Advances in Social Science, Education and Humanities Research, volume 611
International Conference on Educational Studies in Mathematics (ICoESM 2021)

# Description of Factors Affecting Students Mathematical Connection

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**ABSTRACT**

This study aims to describe several factors that influence students' mathematical connections. The research samples were 144 students at grade 8th selected using stratified cluster random sampling. Data were collected using the GEFT test, mathematics learning motivation questionnaire, self-concept questionnaire, and mathematical connection test. Data were analyzed by descriptive statistics and inferential statistics using multiple regression. The results obtained were: (1) the average mathematical connection of students was in the medium category, (2) the average cognitive style of students was in the field-dependent type, (3) the average motivation for learning mathematics was in the medium category, (4) the average self-concept students were categorized as moderate, (5) cognitive style, motivation to learn mathematics and self-concept together had a relationship with mathematical connection, (6) cognitive style had a positive relationship with mathematical connection, (7) motivation to learn mathematics had no positive relationship with mathematical connection, and (8) self-concept did not have a positive relationship with mathematical connections.

***Keywords:*** *Mathematical Connection, Cognitive Style, Mathematics Learning Motivation, Self - Concept, Independent Field, Dependent Field.*

## 1. INTRODUCTION

*National Council of Teachers of Mathematics* ([1]) stated that five basic mathematical abilities consist of problem-solving, reasoning and proof, communication, connection, and representation. One of the basic skills of mathematics that students must have is mathematical connection. Mathematical connections help students better understand mathematics to use their knowledge to solve math problems. According to [2], students with high mathematical connection abilities have better learning achievements than students with moderate and low connection abilities.

Mathematical connection is a term popularized by NCTM and used as one of the standard mathematics curricula for primary and secondary schools. Mathematical connection is the ability to relate mathematical concepts or rules in the same topic, link mathematical concepts in a particular topic or different topics, associate mathematical concepts or rules with other fields of study and everyday life [3]. The ability of mathematical connections possessed by students cannot be separated from several factors.

The factors that affect students' mathematical connections consist of internal factors and external factors. Internal factors are factors that come from within a person or the individual himself. Internal factors are usually in the form of traits or attitudes that are inherent in a person. These factors come from outside a person or individual. Internal factors that affect mathematical connections are cognitive style, learning motivation, and self-concept, while external factors come from outside a person or individual. External factors that affect mathematical connections are learning media, curriculum, teacher professional abilities, etc.

 

One of the internal factors that influence mathematical connections is cognitive style. Cognitive style is the typical way of each individual in thinking, responding, processing, and remembering information consistently [4]. A similar opinion is presented by Witkin ([5]) that the cognitive style is defined as the preferred way for each individual to organize new information with existing information, interpret further information and adapt it according to the characteristics of each individual. Cognitive style is a characteristic of each individual in receiving, processing information, and solving problems encountered. Therefore, cognitive style is a way for students to learn through their respective ways that differ from one individual to another in solving problems that affect the quantity and quality of the results of learning activities. As in the research conducted by [6], students' cognitive style affects learning outcomes. Learning outcomes should include students' reasoning, communication, and connection abilities.

Another internal factor that affects the mathematical connection is the motivation to learn mathematics. Motivation is a will or power that drives someone to do something [7]. Motivation is a process of generating, directing, and strengthening behavior towards a goal. In addition, motivation is defined as a strong desire that arises from within oneself to achieve a goal [8]. Learning motivation is essential for successful learning. Students with high learning motivation produce good mathematics learning outcomes because they have a strong will to learn, while students with low motivation have low learning outcomes. This is in line with research conducted by [9], conveying that learning motivation affects students' mathematics learning outcomes.

In addition to cognitive style and learning motivation, internal factors that influence mathematical connections are self-concept. Self-concept is an individual's perception in the form of a person's judgment, views, and feelings about himself. One of the primary sources of individuals' expectations for success is perceptions of their abilities (self-concept). Self-concept is an individual's view and attitude towards oneself, both physical and psychological, positive and negative attitudes. In learning, it is necessary to build a positive self-concept to form self-confidence. The greater the self-confidence, the greater the chances of achieving success in any activity. So that the greater the confidence in learning, the greater the opportunity to have good mathematics learning outcomes. In particular, self-concept in mathematics assesses students' abilities and feelings of liking or interest in mathematics [10]. This is in line with research conducted by [11] that self-concept affects mathematics learning outcomes.

Cognitive style, learning motivation, and self-concept are internal factors that support mathematical connections. Thus, the purpose of this study is to examine the effect of cognitive style on students' mathematical connections, the impact of learning motivation on students' mathematical connections, and the effect of self-concept on students' mathematical connections.

## 2. RESEARCH METHOD

This study is quantitative research with an ex post facto approach. In this study, there were two types of variables, namely the independent variable and the dependent variable, where cognitive style (X1), motivation to learn mathematics (X2), and self-concept (X3) as independent variables and mathematical connection (Y) as dependent variables. The research design is as follows:

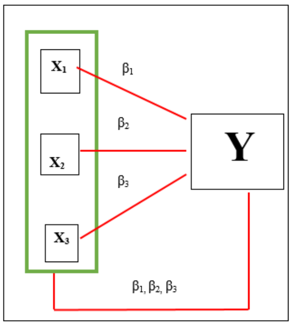


**Figure 1.** Research Design

Information:

$X_1$= Cognitive Style

$X_2$= Motivation to Learn Mathematics

$X_3$= Self Concept

$Y$ = Mathematical Connection

1, 2, 3 = Regression Coefficient

This study was conducted in a junior high school in Pattallassang District. The sample in this study were

114 8th-grade students consisting of two classes of A-accredited schools, one B-accredited school, one C-accredited school, and one unaccredited school.

The sample in this study was selected using a stratified cluster random sampling technique. One school was chosen from each accreditation type, namely, A accredited, B accredited B, C accredited, and not accredited schools. Then, two classes at an A-accredited school and one class at each of the other schools were randomly picked as the research samples. Data collection techniques used instruments: (1) GEFT (Group Embedded Figure Test), (2) questionnaire on motivation to learn mathematics, (3) self-concept questionnaire, and (4) mathematics connection test.

The data collected were then processed using statistical analysis techniques, namely descriptive statistical analysis and inferential statistical analysis. Descriptive statistical analysis was used to describe the characteristics of the research respondents' scores for each variable, including the mean, median, variance, minimum, maximum, and categorization. Inferential statistical analysis was used to test the research hypotheses. In this study, multiple regression analysis was applied to determine whether an exogenous variable affected endogenous variables.

The hypotheses of this research were (1) cognitive style, motivation to learn mathematics, and self-concept together had a relationship with student's mathematical connections (2) cognitive style had a positive relationship with mathematical connections (3) motivation to learn mathematics had a positive relationship with mathematical connections (4) self-concept had a positive relationship with mathematical connections.

## 3. RESULTS AND DISCUSSION

### *3.1 RESULT*

### *3.1.1 Descriptive statistical analysis results*

#### *3.1.1.1 Math Connection*

The results of descriptive analysis of a mathematical connection of students are given in the following table:

**Table 1**. Math Connection Score Statistics

| Statistics | Statistical Value |
|---|---|
| Sample size (n) | 114 |
| Average score ($x$) | 41.23 |
| Standard deviation (σ) | 17,721 |
| Variance ($σ^2$) | 314,047 |
| Highest score ($X_{max}$) | 100 |
| The lowest score ($X_{min}$) | 11 |

Based on Table 1, the mean score of mathematical connection of students was 41.23, with a standard deviation of 17.721. This standard deviation value is much smaller than the average score so that no data was far from other data and data were only around the average value. In addition, the highest score obtained was 100, which was the maximum score. Therefore, it can be said that there were students who answered the math connection questions perfectly.

**Table 2**. Frequency Distribution and Percentage of Mathematical Connections

| Value Interval | Category | Frequency | Percentage (%) |
|---|---|---|---|
| 76 – 100 | Very high | 1 | 0.9 |
| 51 – 75 | Tall | 26 | 22.8 |
| 26 – 50 | Currently | 64 | 56.1 |
| 0 – 25 | Low | 23 | 20.2 |
| | Amount | 114 | 100 |

Batari [12]

Based on Table 2, the students' mathematical connection scores were in the medium category with a percentage of 56.1% and a frequency of 64 out of 114 total students. In addition, the percentage of students who had a low mathematical connection category was 20.2%, meaning that there were still students having low mathematical connections.

#### *3.1.1.2 Cognitive Style*

The results of the descriptive analysis of the cognitive style score of students can be seen in the following table:

**Table 3.** Cognitive Style Score Statistics

| Statistics | Statistical Value |
|---|---|
| Sample size (n) | 114 |
| Average score ($x$) | 8.55 |
| Standard deviation (σ) | 4.079 |
| Variance (σ2) | 16,639 |
| Highest score (Xmax) | 17 |
| The lowest score (Xmin) | 2 |

Based on Table 3, the average score of mathematical connection was 8.55 with a standard deviation of 4.079. Since the standard deviation value was much smaller than the average score, it can be said that no data is far from other data and the data were only around the average value.

**Table 4.** Frequency Distribution and Percentage of Cognitive Style

| Value Interval | Category | Frequency | Percentage (%) |
|---|---|---|---|
| 0 ≤ x ≤ 9 | *Field dependent* | 79 | 69.3 |
| 10 ≤ x ≤ 18 | *Field independent* | 35 | 30.7 |
| | Amount | 114 | 100 |

Based on Table 4, the cognitive style of students belonging to the field-dependent category had a fairly large percentage of 69.3%, with a frequency of 79 out of 114 students. On the other hand, the number of students in field independent categories was 30.7%.

*3.1.1.3. Learning Motivation*

The results of the descriptive analysis of mathematics learning motivation score of students are given in the following table:

**Table 5**. Mathematics Learning Motivation Score Statistics

| Statistics | Statistical Value |
|---|---|
| Sample Size (n) | 114 |
| Average score ($x$) | 84.01 |
| Standard deviation (σ) | 10,050 |
| Variance ($\sigma^2$) | 101.005 |
| Highest score ($X_{max}$) | 110 |
| The lowest score ($X_{min}$) | 66 |

Based on Table 5, the average score of students' motivation to learn mathematics was 84.01, with a standard deviation of 10.050. This standard deviation value was much smaller than the average value so that it can be said that no data was far from other data and the data were only around the average value.

**Table 6.** Distribution of Frequency and Percentage of Mathematics Learning Motivation

| Vulnerable Score | Category | Frequency | Percentage (%) |
|---|---|---|---|
| *Score* > 99,100 | Very high | 11 | 9.6 |
| 89,040 Score < 99,100 | Tall | 22 | 19.3 |
| 78,487 Score < 89,040 | Currently | 42 | 36.8 |
| 68,940 Score < 78,487 | Low | 33 | 29 |
| *Score* 68,940 | Very low | 6 | 5.3 |
| | Total | 114 | 100 |

Based on Table 6, students' mathematics learning motivation scores were in the medium category with a percentage of 36.8% and a frequency of 42 out of 114 total students. In addition, the number of students with a very low category of mathematics learning motivation was 5.3%, which means that there were still students classified as having very low mathematics learning motivation.

*3.1.1.4. Self-concept*

The results of statistical analysis of the self-concept scores of students are given in the following table:

**Table 7**. Self-Concept Score Statistics

| Statistics | Statistical Value |
|---|---|
| Sample Size (n) | 114 |
| Average score ()$x$ | 89.53 |
| Standard deviation (σ) | 10,140 |
| Variance ($\sigma^2$) | 102,821 |
| Highest score ($X_{max}$) | 119 |
| The lowest score ($X_{min}$) | 60 |

Based on Table 7 it is known that the average self-concept score is 89.53 with a standard deviation of 10.140. The standard deviation is much smaller than the average value, which means that no data is far from other data, which is only around the average value.

**Table 8.** Frequency Distribution and Percentage of Self- Concept

| Vulnerable Score | Category | Frequency | Percentage (%) |
|---|---|---|---|
| *Score* > 104.74 | Very high | 18 | 7 |
| 94.597 Score < 104.74 | Tall | 29 | 25.4 |
| 83,950 Score < 94,597 | Currently | 41 | 36 |
| 74,317 Score < 83,950 | Low | 30 | 26.3 |
| *Score* 74,317 | Very low | 6 | 5.3 |
| | Total | 114 | 100 |

Table 8 showed that the students' self-concept scores belong to the medium category with a percentage of 36% with a frequency of 41 out of 114 total students. In addition, students with a very low self-concept category reached a percentage of 5.3%, which implied that there were still students having very low self-concepts.

### *3.1.2 Descriptive statistical analysis results*

3.1.2.1. Preliminary tests

The results of the multicollinearity test are given in the following table.

**Table 9.** Multicollinearity Test Results

| Model | Variable | Tolerance | VIF | Information |
|---|---|---|---|---|
| 1 | Cognitive Style | 0.972 | 1.029 | There is no multicollinearity |
| | Motivation to Learn Mathematics | 0.463 | 2,161 | There is no multicollinearity |
| | Self - Concept | 0.462 | 2,163 | There is no multicollinearity |

Table 9 showed that the Tolerance value of each variable was greater than 0.1, and the VIF value for each variable in each model was less than 10. Between independent variables, there were no signs of multicollinearity.

**Table 10.** Heteroscedasticity Test Results

| Model | Variable | Sig | Information |
|---|---|---|---|
| 1 | Cognitive Style | 0.679 | There is no heteroscedasticity. |
| | Motivation to learn Mathematics | 0.521 | There is no heteroscedasticity. |
| | Self-Concept | 0.451 | There is no heteroscedasticity. |

Table 10 showed that each variable obtained a sig value > 0.05. It indicated that there was no independent variable that was statistically significant affecting the dependent variable. So, it can be concluded that the regression model did not contain heteroscedasticity.

3.1.2.2. Hypothesis Testing

**Table 11.** The results of hypothesis testing 1

**ANOVA**[a]

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 7611,885 | 3 | 2537,295 | 10,012 | .000[b] |
| | Residual | 27875,444 | 110 | 253,413 | | |
| | Total | 35487,329 | 113 | | | |

Predictors: (Constant), Self-Concept, Cognitive Style, Mathematics Learning Motivation.

**Table 12.** The results of hypothesis testing 1

**Model Summary**

| R | R Square | Adjust R Square | Std. Error of the Estimate |
|---|---|---|---|
| .463[a] | .214 | .193 | 15.919 |

Predictors: (Constant), Self-Concept, Cognitive Style, Mathematics Learning Motivation.

1. Hypothesis testing 1

Cognitive style, motivation to learn mathematics, and self-concept together with students' mathematical connections.

$H_0$: $H_0$: $\beta_1 = \beta_2 = \beta_3 = 0$ vs $H_1$: $\beta_i \neq 0$, i = 1, 2, 3.

Table 11 shows that $F_{hitung}$ = 10,012 and a significance value of 0.000, smaller than 0.05, which means that $H_0$ is rejected. Thus, cognitive style, motivation to learn mathematics, and self-concept together have a relationship with students' mathematical connections.

Dependent Variable: Math Connection (Y)

2. Hypothesis testing 2

Cognitive style has a positive relationship with students' mathematical connections.

$H_0$: $\beta_1 \leq 0$ vs $H_1$: $\beta_1 > 0$.

Table 13 shows that $T_{hitung}$ = 2.666 and a significance value of 0.009, smaller than 0.05, which means that $H_0$ is rejected. Thus, the cognitive style has a positive relationship with students' mathematical connections.

3. Hypothesis testing 3

Motivation to learn mathematics has a positive relationship with mathematical connections.

$H_0$:$\beta_2 \leq 0$ vs $H_2$: $\beta_2 > 0$.

Table 13 shows that $T_{hitung}$ = 1.558 and a significance value of 0.122, greater than 0.05, then $H_O$ is accepted, or $H_1$ is rejected. Thus, it can be stated that the motivation to learn mathematics does not have a positive relationship with mathematical connections.

4. Hypothesis testing 4

Self-concept has a positive relationship with mathematical connections.

$H_0$: $\beta_3 \leq$ vs $H_3$: $\beta_3 > 0$.

Table 13 shows that $T_{hitung}$ = 1.610 and a significance value of 0.110, greater than 0.05, means that $H_O$ is accepted or H1 is rejected. Thus, it can be stated that self-concept does not have a positive relationship with mathematical connections.

### *3. 2. DISCUSSION*

Based on Table 13, it is known that the coefficient value of each variable. The coefficient value for cognitive style is 0.993. The coefficient value for the variable of motivation to learn mathematics is 0.341. The value for the self-concept coefficient is 0.350, and the constant value is -27,235. Thus the regression equation model can be expressed as = -27.235 + $0.993X_1 + 0.341X_2 + 0.350\ X_3$.

Furthermore, by paying attention to the significant value of each variable, it is known that the cognitive style variable has a significance of 0.009, which is smaller than. This means that the cognitive style, which consists of 2 categories, namely field dependent and field independent, affects the ability of mathematical connections, especially those with a field-dependent cognitive style. This means that students with field-dependent cognitive styles have better mathematical connection skills than students in the field-independent category. The study results are in line with the results of research [13], which concluded that cognitive field style has a positive effect on learning outcomes in mathematics. According to him, the field-dependent cognitive style tends to be easy to understand and has better-thinking skills towards mathematics.

The variable of motivation to learn mathematics has a significant value of 0.1222, which is greater than. This means that the motivation to learn mathematics does not affect students' mathematical connections. This is in line with the results of the research conducted [14]. The self-concept variable has a significance of 0.110, which is greater than. This means that self-concept does not affect mathematical connections.

## 4. CONCLUSION

Based on the results of the study, the conclusions in this study are 1) cognitive style has a positive relationship with mathematical connections, 2) motivation to learn mathematics does not have a positive relationship with mathematical connections, 3) self-concept does not have a positive relationship with mathematical connections, 4) contribution cognitive style, motivation to learn mathematics and self-concept with mathematical connections by 21.4% of class VIII students in Pattallassang District, Gowa Regency.

## AUTHOR CONTRIBUTIONS

Avida compiles questionnaires, carries out research, and compiles articles. Baso Intang, Ilham Minggi, Suradi Tahmir and Nurdin Arsyad as a supervisors in the implementation and preparation of articles.

## ACKNOWLEDGMENTS

The author wishes to thank the advisers for their support. The author also praised everyone who helped make the study a success.

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