

# **The Effect of Means Ends Analysis Model on Reasoning Skills of Planes**

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**Abstract:** This research aimed to determine the effect of the Means Ends Analysis (MEA) learning model on the reasoning skills of planes in the fourth-grade students of the public elementary schools of Nakula cluster of UPTD DIKPORA, Serengan District, Surakarta City in the 2018/2019 academic year. The approach used in this research is a quantitative descriptive approach. The research design is a one-group pretest-posttest, with a population of fourth-grade students in the public elementary schools of Nakula cluster and the sample obtained is SDN Serengan II No. 256 Surakarta. The reasoning-skill test was used to collect the data, which were then analyzed using N-Gain. The research findings stated that there was an increase in reasoning skills. The percentage of indicators of proving and concluding is 89% (high), testing validity 79% (high), guessing 57% (moderate), determining patterns 66% (moderate), and mathematical manipulation 38%. These findings indicate that the Means Ends Analysis (MEA) learning model can improve reasoning skills.

**Keywords:** *reasoning skills, means ends analysis, planes, elementary school*

## **INTRODUCTION**

Reasoning skills are abstract skills essential for students to master. Mathematical reasoning is one part of mathematical thinking with the process of problem generalization to obtain valid conclusions (Faradillah, Hadi, & Tsurayya, 2018). National Council of Teacher Mathematics (NCTM) revealed that mathematics reasoning required to improve general mathematical abilities (Sukirwan, Darhim, & Herman, 2018). Reasoning itself means a person's ability to analyze, generalize, synthesize, provide the right reasons, and solve a problem to conclude or a new logical statement based on facts (Shadiq, 2014)(Lestari & Yudhanegara, 2015) (Isrok'atun & Rosmala, 2018). Kaur and Lam explained that mathematical reasoning is a basic component consisting of logical thinking, communication, connection, and basic skills. Therefore, mathematical reasoning needs to be integrated into learning to produce competent citizens and employees to deal with the 21<sup>st</sup> century (Sumarsih, Budiyo, & Indriati, 2018).

Conjecturing, proofing, and problem-solving are essential competencies applied reasoning skills (Rofiki, Nusantara, Subanji, & Chandra, 2018). The indicators of reasoning based on Director-General of Education and Culture No. 506/C/PP/2004 (Shadiq, 2014) are (1) proposing a hypothesis; (2) doing mathematical manipulation; (3) drawing conclusions, compiling evidence, providing reasons or evidence of the correctness of the solution; (4) checking the validity of arguments; and (5) determining the pattern of mathematical symptoms to make generalizations. The National Council of Teacher of Mathematical Sciences revealed that mathematics is learning whose activities cannot be separated from reasoning. Thus, reasoning is something needed to improve mathematical skills in general (Sukirwan et al., 2018). The program of International Students Assessment states that mathematical reasoning is a basic mathematical skill that will continue to develop and be useful in the future (Sukirwan et al., 2018). According to Permendiknas Number 22 of 2006, students can use reasoning on properties and patterns, mathematical manipulations, and compile evidence (Kadarisma,

Nurjaman, Sari, & Amelia, 2019). Based on this, mathematical reasoning needs to be developed.

The status quo shows that mathematical reasoning is still relatively low. This was proven from various researches. The research conducted by TIMSS and PISA states that Indonesia ranked 61 from 65 participants with a mean score of 371 (Lailiyah et al., 2018). This is evidence that students' mathematical reasoning is low. Another research conducted by Rizta, Zulkardi, and Hartono showed that only 28.15% of students belonged to the good category (Sukirwan et al., 2018). Various researches have been conducted to improve mathematical reasoning. One of them is the research conducted by Ruhimat, Sulistyowati, and Darmawanti (Ruhimat, Ningrum, & Wijayanto, 2018) which states that there are effects of the innovative learning models on the results of student reasoning. Research conducted by Kane, Mishra, and Dutta (Kane, Mishra, & Dutta, 2016) showed that the score of N-Gain is still low. Based on the research, there is the effect of the innovative learning models on student reasoning.

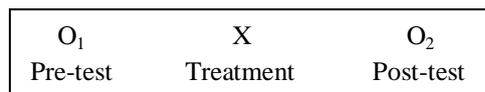
One innovative learning model is Means Ends Analysis (MEA). MEA is a variation of problem-based learning through a heuristic approach in the form of a series of questions as a guide to problem-solving (Lestari & Yudhanegara, 2015)(Shoimin, 2016)(Wahid, 2017). This learning model is done by group discussion. In the group, students analyze the problems from the one they recognize, set goals, simplify a goal to be sub-goals, arrange sub-goals, and find solutions (Wahid, 2017)(Nugroho, Mahfud, & Karsono, 2016)(Ngalimun, 2017)(Isrok'atun & Rosmala, 2018). Meanwhile, the main stage in this model is the identification of differences between the current state and the goal state, the organization of the sub-goals, and the selection of solutions (Huda, 2013). Eysennck added the stage of presenting the material with a problem-solving approach based on heuristic learning (Wahid, 2017). Based on the above explanation, the researcher examined the effect of the MEA learning model on the reasoning skills of planes.

Based on this explanation, this research aimed to determine the reasoning skills of the fourth-grade students of the public elementary schools of Nakula cluster of UPTD DIKPORA Serengan District Surakarta City in the 2018/2019 academic year by applying MEA learning model. Besides, with the increase in reasoning skills, this research can be of relevance in knowing the effect of the MEA learning model on reasoning skills.

**METHOD**

This research is quantitative-descriptive research with a one-group pretest-posttest research design. The data collection technique used is the reasoning-skill test. The data were analyzed using N-Gain. The population is the students of the Nakula Cluster of UPTD DIKPORA Serengan District Surakarta City in the 2018/2019 academic year and the research sample is SDN Serengan II No. 256 Surakarta taken by purposive random sampling technique.

Before the research was carried out, the students were given a pre-test. After the action was taken, the students were given a post-test. The research design (Sugiyono, 2015) can be seen in Figure 1.



**Figure 1.** The research design (one-group pretest-posttest).

The data obtained quantitative data. The data were taken from the pre-test and post-test of the reasoning of planes. Then, the data obtained were analyzed using N-Gain. The analysis was carried out with the following formula.

$$\langle g \rangle = \frac{\text{Post-test score} - \text{pre-test score}}{\text{ideal score} - \text{Pre-test score}}$$

The value categories after calculated with N-Gain (Atmojo, Sajidan, Sunarno, & Ashandi, 2019) can be seen in Table 2 as follows:

**Table 1.** Normalized of N-Gain

$\langle g \rangle$	Categories
$\geq 0.7$	High
$0.3 < \langle g \rangle < 0.7$	Medium
$> 0.3$	Low

## RESULTS AND DISCUSSION

The material taught in this plane mathematical skill is (1) the circumference of a joint plane and (2) the area of a joint plane. The results of the N-Gain analysis can be seen in Table 2 as follows:

**Table 2.** Normalized N-Gain per Sub-Concept

Sub-Concepts	Mean Scores		$\langle g \rangle$	Criteria
	Pre-test	Post-test		
1	34	77	0.95	High
2	42	79	0.85	High
Overall	76	156	0.90	High

Based on Table 2, it is known that the overall reasoning skills of students with the implementation of the Means Ends Analysis (MEA) learning model is high. Significant results were found in the second learning with the material of joint planes. The N-Gain obtained is 0.93. When the results of the first and second learning are accumulated, the N-Gain is 0.88 of the high category.

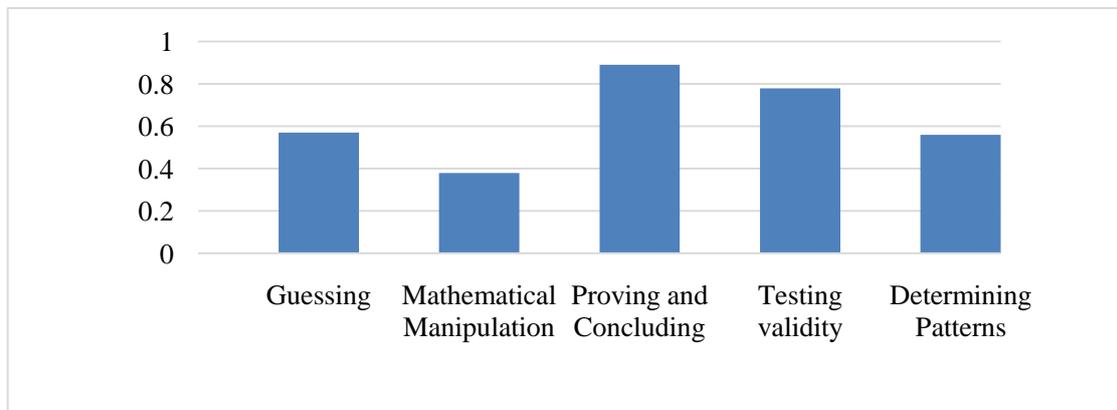
There are 6 indicators of reasoning skills; they are: presenting images, guessing, manipulating mathematics, proving and concluding, testing validity, and determining patterns. The development of reasoning skills per indicator is presented in Table 3 as follows:

**Table 3.** Normalized N-Gain per Sub-Concept

Indicators	Mean Scores		$\langle g \rangle$	Criteria
	Pre-test	Post-test		
Guessing	0.96	2.46	0.57	Moderate
Mathematical Manipulation	0.07	0.74	0.38	Moderate
Proving and Concluding	0.67	2.02	0.89	High
Testing validity	0.73	2.35	0.78	High
Determining Patterns	0.78	2.21	0.56	Moderate

Based on the results of data analysis in Table 3, it is known that a significant increase occurred in the indicators of determining, proving, and concluding with N-Gain of 0.89 included in the high category. The indicator of test validity also experienced a significant increase with N-Gain of 0.79 in the high category. Meanwhile, there is one indicator that obtains a low N-Gain, which is presenting an image. This is because, before given treatment, the students have

been skilled in presenting images. The other indicators are classified as moderate. Furthermore, the results of the N-Gain analysis can be seen in the diagram in Figure 2, as follows:



**Figure 2.** Development of Reasoning Skills per Indicator

Based on Table 2 and Figure 2, it can be analyzed that there is an effect of the MEA learning model on reasoning skills. This is in line with Wahid's opinion (Wahid, 2017) that this learning model affects mathematics learning outcomes. These results indicate that through this model the students will develop their thinking ability. This is in line with Shoimin's opinion (Shoimin, 2016) stating that the Means Ends Analysis (MEA) learning model can develop reflective, critical, logical, systematic, and creative thinking of the students. Through this research, students are guided to develop their reasoning ability so that they can solve reasoning problems in various ways. This is following the results of Nugroho's research (Shoimin, 2016) which stated that the Means Ends Analysis learning model can help students in analyzing a problem by using various ways to achieve the desired goals.

## CONCLUSION

Based on the research findings, it can be concluded that the Means Ends Analysis (MEA) learning model can improve reasoning skills with high N-Gain on the reasoning skills of planes. The development of reasoning skills was found in several indicators with the highest increase in determining the pattern. The practical implication of this research is that the Means Ends Analysis (MEA) learning model can be used to improving reasoning skills for students'.

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