



IMPLEMENTATION OF THE INQUIRY LEARNING MODEL TO IMPROVE STUDENTS' MATHEMATICAL UNDERSTANDING AND SELF-CONCEPT AT SMAN 1 LHOKNGA

PENERAPAN MODEL *INQURY LEARNING* UNTUK MENINGKATKAN KEMAMPUAN PEMAHAMAN MATEMATIS DAN *SELF-CONCEPT* SISWA DI SMAN 1 LHOKNGA

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DOI: <https://doi.org/10.62567/micjo.v3i4.3408>

Abstract

This study aimed to determine the improvement of students' mathematical understanding and self-concept through the implementation of the Inquiry Learning model and to examine the differences in mathematical understanding and self-concept between students who received Inquiry Learning and those who received conventional learning at SMAN 1 Lhoknga. This study employed a quantitative approach using a quasi-experimental method with a pretest-posttest control group design. The sample consisted of 50 students divided into an experimental class and a control class. The research instruments were a mathematical understanding test and a self-concept questionnaire. The data were analyzed using N-Gain, normality, homogeneity, and t-tests. The results showed that the improvement in mathematical understanding in the experimental class was higher than that in the control class, with mean N-Gain scores of 0.80 and 0.52, respectively. The t-test results indicated a significant difference between the two classes, with a significance value of $0.001 < 0.05$. The implementation of Inquiry Learning also showed a positive development in students' self-concept. Therefore, Inquiry Learning can be used as an alternative instructional model to improve students' mathematical understanding and self-concept.

Keywords : Inquiry Learning, Mathematical Understanding, Self-Concept, Mathematics Learning.



Abstrak

Penelitian ini bertujuan untuk mengetahui peningkatan kemampuan pemahaman matematis dan *self-concept* siswa melalui penerapan model pembelajaran Inquiry Learning serta mengetahui perbedaan kemampuan pemahaman matematis dan *self-concept* antara siswa yang memperoleh pembelajaran Inquiry Learning dan siswa yang memperoleh pembelajaran konvensional di SMAN 1 Lhoknga. Penelitian ini menggunakan pendekatan kuantitatif dengan metode eksperimen *semu* (*quasi experimental*) dan desain *pretest-posttest control group design*. Sampel penelitian terdiri atas 50 siswa yang terbagi menjadi kelas eksperimen dan kelas kontrol. Instrumen penelitian berupa tes kemampuan pemahaman matematis dan angket *self-concept*. Data dianalisis menggunakan uji *N-Gain*, uji normalitas, uji homogenitas, dan uji-t. Hasil penelitian menunjukkan bahwa peningkatan kemampuan pemahaman matematis pada kelas eksperimen lebih tinggi dibandingkan kelas kontrol, dengan rata-rata *N-Gain* masing-masing sebesar 0,80 dan 0,58. Hasil uji-t menunjukkan adanya perbedaan yang signifikan antara kedua kelas dengan nilai $0,001 < 0,05$. Penerapan Inquiry Learning juga menunjukkan perkembangan positif terhadap pemahaman matematis dan *self-concept* siswa. Dengan demikian, Inquiry Learning dapat digunakan sebagai alternatif pembelajaran untuk meningkatkan kemampuan pemahaman matematis dan *self-concept* siswa.

Kata Kunci : *Inquiry Learning*, Pemahaman Matematis, *Self-Concept*, Pembelajaran Matematika.

1. INTRODUCTION

Education is a crucial part of developing human capabilities and achieving national education goals. Educational success in schools is influenced by various resources, such as the principal, teachers, students, educational staff, and administrative staff (Brenner, 2022; Klassen, 2022). In the educational context, mathematics plays a crucial role in developing logical, rational, and objective thinking skills and serves as a foundation for understanding science and technology. However, mathematics is often viewed as a difficult subject because the learning process does not fully support students' in-depth conceptual understanding. At the high school level, students are required not only to master the material cognitively but also to analyze, evaluate, and construct information to solve various problems (Mangelep et al., 2024).

Mathematical understanding is a student's ability to grasp meaning, ideas, situations, and information, beyond simply memorizing formulas or procedures. Students are said to understand mathematics when they can explain ideas in their own words, apply information to different situations, draw analogies, and generalize (Khairunnisa et al., 2022). Conceptual understanding is fundamental to understanding mathematical principles and theories, making conceptual mastery crucial in the learning process (Putri Diana, 2020). Polya divides understanding into four levels: mechanical, inductive, rational, and intuitive, from the most basic to the most complex (Khairunnisa et al., 2022). Meanwhile, Skemp differentiates understanding into instrumental understanding, which is the ability to use rules or formulas without understanding the rationale for their use, and rational understanding, which is the ability to solve problems and explain the rationale for the solution (Imami, 2021).

Problems with conceptual understanding were also found based on initial observations at SMAN 1 Lhoknga. Students tended to solve problems based on given formulas without understanding the underlying concepts, resulting in easily forgotten material. This situation suggests that mathematics learning needs to be directed not only at numeracy skills but also at conceptual understanding to make learning more meaningful. Low mathematical understanding can be influenced by external factors, such as learning methods and strategies, as well as internal factors such as students' feelings and perspectives on mathematics (Putri Diana, 2020). Poor conceptual understanding can also impact students' thinking skills and development at subsequent levels of education (Lestari & Andinny, 2023).



In addition to mathematical comprehension, an internal factor that plays a role in the learning process is self-concept. Self-concept is an individual's ideas, thoughts, feelings, beliefs, and perspectives about themselves as they interact with their environment (Sholiha & Aulia, 2020). Self-concept encompasses physical, psychological, social, emotional, aspirations, and achievements and plays a role in building self-confidence and developing students' potential (Alamsyah et al., 2022). A positive self-perception can support students in navigating the learning process more effectively (Liberna & Lestari, 2024). Therefore, improving mathematical understanding needs to be accompanied by efforts to build a positive self-concept in students.

One effort that can be made is implementing the Inquiry Learning model, which emphasizes the process of seeking and finding answers to a problem. In this model, students play an active role in discovering and constructing their own knowledge, while the teacher acts as a facilitator and guide (Budiarsa, 2021). Inquiry learning encourages students to conduct investigations through discussions, questions and answers, and problem-solving activities, so that students not only receive information from the teacher but also construct their own knowledge. This model aligns with constructivism theory, which views learning as a process of building knowledge based on students' experiences and activities (Astawayasa et al., 2022). Therefore, Inquiry Learning is expected to help students understand mathematical concepts more meaningfully while simultaneously improving their self-concept through active involvement in the learning process.

Based on these issues, this study aims to determine the improvement in students' mathematical comprehension and self-concept through the implementation of the Inquiry Learning model at SMAN 1 Lhoknga and to determine the differences in mathematical comprehension and self-concept between students who received Inquiry Learning and those who received conventional learning. The results of this research are expected to contribute to the development of mathematics learning, especially as an alternative learning model that can help improve mathematics learning.

2. RESEARCH METHOD

This research was conducted at SMA Negeri 1 Lhoknga, Lhoknga District, Aceh Besar Regency, from May 12–25, 2026, during the even semester of the 2025/2026 academic year. The study used a quantitative method with a quasi-experimental research approach and a pretest-posttest control group design. This design compared the abilities of students who received instruction using the Inquiry Learning model as the experimental class and those who received conventional learning as the control class (Anantasia & Rindrayani, 2025; Ding et al., 2023). Both groups were given a pretest before the treatment and a posttest after the treatment to measure changes in students' mathematical comprehension and self-concept.

The study population was all 277 students at SMA Negeri 1 Lhoknga in the 2025/2026 academic year, across nine classes. A population is the entire object or subject with certain characteristics and the target of research generalization (Asrullah et al., 2023). The sample was determined using a purposive sampling technique, taking into account appropriate grade levels, a relatively balanced student population, and relatively homogeneous academic abilities, based on information from mathematics teachers. The sample consisted of 30 students from grade XI-2 as the experimental class and 27 students from grade XI-3 as the control class, resulting in a total sample size of 57 students. Grade XI-2 received inquiry learning, while grade XI-3 received conventional learning. The sample selection also took into account equivalence in student characteristics and initial abilities.

Data collection was conducted through tests, questionnaires, observation, and documentation. Essay-based tests were administered via pretests and posttests to measure students' mathematical understanding. The test design focused on indicators of conceptual understanding, such as restating concepts, identifying and classifying objects, presenting concepts in mathematical representations, and applying concepts to problem-solving. Validity test results showed that five test items had calculated r values of 0.566–0.761, greater than the table r value of 0.388, thus all items were declared valid



(Saputra, A., 2025). The test was used to determine students' initial abilities and changes in abilities after treatment.

A questionnaire was used to measure students' self-concept using a Likert scale. Questionnaire statements included self-confidence in learning mathematics, attitudes toward mathematics, and perceptions of self-ability in solving mathematics problems, consisting of positive and negative statements (Hapsari et al., 2023). Validity tests on the questionnaire items showed that all 35 statements had calculated *t* values greater than the table *t* value of 2.0484, thus being declared valid (Musriandi, 2013).

Observations were conducted to determine the implementation of Inquiry Learning in the experimental class. Observation sheets cover teacher activities in implementing the Inquiry Learning stages and student activities during the learning process (Silalahi & Hasibuan, 2024; Nawawi & Nurita, 2024). Meanwhile, documentation is used as supporting data in the form of student lists, student numbers, learning materials, activity photos, and other relevant documents (Sugiyono, 2022).

Data analysis was conducted quantitatively using descriptive statistics, N-Gain, and hypothesis testing. Descriptive statistics were used to obtain an overview of the data through the mean, maximum, minimum, and standard deviation (Sugiyono, 2022). Improvements in mathematical understanding and self-concept before and after treatment were analyzed using N-Gain, with low, medium, and high criteria to determine the level of improvement after the learning process (Hake in Sari & Nurhasanah, 2022).

Before conducting the hypothesis testing, the data were tested for normality and homogeneity. The normality test used Shapiro-Wilk because the number of samples in each group was less than 50 (Ghasemi & Zahediasl, 2020), while the homogeneity test used Leven to determine the equality of variance between the two groups (Kim & Park, 2021). If the data is normally distributed and homogeneous, the difference test is carried out using the Independent Sample *t*-Test to compare the means of two independent groups (Sugiyono, 2022). If the data does not meet the assumption of normality, the nonparametric Mann-Whitney *U* test is used (Nachar, 2021). All tests are carried out at a significance level of 5% ($\alpha = 0.05$) with the help of statistical software.

3. RESULT AND DISCUSSION

Results

The research was conducted at SMAN 1 Lhoknga in the even semester of the 2025/2026 academic year, involving eleventh-grade students: eleventh-grade students (classes XI-2 as the experimental class and XI-3 as the control class). The study aimed to determine the effect of implementing the Inquiry Learning model on students' mathematical comprehension and self-concept. The study used a quasi-experimental method with a pretest-posttest control group design. The experimental class received instruction using the Inquiry Learning model, while the control class received conventional instruction.

Data on mathematical comprehension were obtained through pretests and posttests administered before and after the instruction. Meanwhile, self-concept data were obtained through questionnaires administered after the instruction. Data from both classes were then analyzed to determine changes in mathematical comprehension and differences in self-concept between students who received Inquiry Learning and those who received conventional instruction.

Tabel 1 Deskripsi Hasil Penelitian Pemahaman matematis dan Self-Concept

CLAS S	MATHEMATICAL UNDERSTANDING						SELF-CONCEPT					
	Pretest			Posttest			Pretest			Posttest		
	S _{Max}	S _{Min}	Avera ge	S _{Max}	S _{Min}	Rata- rata	S _{Max}	S _{Min}	Averag e	S _{Max}	S _{Min}	Aver age
Kontro l	45	5	30,60	85	50	67,40	64	42	53,28	75	42	62,8 8



Eksperimen	45	10	25,00	100	75	86,00	63	43	53,44	94	72	81,08
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(Source: Research Results at SMAN 1 Lhoknga, 2026)

Based on Table 1, students' mathematical comprehension and self-concept improved after the learning process in both classes. In the control class, the average mathematical comprehension increased from 30.60 in the pretest to 67.40 in the posttest, while the experimental class's score increased from 25.00 to 86.00. Regarding self-concept, the control class's average score increased from 53.28 to 62.88, while the experimental class's score increased from 53.44 to 81.08. Thus, the average increase in mathematical comprehension and self-concept in the experimental class was higher than in the control class.

The N-Gain test is used to determine the level of improvement in students' mathematical comprehension based on a comparison of pretest and posttest results. The results of the N-Gain calculation of mathematical understanding ability in the experimental class and control class are presented in Table 2.

Tabel 2 Nilai N-Gain Pemahaman Matematis Kelas Eksperimen dan Kelas Kontrol

CLASS	N	N – GAIN _{MAX}	N – GAIN _{MIN}	N – Gain _{RATA-RATA}
Kontrol	25	0,8	0,28	0,52
Eksperimen	25	1	0,61	0,80

(Source: N-Gain Data Processing Results, July 2026)

Based on Table 2, the number of students analyzed in the control and experimental classes was 25 each. The N-Gain value for mathematical comprehension in the control class ranged from 0.28 to 0.80, while the N-Gain value for the experimental class ranged from 0.61 to 1.00. This range indicates that the improvement in mathematical comprehension in the experimental class was higher than in the control class.

The N-Gain test was used to determine the level of improvement in students' self-concept based on a comparison of scores before and after learning. Analysis was conducted on the experimental and control classes to observe changes in self-concept after each group received the treatment. The results of the N-Gain self-concept calculations for both classes are presented in the following table.

Tabel 3 Nilai N-Gain Self-Concept Kelas Eksperimen dan Kelas Kontrol

CLASS	N	N – GAIN _{MAX}	N – GAIN _{MIN}	N – GAIN _{RATA-RATA}
Kontrol	25	0,36	0,04	0,22
Eksperimen	25	0,89	0,33	0,58

(Source: N-Gain Data Processing Results, July 2026)

Based on Table 3, the results of the N-Gain self-concept, the number of students in the control class and the experimental class was 25 people each. In the control class, the N-Gain value ranged from 0.04 to 0.36, while in the experimental class it ranged from 0.33 to 0.89. These data indicate that the range of N-Gain self-concept values in the experimental class was higher than in the control class.

Hypothesis testing was conducted to determine the differences in mathematical comprehension and self-concept improvement between students who received the Inquiry Learning model and those who received conventional learning. Testing was conducted using normality, homogeneity, and an Independent Samples t-test. Data were considered normal and homogeneous if the significance value was ≥ 0.05 , while a significance value < 0.05 indicated non-normal or heterogeneous data (Ummyza F., 2026).

The results of the normality test showed that the N-Gain for mathematical comprehension in the experimental and control classes had significance values of 0.991 and 0.741, respectively. Meanwhile, the N-Gain for self-concept had significance values of 0.383 in the experimental class and 0.546 in the control class. All values were greater than 0.05, indicating that the N-Gain for mathematical comprehension and self-concept data in both classes were normally distributed.

The homogeneity test results showed that the N-Gain mathematical understanding achieved a significance value of 0.067, thus declaring the data homogeneous. Conversely, the N-Gain self-



concept achieved a significance value of 0.034, thus declaring the variances of the two groups non-homogeneous. However, the differences were tested using an Independent Samples t-test, taking into account the variance test results for each data set.

The Independent Samples t-test results for the N-Gain mathematical understanding showed a t-value of 9.097, $df = 48$, with a 2-tailed significance of 0.001 and a 1-tailed significance of 0.0005. For the N-Gain self-concept, the t-value was 24.066, $df = 48$, with a 2-tailed significance of 0.001 and a 1-tailed significance of 0.0005. Because all significance values were less than $\alpha = 0.05$, H_0 was rejected and H_a was accepted.

Thus, there was a significant difference in the improvement of mathematical understanding and self-concept between students who received the Inquiry Learning model and those who received conventional learning. These results indicate that the implementation of Inquiry Learning was associated with a higher improvement in both research variables compared to conventional learning.

Discussion

This study aims to determine the improvement in students' mathematical comprehension and self-concept through the application of the Inquiry Learning model and its differences from conventional learning. The experimental class received Inquiry Learning, while the control class received conventional learning. Mathematical comprehension was measured through pretests and posttests, while self-concept was measured through pre- and post-learning questionnaires.

The application of Inquiry Learning provides opportunities for students to actively participate in identifying problems, asking questions, seeking information, conducting investigations, discussing, and drawing conclusions. The teacher acts as a facilitator, providing guidance when students encounter difficulties. This process encourages students to build understanding through their own experiences and investigations, rather than simply accepting formulas or procedures from the teacher. Discussions also provide opportunities for students to explain their reasoning, compare solution strategies, and connect mathematical concepts to the problems they face.

The results showed that the average mathematical comprehension ability of the experimental class increased from 25.00 in the pretest to 86.00 in the posttest, while the control class increased from 30.60 to 67.40. For the self-concept variable, the experimental class's average increased from 53.44 to 81.08, while the control class's increased from 53.28 to 62.88. Thus, the increase in both variables was descriptively higher in the experimental class than in the control class.

These results were also evident from the N-Gain analysis. The average N-Gain for the experimental class's mathematical comprehension ability was 0.80, while the control class's was 0.52. Meanwhile, the average N-Gain for self-concept was 0.58 and the control class's was 0.22. These findings indicate that the improvement in mathematical comprehension and self-concept in the class receiving Inquiry Learning was descriptively higher than in the class receiving conventional learning.

This improvement is supported by statistical test results. The improvement test showed a significance value of $0.000 < 0.05$, indicating an improvement in mathematical comprehension and self-concept after the implementation of Inquiry Learning. Furthermore, the results of the Independent Samples t-test showed a t-value of 9.097 for mathematical comprehension and 24.066 for self-concept, with a significance value of $0.001 < 0.05$ for each. These results indicate a significant difference between students receiving Inquiry Learning and those receiving conventional learning in both variables studied.

This difference can be attributed to the characteristics of Inquiry Learning, which positions students as active subjects in learning. Through observing problems, seeking information, conducting investigations, discussing, and drawing conclusions, students have the opportunity to connect information with mathematical concepts and understand the rationale behind the solution process. This helps develop understanding that is not only procedural but also allows students to apply concepts to new problems.

In addition to cognitive aspects, activities in Inquiry Learning also provide experiences that support the development of self-concept. Opportunities to ask questions, express opinions, solve



problems, and present the results of investigations enable students to recognize their own abilities. Successfully completing assignments and engaging in discussions can provide positive experiences, while group work helps students learn to accept opinions and collaborate with others. Thus, Inquiry Learning not only supports mathematical understanding but also provides learning experiences that can strengthen students' positive views of their own abilities.

Overall, research findings indicate that Inquiry Learning can be an alternative in mathematics learning to improve students' mathematical understanding and self-concept. These improvements are related to active learning, providing investigative experiences, encouraging discussion, and positioning students as constructors of their own knowledge. In contrast to conventional learning which focuses more on explaining material and practicing questions, Inquiry Learning provides more space for students to discover concepts, express their thoughts, and evaluate their learning outcomes.

4. CONCLUSION

Based on the data analysis and discussion, several conclusions are drawn as follows:

1. The application of the Inquiry Learning model can improve students' mathematical understanding and self-concept at SMAN 1 Lhoknga. This improvement is evident in the experimental class's results, which showed higher scores than the control class, and is supported by an average N-Gain score of 0.80 for mathematical understanding and 0.58 for self-concept, both of which are better than the control class. This improvement occurs because the Inquiry Learning model provides opportunities for students to actively engage in every stage of the learning process, from formulating issues and developing hypotheses, gathering information, testing analyses, and drawing conclusions. This process helps students understand mathematical concepts more deeply while improving their self-concept, courage to express opinions, and positive attitudes toward mathematics learning.
2. There are differences in mathematical understanding and self-concept between students learning with the Inquiry Learning model and students learning with conventional learning. The analysis shows that students in the experimental class achieved higher levels of mathematical understanding and self-concept than students in the control class. This difference is proven by the results of the Independent Samples t-test which shows a significance value (2-tailed) of 0.001.

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