37.50%. The CORE learning model applied to class VIII students can develop and improve reading skills, especially at the Organizing stage.

Mathematical communication ability, which refers to the discussion aspect through the application of the CORE model in cycle 1, is 48.44% or low category, while in cycle two, it is 84.38% or high category. The increase in mathematical communication skills in the discussion aspect through the CORE learning model from cycle 1 to cycle 2 is 35.94%. This shows that the Organizing and Reflecting stages of the CORE learning model can improve students' communication skills in the discussion aspect.

The mathematical communication skills of students who refer to the writing aspect through the application of the CORE model show that in the first cycle, the percentage is 62.50% or the medium category, and in the second cycle, it is 92.19%, or the high category. This shows that students' writing ability has increased by 29.69% during the application of the CORE learning model.

Overall, that through the application of the CORE learning model students' mathematical communication skills have increased. This is because at the organizing stage, where each student interacts personally or in groups to convey ideas during problem solving. In addition, students also experienced an increase in mathematical communication when presenting answers in front of the class and when conducting class discussions.

Table 2. Learning Outcomes Through Application of the CORE Model.

cycles	∑ Learners	∑ PD Complete	Prosentase (%)	∑ PD Not Complete	Persentage (%)
1	16	6	37.5%	10	62.5%
2	16	11	68.75%	5	31.25%

3.2 Mathematics Learning Outcomes of Class VIII Students Through the Application of the CORE Learning Model

Mathematics learning outcomes analyzed in this study are cognitive aspects. The results of the analysis on cognitive aspects during the application of the CORE learning model by comparing the completeness in cycle one and cycle two are presented.

Based on Table 2, there is an improvement in the analysis of mathematics learning outcomes based on the tests given in cycle one and cycle 2. Mathematics learning outcomes in the cognitive aspect in cycle 1 through the implementation of learning through the CORE model on 16 students there are six students in the complete category and ten students in the incomplete category so that the percentage of classical completeness is 37.5%. In cycle 2, there were 11 students in the complete category and five in the incomplete category, so the percentage of classical completeness was 68.75%. The average student learning achievement in cycle 1 is 68.69, while the average learning outcome in cycle 2 is 86. This indicates that the CORE learning model effectively improves mathematical communication skills and student learning outcomes.

Based on the research results above, the CORE learning model effectively improves students' mathematical communication skills, especially in representation, reading, discussion, writing, and listening. This follows research [16, 17] that the CORE model emphasizes more on student activities, especially during discussions. Students interact more with peers to exchange ideas and ideas. Furthermore, in developing mathematical communication skills during learning, of course, the teacher has an essential role so that students can explore it optimally, which is associated with critical thinking processes and creative thinking [5, 11, 12].

4 Conclusion

Based on the study's results, it was shown that the application of the CORE learning model could improve mathematical communication skills and learning outcomes of junior high school students. The average mathematical communication ability in cycle 1 is 55% or the medium category, while in cycle 2, it is 85% or in the high category, so the increase in mathematical communication skills is 30%. The average student learning outcomes in cycle 1 are 68.69, while the average learning outcomes in cycle 2 are 86. This indicates that the CORE learning model effectively improves mathematical communication skills and student learning outcomes.

Acknowledgments. The researcher expresses his gratitude to the head of STKIP PGRI Jombang who has provided motivation and support to researchers. The researcher also thanked the principal of SMPN 1 Jombang for granting the research permit.

Authors' Contributions. Author 1 contributes to developing research instruments and concepts. Author 2 performs data processing, and author 3 contributes by presenting data and representing research results. The researcher's contribution is adjusted to the field and expertise.

References

1. J. Gammath, "PENERAPAN MODEL CORE DALAM," vol. I, no. September, pp. 33–40, 2016.
2. M. Okur and H. H. Bahar, "Learning styles of primary education prospective mathematics teachers; states of trait-anxiety and academic success," *Procedia - Soc. Behav. Sci.*, vol. 2, no. 2, pp. 3632–3637, 2010, doi: https://doi.org/10.1016/j.sbspro.2010.03.565.
3. P. Aunio, J. Korhonen, L. Ragpot, M. Törmänen, and E. Henning, "An early numeracy intervention for first-graders at risk for mathematical learning difficulties," *Early Child. Res. Q.*, vol. 55, pp. 252–262, 2021, doi: https://doi.org/10.1016/j.ecresq.2020.12.002.
4. J. Trickett *et al.*, "The role of parent-led and child-led home numeracy activities in early mathematical skills," *Cogn. Dev.*, vol. 63, no. April, p. 101189, 2022, doi: https://doi.org/10.1016/j.cogdev.2022.101189.
5. E. S. Utomo and F. Rahman, "Implementasi Model CORE (Connecting , Organizing , Reflecting , Extending) untuk Meningkatkan Aktivitas Siswa SMP Selama Pembelajaran Tatap Muka (PTM) Terbatas," vol. 06, no. 02, pp. 1935–1945, 2022.
6. S. Darihastining, E. S. Utomo, and Chalimah, "The effectiveness of communication and online language disruption during the era of pandemic covid-19 in senior high school students in implementation of learning cycle 7e," *J. Phys. Conf. Ser.*, vol. 1722, p. 012024, 2021, doi: https://doi.org/10.1088/1742-6596/1722/1/012024.
7. B. Basori, "Efektifitas Komunikasi Pembelajaran Online Dengan Menggunakan Media E-Learning Pada Perkuliahan Body Otomotif," *J. Ilm. Pendidik. Tek. dan Kejuru.*, vol. 7, no. 2, pp. 39–45, 2017, doi: https://doi.org/10.20961/jiptek.v7i2.12722.
8. R. A. Nurhasanah, Waluya, and I. Kharisudin, "Kemampuan Komunikasi Matematis dalam Menyelesaikan Masalah Soal Cerita," *Semin. Nas. Pascasarj. 2019*, no. 2017, pp. 769–775, 2019.
9. M. Kholil and E. D. Putra, "Kemampuan Komunikasi Matematis Siswa Dalam Menyelesaikan Soal PISA Konten Space And Shape," *Indones. J. Math. Nat. Sci. Educ.*, vol. 1, no. 1, pp. 53–64, 2019, doi: https://doi.org/10.35719/mass.v1i1.6.
10. K. D. Harahap, "Pengaruh Model Core (Connecting , Organizing , Reflecting , Extending) Terhadap Berpikir Kritis Peserta Didik Pada Kelas V Sd Negeri 112224 Kota Pinang," vol. 1, no. November, pp. 1–14, 2021.
11. D. Safitri, S. Handayani, and N. Umamah, "Penerapan Model Connecting , Organizing , Reflecting , dan Extending (CORE) Untuk Meningkatkan Kreativitas dan Hasil Belajar Sejarah Peserta Didik Kelas X3 SMAN 1 Bangorejo Tahun Ajaran 2013 / 2014 The Application of Model Connecting , Organizing , Refl," *Edukasi Unej*, vol. I, no. 2, pp. 10–14, 2014.

12. K. D. Harahap, F. Keguruan, D. A. N. Ilmu, U. Muhammadiyah, and S. Utara, "Pengaruh Model Core (Connecting , Organizing , Reflecting , Extending) Terhadap Berpikir Kritis Peserta Didik Pada Kelas V Sd Negeri 112224 Kotapinang," vol. 1, no. November, pp. 1–14, 2021.
13. K. W. Wardika, K. Udy Ariawan, I. Putu, and S. Arsa, "Penerapan Model CORE (Connecting, Organizing, Reflexting, Extending) Meningkatkan Hasil Aktivitas Belajar Perakitan Komputer Kelas XTkj2," *J. Pendidik. Tek. Elektro Undiksha*, vol. 6, no. 3, pp. 127–136, 2017, [Online]. Available: https://ejournal.undiksha.ac.id/index.php/JJPTE/article/view/20856.
14. I. S. Nasution and B. S. Samosir, "Model Pembelajaran Connecting, Organizing, Reflecting, Dan Extending (Core) Untuk Meningkatkan Kreativitas Siswa Di Smk Muhammadiyah 13 Sibolga," *PeTeKa*, vol. 1, no. 3, p. 213, 2018, doi: https://doi.org/10.31604/ptk.v1i3.213-221.
15. J. W. Creswell, *Research Design Qualitative, Quantitative, and Mixed Methods Approaches*. 1386.
16. E. Luksiana and J. P. Purwaningrum, "Model Pembelajaran Core untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Berbantuan Media Batik," *ANARGYA J. Ilm. Pendidik. Mat.*, vol. 1, no. 2, pp. 98–102, 2018, doi: https://doi.org/10.24176/anargya.v1i2.2936.
17. A. A. P. Rosyadi, C. Sadijah, S. Susiswo, and S. Rahardjo, "Berpikir Kritis Calon Guru Dalam Menyelesaikan Masalah Kontroversial Matematika Dengan Menggunakan High Order Thinking Skills," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 10, no. 4, p. 1973, 2021, doi: https://doi.org/10.24127/ajpm.v10i4.4082.