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# Students' Mathematics Self-Concept, Mathematics Anxiety and Mathematics Self-Regulated Learning during the Covid-19 Pandemic

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***Abstract***

Online learning during the Covid-19 pandemic requires lecturers to provide a stimulus that can increase student learning independence. However, not all lecturers and students are ready to carry out online learning, as a result, the anxiety factor for students is getting higher. In some studies, it is said that anxiety has a negative correlation with student self-concept. This study aims to find out how the mathematics self-concept (MSC), mathematics anxiety (MA), and mathematics learning independence (MSRL) of students are during the Covid-19 pandemic. This research is quantitative descriptive. The population of this study was active students in the Mathematics and Mathematics Education study program. Data were collected using a cross-sectional survey technique with cluster sampling. The data analysis technique used descriptive statistical analysis, Spearman correlation analysis, and ordinal regression analysis. The results showed that the average student had a positive MSC, MA, and moderate MSRL. Students with negative MSC had a significant tendency to have a high MSRL than students with positive MSC. The increasing probability of students with negative MSC having a high MSRL is 0.5110 times better than students with positive MSC. MSC and MA have an effect of 7.9% on changes in the student's MSRL variable. Thus, during the Covid-19 pandemic mathematics self-concept directly affects changes in student learning independence, but not with math anxiety.

**Keywords:** Mathematics Self-Concept, Anxiety, Self-Regulated Learning

**Abstrak**

Pembelajaran online pada masa pandemi Covid-19 menuntut dosen untuk memberikan stimulus yang dapat meningkatkan kemandirian belajar mahasiswa. Namun, tidak semua dosen maupun mahasiswa siap dalam melaksanakan pembelajaran online, akibatnya faktor kecemasan mahasiswa menjadi semakin tinggi. Pada beberapa penelitian dikatakan bahwa kecemasan memiliki korelasi negatif dengan konsep diri mahasiswa. Penelitian bertujuan untuk mengetahui mengenai bagaimanakah konsep diri matematika (MSC), kecemasan matematika (MA) serta kemandirian belajar matematika (MSRL) mahasiswa pada masa pandemi Covid-19. Penelitian ini merupakan penelitian deskriptif kuantitatif. Populasi penelitian ini adalah mahasiswa aktif pada program studi Matematika dan Pendidikan Matematika. Pengumpulan data dilakukan dengan teknik survey *cross-sectional* dengan *cluster sampling*. Teknik analisis data menggunakan analisis statistika deskriptif, analisis korelasi Spearman dan analisis regresi ordinal. Hasil penelitian menunjukkan bahwa rata-rata mahasiswa memiliki MSC positif, MA dan MSRL level sedang. Mahasiswa dengan MSC negatif memiliki kecenderungan yang signifikan untuk memiliki MSRL tinggi daripada mahasiswa dengan MSC positif. Peningkatan kecenderungan mahasiswa dengan MSC negatif dalam memiliki MSRL tinggi 0.5110 kali lebih baik daripada mahasiswa dengan MSC positif. MSC dan MA memberikan pengaruh sebesar 7.9% terhadap perubahan-perubahan pada variabel MSRL mahasiswa. Dengan demikian, selama pandemi Covid-19 mathematics self-concept mempengaruhi secara langsung pada perubahan kemandirian belajar mahasiswa, tetapi tidak dengan kecemasan matematika.

**Kata kunci:** Konsep Matematika, Kecemasan, Pembelajaran Mandiri

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## INTRODUCTION

The spread of Covid-19 first appeared in Wuhan, China, and has developed into a pandemic since the

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end of 2019. Several countries have implemented regional closures to minimize the spread of Covid-19. However, Indonesia has not yet issued a policy to close the territory because it considers various things, especially those related to the economy of its people. Efforts made by Indonesia to minimize the spread of Covid-19 are by applying the concept of physical distancing. This policy applies to every field, including education. This is the basis for the Minister of Education and Culture to issue circular letter Number 4 of 2020 which states that all teaching and learning activities on the College campus are carried out online. This online learning can make teaching and learning activities not hindered by time and place (Shukla et al., 2020). The use of this technology is considered very helpful in carrying out learning during physical distancing during the Covid-19 pandemic (Pakpahan & Fitriani, 2020). In addition, the current generation is very close to technology so it is easier to adapt to online learning (Hastini et al., 2020).

The concept of online learning cannot work well in certain areas due to inadequate networks (Hastini et al., 2020). The use of internet quotas also raises new expenses which can be a problem for some students who experience financial difficulties (Morgan, 2020). Another obstacle in implementing online learning is the readiness of lecturers and students in carrying out teaching and learning activities. Online learning requires lecturers to provide a stimulus that can increase the learning independence of their students and not all lecturers and students are ready to carry out online learning (Morgan, 2020). Some lecturers still rely on unstructured assignments. This affects the student anxiety factor. Chaterine (2020) strengthens this statement with the results of his research which found that the large number of tasks given by the teacher makes students feel stressed in undergoing online learning.

A person's anxiety factor will affect their performance in learning activities. PISA suggests that students' cognitive, affective, and motor performance in learning can be influenced by mathematics self-belief. PISA classifies mathematics self-confidence into mathematics self-concept, mathematics self-efficacy, mathematics anxiety, and students' engagement in doing mathematics. Isiksal et al. (2009) stated that there is a significant negative correlation between mathematics anxiety and students' mathematics self-concept. This study is in line with Morony et al. (2013) who found that self-efficacy and self-concept were negatively correlated with students' math anxiety. Students who have positive mathematics self-concept have shown good mathematics learning achievement (Adegoke, 2015; Delima et al., 2018)). Meanwhile, Wolters & Rosenthal (2000) stated that students with high self-efficacy have good self-regulated learning in their daily lives. This study strengthens the research of Zimmerman & Martinez-Pons (1988) and Hansford (1994) regarding the correlation between self-efficacy and student self-regulated learning. Self-regulated learning also correlates with student anxiety (Kesici et al., 2011). Al Mutawah et al. (2017) found that students' self-regulated learning affects their mathematics learning outcomes.

The relationship between mathematics self-concept, mathematics anxiety, and students' mathematics self-regulated learning described above is the basic idea that it is necessary to conduct a

study to find out about the self-concept of mathematics, mathematics anxiety, and mathematics self-regulated learning during the Covid-19 pandemic. Whether during the Covid-19 pandemic, the self-concept of mathematics has a direct correlation to students' mathematics self-regulated learning. Does mathematics anxiety have a direct correlation to students' mathematics self-regulated learning? Do mathematics self-concept and mathematics anxiety together have a direct correlation to students' mathematics self-regulated learning. If it is described in diagrammatic form, then this research has the following framework of thinking.

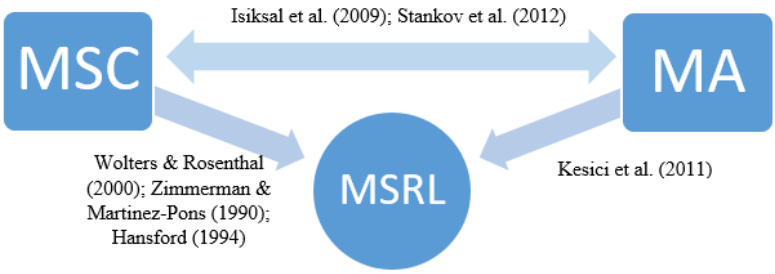


**Figure 1**. Research Framework

In this study, what is meant by mathematics self-concept is students' perceptions of themselves regarding their mathematical abilities and skills, pleasure, and interest in carrying out mathematical activities. Meanwhile, mathematics anxiety is a feeling of tension and worry that disturbs students in completing assignments given by the lecturer. Mathematics self-regulated learning in this study is a process that students go through to self-regulate in controlling aspects of cognition, motivation, and behavior in carrying out learning activities. The indicators of mathematics self-concept measurement used in this study are (1) having confidence that they can understand any mathematics material; (2) have confidence that they are capable of solving any mathematical problem; and (3) have the confidence that they can get excellent achievements in mathematics (Delima, 2019). Mathematics anxiety can be measured by two indicators, namely affective anxiety and cognitive anxiety (Suinn & Winston, 2003). Meanwhile, the measurement of mathematics self-regulated learning is based on ten indicators, namely: (1) goal setting and planning; (2) organizing and transforming; (3) keeping records and monitoring; (4) environment structuring; (5) seeking information; (6) rehearsing and memorizing; (7) reviewing records; (8) seeking social assistance; (9) self-consequence; (10) self-evaluation (Purdie et al., 1996; Zimmerman, 2002).

## METHODS

This research is quantitative descriptive. The subject of this study were active students in the odd semester of the academic year 2020/2021 in the Mathematics and Mathematics Education study program. Data collection was carried out using a cross-sectional cluster sampling technique through an online survey with a total sample of 150. Data collection time was set for eight days in August

2020, from 10 to 17 August 2020. Because this research data has an ordinal measurement scale, the statistical analysis used is Spearman's rho correlation (Vusvitasari et al., 2016) and ordinal regression analysis (Darnah, 2011).

The instrument used in this study was a questionnaire containing information about the identity of the respondents and research variables, namely MSC, MA, and MSRL. The MSC questionnaire used consists of 9 statements with alternative answers on a Likert scale with 5 answer choices. This questionnaire is the result of adaptation and modification of the MSC questionnaire proposed by Githua & Mwangi (2003). This questionnaire has a validity coefficient of 0.529 successively; 0.392; 0.302; 0.463; 0.356; 0.381; 0.314; 0.353; 0.416 with a reliability coefficient of 0.536; So it can be said that this questionnaire has good reliability with all valid statement items to be used as an MSC measurement instrument. Meanwhile, the MA questionnaire consisted of 10 statements with 5 alternative answers on a Likert scale. This questionnaire is the result of adaptation and modification of the MA questionnaire proposed by Richardson & Suinn (1972) with the validity coefficient of each statement in the questionnaire being 0.500 consecutively; 0.669; 0.765; 0.627; 0.782; 0.693; 0.756; 0.517; 0.725; 0.560 with a reliability coefficient of 0.868. Thus, the MA questionnaire has very good reliability and all statement items in the questionnaire are valid to be used as an MA measuring instrument. The MSRL questionnaire consisted of 13 statements with 5 alternative answers on a Likert scale. This questionnaire is the result of adaptation and modification of the MSRL questionnaire proposed by Purdie et al. (1996) where the coefficient of the validity of each statement item in this questionnaire was respectively 0.586; 0.699; 0.642; 0.572; 0.517; 0.408; 0.503; 0.599; 0.410; 0.681; -0.161; 0.561; 0.569 with a reliability coefficient of 0.792. Thus, the MSRL questionnaire has excellent reliability and all statement items in the questionnaire are valid to be used as an MSRL measurement instrument.

## RESULTS AND DISCUSSION

This study aims to find out about how students MSC, MA and MSRL were during the Covid-19 pandemic. To see the level of MSC, MA and MRSL each student has, the score of questionnaire MSC, MA and MRSL are grouped based on data obtained, as follows:

**Table 1**. Distribution of student MSC, MA and MSRL levels

| Variable | Interval | Level | % |
|---|---|---|---|
| MSC | $1.00 \leq MSC < 3.00$ | Negative | 13 |
| (Delima, 2019) | $3.00 \leq MSC \leq 5.00$ | Positive | 87 |
| MA | $1.00 \leq MA < 2.35$ | Low | 11 |
| (Baloğlu & Balgalmiş, 2010) | $2.35 \leq MA < 3.70$ | Moderate | 55 |

| Variable | Interval | Level | % |
|---|---|---|---|
| MRSL (Cakir et al., 2016) | $3.70 \leq MA \leq 5.00$ | High | 34 |
| | $1.00 \leq MSRL < 2.35$ | Low | 0 |
| | $2.35 \leq MSRL < 3.70$ | Moderate | 57 |
| | $3.70 \leq MSRL \leq 5.00$ | High | 43 |

In Table 1, it is found that the majority of respondents have positive MSC. Only a small proportion of respondents have a low MA, the majority of respondents have math anxiety at medium and high levels. None of the respondents had a low MSRL. Self-regulated learning is important in the implementation of learning at both the basic and advanced levels (Latifah, 2015), but it is much more important for students (Cohen, 2012). Self-regulated learning can help students to form better study habits and strengthen their learning abilities (Wolters & Hussain, 2015). The results of this study found that not a single student has mathematics self-regulated learning at a low level. This data supports one of the main goals of higher education, namely to create lifelong learners who are independent and have self-regulated learning in finding, maintaining and processing knowledge (Jado, 2015). In line with Maksum & Lestari (2020); Dina & Nugraheni (2017) who found that the self-regulated learning profile of the students studied was at a good and good level, this study also showed that 57% of students had mathematics self-regulated learning at a moderate level and 43% of students had independent learning. at a high level. Sudiana et al. (2017) showed that the scores of students who received learning with virtual class were higher than students who received conventional learning. This research took place during the Covid-19 pandemic, where classroom learning was conducted online. Online learning during the Covid-19 pandemic was able to increase student self-regulated learning (Sadikin & Hamidah, 2020).

In addition, this study shows that there are still 13% of students in mathematics and mathematics education study programs who have negative mathematics self-concept. Mathematics self-concept is a person's confidence in their ability to carry out their own mathematical activities (OECD, 2013). Mathematical self-concept can be a strong predictor in predicting school achievement or making educational and occupational choices (Nagy et al., 2010). Thus, it is very possible if there are students in study programs that are closely related to mathematics having negative mathematics self-concept.

Isiksal et al. (2009); Morony et al. (2013) stated that there is a significant negative correlation between mathematics anxiety and students' mathematics self-concept. However, this study found that only 11% of students had a low level of mathematics anxiety. This happened because this research took place during the Covid-19 pandemic, where online learning was felt to be less effective by students (Loviana & Baskara, 2020).

Based on the results of the online survey, a statistical description of the research data was

obtained as follows.

**Table 2.** Statistics data respondents at each variable

| Statistics | MSC | MA | MSRL |
|---|---|---|---|
| Mean | 3.271 | 3.359 | 3.694 |
| SD | 0.352 | 0.747 | 0.454 |
| Max. | 4.220 | 5.000 | 5.000 |
| Min. | 2.333 | 1.500 | 2.770 |
| n | 150 | 150 | 150 |
| Level | Positive | Moderate | Moderate |

Table 2 shows that during the Covid-19 pandemic, although there were students who had a negative mathematics self-concept, overall it could be said that students had a positive mathematics self-concept. Even though there are students who have mathematics anxiety at a high level, overall students still have mathematics anxiety at a moderate level. lready have mathematics self-regulated learning at a moderate level. Likewise with the mathematics self-regulated learning that students have, although there are some students who have high mathematics self-regulated learning, overall students' self-regulated learning mathematics is at a moderate level.

To find out the correlation between MSC, MA and MSRL students during the Covid-19 pandemic, a correlation analysis was carried out using the Spearman's correlation coefficient, as follows.

**Table 3.** Spearman's correlation coefficient

| | | | MSC | MA | MSRL |
|---|---|---|---|---|---|
| Spearman's rho | MSC | Correlation Coefficient | 1.000 | 0.123 | 0.432** |
| | | Sig. (2-tailed) | . | 0.134 | 0.000 |
| | MA | Correlation Coefficient | 0.123 | 1.000 | 0.098 |
| | | Sig. (2-tailed) | 0.134 | . | 0.231 |
| | MSRL | Correlation Coefficient | 0.432** | 0.098 | 1.000 |
| | | Sig. (2-tailed) | 0.000 | 0.231 | . |

**. Correlation is significant at the 0.01 level (2-tailed).

There is a positive and significant correlation between MSC and MSRL. Meanwhile, there is no significant correlation between MA and MSRL. Likewise with MSC and MA students, there is no significant correlation between mathematics self-concept and students' mathematics anxiety.

Different from Kesici et al. (2011) who stated that students with good self-regulated learning showed lower statistical anxiety, this study found that there was no significant correlation between

mathematics anxiety and mathematics self-regulated learning students. In addition, this study finds that there is no significant correlation between mathematics self-concept and mathematics anxiety of students during the Covid-19 pandemic. This is different from the research conducted by Kvedere (2014) in that there is a correlation between mathematics self-concept and mathematics anxiety. As stated by Morgan (2020), online learning requires lecturers to provide a stimulus that can increase student self-regulated learning and not all lecturers and students are ready to carry out online learning, as a result the student's mathematics anxiety factor becomes higher and is no longer closely related to mathematics self-concept.

This study also aims to determine whether MSC and MA together have a direct correlation to student MSRL. To achieve these objectives, ordinal regression analysis were carried out. The regression analysis begins with model fitting test, as follows.

**Table 4.** Model fitting test result

| Model | -2 Log Likelihood | Chi-Square | df | Sig. |
|---|---|---|---|---|
| Intercept Only | 26.379 | | | |
| Final | 17.232 | 9.148 | 3 | 0.027 |
| Link function: Logit. | | | | |

The table above shows that the value of sig $<$ 5%, the table above shows that the value of sig < 5%, meaning that the regression model with MSC and MA variables is better than the regression model without these two variables. Furthermore, the goodness-of-fit test was carried out, the results are as shown in the following table.

**Table 5.** The goodness-of-fit test

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Pearson | 0.662 | 2 | 0.718 |
| Deviance | 0.808 | 2 | 0.668 |
| Link function: Logit. | | | |

Based on Table 5, it is found that value of sig $>$ 5%, thus, it can be concluded that the ordinal regression model can be used to analyze the research data. Therefore, the next step is to determine the estimated parameters of the ordinal regression model, so that the following results are obtained.

**Table 6.** The parameter estimates

| | | Estimate | Std. Error | Wald | df | Sig. |
|---|---|---|---|---|---|---|
| Threshold | [X3_MSRL=3] | -0.100 | 0.297 | 0.114 | 1 | 0.736 |
| Location | [X1_MSC=1] | -1.631 | 0.654 | 6.219 | 1 | 0.013 |
| | [X1_MSC=2] | 0[a] | . | . | 0 | . |
| | [X2_MA=1] | -0.140 | 0.573 | 0.060 | 1 | 0.807 |
| | [X2_MA=2] | -0.379 | 0.372 | 1.041 | 1 | 0.308 |
| | [X2_MA=3] | 0[a] | . | . | 0 | . |

Table 6 shows that the negative MSC variable has a value of sig $< 5\%$, meaning that this variable is suitable for the ordinal regression model. The ordinal regression model obtained is.

$$\ln[P(X3_{MSRL} \leq 3|X)] = -0.1 + 1.631X^*_{MSC1} + 0.14X_{MA1} \quad \ldots(1)$$

$$\ln[P(X3_{MSRL} \leq 3|X)] = -0.1 + 1.631X^*_{MSC1} + 0.379X_{MA2} \ldots(2)$$

Thus, it can be concluded that the probability of students with negative MSC having a high MSRL is lower than students with positive MSC. This study is in line with Hansford (1994) which states that students with high self-concept have good self-regulated learning. To find out the probability of MSC affecting students' MSRL, the odds ratio is calculated as follows.

$$odd\ ratio = \exp(koef\ X^*_{MSC1}) = \exp(1{,}631) = 5{,}110$$

The value above means that there is an increasing tendency of 5,110 times obtaining a high MSRL for students with negative MCS than students with positive MSC. Self-regulated learning is an activity that is capable of solving one's own problems and having self-confidence without the help of others (Prayekti, 2015). Self-regulated learning is emphasized on student learning activities which are carried out on their own will, choice, and responsibility (Meric & Ilhan, 2016). Self-regulated learning is not a mental ability or specific academic achievement but is a self-direction process when a person transforms aspects of his behavior into a target achievement of an academic skill (Zimmerman, 2002). Thus, it is reasonable to say that students with negative MSC have a higher effort to be independent in learning than students with positive MSC. Furthermore, to determine the percentage of MSC and MA variables in explaining MSRL, the coefficient of determination is calculated as follows.

**Table 7.** Pseudo R-Square

| | |
|---|---|
| Cox and Snell | 0.059 |
| Nagelkerke | 0.079 |
| McFadden | 0.045 |
| Link function: Logit. | |

Table 7 shows that the MSC and MA variables can explain students' MSRL by 7.9%. Thus, the remaining 92.1% is explained by other factors not discussed in this study. The involvement of parents

can increase their children's self-regulated learning through providing role models, encouragement, facilitating, rewarding, providing good strategies in punishing, and other processes so that their academic performance increases (Martinez-Pons, 2002). Children's self-regulated learning is also influenced by the level of income of their parents (Howse et al., 2003). Therefore, it is reasonable to say that 92.1% of changes in the mathematics self-regulated learning variable of students are influenced by other factors which are not observed in this study.

## CONCLUSION

This research shows that there are 13% of students in mathematics departments and mathematics education departments have a negative mathematics self-concept. During the Covid-19 pandemic, only 11% of students had a low level of mathematics anxiety, the majority of students still had a high and moderate level of anxiety. This study also found that no one student has low mathematics self-regulated learning, 57% of students have a moderate level of mathematics self-regulated learning and 43% of students have a high level of mathematics self-regulated learning. Thus, during the Covid-19 pandemic, students had a positive mathematics self-concept, mathematics anxiety was at a moderate level, and already had mathematics self-regulated learning at a low level. The Student with negative mathematics self-concept has a significant effect on students' mathematics self-regulated learning than others. There is an increasing tendency of 5,110 times obtaining a high mathematics self-regulated learning for students with negative mathematics self-concept than students with positive mathematics self-concept. Thus, it is reasonable to say that students with negative mathematics self-concept have a higher effort to be independent in learning than students with positive mathematics self-concept during the Covid-19 pandemic. Mathematics self-concept and mathematics anxiety have an effect of 7.9% on changes in the mathematics self-regulated learning variables of students. Thus, 92.1% of the changes in the mathematics self-regulated learning variable are influenced by other factors which are not examined.

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