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The Role of the Need for Cognition towards Student's Mathematics Self-Efficacy

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Abstract. Numerous research has established the impact of mathematical self-efficacy on an individual's ability to successfully solve mathematical tasks. However, according to the need for cognition paradigm, the element of difficulty in mathematics is also connected to both high and low degrees of cognitive function participation. This study intends to evaluate the contribution of one's need for cognition to one's degree of mathematical self-efficacy. 40 students studying at Mathematics Education Department in Sebelas April University Sumedang, Indonesia, participated in this study. The need for cognition and mathematical self-efficacy questionnaires, which used Likert scale scoring, were used to gather the data, which was then analyzed using correlational and regression methods. The findings revealed a significant and strong correlation between student need for cognition and mathematical self-efficacy. In addition, the need for cognition has also been shown to have a significant and positive impact on students' mathematical self-efficacy. This means that a higher level of student needs for cognition will lead to a higher level of mathematical self-efficacy.

Key words: Mathematics self-efficacy, Need for cognition

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INTRODUCTION

Since academic success is multifaceted, it cannot just be described by cognitive elements but also necessitates the use of soft skills (Yüksel & Gevan, 2016). It also applies to achieving learning success in mathematics, where mathematical self-efficacy, as a component of soft skills, shapes one's learning behavior and attitudes through the degree of challenge the goals set for oneself, the amount of effort directed, and the degree of persistence in facing challenges (Zimmerman et al., 1992:664). According to several findings from earlier research, students' levels of problem-solving ability are predicted by their mathematical self-efficacy (Öztürk et al., 2019) and are directly proportional to their level of mathematical performance (Negara et al., 2021). However, it has been reported that the mathematical mastery experience, which is one of the factors contributing to students' high levels of mathematical self-efficacy, has the potential to also lead to an unrealistic perception of their mathematical skills and a lack of effort put forth to actually perform better on math tasks than they did (Bowden et al., 2015; Morán-Soto & Benson, 2018). This phenomenon contradicts the literature evidence that one of the four sources of mathematical self-efficacy, the experience of being successful in mathematics (mastery experience), mediates the link between cognitive activation and students' mathematics performance (Li et al., 2020). Mastery experience itself is the overall experience that a person has throughout his/her life when successfully overcomes difficulties in completing mathematical tasks (Bandura, 1997; Özcan & Kültür, 2021). Overall, it illustrates how the level of effort put into a mathematical task affects the quality of the outcomes/achievement. That is, if the tasks they typically face tend to be routine and do not involve higher-order thinking skills, then their quality of the achievement will form learning habits based on the expectation of getting results quickly and having an attitude of giving up easily when facing obstacles from non-routine tasks (Özcan & Kültür, 2021). On the other hand, if the tasks tend to be non-routine, the quality of their achievement will shape learning behavior that views failure as part of the learning process (Öztürk et al., 2019) thus promoting the opportunity to try out new mathematical tasks and activities, devoting efforts and more time to successfully complete complex tasks and self-regulated learning in order to achieve learning goals (Li et al., 2020). Therefore, we believe that the level of students' mathematical self-efficacy will be better explained by the tendency that a person has to engage and enjoy more effort in cognitive processes or what is commonly called the need for cognition (NFC) (Cacioppo & Petty, 1982).

Measurement of the need for cognition is carried out on a person's affective reactions to cognitive tasks based on the individual's tendency to organize, abstract, and evaluate information (Cacioppo & Petty, 1982). It has been demonstrated that a person's NFC level is closely connected with students' satisfaction with the studies they are pursuing (Grass et al., 2017). In this case, a person's NFC level represents the amount of investment in cognition efforts they have in approaching challenging problems and appreciating complex thinking. The ability to expound on the complexity of the content being learned as part of the desired difficulty allows learners with high levels of NFC to digest information more thoroughly and autonomously control their learning processes (Weissgerber et al., 2017). As a result, they will engage in cognitive tasks, such as problem-solving, more frequently and intensively throughout their life, which fosters a high level of complex problem-solving skills (Rudolph et al., 2018). Thus, this form of self-exposure ultimately facilitates students with additional experiences of mathematical success, which is one of the four sources of students' mathematical self-efficacy.

Research related to the level of NFC on students' mathematical self-efficacy is still very limited. In this instance, Elias and Loomis (2002) reported that students' NFC and perceived self-efficacy were proven to significantly predict the academic achievement they would get. In this regard, Rooji et al. (2017) have also proven that high school students' NFC and academic self-efficacy are directly corelated, which can improve their chances of succeeding in college academics. In light of this, the present study aims to explore more into the role of NFC in mathematical self-efficacy. To that end, we develop two research hypotheses: (1) NFC and students' mathematical self-efficacy are significantly correlated; and (2) NFC has a significant effect on students' mathematical self-efficacy.

METHODS

This study is a quantitative study using a survey method. The population of this study consists of 40 fifth-semester students majoring in mathematics education at Sebelas April University Sumedang, Indonesia. Need for Cognition (NFC) and Mathematical Self-Efficacy (MSE) questionnaires on a Likert scale of 1 to 5 were used to collect data. The NFC questionnaire was adapted from Cacioppo et al. (1996) and consists of 18 statement items. While the MSE questionnaire was based on four sources of self-efficacy and consisted of 24 statement items, it was adapted from Usher and Pajares (2009). The data analysis technique employed is the prerequisite analysis and hypothesis testing with a 5% level of significance. The prerequisite test consists of a Kolmogorov-Smirnov normality test and a two-variance homogeneity test. To address the study's hypothesis, data were analyzed using correlation and regression methods assisted by the SPSS ver.25 application.

RESULTS AND DISCUSSION

The main focus of this study is to determine the correlation between NFC and MSE, and the effect of NFC on students' MSE. For this reason, before testing the hypothesis, a prerequisite analysis test is carried out in the form of a normality test and a homogeneity test as shown in Table 1 and Table 2.

Table 1. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		40
Normal Parametersa,b	Mean	.0000000
	Std. Deviation	6.63486505
Most Extreme Differences	Absolute	.097
	Positive	.097
	Negative	-.086
Test Statistic		.074
Asymp. Sig. (2-tailed)		.200c.d

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

Based on Table 1, we may conclude that the value generated in Asym.sig is 0.200, which is more than 0.05. Thus, it can be concluded that the data distribution in this study is normally distributed.

Table 2. ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
MSE * NFC	Between Groups	(Combined)	2837.250	18	157.625	3.057	.008
		Linearity	2203.064	1	2203.064	42.733	.000
		Deviation from Linearity	634.186	17	37.305	.724	.749
	Within Groups		1082.650	21	51.555		
	Total		3919.900	39			

According to Table 2, the NFC significance value (Sig.) to MSE is 0.749, while the F-count value is 0.724 with df(17;21), resulting in F-table of 2.15. According to the requirements, the value of Sig. > 0.05 and the value of Fcount > Ftable, indicate that there is a significant linear relationship between students' NFC and MSE.

The completion of the analysis prerequisite test demonstrates that linear regression analysis can be used to evaluate the hypothesis in this research. The first hypothesis is tested by doing computations with a simple correlation test to demonstrate the relationship between students' NFC and MSE. Table 3 displays the following results.

Table 3. Correlations

		NFC	MSE
NFC	Pearson Correlation	1	.750**
	Sig. (2-tailed)		.000
	N	40	40
MSE	Pearson Correlation	.750**	1
	Sig. (2-tailed)	.000	
	N	40	40

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

According to Table 3, the statistical computation of the simple correlation coefficient reveals that r-count of 0.750 is larger than r-table of 0.312, indicating that there is a correlation between NFC and MSE. The magnitude of the correlation is 0.750, indicating that the correlation is strong. When the significance is assessed, the outcome is a Sig. (2-tailed) value of 0.000, which is less than 0.05, indicating that there is a significant correlation between NFC and MSE. The result to the first hypothesis in this study is that there is a significant correlation between students' NFC and MSE based on the findings of these statistical analyses.

Meanwhile, to demonstrate the effect of NFC on students' MSE, the second hypothesis was examined using a simple regression test. Table 4 displays the following results.

Table 4. Coefficientsa

	Unstandardized Coefficients		Standardized Coefficients			
Model	B	Std. Error	Beta	t	Sig.	R2
1 (Constant)	26.940	7.892		3.413	.002	.562
NFC	.888	.127	.750	6.983	.000	

a. Dependent Variable: MSE

Based on the information in Table 4, the regression equation is $\hat{y}$ = 26.940 + 0.888X. The constant in the calculation is 26.940, thus if the NFC value does not change, the MSE value remains the same. The regression coefficient of the equation is 0.888, which means that changing one NFC value results in an increase in MSE of 27.828.

The significance test for this regression uses a significance value (Sig.) of 0.000, whereas the t-count result is 6.983 and the t-table value is 2.024. If the value of Sig. 0.05 and t-count > t-table, it indicates that the influence of NFC on MSE is significant. The result to the second hypothesis in this study is that the presence of NFC has a significant effect on students' MSE based on the findings of these statistical computations. The degree of the impact exerted by NFC on MSE is determined by calculating the coefficient of determination, as shown in Table 5.

Table 5. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.750a	.562	.550	6.722

a. Predictors: (Constant), NFC

According to the information in Table 5, the coefficient of determination is 0.562. This demonstrates that NFC has a 56.2% effect on students' MSE. The remaining 43.8% is due to the effect of other variables that were not investigated in this study.

The results of this study support the findings of Rooji et al. (2017) that students' NFC and academic self-efficacy are closely corelated. The results from this present study provide additional evidence that NFC held by students can facilitate students' mastering experience in mathematics as part of their MSE sources. Students with high NFC appreciate becoming involved in assignments that need the development of new solutions to a problem, therefore they become the driving force behind a good mathematics experience. This is consistent with Rudolph et al. findings (2018) that students with high NFC spend more time investigating complicated activities, allowing more opportunity to investigate complex situations and evaluate the validity of the system's attributes. This is understandable since NFC serves as an intrinsic motivation in a person, becoming fuel for cognitive engagement and manifesting as learning behavior. As a result, a high NFC score will result in strong mathematical self-efficacy.

CONCLUSION

The NFC of the learner may serve as a part of the source of mathematical self-efficacy. There is a significant corelation between students' NFC and mathematical self-efficacy. Furthermore, students' NFC has a significant and strong effect on their mathematical self-efficacy.

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