Jurnal Elemen, 9(1), 183-196, January 2023
https:/doi.org/10.29408/jel.v9i1.6898

e- ISSN: 2442 - 4226

The impact of undergraduate students' mathematics anxiety and self-concept on their self-regulated learning and academic achievement

Dian Cahyawati [1 *], Nita Delima [2], Muji Gunarto [3]

[1] Department of Mathematics, Universitas Sriwijaya, South Sumatera, Indonesia

[2] Department of Mathematics Education, Universitas Subang, West Java, Indonesia

[3] Department of Economic and Business, Universitas Bina Darma, South Sumatera, Indonesia

[*] Correspondence: dianc_mipa@unsri.ac.id

Abstract

Several types of research showed math anxiety as the learning outcome, but another showed that as the predictor variable. Math anxiety was predicted based on other variables, such as self-regulated learning and self-concept. Self-regulated learning is associated with academic achievement. This study aimed to obtain valid and significant indicators of each latent variable and to develop the structural model of those latent variables on students' academic achievement. The research used an interval scale questionnaire to measure all latent variables except academic achievement. The PLS-SEM was applied by SmartPLS software. The structural model showed that math anxiety directly affected academic achievement but indirectly affected self-regulated learning, which is self-concept as the mediating variable. For students with low math anxiety, their self-regulated learning tends to be high by controlling their self-concept in math.

Keywords: academic achievement; latent variables; mathematics anxiety; self-concept; self-regulated learning; PLS-SEM

How to cite: Cahyawati, D., Delima, N., & Gunarto, M. (2023). The impact of undergraduate students' mathematics anxiety and self-concept on their self-regulated learning and academic achievement. *Jurnal Elemen*, *9*(1), 183-196. https://doi.org/10.29408/jel.v9i1.6898

Received: 1 November 2022 | Revised: 15 November 2022
Accepted: 12 December 2022 | Published: 2 January 2023

Introduction

There were various dependent variables in the study of mathematics learning outcomes based on their predictor variables. Mathematics anxiety is the outcome of predictor variables: optimism, perceived classroom, and mathematics attitude (Dehsheykh et al., 2021). The reciprocal relationships between self-concept and math anxiety (Ahmed et al., 2012). The predicting model of math anxiety is based on self-regulation and self-efficacy (Lavasani et al., 2011). Multidimensional self-regulated learning and self-efficacy as the predictor variables of math anxiety (Jain & Dowson, 2009). The difference focuses on Villavicencio & Bernardo's research, which studied the impact of math anxiety on math achievement, self-regulated learning, and self-efficacy (Villavicencio & Bernardo, 2016). The impact of self-concept and math anxiety on self-regulated learning, self-efficacy, and math literacy (Gabriel et al., 2020).

Self-regulated learning could be as the learning outcome, predictor variable, or mediating variable between math anxiety and achievement, such as final grade. The relationship between self-regulated learning and academic achievement was positive (Sadi & Uyar, 2013). Although it was small, self-regulated learning could increase academic achievement (Kesici et al., 2011; Labuhn et al., 2010). Self-regulated learning has a positive and long-lasting impact on student's academic development (Gabriel et al., 2020).

Some research showed math anxiety as the learning outcome, but another showed that as the predictor variable. Math anxiety was predicted based on other variables, such as self-regulated learning and self-concept. Self-regulated learning is associated with academic achievement. This study aimed to investigate the impact of mathematics anxiety and self-concept on self-regulated learning and academic achievement.

Methods

This research used partial least square of structural equation modeling (PLS-SEM). This method analyzes variables that cannot be measured directly, namely constructs or latent variables (Hair et al., 2010; Hair, Black, et al., 2014). Based on the same reference, PLS-SEM does not require assumptions about data distribution because it is robust to the assumption of normality. The other advantages of PLS-SEM are that although the PLS-SEM algorithm is used for metric data, it can be used for ordinal and binary data very well, and PLS-SEM can be used for the reflective and formative variables.

The data was collected by an online survey of 150 students of mathematics and mathematics education study programs in the even semester of the 2019/2020 academic year. The questionnaire was the same as Delima's questionnaire (Delima & Cahyawati, 2021), which has been tested for the validity and reliability instrument.

Operational variables

Mathematics anxiety was defined as negative thoughts and feelings when interacting with mathematics. Mathematical self-concept was a belief in one's ability to interact with mathematics. Mathematical self-regulated learning directs aspects of herself, namely

motivation, cognition, and behavior, in learning activities to achieve maximum learning goals. Academic achievement was the cumulative achievement index value of learning outcomes in higher education.

Academic achievement was a formative variable that could be analyzed by PLS-SEM even though it has only one indicator, Grade-Point Average. The name of latent variables and indicators and their notations are displayed in Table 1.

Table 1. Name of variables, indicators, and notations

No	Name of variables	Indicators	Notations	Number of Item(s)
1	Anxiety (Exogenous)	1. Have negative feelings towards mathematics related to affective aspects	ANX1	5
		2. Have negative thoughts about mathematics related to cognitive aspects	ANX2	5
2	Self-Concept (Endogenous)	1. Believing that you can understand the problem	SC1	6
		2. Believing that you can solve the problem	SC2	2
		3. Believing that you can get achievements	SC3	2
3	Self-Regulated (Endogenous)	1. Setting goals, making plans, organizing	SRL1	4
		2. Conditioning the physical and the environment	SRL2	2
		3. Looking for material related information	SRL3	4
		4. Seek help and review	SRL4	2
		5. Prepare rewards and evaluate yourself	SRL5	2
4	Academic Achievement (Endogenous)	Grade-Point Average	ACH	1

Anxiety and self-concept**,** respectively**,** have ten indicators. Self-regulated has 13 indicators. Academic achievement is only measured by one indicator, but this is not a barrier in PLS-SEM for formative variables.

Hypotheses

The first stage of using PLS-SEM is to design an initial model which describes the relationship among latent variables. Figure 1 is the initial model, and it describes the research hypothesis. The hypothesis on Fig.1 can be stated based on the relationship among exogenous and endogenous variables are as follows.

H1: There is the impact of anxiety on self-concept

H2: There is the impact of anxiety on self-regulated learning

H3: There is the impact of self-concept on self-regulated learning

H4: There is the impact of anxiety on academic achievement

H5: There is the impact of self-regulated learning on academic achievement

H6: There is the impact of self-concept on academic achievement

H7: The self-concept is a mediating variable within the impact of anxiety on self-regulated learning

H8: The self-concept is a mediating variable within the impact of anxiety on academic achievement

H9: The self-regulated learning is a mediating variable within the impact of anxiety on academic achivement

H10: The self-regulated learning is a mediating variable within the impact of self-concept on academic achievement

H11: The self-concept and self-regulated learning are the mediating variables within the impact of anxiety on academic achievement

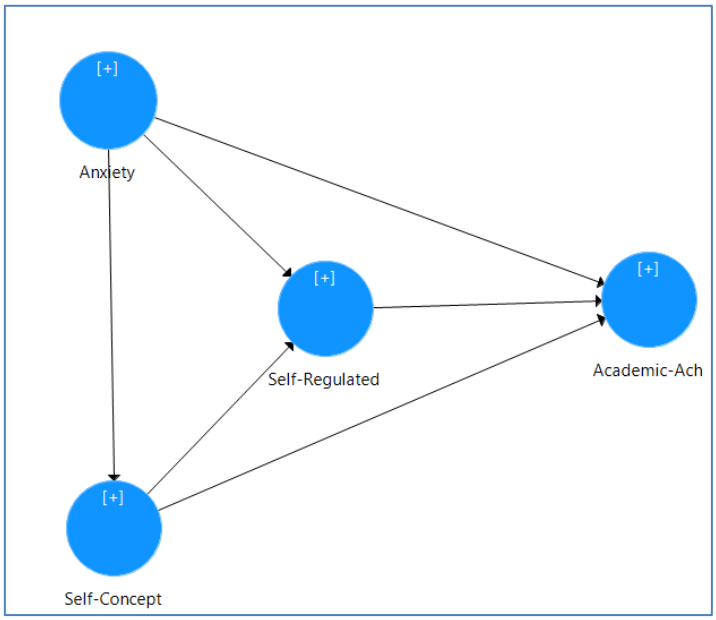

Figure 1. Research hypothesis

Data analysis

Data analysis used partial least square of structural equation modeling by SmartPLS software version 3.3.2 (Ringle et al., 2015). The procedure of PLS-SEM (Ghozali & Kusumadewi, 2016; Gunarto, 2018; Hair, Hult, et al., 2014; Mustofa & Wijaya, 2016) is clearly described. In brief, applying PLS-SEM involves drawing a path diagram, designing a measurement model, verifying until it meets criteria, defining and interpreting the structural model about all related variables, and hypothesis testing.

The path diagram displays the relationship among latent variables, as shown in Figure 1, then image the relationship of each latent variable with its indicators listed in Table 1. The image is an initial measurement model of PLS-SEM that is verified in stages based on the value of the loading factor. The value should reach 0.7, but the indicators with loading factor values between 0.6 – 0.7 can still be used for exploratory research (Hair, Black, et al., 2014). The final measurement model is verified by construct validity and reliability. The construct validity consists of convergent and discriminant validity, and it uses Average Variance Extracted (AVE), outer loading, and cross-loading values. The construct reliability uses the internal consistency measure, composite reliability, and Cronbach's Alpha.

PLS-SEM structural model or inner model displays the result of research hypothesis testing. There were 11 direct and indirect impact hypotheses based on the sub-structures of exogenous and endogenous latent variables, as pictured in Figure 1. The structural model is explained by hypothesis testing results and interpreted by path coefficients among variables and their p-values.

Results

Respondent description

The number of respondents was 150 consisting of female and male students—Table 2 displays respondent characteristics.

Table 2. Respondent's characteristics description

Characteristics		Number of Respondent	Percentage (%)
Study Program	Pure Mathematics	127	84.6
	Mathematics Education	23	25.4
Grade-Point Average (GPA)	GPA < 2.50	12	8.0
	2.50 ≤ GPA < 3.00	40	27.0
	3.00 ≤ GPA < 3.51	63	42.0
	GPA ≥ 3.51	35	23.0

Measurement Model

An initial measurement model displays the relationships among indicators and latent variables. The model is shown in Figure 2. It has to be verified stage by stage.

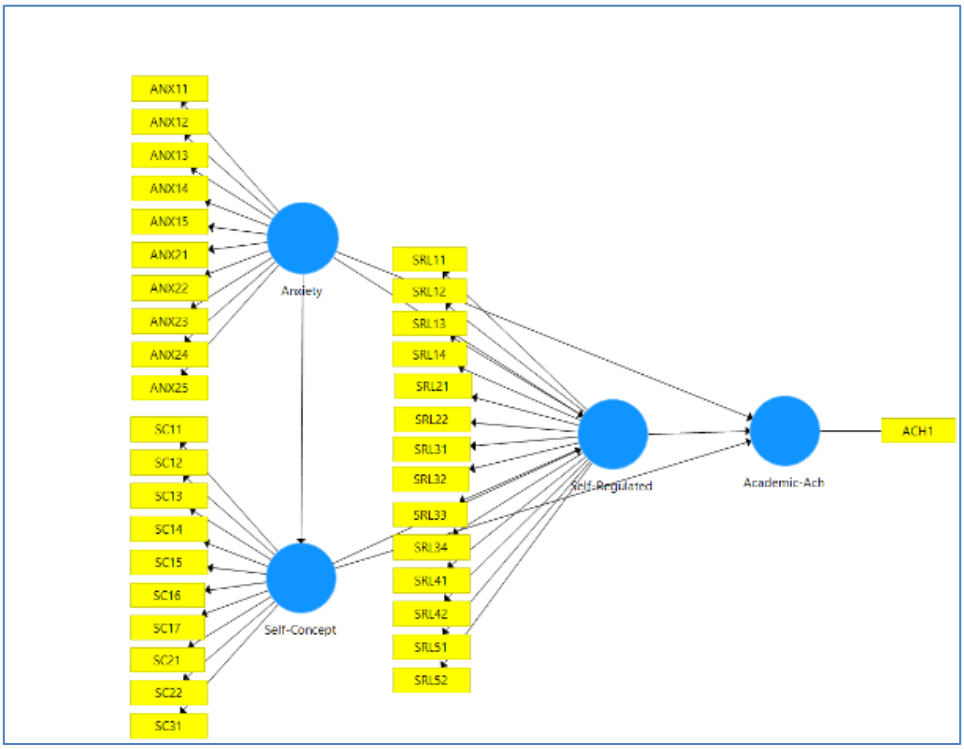

Figure 2. Initial measurement model of PLS-SEM

The result of the first verification stage is shown in Figure 3. There are indicators with loading factors less than 0.7. It was removed and continued to the following stages until the indicators met the criterion as the valid indicator.

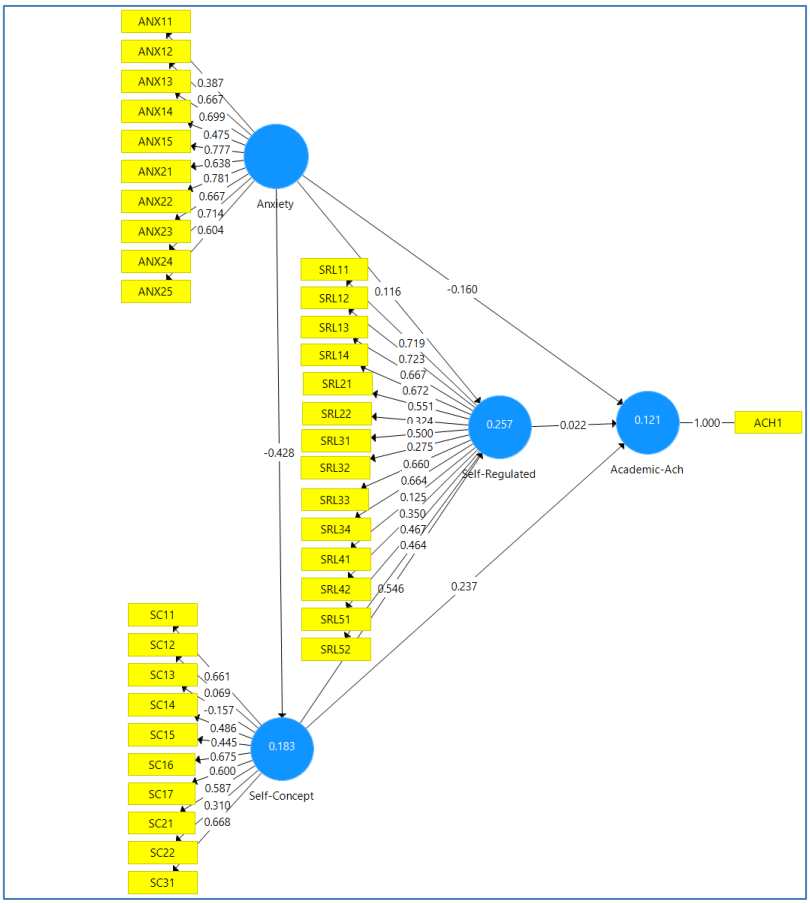

Figure 3. First stage of measurement model verification

The final stage is displayed in Figure 4 as the final measurement model with a minimum loading factor of 0.6.

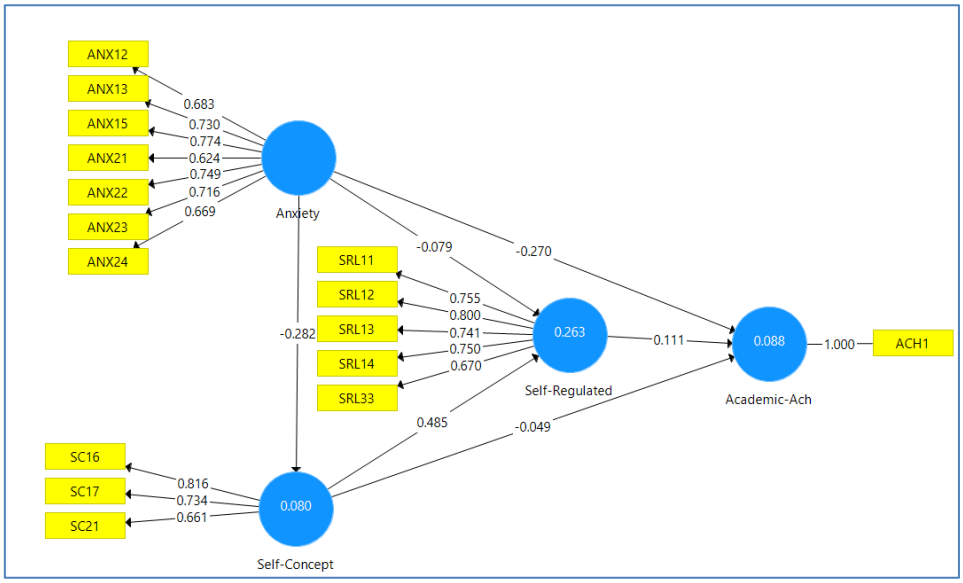

Figure 4. Final stage of measurement model verification

The number of indicators of anxiety, like self-regulated learning and self-concept, are reduced from what was shown in Figure 2. The following process was to check the validity and reliability of the construct. The AVE score in Table 3 checks it. All the variables meet the convergent validity criteria because all the AVE scores exceed 0.5. This AVE score indicates that each variance of the latent variable can be reflected by more than 50 percent of the variance in each indicator.

Table 3. AVE scores

Variables	AVE
Academic-Ach	1.000
Anxiety	0.501
Self-Concept	0.547
Self-Regulated	0.554

The value of outer loading and cross-loading indicators checks the reliability criteria. Table 4 shows that each outer loading value (bold text) of the indicator exceeds the value of cross-loading.

Table 4. Outer loading and cross loading values

Indicators	Academic-Ach ACH	Anxiety ANX	Self-Concept SC	Self-Regulated SRL
ACH1	**1.000**	-0.280	0.083	0.145
ANX12	-0.271	**0.683**	-0.130	-0.146
ANX13	-0.162	**0.730**	-0.110	-0.147
ANX15	-0.141	**0.774**	-0.121	-0.053
ANX21	0.030	**0.624**	-0.147	-0.077
ANX22	-0.185	**0.749**	-0.242	-0.099
ANX23	-0.291	**0.716**	-0.326	-0.278
ANX24	-0.083	**0.669**	-0.133	-0.063
SC16	0.110	-0.155	**0.816**	0.470
SC17	0.032	-0.273	**0.734**	0.296
SC21	0.032	-0.214	**0.661**	0.342
SRL11	0.103	-0.246	0.488	**0.755**
SRL12	0.126	-0.176	0.368	**0.800**
SRL13	0.065	-0.074	0.285	**0.741**
SRL14	0.136	-0.177	0.397	**0.750**
SRL33	0.096	-0.056	0.275	**0.670**

Based on Table 4, the indicators of the measurement model in Figure 4 were the valid construct indicators. The internal consistency score in Table 5 assesses the reliability test. Composite reliability and Cronbach's Alpha scores were more than 0.708 except self-concept variable. The internal consistency criteria have been met. Cronbach's Alpha value for the self-concept variable was around 0.6. Nevertheless, the variable can be maintained for this exploratory research.

Table 5. Internal consistency

Variable	Composite Reliability	Cronbach's Alpha
Academic-Ach	1.000	1.000
Anxiety	0.875	0.847
Self-Concept	0.783	0.584
Self-Regulated	0.861	0.803

Based on Table 5, the indicators of the measurement model in Figure 4 were a valid and reliable construct. All significant indicators can be used for measuring math anxiety, self-regulated, self-concept, and academic achievement. The significant indicators are shown in Table 6.

Table 6. Significant indicators of latent variables

Variables	Indicators	
Academic-Ach	Grade Point Average	
Anxiety	ANX12	Shy in presenting and sharing answers to mathematical problems
	ANX13	Fear of being laughed at when giving the wrong answer
	ANX15	Thinking that you will fail in completing college
	ANX21	Worried about not being able to quickly solve the mathematical problems
	ANX22	Doubt about the results of the answers to mathematical problems
	ANX23	Thinking about changing majors/study programs
	ANX24	Worried about making mistakes in solving mathematical problems
Self-Concept	SC16	Enjoying the lecture
	SC17	Liked the material in each course
	SC21	Easy to think in determining the process of working on mathematical problems
Self-Regulated	SRL11	Knowing the purpose of studying in the mathematics study program
	SRL12	Developing a plan that must be done in learning
	SRL13	Immediately re-read the notes of the lessons learned in class
	SRL14	Enjoy working on questions related to the subjects studied
	SRL33	Looking for more than one reading source to support coursework
	SRL34	Regularly check the lecture material notes whether those were complete or not

Structural model

Figure 5 displays the structural model. The direct and indirect relationships between variables in each sub-structure were tested to obtain a significant structural model.

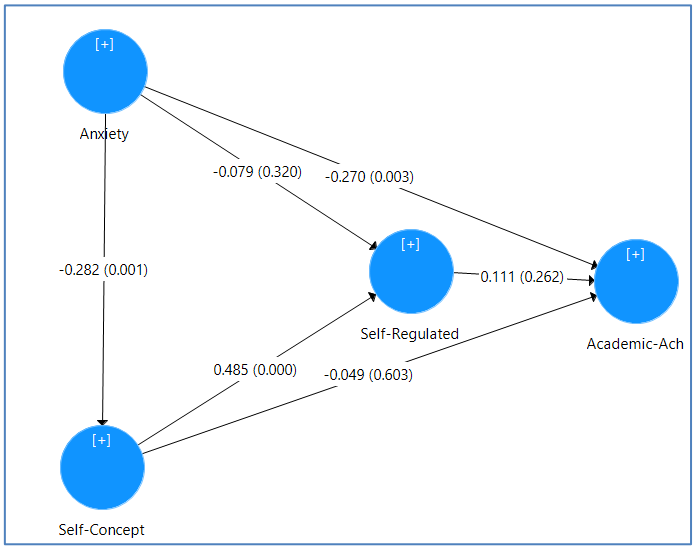

Figure 5. Structural model and test result

Figure 5 shows the path coefficient values and their p-values in the brackets. The path coefficients and p-value of direct effect between variables in Fig. 5 can be written in Table 7.

Table 7. Direct effect test

Effect between Variables	Path Coefficients	P-Values
Anxiety → Academic Ach	-0.270	**0.003**
Anxiety → Self-Concept	-0.282	**0.001**
Anxiety → Self-Regulated	-0.079	0.320
Self-Concept → Academic Ach	-0.049	0.603
Self-Concept → Self-Regulated	0.485	**0.000**
Self-Regulated → Academic Ach	0.111	0.262

Based on Fig. 5 or Table 7, the research hypothesis testing can be answer.

1. The p-value of H1 was 0.001. It means that the impact of anxiety on self-concept was statistically significant. Math anxiety negatively affected self-concept by as much as 0.282.
2. The path coefficient of anxiety and self-regulated was negatively small, but this hypothesis H2 could not be accepted because the p-value was more than 0.05. The impact of anxiety on self-regulated was not statistically significant.
3. H3: There was the impact of self-concept on self-regulated learning. The impact of self-concept on self-regulated learning was statistically significant based on the p-value was 0.000.
4. The p-value of H4 was less than 0.005. It means that the impact of anxiety on academic achievement was significant.
5. The p-value of H5 was more than 0.05. The impact of self-regulated learning on academic achievement was not significant.
6. The hypothesis of H6 was not significant. The self-concept effected negatively on academic achievement, but it was not statistically significant.

The indirect relationship effects among variables are displayed on Table 8.

Table 8. Indirect effect test

Indirect effect among variables	Path Coefficients	P-Values
Anxiety → Self-Concept → Academic-Ach	0.014	0.640
Anxiety → Self-Regulated → Academic-Ach	-0.009	0.534
Self-Concept → Self-Regulated → Academic-Ach	0.054	0.280
Anxiety → Self-Concept → Self-Regulated → Academic-Ach	-0.015	0.347
Anxiety → Self-Concept → Self-Regulated	-0.137	**0.008**

Based on Table 8, there was the significant effect of anxiety on self-regulated through self-concept. It means that self-concept was a significant mediating variable between anxiety and self-regulated. The result of overall testing effect between variables is shown in Table 9.

Table 9. Total effect test

Effect between Variables	Path Coefficients	P-Values
Anxiety → Academic Ach	-0.280	**0.001**
Anxiety → Self-Concept	-0.282	**0.001**
Anxiety → Self-Regulated	-0.216	**0.005**
Self-Concept → Academic Ach	0.005	0.956
Self-Concept → Self-Regulated	0.485	**0.000**
Self-Regulated → Academic Ach	0.111	0.262

There was a significant negative impact of math anxiety on academic achievement. Math anxiety had a negative effect on self-concept. Mathematical anxiety had a negative effect on self-regulated learning, but self-concept had a positive effect on self-regulated learning.

Discussion

A brief description of the respondents based on their study program and academic achievement is shown in Table 2. 84.6% of students came from pure mathematics program study, and 25.4% were mathematics education students. More than half of the respondents (65%) have a GPA in the range of more than 3-score of 4-scale. It showed that students had high academic achievement scores and very good learning outcomes.

Seven indicators reflected mathematics anxiety in Figure 4. Three indicators reflected self-concept. Five indicators reflected self-regulation. These indicators are explained in Table 6, which can be used to measure math anxiety, self-concept, and self-regulated as valid indicators for subsequent studies. Academic achievement was a formative variable that Grade Point Average measured.

Mathematics anxiety contains seven indicators representing anxiety's affective and cognitive aspects. The self-concept contained three indicators consisting of indicators of understanding problems, solving problems, and achieving achievements. Self-regulated learning contained six indicators which were four indicators for learning strategies, seeking information, and repeating material.

Based on the structural model, mathematics anxiety directly and statistically significantly affected academic achievement. The path coefficient was -0.270. It means the lower anxiety, the higher the academic achievement. The student who can control the affected and cognitive aspect of anxiety tends to have good academic achievement. The negative effect of math anxiety on academic achievement was the same as the negative effect on the final grade of Villavicencio's research (Villavicencio & Bernardo, 2016).

Math anxiety significantly affected self-concept by -0.282. It means the lower anxiety, the higher self-concept. Mathematics anxiety negatively influences self-concept, meaning that someone who has not been able to control their feelings and thoughts when interacting with mathematics tends to have a high level of mathematic anxiety. In other words, mathematics anxiety can be reduced by increasing self-concept. This result follows Gabriel's research (Gabriel et al., 2020). The higher a student's self-concept, the lower their mathematics anxiety.

On the other side, self-concept significantly positively affected self-regulated learning about the number 0.485. The higher a person's self-concept, the higher the self-regulated learning.

Self-concept in math is a belief in one's ability to interact with mathematics. Paying attention to significant indicators of self-concept listed in Table 6 is one of the ways to increase its level. Those indicators were enjoying lectures, liking lecture materials, and thinking easily in determining mathematical problem-solving. The learning process should be created in comfortable conditions for students.

Learning material needs to be packaged and attract the students, both in terms of substance and appearance, so that students can like the content of the message conveyed on each lecture topic. Giving mathematical problems as a trigger for the thought process to work on and solve problems needs to be introduced in various ways to achieve solutions so that students can choose the way that suits their thinking process.

Mathematics anxiety has an indirect effect on self-regulated learning through the self-concept variable. The path coefficient was -0137, and its p-value in Table 8 was 0.008. The self-concept variable is a good intervening (mediating) variable between mathematics anxiety and self-regulated learning. Math anxiety has a negative impact on self-regulated learning, but this negative impact can be minimized by having a good self-concept. There was a mediating variable for the relationship between mathematics anxiety and self-regulated learning, in line with the research results (Jain & Dowson, 2009), but with a different mediating variable, self-efficacy. The research states that self-efficacy is an essential mediating variable in the relationship between mathematics anxiety and self-regulated learning.

Self-regulated learning can be measured by indicators of goal setting and organizing, seeking information, and repeating material. This indicator was a part of the same indicator produced by Jain and Dowson (2009), who wrote that rehearsal, elaboration, and organization are significant variables closely related to self-regulated learning. The items that represent these indicators can be used to provide recommendations in terms of increasing self-regulated learning to achieve maximum learning goals. Students are given direction and motivation to make learning goals, develop learning plans and techniques, have notebooks, look for additional material as learning support, and repeat the study material.

Math anxiety and self-regulated learning are negatively correlated, in line with those produced by Gabriel et al. (2020) and Jain and Dowson (2009). A higher level of mathematical anxiety is associated with lower self-regulated learning. Math anxiety was also correlated with self-concept, self-efficacy, and motivational strategies, which are self-regulated learning components. Controlling to reduce math anxiety can increase self-regulated learning and provide enthusiasm for learning. The same result was also expressed by Gabriel et al. (2020).

Other variables have no significant indirect effect on academic achievement. In contrast to what has been written by Kesici et al. (2011), Labuhn et al. (2010), and Sadi and Uyar (2013), which revealed that self-regulated learning and the strategies contained in it have a positive effect, even though the effect is small on achievement as measured by calculation ability, statistical ability, and academic achievement.

GPA values were a general measurement of student academic achievement. Therefore, it is necessary to determine more precisely the instrument of academic achievement in math closely related to mathematics anxiety, self-concept, and self-regulated learning. Measurement of academic achievement can be replaced with other, more specific variables, such as mathematical understanding, mathematical reasoning, or other mathematical abilities.

Conclusion

The results of the PLS-SEM model are the significant indicators in the measurement model that can be used to measure mathematics anxiety, self-concept, and self-regulated learning in subsequent studies. GPA as one academic achievement indicator was not a barrier to formative variables in PLS-SEM, but the following research can use other reflective variables for academic achievement.

Self-concept was a good mediating variable in the relationship between anxiety and self-regulated learning. There were no significant effects of variables on academic achievement except anxiety in math. Student academic achievement needs to be explored deeply through various variables, including internal and external factors. The example variables are socio-economic factors, interests, motivations, or other psychological factors in the learning process.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies, have been completed by the authors.

Funding Statement

This work received no specific grant from any public, commercial, or not-for-profit funding agency.

Author Contributions

Dian Cahyawati: Conceptualization, methodology, formal analysis, investigation, writing - original draft, editing, visualization; **Nita Delima:** Conceptualization, validation; **Muji Gunarto:** Formal analysis, data curation.

References

Ahmed, W., Minnaert, A., Kuyper, H., & Werf, G. (2012). Reciprocal relationships between math self-concept and math anxiety. *Learning and Individual Differences*, *22*(3), 385–389. https://doi.org/10.1016/j.lindif.2011.12.004

Dehsheykh, M. N., Hafezi, F., & Bozorgi, Z. D. (2021). Relationship of students' math anxiety with their optimism and perceived classroom structure. *Mathematics Attitudes*, *4*(15), 69–76.

Delima, N., & Cahyawati, D. (2021). Students' mathematics self-concept, mathematics anxiety and mathematics self-regulated learning during the COVID-19 pandemic. *Jurnal Pendidikan Matematika*, *15*(2), 103–114. https://doi.org/10.22342/jpm.15.2.13200.103-114

Gabriel, F., Buckley, S., & Barthakur, A. (2020). The impact of mathematics anxiety on self-regulated learning and mathematical literacy. *Australian Journal of Education*, *64*(3), 227–242. https://doi.org/10.1177/0004944120947881

Ghozali, I., & Kusumadewi, K. A. (2016). *Model persamaan struktural PLS-PM GSCA RGCCA [PLS-PM structural equation model GSCA RGCCA]*. Yoga Pratama.

Gunarto, M. (2018). *Analisis statistika dengan model persamaan struktural (SEM): Teoritis & praktis [Statistical analysis with structural equation models (SEM): Theoretical & practical]*. Alfabeta.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis*. Prentice-Hall International, Inc. https://doi.org/10.1016/j.ijpharm.2011.02.019

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis*. Pearson.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). *A primer on partial least squares structural equation modeling (PLS-SEM*. SAGE Publications, Inc.

Jain, S., & Dowson, M. (2009). Mathematics anxiety as a function of multidimensional self-regulation and self-efficacy. *Contemporary Educational Psychology*, *34*(3), 240–249. https://doi.org/10.1016/j.cedpsych.2009.05.004

Kesici, Ş., Balo, M., & Deniz, M. E. (2011). Self-regulated learning strategies in relation with statistics anxiety. *Learning and Individual Differences*, *21*, 472–477. https://doi.org/10.1016/j.lindif.2011.02.006

Labuhn, A. S., Zimmerman, B. J., & Hasselhorn, M. (2010). Enhancing students' self-regulation and mathematics performance: The influence of feedback and self-evaluative standards. *Metacognitive Learning*, *5*, 173–194. https://doi.org/10.1007/s11409-010-9056-2

Lavasani, M. G., Hejazi, E., & Varzaneh, J. Y. (2011). The predicting model of math anxiety: The role of classroom goal structure, self-regulation and math self-efficacy. *Procedia - Social and Behavioral Sciences*, *15*, 557–562. https://doi.org/10.1016/j.sbspro.2011.03.141

Mustofa, E. Z., & Wijaya, T. (2016). *Panduan teknik statistik SEM & PLS dengan SPSS AMOS [Guide to SEM & PLS statistical techniques with SPSS AMOS]*. Cahaya Atma Pustaka.

Ringle, C. M., Wende, S., & Becker, J. M. (2015). SmartPLS 3. SmartPLS GmbH, Boenningstedt. http://www.smartpls.com

Sadi, Ö., & Uyar, M. (2013). The relationship between cognitive self-regulated learning strategies and biology achievement: A path model. *Procedia - Social and Behavioral Sciences*, *93*, 847–852. https://doi.org/10.1016/j.sbspro.2013.09.291

Villavicencio, F. T., & Bernardo, A. B. I. (2016). Beyond math anxiety: Positive emotions predict mathematics achievement, self-regulation, and self-efficacy. *Asia-Pacific Education Researcher*, *25*(3), 415–422. https://doi.org/10.1007/s40299-015-0251-4