EJI | Education Journal of Indonesia
Vol 7 Nomor 1 May 2026, hal: 29-33
ISSN: 2774-4949

The Effectiveness Of The Cognitive Apprenticeship Model On The Reflective Thinking Skills Of Junior High School Students At Prof. Dr. H. Mohd. Hatta Education And Training Foundation (YPP) In Algebra Learning

Roni Darmawan[1], Tua Halomoan Harahap[2]

[1,2] Master of Mathematics Education, Universitas Muhammadiyah Sumatera Utara, Indonesia

[1] ronidarmawan57@gmail.com, [2] tuaholomoan@umsu.ac.id

Abstract

This study aims to examine the effectiveness of the Cognitive Apprenticeship learning model on the mathematical reflective thinking skills of junior high school (MTs) students at YPP Prof. Dr. H. Mohd. Hatta in algebraic topics. This research is a quasi-experimental study utilizing a Non-equivalent Control Group Design. The research population comprised all seventh-grade students at MTs YPP Prof. Dr. H. Mohd. Hatta Stabat, with sample selection conducted through a cluster random sampling technique to determine the experimental class (Cognitive Apprenticeship learning) and the control class (conventional learning). The research instrument employed was a reflective thinking skills test consisting of essay questions on algebraic material that met the indicators of reacting, comparing, and contemplating. Data analysis was performed using the Independent Samples T-Test and the N-Gain Score test. The results indicated that the improvement in the reflective thinking skills of students taught with the Cognitive Apprenticeship model was significantly higher than that of students who received conventional learning. Consequently, the Cognitive Apprenticeship model is effectively implemented to optimize students' reflective thinking skills in algebra learning.

Keyword : Cognitive Apprenticeship, Reflective Thinking, Algebra, Junior High School (MTs).

1. INTRODUCTION

Mathematics education plays a fundamental role in developing students' higher-order thinking skills, including critical thinking, creative thinking, problem-solving, and reflective thinking. Among these competencies, reflective thinking is particularly important because it enables students to analyze mathematical situations, evaluate problem-solving strategies, and make informed decisions based on logical reasoning. Reflective thinking helps students understand not only what they learn but also how and why they arrive at particular solutions.

In algebra learning, reflective thinking is an essential cognitive skill. Algebra requires students to understand abstract symbols, identify relationships among variables, formulate mathematical models, and solve problems systematically. However, many students experience difficulties in algebra because they tend to focus on procedural calculations rather than conceptual understanding. As a result, students often struggle to explain their reasoning, evaluate alternative solution methods, and connect new concepts with prior knowledge. These conditions indicate that students' reflective thinking skills remain underdeveloped.

Reflective thinking consists of several cognitive processes, including reacting, comparing, and contemplating. The reacting stage involves identifying and understanding mathematical problems. The comparing stage requires students to relate current situations to previous experiences or relevant concepts. The contemplating stage encourages students to evaluate solution strategies and draw conclusions based on logical considerations. These indicators are crucial in helping students develop deeper mathematical understanding and meaningful learning experiences.

One instructional approach that has the potential to enhance reflective thinking skills is the Cognitive Apprenticeship learning model. Cognitive Apprenticeship is a learning model

that emphasizes the process of making expert thinking visible through guided learning activities. The model was developed based on constructivist learning theory and focuses on the development of cognitive and metacognitive skills through social interaction and authentic learning experiences.

The Cognitive Apprenticeship model consists of several instructional stages, namely modeling, coaching, scaffolding, articulation, reflection, and exploration. Through modeling, teachers demonstrate expert problem-solving processes. During coaching and scaffolding, students receive guidance and support while practicing new skills. Articulation and reflection encourage students to explain and evaluate their thinking processes, while exploration provides opportunities for independent learning. These stages create a learning environment that actively engages students in reflective thinking.

Several previous studies have reported that Cognitive Apprenticeship positively influences students' conceptual understanding, problem-solving abilities, mathematical communication, and metacognitive skills. However, studies specifically investigating its effectiveness in improving mathematical reflective thinking skills in algebra learning among junior high school students remain limited, particularly within the Indonesian educational context. Therefore, further investigation is necessary to determine whether this learning model can effectively improve students' reflective thinking abilities.

This study aims to examine the effectiveness of the Cognitive Apprenticeship learning model on the mathematical reflective thinking skills of seventh-grade students at YPP Prof. Dr. H. Mohd. Hatta Stabat in algebra learning. The findings are expected to contribute to mathematics education literature and provide practical implications for teachers seeking innovative instructional strategies to improve students' higher-order thinking skills..

2. METHOD

This study employed a quasi-experimental design using a Non-equivalent Control Group Design. The research was conducted at MTsS YPP Prof. Dr. H. Mohd. Hatta Stabat. The population consisted of all seventh-grade students, while the sample was selected through cluster random sampling. Class VII-A (25 students) was assigned as the experimental group and taught using the Cognitive Apprenticeship model, whereas Class VII-B (25 students) served as the control group and received conventional learning. Thus, the total sample comprised 50 students.

The instrument used was a mathematical reflective thinking skills test in the form of essay questions on algebraic topics. The test was developed based on three indicators of reflective thinking: reacting, comparing, and contemplating. Prior to implementation, the instrument was validated and tested to ensure its validity and reliability.

Data collection was carried out through pretest and posttest administration in both groups. The experimental group received instruction through the Cognitive Apprenticeship model, while the control group was taught using conventional learning.

Data were analyzed using descriptive and inferential statistics. Normality and homogeneity tests were conducted as prerequisite analyses. The effectiveness of the Cognitive Apprenticeship model was examined using the Independent Samples T-Test, while the N-Gain Score was used to measure the improvement in students' reflective thinking skills. All analyses were conducted at a significance level of 0.05.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experimental	O_1	Cognitive Apprenticeship Model	O_2
Control	O_3	Conventional Learning	O_4

Where O_1 and O_3 represent pretest scores, while O_2 and O_4 represent posttest scores. This design was used to determine the effectiveness of the Cognitive Apprenticeship model in improving students' mathematical reflective thinking skills in algebra learning.

3. RESULT

Descriptive Analysis of Students' Reflective Thinking Skills

Students' reflective thinking skills were measured through pre-test and post-test assessments administered to both the experimental and control groups. The pre-test was used to determine students' initial abilities before the treatment, while the post-test was used to evaluate their reflective thinking skills after the learning intervention. The descriptive statistics are presented in Table 2.

Table 2. Descriptive Statistics of Students' Reflective Thinking Skills

Class	N	Test	Minimum	Maximum	Mean	SD
Experimental (VII – A)	25	Pre test	33,2	50,4	41,68	4,85
		Post test	71,5	89,2	79,90	4,32
Control (VII-B)	25	Pre test	31,5	51,0	42,35	5,10
		Post test	52,0	74,3	63,00	5,45

Table 2 shows that the mean pre-test scores of the experimental and control groups were relatively similar, indicating that both groups had comparable initial reflective thinking abilities before the treatment. The experimental group obtained a mean score of 41.68, while the control group achieved a mean score of 42.35.

After the implementation of the learning treatments, both groups demonstrated improvement in reflective thinking skills. However, the increase in the experimental group was considerably higher. Students taught using the Cognitive Apprenticeship model achieved a mean post-test score of 79.90, whereas students receiving conventional instruction obtained a mean score of 63.00. These findings suggest that the Cognitive Apprenticeship model provided a more effective learning environment for developing students' reflective thinking skills in algebra.

.

Improvement of Reflective Thinking Skills

To determine the effectiveness of the learning intervention, the improvement in students' reflective thinking skills was analyzed using the Normalized Gain (N-Gain) score. The results are presented in Table 3.

Table 3. N-Gain Analysis Results

Class	Mean N-Gain	Catagory
Experimental (VII-A)	0,65	Medium
Control (VII-B)	0,35	Medium (Lower Bound)

The results indicate that both groups experienced improvement after the learning process. Nevertheless, the experimental group achieved a substantially higher N-Gain score (0.65) compared to the control group (0.35). Although both scores fall within the medium category, the gain achieved by the experimental group was nearly twice that of the control group.

This finding demonstrates that the Cognitive Apprenticeship model was more effective in facilitating students' reflective thinking development. Through the stages of modeling, coaching, scaffolding, articulation, reflection, and exploration, students were provided with opportunities to actively construct knowledge, evaluate solution strategies, and reflect on their mathematical reasoning processes.

Hypothesis Testing

Prior to hypothesis testing, normality and homogeneity tests were conducted. The results showed that the data were normally distributed and homogeneous ($p > 0.05$), indicating that the assumptions for parametric testing were satisfied. The effectiveness of the Cognitive Apprenticeship model was subsequently examined using the Independent Samples T-Test. The results are summarized as follows:

- -value = 14.389
- Degrees of freedom (df) = 48
- Significance value (p-value) = 0.000

Since the significance value was lower than 0.05 ($0.000 < 0.05$), the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. This result indicates a statistically significant difference between the reflective thinking skills of students taught using the Cognitive Apprenticeship model and those taught through conventional learning. The findings confirm that the Cognitive Apprenticeship model is significantly more effective in improving students' reflective thinking skills in algebra learning than conventional instructional approaches.

4. DISCUSSION

The findings of this study indicate that students who learned through the Cognitive Apprenticeship model achieved significantly better reflective thinking skills than those who received conventional instruction. This result can be attributed to the learning characteristics embedded in the Cognitive Apprenticeship model, which emphasize active participation, guided practice, reflection, and independent exploration.

During the modeling stage, students observed how mathematical problems were analyzed and solved systematically. Through coaching and scaffolding, they received continuous guidance that helped them understand algebraic concepts and problem-solving procedures. Furthermore, the articulation and reflection stages encouraged students to explain their reasoning and evaluate the appropriateness of their solutions, which directly supported the development of reflective thinking skills.

The improvement observed in the experimental group was reflected in the three indicators of reflective thinking, namely reacting, comparing, and contemplating. Students became more capable of identifying relevant information, relating current problems to prior knowledge, and evaluating the validity of their solutions before drawing conclusions.

These findings support constructivist learning theory, which emphasizes that knowledge is actively constructed through meaningful experiences and social interaction. The results also align with previous studies reporting that Cognitive Apprenticeship contributes positively to the development of higher-order thinking skills, mathematical reasoning, and metacognitive awareness. Therefore, the model can serve as an effective alternative instructional approach for enhancing students' reflective thinking skills, particularly in algebra learning.

5. CONCLUSION

This study examined the effectiveness of the Cognitive Apprenticeship learning model on the mathematical reflective thinking skills of seventh-grade students at MTsS YPP Prof. Dr. H. Mohd. Hatta Stabat in algebra learning. The findings revealed that students who were taught using the Cognitive Apprenticeship model achieved significantly better reflective thinking skills than those who received conventional instruction.

The descriptive analysis showed that the experimental group obtained a higher post-test mean score (79.90) than the control group (63.00). Furthermore, the N-Gain analysis indicated that the improvement in reflective thinking skills of the experimental group (0.65) was higher than that of the control group (0.35). The results of the Independent Samples T-Test also demonstrated a significant difference between the two groups ($p = 0.000 < 0.05$).

These findings indicate that the Cognitive Apprenticeship model is effective in enhancing students' reflective thinking skills, particularly in the aspects of reacting, comparing, and contemplating. Therefore, the Cognitive Apprenticeship model can be recommended as an alternative instructional approach for mathematics teachers to foster students' reflective thinking skills and improve learning outcomes in algebra..

REFERENCE

Ariawan, R., & Nufus, H. (2020). Hubungan kemampuan berpikir reflektif matematis dengan hasil belajar aljabar siswa sekolah menengah. *Jurnal Pendidikan Matematika*, 14(1), 45–56. doi.org

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–42. doi.org

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator*, 15(3), 6–11.

Dennen, V. P., & Burner, K. J. (2008). Cognitive apprenticeship in educational practice: Research on scaffolding, modeling, mentoring, and thinking aloud. In J. M. Spector, M. D. Merrill, J. van Merriënboer, & M. P. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed., pp. 425–439). Lawrence Erlbaum Associates.

Gurol, A. (2011). Determine the reflective thinking skills of pre-service teachers in process of teaching and learning. *Global Journal of Guidance and Counseling*, 1(1), 41–47.

Hidayat, W., & Sariningsih, R. (2018). Kemampuan berpikir reflektif matematis siswa melalui model pembelajaran berbasis masalah dan *cognitive apprenticeship*. *Jurnal Elemen*, 4(2), 151–160. doi.org

Kember, D., Leung, D. Y., Jones, A., Loke, A. Y., McKay, J., Sinclair, K., Tse, H., Webb, C., Wong, F. K., Wong, M., & Yeung, E. (2000). Development of a questionnaire to measure the level of reflective thinking. *Assessment & Evaluation in Higher Education*, 25(4), 381–395. doi.org

Mentari, D., & Juandi, D. (2021). Efektivitas model *cognitive apprenticeship* terhadap peningkatan kemampuan pemecahan masalah matematis siswa: Sebuah meta-analisis. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(3), 2311–2324. doi.org

Schoenfeld, A. H. (2016). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. *Journal of Education*, 196(2), 1–38. doi.org

YPP Prof. Dr. H. Mohd. Hatta. (2025). *Dokumen kurikulum dan data kependidikan Madrasah Tsanawiyah Yayasan Pendidikan dan Pelatihan Prof. Dr. H. Mohd. Hatta*. MTs YPP Prof. Dr. H. Mohd. Hatta.