

EFFECT OF THE CONTEXTUAL TEACHING AND LEARNING APPROACH ON THE MATHEMATICAL COMMUNICATION SKILLS OF EIGHTH-GRADE STUDENTS

Nisrina Wulandari¹, Yerizon², Armianti³, Yarman⁴

^{1,2,3,4}Pendidikan Matematika, Universitas Negeri Padang

Email: ¹nisrinawulandari0407@gmail.com, ²yerizon@fmipa.unp.ac.id,

³armiati@fmipa.unp.ac.id, ⁴yarman@fmipa.unp.ac.id

Abstract: *Mathematical communication is an essential aspect of mathematics learning because students need to express mathematical ideas, explain their reasoning, and represent problems using appropriate mathematical forms. This study examined whether the Contextual Teaching and Learning (CTL) approach produced different mathematical communication outcomes from conventional instruction among eighth-grade students at SMPN 20 Padang. A quasi-experimental study was conducted using a Nonequivalent Posttest-Only Control Group Design. The participants were 59 students, comprising 29 students in the experimental group and 30 students in the control group. The experimental group received instruction based on CTL, whereas the control group was taught through conventional instruction. Students' mathematical communication skills were measured using a four-item essay test administered at the end of the learning process. Prior to hypothesis testing, the data were examined for normality and homogeneity, followed by a one-tailed t-test using Minitab. The analysis showed that the data satisfied the required normality and homogeneity assumptions. The hypothesis test produced a P-value of 0.034, which was lower than the significance level of 0.05; therefore, H_0 was rejected. The experimental group obtained a mean score of 18.35, while the control group achieved 16.00. The results provide evidence of a significant difference in mathematical communication skills between students learning through CTL and those receiving conventional instruction.*

Keywords: *Mathematical Communication Skills, Contextual Teaching and Learning (CTL), Quasi-Experimental Research, Mathematics Learning*

Abstrak: Kemampuan komunikasi matematis merupakan salah satu aspek penting dalam pembelajaran matematika karena peserta didik perlu mengungkapkan ide, menjelaskan proses berpikir, serta merepresentasikan permasalahan dalam bentuk matematika yang tepat. Penelitian ini bertujuan untuk mengetahui perbedaan kemampuan komunikasi matematis peserta didik kelas VIII SMPN 20 Padang antara pembelajaran yang menggunakan pendekatan *Contextual Teaching and Learning* (CTL) dan pembelajaran konvensional. Penelitian dilaksanakan dengan metode kuasi eksperimen menggunakan desain *Nonequivalent Posttest-Only Control Group Design*. Subjek penelitian berjumlah 59 peserta didik yang terdiri atas 29 peserta didik pada kelompok eksperimen dan 30 peserta didik pada kelompok kontrol. Kelompok eksperimen memperoleh pembelajaran dengan pendekatan CTL, sedangkan kelompok kontrol mengikuti pembelajaran konvensional. Kemampuan komunikasi matematis diukur melalui tes akhir berupa empat soal esai yang diberikan setelah proses pembelajaran selesai. Sebelum pengujian hipotesis, data terlebih dahulu dianalisis melalui uji normalitas dan homogenitas, kemudian dilanjutkan dengan uji-t satu pihak menggunakan bantuan *Minitab*. Hasil analisis menunjukkan bahwa data kedua kelompok memenuhi asumsi normalitas dan homogenitas. Pengujian hipotesis menghasilkan *P-value* sebesar 0,034 yang lebih kecil daripada taraf signifikansi 0,05 sehingga H_0 ditolak. Rata-rata skor kelompok eksperimen sebesar 18,35, sedangkan kelompok kontrol sebesar 16,00. Hasil tersebut menunjukkan adanya perbedaan yang signifikan dalam kemampuan komunikasi matematis antara peserta didik yang

memperoleh pembelajaran dengan pendekatan CTL dan peserta didik yang memperoleh pembelajaran konvensional.

Kata kunci: Kemampuan Komunikasi Matematis, *Contextual Teaching and Learning* (CTL), Kuasi Eksperimen, Pembelajaran Matematika

INTRODUCTION

Mathematics is an integral part of education in Indonesia and contributes to the development of students' reasoning abilities. Its role in the classroom extends beyond teaching students to carry out numerical operations, as mathematics learning is also expected to cultivate logical, critical, systematic, and analytical ways of thinking. One of the competencies that supports these objectives is mathematical communication. Through this competency, students are expected to communicate mathematical ideas, describe the procedures used to solve problems, employ symbols and other forms of mathematical representation, and construct logical explanations both verbally and in writing. The *National Council of Teachers of Mathematics* (NCTM, 2000) places communication among the process standards that are essential in mathematics education. Therefore, mathematics instruction should not focus exclusively on whether students arrive at the correct answer or master computational procedures. It should also create learning opportunities in which students can express their mathematical thinking and communicate the reasoning underlying their solutions in a clear and organized way.

Mathematical communication is manifested through both written and oral interactions during mathematics learning. Through written communication, students have an opportunity to record, organize, and elaborate their mathematical thinking, which may support a deeper understanding of the concepts under discussion. Oral communication, on the other hand, enables students to convey their perspectives, justify their reasoning, and discuss mathematical arguments with others

(Hendriana et al., 2017). The ability to communicate mathematically also allows students to represent a problem in different mathematical forms, which can assist them in considering and selecting appropriate solution strategies.

Despite its importance, mathematical communication remains an area in which many Indonesian students experience difficulties. Amalia and Dwidayati (2020) found that students still struggled to present their mathematical ideas in a logical and well-organized sequence when working on problems. This condition was also reported by Andini and Marlina (2021), who found that junior high school students' mathematical communication achievement was still relatively low, at $\leq 33\%$. Similar problems have been observed at higher levels of education. Tina et al. (2025), for example, reported that 55.5% of senior high school students demonstrated low mathematical communication skills when studying trigonometry. These findings highlight the importance of learning activities that require students to communicate how they obtain an answer, use appropriate mathematical representations, and provide clear explanations of their reasoning, rather than concentrating only on the correctness of the final result.

Evidence of limited mathematical communication has been reported in various mathematical topics and across different levels of education. Chasanah (2020) identified an association between students' written mathematical communication abilities and their cognitive styles, suggesting that instructional practices need to consider differences in the ways students process and communicate mathematical information. In the study of relations and functions, Cahyati et al. (2021) likewise

found that junior high school students' reasoning and mathematical communication abilities were still relatively low. Comparable difficulties were identified by Dewi et al. (2021) in circle geometry, particularly in students' ability to communicate mathematical ideas, which was examined in relation to gender differences.

Students' mathematical communication is shaped not only by their individual characteristics but also by the instructional environment in which learning takes place. Evidence from Hanipah and Sumartini (2021), who compared *Problem Based Learning* with *Direct Instruction*, shows that involving students actively in classroom activities is associated with the development of their mathematical communication skills. Communication difficulties have also been documented in specific mathematical content. Syah and Sofyan (2021), for instance, identified such difficulties in the learning of quadrilaterals and triangles. Anggraeni and Sundayana (2021) further reported a relationship between students' mathematical communication skills and their level of learning independence. Similar challenges have emerged when students work with cubes and cuboids as well as systems of linear equations in two variables. Hakiki and Sundayana (2022) and Sulastri and Sofyan (2022) found that students still encountered problems when converting contextual information into suitable mathematical symbols or representations. These difficulties may also be associated with students' cognitive characteristics. Nugroho and Toyib (2023) reported that students with a *field-dependent* cognitive style experienced limitations in communicating mathematical ideas through visual and symbolic representations. In addition, Ikhsan and Afriansyah (2023) documented low mathematical communication skills among junior high school students learning sets, while Pratiwi et al. (2023) reported similar conditions among elementary school students.

The way learning activities are organized can therefore play an important role in creating opportunities for students to communicate mathematical thinking. Arwadi (2023) and Berliana and Sholihah (2023) found that instructional activities involving active student participation were associated with better mathematical communication outcomes than conventional instruction. Beyond communication itself, Dwitasari and Yudhanegara (2024) identified a strong relationship between students' mathematical communication skills and their problem-solving abilities. In this sense, the ability to represent and explain mathematical ideas is closely connected with how students interpret problems and develop solutions. Learning environments that require students to communicate their reasoning may consequently provide greater opportunities for the development of both communication and problem-solving processes.

One instructional approach that emphasizes meaningful learning experiences is *Contextual Teaching and Learning* (CTL). Previous research has reported positive findings concerning the use of contextual learning in mathematics. Hakim and Ardiyanti (2025), through a literature review, found that CTL was consistently associated with improved students' mathematical conceptual understanding when compared with conventional learning. Sabri et al. (2026) similarly reported that students who were given opportunities to formulate and solve problems situated in real-life contexts demonstrated higher mathematical communication skills than students in the control group. Taken together, these findings provide an indication that learning which relates mathematical concepts to students' everyday experiences and involves them actively in the learning process may create favorable conditions for developing mathematical communication. However, research specifically addressing the effect of the CTL approach on the mathematical communication skills of eighth-grade

junior high school students is still limited. Therefore, the present study was conducted to examine the effect of *Contextual Teaching and Learning* on the mathematical communication skills of eighth-grade students at SMPN 20 Padang.

Preliminary information obtained at SMPN 20 Padang revealed that the mathematical communication difficulties reported in earlier studies were also present among eighth-grade students. Although classroom instruction had generally followed the intended stages of learning, students still showed limitations in communicating the mathematical concepts they had acquired. Interviews and initial observations indicated that students often had difficulty explaining concepts in their own words, organizing the steps of a solution, and selecting appropriate mathematical symbols or representations. Their involvement in classroom discussions was also limited, which consequently reduced opportunities to share ideas and explain mathematical reasoning. These conditions suggest that mathematics instruction needs to accommodate not only students' ability to obtain correct answers but also their ability to communicate the thinking behind those answers. Purnama and Afriansyah (2016) described a learning strategy as a means used by educators to plan and organize the various activities involved in the learning process.

Further evidence was obtained from an initial assessment involving 224 seventh-grade students on linear equations and inequalities in one variable. The results showed that most students could perform the required mathematical procedures and obtain solutions. However, the written work indicated that the reasoning supporting those solutions was not adequately communicated. Most responses focused on calculations, with relatively few students providing explanations in their own words, drawing complete conclusions, or presenting their reasoning in a well-organized sequence. Difficulties became more apparent when students were presented with contextual

problems requiring the construction of mathematical models. Students encountered obstacles in determining the relevant information from the problem, representing the context mathematically, and arranging the solution process in a logical sequence.

The findings from the preliminary assessment pointed to the need for an instructional approach that provides students with greater opportunities to participate, communicate, and relate mathematical concepts to meaningful situations. *Contextual Teaching and Learning* (CTL) offers such an approach by linking classroom knowledge with circumstances that students may encounter in their everyday lives. By engaging directly with contextual situations, students can take a more active role in learning instead of primarily receiving explanations and recording information from the teacher (Nababan & Sipayung, 2023). Kismatun (2021) explained that CTL allows teachers to introduce mathematical material through contexts familiar to students and to guide them in recognizing how the knowledge they acquire can be used in everyday situations. Consequently, learning is directed not only toward achieving an understanding of the competencies presented in class but also toward enabling students to apply that knowledge in real-life contexts (Hamid et al., 2024).

The CTL approach consists of seven related components: constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment (Hasibuan, 2014). Through these components, students are encouraged to develop knowledge from their own learning experiences rather than relying solely on information transmitted by the teacher. Group-based learning also creates space for students to collaborate and develop critical and creative thinking while working on mathematical tasks. More importantly, these activities provide repeated opportunities for students to communicate mathematical ideas, clarify their reasoning, ask questions, and

exchange interpretations of mathematical concepts with their classmates.

The emphasis of CTL on meaningful contexts, active participation, interaction, and reflection corresponds with the characteristics required to develop mathematical communication skills. On this basis, the present study was undertaken to examine the effect of the *Contextual Teaching and Learning* (CTL) approach on the mathematical communication skills of eighth-grade students at SMPN 20 Padang. The study specifically compares the mathematical communication skills achieved by students who learn through CTL with those of students who receive conventional instruction.

METHOD

A quasi-experimental study was conducted to compare two instructional conditions. The experimental group was taught through the *Contextual Teaching and Learning* (CTL) approach, while the control group participated in conventional mathematics instruction. The study used a *Nonequivalent Posttest-Only Control Group Design*. This design was appropriate because the students were members of pre-existing classes, so assigning individual students randomly to different groups was not feasible. Throughout the treatment period, CTL was applied in the experimental class and conventional instruction was maintained in the control class. At the end of the instructional period, a *posttest* was administered to students in both groups to measure their mathematical communication skills.

The population included 317 eighth-grade students at SMPN 20 Padang in the 2026/2027 academic year, who were distributed among 10 classes. Before determining the sample, the classes were examined to identify groups with comparable mean abilities. This preliminary procedure involved testing the data for normality using the *Anderson–*

Darling test, assessing variance homogeneity with the *Bartlett* test, and comparing the class means through one-way ANOVA. All analyses were performed with *Minitab*. Once the required criteria had been fulfilled, two classes were chosen through *simple random sampling*. The selected groups comprised 29 students in the experimental class and 30 students in the control class.

The study involved two main variables. The instructional treatment served as the independent variable, with CTL applied to the experimental group and conventional instruction used in the control group, whereas students' mathematical communication skills constituted the dependent variable. Measurement of the dependent variable was carried out using a *posttest* containing four essay items. The test was constructed according to three indicators of mathematical communication: (1) explaining mathematical ideas or solution procedures for a problem through concrete objects, pictures, or algebraic expressions; (2) transforming situations, concrete objects, pictures, or diagrams into mathematical ideas; and (3) representing problems or situations from everyday life using mathematical symbols or mathematical models.

The suitability of the research instrument was established through a series of evaluation procedures before its application in the study. Two expert lecturers were involved in the initial validation of the instrument. The validated items were subsequently subjected to an item analysis covering discrimination and difficulty levels, while the reliability of the instrument was assessed using the Alpha formula. The results showed that the items possessed discrimination indices ranging from adequate to very good, with all items falling within the moderate difficulty category. The reliability analysis also confirmed that the instrument met the required reliability criteria. Accordingly, the entire set of items was deemed suitable for use as the research instrument.

The instructional treatment was implemented in both groups for six meetings, followed by the administration of the *posttest* during the seventh meeting. After the data had been obtained, statistical analysis was carried out sequentially. The first stage involved the *Anderson–Darling* test to examine normality, followed by the F-test to assess the homogeneity of variances between the two groups. The latter analysis was conducted to establish whether the equal-variance assumption required for the subsequent hypothesis test was satisfied. After these prerequisite tests were completed, the research hypothesis was evaluated using a one-tailed right-sided t-test at $\alpha = 0.05$. The statistical

procedures were conducted with the assistance of *Minitab* software.

RESULTS AND DISCUSSION

Final Test Results of Mathematical Communication Skills

Upon completion of the instructional treatment, a four-item essay *posttest* was given to both groups to measure students' mathematical communication skills. The experimental class consisted of 29 students, whereas the control class consisted of 30 students. The descriptive statistics obtained from the *posttest* are summarized in Table 1.

Table 1. Mathematical Communication Skills Test Results of the Sample Groups

Group	Number of Students	Mean	Standard Deviation	Highest Score	Lowest Score
Experimental	29	18,35	3,26	15,00	1,80
Control	30	16,00	3,37	14,52	1,30

As shown in Table 1, the experimental group obtained a mean score of 18.35, whereas the corresponding mean for the control group was 16.00. The two groups also differed in terms of their score ranges. The highest score recorded by the experimental group was 15.00, compared

with 14.52 in the control group, while the lowest scores were 1.80 and 1.30, respectively. The distribution of achievement according to each mathematical communication indicator is presented in Table 2.

Table 2. Mean Scores for Each Indicator of Mathematical Communication Skills

Indicator	Maximum Score	Experimental Class Mean	Control Class Mean
1 (question 3)	4	2,44	1,62
2 (question.2)	4	2,56	2,44
2 (question 4)	4	2,01	1,19
3 (question 1)	4	3,10	2,99

Table 2 shows that the mean score obtained by the experimental group was higher than that of the control group on each of the assessed mathematical communication indicators. The differences in achievement were subsequently examined through statistical tests to determine whether the observed results were statistically significant.

Hypothesis Test Assumption Tests

Before the research hypothesis was tested, the *posttest* data were first examined to determine whether they

satisfied the statistical assumptions required for further analysis. The normality test results for both groups are presented in Table 3.

Table 3. Normality Test Results for the Sample Groups

Group	P-value	Description
Experimental	0,127	Normally distributed data
Control	0,881	Normally distributed data

The *Anderson–Darling* analysis resulted in *P-values* of 0.127 for the experimental group and 0.881 for the control group. Both values were greater than 0.05. Thus, the posttest data for the experimental and control groups satisfied the normality assumption.

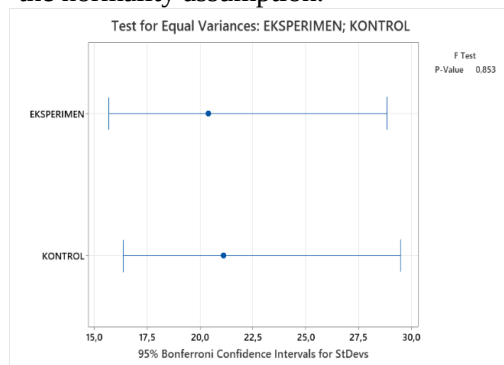


Figure 1. Homogeneity Test of Mathematical Communication Skills Test Data for the Sample Groups

The variance homogeneity analysis resulted in a *P-value* of 0.853. Because this value exceeded 0.05, the variances of the two groups were regarded as homogeneous. With both prerequisite assumptions fulfilled, the analysis proceeded to hypothesis testing using a one-tailed right-sided t-test at $\alpha = 0.05$. The resulting *P-value* was 0.034, which was lower than 0.05. Based on this result, H_0 was rejected.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
EKSPERIMEN	29	63.3	20.4	3.8
KONTROL	31	51.6	21.1	3.8

Estimation for Difference

Difference	95% CI for Difference
11.67	(0.94; 22.40)

Test

Null hypothesis		$H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis		$H_1: \mu_1 - \mu_2 \neq 0$
T-Value	DF	P-Value
2.18	57	0.034

Figure 2. Research Hypothesis Testing

The statistical analysis demonstrated a significant difference in mathematical communication skills between the experimental and control groups. The mean score obtained by students who learned through the *Contextual Teaching*

and Learning (CTL) approach was 18.35, compared with 16.00 among students receiving conventional instruction. These findings indicate that the implementation of CTL was associated with significantly higher mathematical communication skills among eighth-grade students at SMPN 20 Padang than conventional instruction.

Discussion

The posttest findings reveal differences in students' mathematical communication performance following the two instructional approaches. Across the three indicators examined, the experimental group consistently obtained higher mean scores than the control group. On the first indicator, students exposed to CTL were better able to communicate mathematical ideas and describe solution procedures using algebraic representations. Their responses showed that they could determine the first term and common ratio and use these quantities to apply the geometric series concept in obtaining the required solution. In the control group, some students succeeded in finding the ratio but did not complete the subsequent stages of the solution, resulting in incomplete answers.

Performance on the second indicator also showed a difference between the groups. Students in the experimental class were generally more successful in recognizing patterns presented in the problems and relating information from situations or visual representations to the corresponding mathematical concepts, including remainders and geometric series. However, some students still experienced difficulties in arranging their mathematical ideas into a clear and systematic explanation. On the third indicator, the experimental group showed better performance in converting contextual information into mathematical representations. For instance, a situation describing an increase in the number of seedlings in each planting bed could be expressed progressively through mathematical symbols and an arithmetic sequence model until the required solution

was obtained. The finding is in line with Sabri et al. (2026), who reported higher mathematical communication performance among students involved in learning activities based on real-life contexts than among students in the control group.

The observed differences can be related to the learning characteristics promoted by CTL. Rather than receiving mathematical information primarily through teacher explanations, students are engaged in activities that require them to connect mathematical concepts with situations from everyday life. They are also given opportunities to investigate relationships, formulate and respond to questions, discuss their findings with peers, and reflect on the solutions they have developed. Such activities provide a setting in which students can practice communicating mathematical ideas, explaining the procedures they follow, and representing their thinking in different mathematical forms. The higher posttest mean obtained by the experimental group is consistent with this pattern. Moreover, the statistical analysis produced a *P-value* of 0.034, which was below $\alpha = 0.05$. This result provides statistical evidence of a significant difference in mathematical communication skills between students who received CTL-based instruction and those who received conventional instruction.

CONCLUSION

Based on the results of the study, the mathematical communication skills of eighth-grade students at SMPN 20 Padang differed between the group taught using the *Contextual Teaching and Learning* (CTL) approach and the group taught through conventional instruction. The experimental group obtained a higher mean posttest score than the control group, and the hypothesis test produced a *P-value* of $0.034 < 0.05$. These results indicate that the implementation of CTL had a significant effect on the mathematical

communication skills of eighth-grade students at SMPN 20 Padang.

REFERENCES

- Amalia, D., & Dwidayati, N. K. (2020). Mathematical communication ability viewed from mathematical anxiety in Team Assisted Individualization using Edmodo. *Unnes Journal of Mathematics Education*, 9(3), 176–184.
<https://doi.org/10.15294/ujme.v9i3.42925>
- Anggraeni, N. S., & Sundayana, R. (2021). Kemampuan Komunikasi Matematis Siswa dengan Pembelajaran Kooperatif Tipe Group Investigation dan Team Quiz Ditinjau dari Kemandirian Belajar. *Plusminus: Jurnal Pendidikan Matematika*, 1(3), 469–480.
<https://doi.org/10.31980/plusminus.v1i3.950>
- Arwadi, F. (2023). Efektivitas Aplikasi Everyone is a Teacher Here dalam Meningkatkan Kemampuan Komunikasi Matematis Siswa. *Plusminus: Jurnal Pendidikan Matematika*, 3(2).
<https://doi.org/10.31980/plusminus.v3i2.1340>
- Berliana, D. P., & Sholihah, U. (2023). Kemampuan Komunikasi Matematis Siswa dalam Menyelesaikan Masalah Open-Ended Ditinjau dari Self-Efficacy. *Plusminus: Jurnal Pendidikan Matematika*, 3(2).
<https://doi.org/10.31980/plusminus.v2i2.1101>
- Cahyati, R., Mustangin, M., & Hasana, S. N. (2021). Analisis Kemampuan Penalaran dan Komunikasi Matematis Siswa pada Materi Relasi dan Fungsi Kelas VIII SMP PGRI Wonotiro. *Jurnal Penelitian, Pendidikan, dan Pembelajaran*, 16(12).
- Chasanah, C. (2020). The Effectiveness of Learning Models on Written Mathematical Communication Skills Viewed from Students' Cognitive

- Styles. *European Journal of Educational Research*, 9(3), 979–994. <https://doi.org/10.12973/eu-jer.9.3.979>
- Dewi, S. P., Maimunah, M., & Roza, Y. (2021). Analisis Kemampuan Komunikasi Matematis Siswa pada Materi Lingkaran Ditinjau dari Perbedaan Gender. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran*, 7(3), 699–707. <https://doi.org/10.33394/jk.v7i3.3687>
- Dwitasari, D., & Yudhanegara, M. R. (2024). Analisis Klaster untuk Hubungan antara Kemampuan Komunikasi Matematis dengan Kemampuan Pemecahan Masalah Menggunakan K-Means. *Jurnal Educatio*, 10(3). <https://doi.org/10.31949/educatio.v10i3.8234>
- Fitri Andini, S., & Marlina, R. (2021). Analisis Kemampuan Komunikasi Matematis Siswa SMP dalam Menyelesaikan Soal pada Materi Himpunan. *Jurnal Pembelajaran Matematika Inovatif*, 4(2). <https://doi.org/10.22460/jpmi.v4i2.343-354>
- Hakiki, S. N., & Sundayana, R. (2022). Kemampuan Komunikasi Matematis pada Materi Kubus dan Balok Berdasarkan Kemandirian Belajar Siswa. *Plusminus: Jurnal Pendidikan Matematika*, 2(1). <https://doi.org/10.31980/plusminus.v2i1.1088>
- Hakim, S., & Ardiyanti, Y. (2025). Studi Literatur: Pengaruh Pendekatan Contextual Teaching and Learning terhadap Kemampuan Pemahaman Konsep Matematis Siswa. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 5(2). <https://doi.org/10.51574/kognitif.v5i2.3131>
- Hamid, J., Pebriyan, & Gusmaneli. (2024). Pembelajaran Kontekstual: Solusi untuk Meningkatkan Kualitas Pendidikan. *Realisasi: Ilmu Pendidikan, Seni Rupa dan Desain*, 1(3), 1–12. <https://doi.org/10.62383/realisasi.v1i3.113>
- Hanipah, H., & Sumartini, T. S. (2021). Perbandingan Kemampuan Komunikasi Matematis Siswa antara Problem Based Learning dan Direct Instruction. *Plusminus: Jurnal Pendidikan Matematika*, 1(1), 83–96. <https://doi.org/10.31980/plusminus.v1i1.879>
- Hasibuan, I. (2014). Model Pembelajaran CTL (Contextual Teaching and Learning), II(01).
- Hendriana, H., Rohaeti, E. E., & Sumarmo, U. (2017). *Hard Skills dan Soft Skills Matematik Siswa*. Bandung: Refika Aditama.
- Ikhsan, D. M., & Afriansyah, E. A. (2023). Kemampuan Komunikasi Matematis Siswa SMP pada Materi Himpunan. *Jurnal Penelitian Otentik tentang Pendidikan Matematika (JARME)*, 5(2).
- Kismatun. (2021). Contextual Teaching and Learning dalam Pendidikan Agama Islam.
- Nababan, D., & Sipayung, C. A. (2023). Pemahaman Model Pembelajaran Kontekstual dalam Model Pembelajaran (CTL). *Jurnal Pendidikan Sosial dan Humaniora*, 2(2), 825–837.
- National Council of Teachers of Mathematics [NCTM]. (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.
- Nugroho, S. H., & Toyib, M. (2023). Analisis Kemampuan Komunikasi Matematis Siswa Kelas VIII SMP dengan Gaya Kognitif Field Dependent dalam Menyelesaikan Soal Cerita. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(1). <https://doi.org/10.31004/cendekia.v7i1.2040>
- Pratiwi, Y., Ardianti, S. D., & Bintoro, H. S. (2023). Kemampuan Komunikasi Matematis Siswa Sekolah Dasar Ditinjau dari Self Confidence. *Jurnal Educatio*, 9(2).

- <https://doi.org/10.31949/educatio.v9i2.4696>
- Purnama, I. L., & Afriansyah, E. A. (2016). Kemampuan Komunikasi Matematis Siswa Ditinjau Melalui Model Pembelajaran Kooperatif Tipe Complete Sentence dan Team Quiz. *Jurnal Pendidikan Matematika Sriwijaya*.
<https://doi.org/10.22342/jpm.10.1.3267.26-41>
- Sabri., Bosra, N., & Upu, H. (2026). Pengaruh Pendekatan Pengajuan Masalah dalam Pembelajaran Matematika terhadap Kecakapan Komunikasi Matematika Siswa. *Riset Matematika dan Pendidikan Matematika*, 5(3).
<https://doi.org/10.53696/venn.v5i3.506>
- Sulastri, E., & Sofyan, D. (2022). Kemampuan Komunikasi Matematis Ditinjau dari Self Regulated Learning pada Materi Sistem Persamaan Linear Dua Variabel. *Plusminus: Jurnal Pendidikan Matematika*, 2(2).
<https://doi.org/10.31980/plusminus.v2i2.1105>
- Syah, J. M., & Sofyan, D. (2021). Kemampuan Komunikasi Matematis Siswa SMP di Kampung Paledang Suci Kaler pada Materi Segiempat dan Segitiga. *Plusminus: Jurnal Pendidikan Matematika*, 1(2), 373-384.
- Tina, P., Nufus, H., Afni Sinaga, N., & Isfayani, E. (2025). Analisis Kemampuan Komunikasi Matematis Siswa SMA Berdasarkan Self Confidence pada Materi Trigonometri, 5(1).
<https://doi.org/10.29103/jpmm.v5i1.19189>