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The Impact of Inquiry Learning and Discovery Learning Models on Mathematical Communication Skills and Self-Confidence

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ABSTRAK

Kemampuan komunikasi matematis dan self-confidence penting dalam pembelajaran matematika. Namun, banyak siswa masih mengalami kesulitan dalam mengungkapkan ide matematis dan kurang percaya diri dalam pembelajaran. Diperlukan model pembelajaran inovatif seperti *Inquiry Learning* dan *Discovery Learning* yang melibatkan siswa secara aktif. Penelitian bertujuan menganalisis perbedaan peningkatan kemampuan komunikasi matematis dan self-confidence antara siswa yang dibelajarkan dengan model *Inquiry* dan *Discovery Learning*, serta mengkaji hubungan antara kedua kemampuan tersebut. Metode yang digunakan adalah kuasi eksperimen dengan desain *pretest-posttest nonequivalent control group*. Data dikumpulkan melalui tes dan kuesioner, dianalisis menggunakan *Independent Sample t-test* dan *uji t'* untuk membandingkan peningkatan, serta uji korelasi Pearson untuk melihat hubungan antar variabel. Hasil penelitian menunjukkan adanya perbedaan peningkatan kemampuan komunikasi matematis dan self-confidence antara kedua model pembelajaran. Namun, tidak ditemukan hubungan antara peningkatan komunikasi matematis dan *self-confidence* dalam masing-masing model.

Kata Kunci: *Discovery Learning; Inquiry Learning;* Komunikasi Matematis; *Self-Confidence*

ABSTRACT

Mathematical communication skills and self-confidence are two important aspects in learning mathematics. However, many students still have difficulty expressing mathematical ideas and lack confidence in learning. Therefore, innovative learning models such as Inquiry Learning and Discovery Learning are needed that actively involve students. This study aims to analyze the differences in the improvement of mathematical communication skills and self-confidence between students who are taught with the Inquiry and Discovery Learning models, and to examine the relationship between the two abilities. The method used is a quasi-experiment with a nonequivalent control group pretest-posttest design. Data were collected through tests and questionnaires, then analyzed using the Independent Sample t-test and t' test to compare improvements, and the Pearson correlation test to see the relationship between variables. The results showed differences in the improvement of mathematical communication skills and self-confidence between the two learning models. However, no relationship was found between the improvement of mathematical communication and self-confidence in each model.

Keywords: Discovery Learning; Inquiry Learning; Mathematical Communication; Self-Confidence

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1. INTRODUCTION

Mathematical communication skills are one of the essential competencies in mathematics learning because they help students express ideas, explain thinking processes, and solve problems logically (Hapsoh & Sofyan, 2022; Hidayatulloh & Sumartini, 2022). Mathematics itself plays a vital role in developing students' reasoning and potential, making it considered an essential subject (Dewi & Afriansyah, 2017; Nurapni & Kurniawati, 2021). The National Council of Teachers of Mathematics (NCTM) emphasizes five core skills in mathematics education: connections, reasoning, communication, problem-solving, and representation (Sucipto et al., 2019; Robiah & Nuraeni, 2023). Therefore, it is important for teachers to develop these five skills, especially mathematical communication.

However, various study results and international reports such as PISA show that Indonesian students' mathematical literacy remains below the OECD average, with only about 28% of Indonesian students reaching the minimum competency level (Charmila et al., 2020; Munfarikhatin, 2022). This low literacy is closely related to weak communication skills, which are also influenced by limited reading habits and students' lack of active participation in learning (Yanti & Mashitho, 2024; Iswari et al., 2022).

Field observations, such as at SMP Negeri 1 Cigedug, support these findings. Students appear passive, lack confidence in discussions, and struggle to explain mathematical concepts. This indicates that students' mathematical communication skills and self-confidence are still low. Yet, both are crucial assets for success in learning mathematics (Anderha & Maskar, 2020; Kanah & Mardiani, 2022). Self-confidence plays an important role in encouraging students to ask questions, engage in discussions, and express ideas (Robiah & Nuraeni, 2023). Conversely, students with low self-confidence tend to be passive and avoid challenges (Atiyah & Nuraeni, 2022). Previous studies have mentioned that good communication skills can enhance students' self-confidence, and vice versa (Purnomo & Wahyudi, 2021). Therefore, these two aspects need to be improved simultaneously through appropriate learning models.

One approach that can be used is the Inquiry Learning and Discovery Learning models. Both models emphasize active student involvement, encouraging exploration and independent concept discovery. The Inquiry Learning model guides students to think critically in solving problems under the teacher's guidance (Maryati & Monica, 2021), while Discovery Learning gives students space to discover concepts independently through direct experience (Damanik, 2020; Rahima et al., 2022). These two models are believed to be capable of enhancing mathematical communication and self-confidence because they provide students with opportunities to interact, discuss, and express ideas more openly. Teachers also act as facilitators who create an active learning environment and support students in confidently expressing their ideas (Arwadi et al., 2024).

Based on this background, this study aims to:1) Determine the difference in the improvement of mathematical communication skills between students who receive the Inquiry Learning and Discovery Learning models; 2) Determine the difference in the improvement of self-confidence between the two models; 3) Analyze the relationship between mathematical communication skills and self-confidence in each learning model.

2. METHOD

This research is a quasi-experimental study with a pretest-posttest nonequivalent control group design. The study was conducted at SMP Negeri 1 Cigedug, Garut Regency, during the odd semester of the 2024/2025 academic year, specifically in November 2024. The research subjects consisted of two classes selected through purposive sampling. Class VIII C (30 students) was designated as the first experimental group applying the Inquiry Learning model, while Class VIII D (30 students) served as the second experimental group using the Discovery Learning model.

The research instruments consisted of: a mathematical communication ability test in the form of 5 essay questions, and a 28-item self-confidence questionnaire using a Likert scale. Before being used, the instruments were validated by two mathematics teachers at SMPN 1 Cigedug. A trial of the instruments was conducted with 30 students from Class IX B at the same school. The results of the validity test showed that all instrument items were suitable for use. The reliability values of the instruments based on the Cronbach's Alpha test were 0.6755 for the mathematical communication ability test (high category), and 0.8851 for the self-confidence questionnaire (very high category). The test questions varied in difficulty from moderate to difficult, with discrimination indices ranging from adequate to good.

The indicators of mathematical communication ability used in this study included:1) Representing real objects or everyday situations into mathematical models (such as pictures, tables, diagrams, graphs, algebra); 2) Explaining ideas and mathematical models in everyday language; 3) Transforming one mathematical model into another form; 4) Reading and understanding written representations and solving them; 5) Presenting solutions in a logical and accurate manner.

Meanwhile, the indicators of students' self-confidence in this study included: 1)Belief in one's own abilities, lack of anxiety in taking action, feeling free to engage in preferred activities, and taking responsibility;2)Ability to act independently in decision-making;3)A positive self-concept, being polite, able to interact with and respect others;4)Courage to express opinions and having the drive to achieve;5)Ability to recognize one's strengths and weaknesses.

To analyze the difference in the improvement of mathematical communication skills and self-confidence between those who received the InquiryLearning model and Discovery Learning

using a pretest-posttest Nonequivalent control group design. The research design used according to Ruseffendi (Sundayana, 2020) is as follows (see Figure 1).

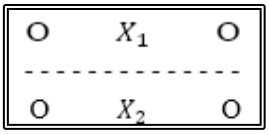

Figure 1. Pretest-Posttest Nonequivalent Control Group

Information:
O = Pretest and Final Test
X1 = Learning using the Inquiry Learning model
X2 = Learning using the Discovery Learning model
- - - = Both groups are not randomly selected

Meanwhile, to analyze the relationship between mathematical communication skills and self-confidence, the research design used was a simple paradigm design (Sundayana, 2020), illustrated in Figure 2.

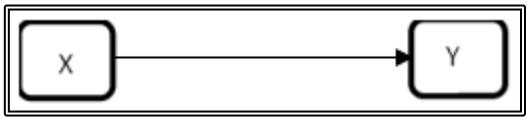

Figure 2. Simple Paradigm

Information:
X = Mathematical Communication Ability
Y = *Self-Confidence*

3. RESULT AND DISCUSSION

a. Research Findings

Based on the data that has been obtained in this study, the researcher conducted a Normalized Gain analysis of mathematical communication skills to determine the magnitude of the increase in mathematical communication skills after being given treatment, namely the Inquiry Learning and Discovery Learning models. Table 1 are the results of the recapitulation of the percentage of Normalized Gains.

Table 1. Normalized Gain Results of the Mathematical Communication Skills

Class		n	x_{max}	x_{min}	$\bar{x}$	s
IL	Pretest	30	13	2	7,3	3,46
	Posttest		27	12	21	4,92
	Gain		0,88	0,25	0,61	0,18
DL	Pretest	30	13	2	7,3	3,46
	Posttest		13	2	7,3	3,46
	Gain		13	2	7,3	3,46

Based on Table 1 of the recapitulation of normalized gain data in the Inquiry Learning class, it shows that there is an increase in students' mathematical communication skills in the

inquiry learning and discovery learning classes with an average difference of normalized gain of 0.25. The N- Gain data from the two classes were then carried out a normality test using the Liliefors test with a significance level of 5% with the results of both distributions normally presented in Table 2, which was followed by the homogeneity test test presented in Table 3.

Table 2. Results of the Normality Test N-Gain data on Mathematical Communication Skills

Class	N	L_{maks}	L_{tab}	Test Criteria
IL	30	0,128	0,164	Normally Distributed
DL	30	0,120	0,164	Normally Distributed

Table 3. Results of the N-Gain data Homogeneity Test of Mathematical Communication Skills

Class	N	$\bar{x}$	s	F	F_{tab}
IL	30	0,61	0,18	0,90	1,861
DL	30	0,36	0,19		

The homogeneity test obtained Fcal = 0.90 F $\leqslant$ table = 1.861. This means that the N-Gain data in both classes is homogeneous. Because the N-Gain data is normally distributed and homogeneous, the difference test uses the t-test. The results are presented in Table 4.

Table 4. Results of the N-Gain data t-Test of Mathematical Communication Skills

Statistic	S_{mix}	t_{hitung}	t_{table}
Value	0,195	4,568	2,002

Based on Table 4. with a significance level of 5% obtained $-$ t_{table} = -2.002 t $\leqslant$ t_{count} = 4.568 and t_{count} = 4.568 t $\geqslant$ t_{table}= 2.002 then H_0 is rejected. This means that there is a difference in the improvement of mathematical communication skills between students who get *the Inquiry Learning* and *Discovery Learning models*.

Furthermore, the researcher conducted a Normalized Gain analysis of self-confidence to determine the magnitude of the increase in self-confidence after being given treatment, namely the Inquiry Learning and Discovery Learning models. The following are the results of the recapitulation of the percentage of Normalized Gains from both classes.

Table 5. Normalized Gain Results of Self-Confidence

Class		n	x_{max}	x_{min}	$\bar{x}$	s
IL	Pretest	30	106,11	63,96	83,89	10,28
	Posttest		109,62	75,70	94,04	7,98
	Gain		0,72	-0,14	0,31	0,24
DL	Pretest	30	103,02	56,60	82,41	12,54
	Posttest		112,13	75,72	95,18	9,57
	Gain		0,33	0,01	0,20	0,08

Based on Table 5, the recapitulation of normalized gain data in the Inquiry Learning class shows that there is an increase in student self- confidence in the inquiry learning and discovery

learning classes with an average difference in normalized gain of 0.11. The results of the N-Gain Normality test use the Liliefors test presented in Table 6. with the results in both classes being normally distributed and continued with the Homogeneity test presented in Table 7.

Table 6. Results of the Normality Test Result of N -Gain Self Confidence

Class	N	L_{maks}	L_{tab}	Test Criteria
IL	30	0,058	0,164	Normally Distributed
DL	30	0,086	0,164	Normally Distributed

Table 7. Results of the Homogeneity Test N-Gain Self- Confidence

Class	N	$\bar{x}$	s	F	F_{tab}
IL	30	0,31	0,24	9,00	1,861
DL	30	0,20	0,08		

Based on Table 7. with a significance level of 5%, the homogeneity test of N-Gain *self-confidence* data in the *Inquiry Learning* class and *the Discovery Learning* class was declared to be non-homogeneous. Because the self-confidence *normalized gain data* is normally distributed and not homogeneous, the difference test uses the t' test.

Table 8. Test Results t' N-Gain *Self-Confidence*

Statistics	w_1	w_2	t_1	t_2	t'count	$\frac{w_1 t_1 + w_2 t_2}{w_1 + w_2}$
Value	0,002	0,000	2,045	2,045	2,268	2,045

Based on Table 8 with a significance level of 5%, it is obtained $-\frac{w_1 t_1 + w_2 t_2}{w_1 + w_2} = -2{,}045 \leq t_{count} = 2{,}268$, therefore $H_0$is rejected.This means there is a difference in the increase of self-confidence between students who received the Inquiry Learning model and those who received the Discovery Learning model. For the analysis of the relationship between the improvement of mathematical communication skills and self-confidence in the two classes, the Pearson Correlation test was carried out, because it can be seen from Table 2. and Table 6. that of the two classes, both the mathematical communication ability data and the self-confidence data showed that the data was normally distributed. The following is a recap of the Pearson correlation test in Table 9. and Table 10.

Table 9. Results of the Pearson Correlation Test of N-Gain Data in the Inquiry Learning Class

Statistics	r_{xy}	r_{table}	Information
Value	0,242	0,361	No correlation

Table 10. Results of the Pearson *Correlation Test* of N-Gain Data in *the Discovery Learning* Class

Statistics	r_{xy}	r_{table}	Information
Value	0,084	0,361	No correlation

The test criteria in the Pearson correlation test are if $r_{xy} < r_{table}$, then H_0 is accepted. Based on Table 9. and Table 10., with a significance level of 5% obtained from the results of $r_{xy} < r_{table}$,

then H_0 is accepted. This means that in both Inquiry Learning and Discovery Learning classes, there is no relationship between improving mathematical communication skills and increasing student self-confidence.

b. Discussion

This study reveals that there is a significant difference in mathematical communication ability between students who participated in the Inquiry Learning model and those in the Discovery Learning model. Although both models showed improvement within the moderate category, the class using the Inquiry Learning model demonstrated a higher average gain. This indicates that more open, student-centered learning provides greater opportunities for exploration, encouraging students to be more active in expressing ideas and gaining a deeper understanding of concepts.

The Inquiry Learning model positions the teacher as a facilitator and the student as an active subject in the learning process. As stated by Gunardi (2020), this approach allows students to develop understanding through questioning, investigation, and independent knowledge construction. This is supported by Kusumadewi and Rosnawati (2020), who found that Inquiry Learning significantly improves mathematical communication skills through active interaction, discussion, and student collaboration.

Conversely, although the Discovery Learning model also results in improvements, the learning process is more structured, with the teacher playing a more dominant role in guiding concept exploration. A study by Wijaya et al. (2022) found that while Discovery Learning encourages students to think creatively, their engagement in mathematical communication remains limited, particularly in expressing ideas and reflecting on solutions. Other obstacles, such as lack of personal responsibility, anxiety during discussions, and time constraints, also contribute to the lower gains in mathematical communication observed in this model compared to Inquiry Learning.

Furthermore, in terms of self-confidence, the study showed a significant difference between the two models. Inquiry Learning generally provided a higher average increase in self-confidence. The strength of this model lies in offering students space to explore information, engage in discussions, and express ideas without the pressure of rigid structure. This aligns with findings by Sari and Pratiwi (2020), which show that an explorative learning environment encourages students to be more confident in expressing opinions and making decisions.

However, it was found that 17% of students in the Inquiry Learning class experienced a decline in self-confidence. This decline was attributed to anxiety when speaking in public, particularly during group presentations. This finding is consistent with Alawiyah et al. (2022), who

noted that negative thoughts about public speaking situations can lead to fear and anxiety, affecting students' behavior and confidence levels.

Meanwhile, Discovery Learning offers a clearer structure with more intensive teacher guidance at the beginning of the learning process. This model helps students organize information more systematically and reduces anxiety due to the availability of concrete guidance. However, because independent exploration is less emphasized, students are less trained in expressing opinions and making decisions independently, which results in slower development of self-confidence. Similarly, Chen and Nasir (2022) revealed that teacher-centered learning approaches can hinder student creativity and increase anxiety, especially in the context of mathematics education.

Further analysis showed that the improvement in mathematical communication skills does not always correlate with an increase in self-confidence. Hasugian et al. (2024) affirmed that the enhancement of mathematical communication is not automatically accompanied by improved self-confidence, as both are influenced by different factors. Communication skills can be developed through cognitive strategies and structured practice in a relatively short time, while self-confidence is more affected by affective factors such as social support, successful experiences, and anxiety management, which require longer-term interventions (Husamah & Widodo, 2023).

Thus, although the Inquiry Learning model excels in enhancing mathematical communication and has a positive impact on self-confidence, learning strategies still need to be tailored. For students with low self-confidence, this approach should be accompanied by emotional support and sufficient guidance structures to prevent excessive anxiety. Conversely, although Discovery Learning provides helpful structure, it needs improvement in terms of student empowerment to make them more active and confident.

As stated by Ramadhani et al. (2021), experiences of success and appreciation for students' efforts are vital in gradually building confidence. Therefore, a combination of strategies such as positive reinforcement, the creation of a psychologically safe environment, and gradually increased opportunities for exploration will support not only the improvement of mathematical communication but also the development of more stable and sustainable self-confidence.

4. CONCLUSION

Based on the results of the study, it can be concluded that the Inquiry Learning model is more effective in improving students' mathematical communication skills compared to the Discovery Learning model. This is due to the characteristics of Inquiry Learning, which provide greater space for students to explore, discuss, and actively express their ideas. In addition, this

model also shows greater potential in promoting an increase in students' self-confidence, although special attention is needed regarding the risk of anxiety arising from the lack of structured guidance.

On the other hand, the Discovery Learning model remains relevant, particularly during the early stages of introducing mathematical concepts, as it offers a more systematic learning structure. However, its impact on enhancing self-confidence is relatively lower, requiring additional strategies such as providing appreciation, encouraging active participation, and creating an emotionally supportive learning environment.

These findings highlight the importance of a learning approach that not only focuses on cognitive development but also considers students' affective and psychological aspects. Therefore, the choice of learning model should balance clear structure and exploratory flexibility to foster students who are not only mathematically competent but also confident in expressing their thoughts.

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