Volume 6, Number 2, June 2025
Journal of Research on Mathematics Instruction
DOI: https://doi.org/10.33578/jrmi.v6i2.111
Journal's Webpage: http://jrmi.ejournal.unri.ac.id

The Relationship between Adaptive Reasoning Ability and Student Self-Efficacy on Comparison Materials

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ARTICLE'S INFORMATION

Article history:

Received: Apr-20-2025

Reviewed: Apr-25-2025

Accepted: Jun-15-2025

Keywords: *Adaptive Reasoning Ability, Comparison Materials, Self-Efficacy*

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ABSTRACT

This study aims to investigate the relationship between Adaptive Reasoning Ability (ARA) and self-efficacy among 8th-grade students at SMP IT Al-Fityah Pekanbaru for the 2024/2025 academic year. This research is a survey study with a quantitative approach. The subjects of this study were 25 8th-grade students at SMP IT Al-Fityah Pekanbaru. Data were collected using two instruments: a mathematical reasoning test and a self-efficacy questionnaire. Data analysis consisted of two parts: descriptive and inferential analysis. The descriptive analysis revealed that the average of the ARA score (62.5) was in the fair category, while the average of the self-efficacy score (71.8) was in the high category. The Pearson correlation analysis indicated a very weak positive correlation (r=0.007) with no statistical significance (p=0.974), suggesting that self-efficacy does not significantly influence ARA. These findings highlight the need for more practice-oriented learning to strengthen students' adaptive reasoning skills regardless of their self-efficacy levels.

INTRODUCTION

Adaptive Reasoning Ability (ARA) is a person's ability to think logically about the relationship between concepts and situations [1]. In mathematics learning, ARA is a way for students to reason logically to solve mathematical problems [2]. In the adaptive reasoning process, there are two basic abilities that students must master, namely the ability to reason inductively, deductively, and intuitively [3]. These three reasoning abilities are high-level abilities that students need in learning mathematics [4]. This indicates that ARA is needed by students in develop their abilities optimally in learning mathematics.

ARA is an ability that is needed by someone, especially a student, in learning mathematics. A student can analyze the problems he faces carefully to determine the solution well if he has an ARA that is optimally trained [1]. ARA that has been optimally trained will support success in learning mathematics so that learning becomes more meaningful and learning objectives can be achieved [4]. Students will be able to act logically in solving mathematical problems and contextual problems if they are accustomed to practicing their ARA, have sufficient basic knowledge, understand tasks that can motivate them, and recognize contexts that are fun for students [2]. Therefore, ARA is one of the mathematical skills that students need to master well.

The importance of ARA for students has not been in line with the level of ARA of students in the field. Research by Agustin et al. [5] found the fact that students' ARA was still in the low category

in terms of the lack of achievement of indicators, and there were still many errors found in students' answers in solving the ARA questions given. In line with these findings, Nada et al. [6] revealed the finding that 40% of the student research subjects had low ARA, where 20% of the overall subjects were unable to fulfill all indicators on the ARA questions given. The findings by Yanti & Laily [7] revealed that students were only able to answer 50% of the questions with the given ARA indicators, so they did not have optimal ARA.

In addition to the need to develop students' ARA as the basis for students' abilities in learning mathematics, affective skills also need to be improved as a support, so that the learning outcomes achieved by students can get maximum results. One of the affective skills that is important to train and develop in learning mathematics is self-efficacy. Self-efficacy refers to an individual's belief in their ability to complete the tasks they are responsible for [8]. A high level of self-efficacy in a person will increase their confidence in their ability to achieve success [8]. Students with high self-efficacy will make greater efforts, be more active in doing the tasks given to them, so that they will achieve more optimal achievement [9]. Based on this explanation, self-efficacy is one aspect that needs to be improved by students, especially in learning mathematics, to obtain maximum learning outcomes.

The importance of self-efficacy in students is not in line with the findings of several studies, which state that students' self-efficacy is still in the low category. Sari et al. [9] revealed that most students have not been able to follow math learning well due to their low self-efficacy, which only reaches a percentage of 37.27% so that it has an impact in low learning outcomes. Other findings by Nuraiman et al. [10] revealed that only 19% of students have self-efficacy in the high category, while the other 81% are spread in the medium and low categories. In line with this, Aziz et al. [11] revealed that only 22.22% of students have self-efficacy in the high category, where most students still have self-efficacy in the medium category.

In learning mathematics, one of the materials that is closely related to everyday life is comparison. The comparison material consists of value comparison and inverse value comparison, where the solution requires students' ability to reason inductively, deductively, and intuitively. High self-efficacy is also needed so that students have the confidence to be able to solve the problems given.

Several previous studies have found a positive relationship between mathematical reasoning ability and self-efficacy. The study by [12] reported a strong relationship between students' mathematical reasoning ability and self-efficacy, indicated by a correlation coefficient of 0.556 in a positive direction. This finding suggests that students' mathematical reasoning ability has a considerable influence on their self-efficacy. Similarly, [13] revealed a positive and significant relationship between self-efficacy and mathematical reasoning ability. These results are supported by [14], who also demonstrated a positive relationship between mathematical reasoning ability and self-efficacy with a correlation coefficient of 0.245.

The aforementioned findings indicate that self-efficacy and mathematical reasoning ability have a positive correlation with varying correlation coefficients. However, these studies have not examined in depth the relationship between more specific aspects of mathematical reasoning ability and students' self-efficacy. One particular aspect of mathematical reasoning that needs to be investigated in relation to self-efficacy is ARA.

Based on the description above, the purpose of this study is to determine whether there is a relationship between statistical reasoning ability and self-efficacy in the comparison material among eighth-grade students of SMP IT Al-Fityah Pekanbaru. The formulation of the research problems

focuses on three main aspects, namely: (1) the description of students' adaptive reasoning ability, (2) the description of students' self-efficacy, and (3) the relationship between adaptive reasoning ability and students' self-efficacy. Therefore, this study is expected to provide a clear overview of how adaptive reasoning ability and self-efficacy are related in the context of mathematics learning.

METHODS

This research is a survey-type research with a quantitative approach. The population in this study was VIII-grade students of IT Junior High School Al-Fityah Pekanbaru. The sample was taken by a purposive sampling technique as many as 25 students who were divided into high, medium, and low ability students, so that they could represent the entire population. The research was conducted in the odd semester of the 2024/2025 school year. Research data were collected using test and non-test instruments. The test instrument in this study was used to collect data on students' adaptive reasoning skills, consisting of 5 description questions prepared based on indicators of adaptive reasoning skills. The non-test instrument in this study is a self-efficacy questionnaire consisting of 18 statement items to measure the dimensions of self-efficacy, which are divided into magnitude, strength, and generality. The test instrument has been tested for validity and reliability, with the results of all questions being valid and in the high reliability category. The validity test on the questionnaire states that all statements are valid, and the reliability level is in the high category.

Data analysis in this study consists of descriptive analysis and inferential analysis. Descriptive analysis describes the condition of adaptive reasoning ability and self-efficacy as a whole. Inferential analysis is intended to determine the relationship between adaptive reasoning ability and student self-efficacy. The results of descriptive analysis presented the average data, standard deviation, maximum, and minimum values obtained by students. The quantitative data obtained were then interpreted based on the criteria in Tables 1 and 2.

Table 1. Interpretation of Adaptive Reasoning Ability Score

Interval Score	Interpretation
$0 \leq$ Adaptive Reasoning Ability < 45	Very Poor
$45 \leq$ Adaptive Reasoning Ability < 65	Poor
$65 \leq$ Adaptive Reasoning Ability < 75	Fair
$75 \leq$ Adaptive Reasoning Ability < 90	Good
$90 \leq$ Adaptive Reasoning Ability ≤ 100	Very Good

Table 2. Interpretation of Self-Efficacy Score Percentage

Interval Score	Interpretation
$25\% \leq$ Percentage of Self-efficacy Score $< 40\%$	Very Low
$40\% \leq$ Percentage of Self-efficacy Score $< 55\%$	Low
$55\% \leq$ Percentage of Self-efficacy Score $< 70\%$	Medium
$70\% \leq$ Percentage of Self-efficacy Score $< 85\%$	High
$85\% \leq$ Percentage of Self-efficacy Score ≤ 100	Very High

The inferential analysis conducted is the Pearson Product-Moment correlation test, which aims to determine the relationship between adaptive reasoning skills and student self-efficacy. The correlation coefficient is in the range of -1 to 1, which indicates the strength or weakness of the tested relationship. The negative and positive signs indicate the direction of the relationship between the two variables tested. Percentage of Self-Efficacy Score.

Journal of Research on Mathematical Instruction, Vol. 6, No. 2, June 2025, 27-34
DOI: https://doi.org/10.33578/jrmi.v6i2.111
jrmi.ejournal.unri.ac.id, Online ISSN: 2715-6869

RESULTS AND DISCUSSION

The results and discussion of this study consist of two parts, namely the results of descriptive analysis and inferential analysis to see the relationship between adaptive reasoning ability and self-efficacy. Adaptive reasoning ability data can be seen in Table 3.

Table 3. Data Description of Adaptive Reasoning Skills

Data Description	Score
Mean	62.5
Standard Deviation	16.51
Ideal Maximum Score	100
Maximum Score Achieved	87.5
Minimum Score Achieved	25

Table 3 displays descriptive data of students' overall adaptive reasoning ability with an average score of 62.5 and a standard deviation of 16.51. The maximum value obtained was 87.5, while the minimum value obtained was 25. The distribution of student categories based on the interval value of adaptive reasoning ability can be seen in Table 4.

Table 4. Adaptive Reasoning Ability (ARA) Score Category

Interval Score	Number of Students	Percentage	Interpretation
$0 \leq$ ARA Score < 45	5	20%	Very Poor
$45 \leq$ ARA Score < 65	9	36%	Poor
$65 \leq$ ARA Score < 75	3	12%	Fair
$75 \leq$ ARA Score < 90	8	32%	Good
$90 \leq$ ARA Score ≤ 100	0	0%	Very Good

From Table 4, the results of the adaptive reasoning ability test 20% of students are in the very poor category, namely 5 students. The highest percentage is in the least category, namely 36% or 9 students. Students with reasoning skills in the moderate category were 12% or 3 students. As many as 32% of students are in the good category, namely 8 students. However, there are no students who are in the excellent adaptive reasoning ability category, namely 0%.

When linked to findings on students' ARA ([5], [6], [7]), which consistently showed that students' ARA remains low and suboptimal, the present study reveals an important insight. Although students may possess relatively high self-efficacy, this does not guarantee improved adaptive reasoning ability unless it is supported by sufficient practice in solving reasoning-intensive problems. Self-efficacy data can be seen in Table 5 below.

Table 5. Data Description of Self-Efficacy

Data Description	Score
Mean	71.08
Standard Deviation	6.64
Ideal Maximum Score	100
Maximum Score Achieved	81.67
Minimum Score Achieved	58.33

Table 5 displays an overall description of the self-efficacy data. The average self-efficacy score of 71.08 is in the high category. The results of data analysis show the standard deviation of self-efficacy data is 6.64, with the maximum value being 81.67, while the minimum value obtained is 58.33. The maximum value is in the high category, while the minimum value is in the medium category.

The self-efficacy questionnaire data are then converted from quantitative data into qualitative data. Quantitative data is divided into five categories according to Table 2. The results of the conversion of the self-efficacy questionnaire data are presented in Table 6.

Table 6. Self-Efficacy (SE) Score Category

Interval Score	Number of Students	Percentage	Interpretation
$0 \leq$ SE Score < 45	0	0%	Very Low
$45 \leq$ SE Score < 65	0	0%	Low
$65 \leq$ SE Score < 75	9	36%	Medium
$75 \leq$ SE Score < 90	16	54%	High
$90 \leq$ SE Score ≤ 100	0	0%	Very High

Table 6 shows that the number of students who have self-efficacy in the high category is 54%, namely 16 students. Meanwhile, 36% of students have self-efficacy in the medium category. Students with self-efficacy in the very low, low, and very high categories were at 0%. The number of students with self-efficacy in the high category indicates that the majority of students have high confidence in completing the task well.

The results of this study indicate that students' self-efficacy is predominantly in the high (54%) and medium (36%) categories, with no students falling into the very low, low, or very high categories. This finding differs from previous studies ([9], [10], [11]), which reported that the majority of students had medium to low levels of self-efficacy, with only a small proportion achieving high self-efficacy. Thus, this study suggests that students' self-efficacy levels tend to be higher compared to earlier findings.

Furthermore, inferential analysis was carried out using the correlation test. Before conducting the correlation test with the Pearson Product-Moment Correlation Test, two assumption tests must be met, namely the normality and linearity tests. Each can be seen in Table 7 and Table 8.

Table 7. Normality Test Results using SPSS

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
ARA Score	0,140	25	0,200	0,962	25	0,446
Self-efficacy Score	0,128	25	0,200	0,951	25	0,264

Based on Table 7, it is known that the Sig. value on Shapiro-Wilk is 0.446 for the FTC value data and 0.264 for the self-efficacy score. Both values are greater than 0.05, so both variables are normally distributed.

Table 8. Linearity Test Results using SPSS

			Sum of Squares	df	Mean Square	F	Sig.
Value ARA*Score Self-Efficacy	Between Groups	Combined	3068.034	13	236.003	0.747	0.695
		Linearity	0.309	1	0.309	0.001	0.976
		Deviation from Linearity	3067.725	12	255.644	0809	0.640
	Within Groups		3474.935	11	315.903		
	Total		6542.969	24			

Based on Table 8, it is known that the linearity significance value is 0.976, which is greater than 0.05; it can be concluded that the two variables are linear. Based on the results of the assumption test, it is obtained that the results of the normality test and linearity test are met, so that the Pearson Product-Moment correlation test to see the relationship between adaptive reasoning skills and student

self-efficacy can be carried out. The results of the Pearson Product-Moment correlation test can be seen in Table 9.

Table 9. Pearson Product-Moment Correlation Test Results

Interval Score	Number of Students	Adaptive Reasoning Ability	Self-Efficacy
Adaptive Reasoning Ability	Pearson Correlation	1	0.007
	Sig. (2-tailed)		0.974
	N	25	25
Self-Efficacy	Pearson Correlation	0.007	1
	Sig. (2-tailed)	0.974	
	N	25	25

From Table 9, it can be seen that the significance value of 0.974 is greater than 0.05, so it can be concluded that there is no significant correlation or relationship between adaptive reasoning ability and self-efficacy of VIII-grade students of SMP IT Al-Fityah Pekanbaru on comparison material. The relationship between statistical reasoning ability and self-efficacy can be seen from the size of the correlation coefficient. The correlation coefficient category is divided into 6 categories [15].

$0 < r < 0.1$: Very weak positive correlation
$0.1 \leq r < 0.3$: Weak positive correlation
$0.3 \leq r < 0.5$: Moderate positive correlation
$0.5 \leq r < 0.8$: Strong positive correlation
$0.8 \leq r < 1$: Very strong positive correlation

Based on Table 9, the correlation coefficient is 0.07, which is in the category of very weak positive correlation between adaptive reasoning ability and student self-efficacy. The correlation test results show that there is no significant relationship between adaptive reasoning ability and self-efficacy. Therefore, it can be concluded that adaptive reasoning in solving comparison problems, both value comparison and inverse value comparison, does not require high self-efficacy in solving them.

Based on the results of this study, the correlation coefficient of 0.07 indicated a very weak and insignificant relationship between ARA and self-efficacy. This finding contradicts previous studies that generally reported a positive and significant relationship between mathematical reasoning ability and self-efficacy ([12], [13], [14]). This discrepancy may be explained by the fact that prior studies focused on mathematical reasoning ability in general, whereas the present study specifically examined adaptive reasoning in the context of solving comparison problems.

Furthermore, more than 50% of students in this study demonstrated ARA between the poor and very poor categories. This suggests that although students may have high self-efficacy, the lack of practice in solving problems that foster ARA prevents self-efficacy from having a significant impact on their adaptive reasoning performance. Therefore, this study extends previous findings by showing that self-efficacy is not necessarily a determining factor across all aspects of mathematical reasoning ability, particularly in adaptive reasoning.

CONCLUSIONS AND SUGGESTIONS

Based on the results and discussion in this study, it can be concluded that 56% of students' adaptive reasoning ability scores are in the less and very less category, while 54% of students have high self-efficacy. The correlation coefficient of 0.07 shows that the relationship between adaptive reasoning ability is very weak, and the significance value of 0.974 shows there is no significant

relationship between adaptive reasoning ability and self-efficacy of 8th-grade students of IT Junior High School Al-Fityah Pekanbaru.

Suggestions for future researchers in exploring information related to similar topics are to examine other variables that can affect students' adaptive reasoning skills. In improving students' adaptive reasoning skills, routine exercises need to be given to students so that students are accustomed to solving complex problems.

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