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The Influence of Cognitive and Affective Factors on the Performance of Prospective Mathematics Teachers

Dwi Juniati*
Universitas Negeri Surabaya, INDONESIA

I Ketut Budayasa
Universitas Negeri Surabaya, INDONESIA

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Abstract: This study aimed to determine the effect of cognitive and affective factors on the performance of prospective mathematics teachers. Cognitive factors include cognitive independence level and working memory capacity, while affective factor include math anxiety. Mathematical performance was then assessed as basic math skills, advanced math skills and problem-solving ability. This research combined quantitative and qualitative research methods. In order to determine the effects of cognitive independence, working memory capacity, and math anxiety on math performance, multiple regression tests were used. To then see the effects of these three factors on problem-solving ability, a qualitative approach was used. Eighty-seven prospective math teachers participated in this study. Based on the results of the multiple regression, it was found that the level of cognitive independence affects basic math skills but has no effect on advanced math skills. Working memory capacity was seen to positively affect math performance (basic and advanced math skills, problem-solving skills), while mathematics anxiety demonstrated negative effects on advanced math skills and problem-solving skills.

Keywords: *Affective factor, cognitive style, math anxiety, working memory capacity.*

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Introduction

Prospective mathematics teachers will become mathematics teachers who will assist students in learning, and teach them how to learn mathematics effectively and efficiently. Their experience in overcoming obstacles and difficulties in learning will play an important role when they eventually become teachers. In other words, their successful performance in pedagogy and mathematics is essential. Therefore, it is important to examine what factors would affect the performance of prospective mathematics teachers.

Although mathematics is a cognitive domain, affective factors also play a role in learning mathematics. The role of the affective domain in mathematics learning has been investigated for the past 50 years (Aiken, 1970; Simon, 1982). According to Simon (1982), the term *affective domain* in the mathematics education context, refers to feelings and moods such as anxiety, confidence, and satisfaction that are experienced while responding to mathematical tasks. Reyes (1984) noted that although mathematics is a cognitive domain, the affective aspect also affects students in learning mathematics. For Reyes, the affective aspect referred to students' feelings about mathematics, about the atmosphere of the mathematics class, and about themselves as mathematics learners. This affective aspect in learning mathematics, as described by Reyes, includes what is known as mathematics anxiety, which is the affective aspect that is the most investigated in mathematics learning.

A good mathematics teacher must demonstrate a strong mathematical and pedagogical performance. Mathematical performance can be considered the mastery of the mathematics material being taught, while pedagogical performance consists of the ability to teach mathematics, which can be observed from aspects such as the way of designing lesson plans, giving instructions, designing tasks that are suitable for students' conditions, and using appropriate learning methods or strategies, among other ways. All of these help students understand the material being taught.

Research on mathematics anxiety among prospective teachers or pre-service teachers has also been carried out. Mathematics anxiety of prospective teachers and pre-service teachers affected their pedagogical performances, such as

* **Corresponding author:**
I Ketut Budayasa, Universitas Negeri Surabaya, Indonesia. ✉ ketutbudayasa@unesa.ac.id

their learning design and implementation, teaching methods, teaching strategies, instructional preparation, and the ways of explaining concepts (Battista, 1986; Brady & Bowd, 2005; Gresham, 2007; Pantaleon, Juniati, Lukito, & Mandur, 2018; Sloan et al., 2002; Vinson, 2001). The experience of prospective teachers when learning mathematics, including the pedagogic lectures that they attend, contributes to the level of mathematics anxiety (Juniati & Budayasa, 2017, 2021; Lake & Kelly, 2014; Sloan, 2010).

Research on the mathematics anxiety of prospective and in-service teachers has focused on their pedagogical performance rather than on their mathematics performance. Some studies have discussed the effect of teacher candidates' math anxiety on math performance but were limited to certain subjects, such as geometry (Gutiérrez-Rubio et al., 2020; Novak & Tassell, 2017), fractions (Rayner, et al., 2009), problem solving (Blanco et al., 2013; Pantaleon, Juniati & Lukito, 2018), and calculus (Awofala & Odogwu, 2017). Therefore, this study aims to examine the effect of mathematics anxiety on the mathematics performance of prospective teachers.

One of the cognitive factors widely used to predict mathematical achievement is cognitive style. Cognitive style is defined as self-consistency in the form of cognitive function (Witkin et al., 1977), as individual characteristics and tendencies in remembering and thinking, and in processing information to be understood, changed, and used. Meanwhile, the rapid development of research in neuroscience has had an impact on education, with many researchers studying the role of working memory capacity in learning. These studies have shown a relationship between working memory capacity and mathematical performance (Adams & Hitch, 1997; Cargnelutti et al., 2017; DeYoung et al., 2008; Friso-van den Bos et al., 2013; Hambrick & Engle, 2003; Juniati & Budayasa, 2020b; Wiley & Jarosz, 2012).

Research on the role of cognitive factors on mathematical performance is still mostly limited to students, few have researched its role in the context of prospective teachers. Based on qualitative research that has been carried out (Budayasa & Juniati, 2019; Pantaleon, Juniati, Lukito & Mandur, 2018; Singer et al., 2016), it has been found that cognitive style influenced the determination of the prospective teacher's strategy and communication in solving math problems. Palengka et al. (2019) showed that the working memory capacity of prospective teachers affects their ability in solving mathematics problems. This raises the question of whether these results also apply to the performance of prospective mathematics teachers in general. In the present study, the cognitive factors investigated were working memory capacity and cognitive style, because these were considered the most appropriate for the case of mathematics. Working memory capacity is related to the capacity of cognition to process information, while cognitive style is related to how cognition receives and processes information.

When learning mathematics, problem-solving becomes important and cannot be ignored because, with problem-solving, students learn to apply the mathematical theories they have learned to solve problems they encounter in their surrounding environment. Prospective mathematics teachers should then have advanced math skills, basic math skills and problem-solving skills. Thus, in this study, the performance of prospective mathematics teachers refers to these three aspects.

Based on the results of research on the influence of affective and cognitive factors on prospective teachers, most have focused on the effect of these factors on pedagogical performance, while few have investigated their effect on mathematical performance. Therefore, this study aims to discover the effects of cognitive and affective factors on the mathematics performance of prospective mathematics teachers. The results of this study will be useful in determining methods to improve the performance of prospective mathematics teachers based on the cognitive and affective factors that influence their performance. Later, when they become mathematics teachers, they will be expected to help students learn mathematics, including students who have difficulty or experience math anxiety.

Literature Review

Math Anxiety

As we know, most students from elementary to high school will answer "math" when asked what subjects they are afraid of and make them anxious when learning (Juniati & Budayasa, 2020b). Mathematics anxiety is a feeling of anxiety related to mathematics, experienced by students when studying mathematics, taking math courses, or taking math tests.

Several studies among elementary to high school students showed that math anxiety has a negative correlation with math performance (Al Mutawah, 2015; Wu et al., 2012). Gürefe and Bakalım (2018) showed math anxiety had a positive correlation with helpless learning. Mathematics anxiety can cause students who have mastered the math material to be stuck and unable to think when taking math tests, causing failure, often unable to communicate the ideas in their minds clearly and correctly.

The role of mathematics anxiety in prospective teachers or pre-service teachers has also received much attention from experts. Teachers' emotions are an important aspect of their experiences as teachers, as well as affecting their students' learning experiences in the classroom. Among the emotion teachers experience, mathematics anxiety has been identified as a potentially important emotion to consider. Juniati and Budayasa (2020a) found that the mathematics anxiety level of prospective mathematics teachers was high.

Some researchers have revealed that mathematics anxiety in learning practices has further consequences for student achievement (Brady & Bowd, 2005; Vinson, 2001). Beilock et al. (2010) showed that the mathematics anxiety of female teachers affects girls' mathematics achievement. Others have shown that the mathematics anxiety of prospective teachers and pre-service teachers influenced their teaching methods, instructional preparation and other pedagogical performances (Battista, 1986; Brady & Bowd, 2005; Budayasa & Juniati, 2019; Gresham, 2007; Sloan et al., 2002; Vinson, 2001). Research on mathematics anxiety among prospective teachers mostly focuses on its effect on pedagogical performance, and few discuss its effect on mathematical performance. Some studies have investigated the effect of prospective teachers' math anxiety on their mathematics performance. The mathematics anxiety of prospective teachers affects their mathematical performance in the subject of geometry (Gutiérrez-Rubio et al., 2020; Novak & Tassell, 2017), fractions (Rayner, et al., 2009), problems solving (Blanco et al., 2013; Pantaleon, Juniati & Lukito, 2018), and calculus (Awofala & Odogwu, 2017).

Juniati and Budayasa (2020a) showed that the negative feelings towards mathematics among prospective teachers originated in their own experiences as mathematics learners, namely their experiences when being taught mathematics in schools and mathematics courses in their teacher education programs. Sloan (2010) investigated the effects of a standards-based mathematics methods course on the mathematics anxiety levels of preservice teachers. Based on these results, the education of prospective teachers should pay attention to the level of mathematics anxiety.

Cognitive Style

Stamovlasis and Tsaparlis (2005) noted that the way of thinking, receiving information and processing information so that it is easy to understand and meaningful is unique to the individual. Some people store the information obtained in the form of an outline of the overall information, while others store the information in the form of details of the information obtained. Cognitive style refers to the way individuals receive, think, perceive, process and remember information. As Hayes and Allinson (1998) put it, "cognitive style influences how individuals look at their environment for information, how they organize and interpret this information, and how they use these interpretations for guiding their actions". Witkin and Asch (1948) demonstrated that individuals differ in the ways they perceive, conceptualize and solve problems. The resulting differences in cognitive strategy would manifest in different cognitive styles, namely in more intuitive (field-dependent) or analytical (field-independent) styles (Cuneo et al., 2018). Stamovlasis and Tsaparlis suggest that retracting ability refers to the degree of field dependence/field independence and represents the ability of the individual to extract embedded information from a complex instructional context. Although cognitive styles are generally stable individual characteristics, they may also change or develop in response to specific environmental circumstances (Kozhevnikov, 2007).

Many researchers have shown that cognitive style affects math performance, with some of them focusing on the effects of cognitive style on solving mathematics problems (Hanifah et al., 2018; Son et al., 2020), and others on understanding mathematics concepts (Mamonto et al., 2018). Onwumere and Reid (2014) showed that more field-independent students perform much better in mathematics.

Few studies have discussed the cognitive style of prospective teachers and the effects of different styles on mathematics performance, though some have discussed their effects on problem solving and consist of qualitative research. Prospective teachers with different cognitive styles solved mathematics problems in different ways, and their reflective thinking was also different (Budayasa & Juniati, 2019; Syamsuddin et al., 2020). Ayvaz et al. (2016) showed that field-dependent prospective teachers spent more time while solving subtraction operations with large numbers. Altıntaş and Görgen (2018) showed the effects of pre-service teachers' cognitive styles on their learning approaches.

Working Memory Capacity (WMC)

The term *working memory* (WM) was introduced by Miller, Galanter, and Pribram by likening the human mind to a computer (Baddeley, 2003). According to Baddeley (2003), WM is a temporary information storage system that is ready to be processed and has limited capacity. Cowan (2013) also defined WM as some information stored in a state ready to be accessed and used in cognitive tasks.

Several studies have shown a relationship between working memory capacity and mathematical performance, suggesting that working memory capacity affects mathematical ability (Ashcraft & Krause, 2007; Holmes & Adams, 2006; Juniati & Budayasa, 2020b; Mousavi, et al., 2018; Panaoura, 2007; Passolunghi et al., 2016). The research of Atkinson et al. (2021) and Brownell et al. (2010) found that the teacher's understanding of working memory was not sufficient to be used in helping students to learn and in determining learning strategies based on working memory capacity.

Only a few studies have investigated the working memory capacity of prospective mathematics teachers. Palengka et al. (2019) showed that prospective teachers with different working memory capacities gave different results in solving mathematical problems. Roeser et al. (2013) found that teachers' working memory capacity can be improved through practice.

Methodology

Research Design

The research design of this study was the mixed-methods sequential explanatory design. Quantitative methods were used to determine the effect of cognitive independence (cognitive style), working memory capacity, and math anxiety on basic math skills and advanced math skills. In this case, a general math test was the test measuring basic math skills, and a math test score was the final test score in one of the math courses students were taking, namely Calculus for the freshman, Multivariate Calculus for the sophomore, and Real Analysis for the junior students. The multiple regression test was carried out twice, with the dependent variables being general math scores and math test scores. In addition, in order to see the effects of mathematics anxiety, cognitive style, and working memory capacity on problem-solving abilities, qualitative research methods were also used. The qualitative research was conducted by selecting 10 participants so that they consisted of five subjects with low cognitive independence and five subjects with high cognitive independence; the group also consisted of five subjects with low WMC and five subjects with high WMC, as well as five subjects with low math anxiety and five subjects with high math anxiety. Subjects were given two problems to solve: a geometry problem and a non-geometry (modeling) problem.

Sample and Data Collection

The sample selection method in this study was cluster random sampling. The sample consisted of three clusters, namely the first-year students (freshman), the second-year students (sophomore) and the third-year students (junior) students. One class was chosen randomly from each cluster. A total of 87 mathematics education students (prospective mathematics teachers) of Universitas Negeri Surabaya, aged 18-23 years old, participated in this study.

Instruments and Analyzing of Data

For the measurement of cognitive independence level, the Group Embedded Figure Test (GEFT) by Witkin and Asch (1948) was used. The GEFT test consists of questions about finding a figure within a more complex figure. The range of GEFT scores is from 1 to 18. Subjects are classified into a low level of cognitive independence group if the score is less than 9, and enter a high level of cognitive independence group if the score is more than 10.

The operation span task was used in this study to measure WMC. The test was computer-based with automatic timing, with each number to be remembered being displayed for 4 seconds, and operations that must be calculated. At the end of the process, subjects were given 10 seconds to write down all the numbers that must be remembered in the correct order. WMC scores were obtained by adding the number of digits that were recalled correctly in the correct order, according to which the percentage records of the correct answers for the operation must be at least 80%. The score was in the range of 0-100. This instrument is standard, meaning that it is almost the same as the existing instruments, differing only in the operations and the numbers that must be remembered. The validity of the WMC instrument was tested using content validity: evaluation by an expert to determine if the instrument in fact measures what it was designed to measure. In addition, in order to check the reliability of the WMC test, the Spearman correlation test and retest were used. The correlation of Spearman test and retest was 0.423, with a significant score=0.001; this value was less than 0.05 (the alpha used). For details, see Juniati and Budayasa (2020b), the WMC test was valid and reliable.

Subjects were classified into a low WMC group if the score was less than 60 and into a high WMC group if the score was greater than 65. Figure 1 below shows one example task of the operation span task with two numbers to be remembered and recalled.

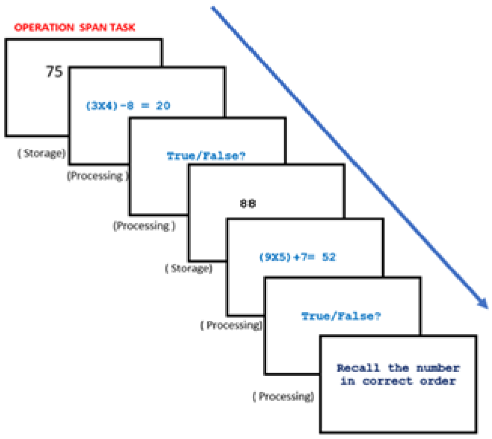


Figure 1. Operation Span Test with Numbers to Be Recalled

The mathematics anxiety test was developed by researchers. The instrument consisted of 15 items: four items about anxiety in learning mathematics, five items about anxiety in attending mathematics lectures, and six items about anxiety to mathematics tests. The Likert scale was used to indicate how often students felt anxious. Responses were rated on a 4-point Likert scale: "never" with a score of 1, "rarely" with a score of 2, "often" with a score of 3, and "always" with a score of 4. For details, see the test in Juniati and Budayasa (2020b); the math anxiety test was valid and reliable. The Cronbach's alpha value obtained from the Reliability Statistics table using SPSS was 0.849, and this score was greater than 0.7, so it concluded that this instrument was reliable. The product moment validity test was performed to correlate the score of each item with the score total of mathematics anxiety. The calculation of correlation showed that all correlation value was positive, with a significance value was 0; this indicated that each item significantly positively correlated with the total score, so that each item meets the valid criteria. Subjects were classified into a low math anxiety group if the mean math anxiety score was less than 2.6, and into a high math anxiety group if the mean math anxiety score was greater than 2.75.

The general math test consisted of five questions, covering calculus, geometry, algebra, mathematical modeling, and strategy questions to determine optimal results. This test was composed of different materials that were considered representative of mathematics, and were designed in such a way that the first-year, second-year, and third-year students could complete it. The math test was a test of advanced math skills, taken from the final test score in one of the math courses students were taking, namely Calculus for the freshman, Multivariate Calculus for the sophomore, and Real Analysis for junior students.

Problem solving in qualitative research consists of two questions: a geometry problem and a non-geometry problem. The geometry problem was simple but there was no routine procedure to solve it (finding the maximum number of circular cake tins with a diameter of 10 cm in a 19 cm x 41 cm tray). The non-geometry problem was a modeling problem that was easy to understand but could not be directly modeled: the time it takes to complete a job by two of the three people is known, and the question is asked how much time it will take if the three of them finish together.

The effects of math anxiety, cognitive style, and WMC on basic math skills were analyzed from the significance value on the multiple regression statistical tests, with the dependent variable being general math test scores. In addition, in order to see the effects of these three aspects on advanced math skills, analysis was made from the significance value of the multiple regression statistical test, with the dependent variable being the final test score of the course (mathematics test). Analysis of the results of problem solving was carried out by comparing the results of each pair of two groups: the group with high math anxiety and the group with low math anxiety, the group with a high cognitive independence level compared to the group with low cognitive independence, and the group with high WMC compared to the group with low WMC.

Findings / Results

A total of 87 prospective mathematics teachers participated in this study. All subjects took a series of tests, starting with the Group Embedded Figure Test (GEFT), then taking the working memory capacity test, filling out a math anxiety questionnaire and then answering general math test questions. The math test score was taken from the final test score of their course. The description of the test results is given in Table 1 below.

Table 1. FI/FD, WMC, Math Anxiety, General Math Score, and Math Score of Students

	FI/FD	WMC	Math Anxiety	General score	Math score
Mean	13.68	79.19	2.56	51.14	53.86
Std dev	3.18	17.33	0.36	18.39	24.95
Min	5	10	1.6	20	10
Max	18	100	3.8	100	100

From the table above, it can be seen that the average level of cognitive independence of participants was 13.68, the average level of WMC was 79.19, and the mean level of math anxiety was 2.56. This shows that prospective math teachers often feel anxious when studying and attending math classes, and when taking math tests.

In order to determine the effects of cognitive independence, WMC, and math anxiety on math performance, multiple regression statistical tests were used. Mathematics achievement was assessed from general math scores (basic math skills) and final exam scores (advanced math skills) of the subjects taken (Calculus for the freshman, Multivariate Calculus for the sophomore, and Real Analysis for the junior students). The statistical test was carried out using SPSS software.

To use multiple regression, several conditions must be met. The assumptions of normality, linearity, homoscedasticity, and the absence of multicollinearity were needed. The residuals of the regression should follow a normal distribution and this condition can be met by using a normal predicted probability (P-P) plot. Figure 2 below show the normal predicted probability (P-P) plot of the data of general math score and final test score.

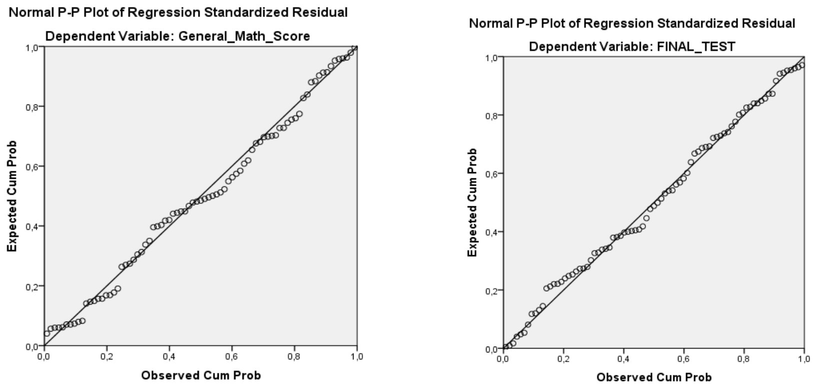


Figure 2. Normal Predicted Probability Plot.

The first figure above shows the plot of general math score points conformed with the diagonal line of normality: this indicated that the normality conditions were met. The same condition also applied to the final test variable in the second figure, which shows that the normality conditions was met.

Homoscedasticity refers to whether these residuals are equally distributed, and this condition can be checked with a scatter plot of the residuals. Figure 3 below shows the scatter plot of the residuals for general math score and final test score.

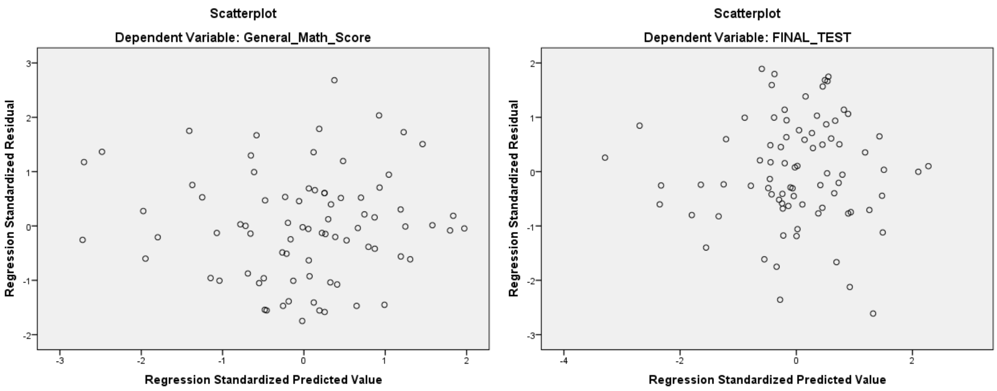


Figure 3. The Scatter Plots of The Residuals.

The scatter plots of the residual in the two above figures show there is no special pattern, and the points are equally distributed above and below zero on the X-axis, and to the left and right of zero on the Y-axis. Thus, the homoscedasticity requirement was fulfilled. The residuals were normally distributed and homoscedastic, so the predictor variables in the regression had a linear relationship with the outcome variable.

Multicollinearity refers to conditions where the independent variables are highly correlated with each other, which is not expected in multiple linear regression. The correlation between two independent variables and the variance inflation factor (VIF) can be used to determine this condition. Pearson's bivariate correlations among all independent variables should be less than 0.80, and the VIF values should be less than 10. The Pearson correlation value between cognitive independence and WMC was -0.008, The Pearson correlation value between cognitive independence and math anxiety was 0.039 and the Pearson correlation value between math anxiety and WMC was -0.226. From the calculation of collinearity statistics, VIF values for the dependent variable for both general mathematics scores and final test scores were less than 5, which can be seen in the following Table 2a. and Table 2b.

Table 2a. Table Collinearity Statistics of General Math Score

Collinearity Statistics	FI/FD	WMC	Math Anxiety
Tolerance	0.987	0.941	0.930
VIF	1.013	1.062	1.075

a. Dependent Variable: General Math Score

Table 2b. Table Collinearity Statistics of Final Test Score

Collinearity Statistics	FI/FD	WMC	Math Anxiety
Tolerance	0.990	0.940	0.931
VIF	1.010	1.063	1.074

b. Dependent Variable: Final Test Score

Based on all scores of Pearson correlation between the two independent variables and all of the VIF scores, the collinearity statistics calculation assumption was met. Thus, there was no multicollinearity. The next step was to determine the regression model, examine the suitability of the model, and investigate the variables that affect mathematics achievement. Table 3 and Table 4 below show the coefficients and the significant values of multiple linear regression analysis.

Table 3. Multiple Linear Regression Analysis

Model	Unstandardized Coeff.		Standardized Coeff	t	Sig p-value
	B	Std Error	Beta		
Constant	25.079	20.956		1.197	0.235
FI/FD	1.535	0.617	0.263	2.487	0.015
WMC	0.301	0.117	0.280	2.581	0.012
Math Anxiety	-0.498	0.405	-0.134	-1.230	0.223

F=5.173 with Sig = 0.003 and R= 0.414, R Square = 0.171 with the dependent variable: general math score

From the ANOVA table tests, it was found that F=5.173 with Sig p-value = 0.003 < 0.05. Thus, the overall regression model is a good fit for the data. The model regression was: $y = 25.079+ 1.535x_1 +0.301x_2– 0.498 x_3$, with y: general math score, x_1: cognitive independence, x_2: WMC, and x_3: math anxiety. The Sig p-value of the two predictors, for cognitive independence was 0.015 and for WMC was 0.012; as these were less than 0.05, cognitive independence and WMC thus affected basic math skills, while math anxiety did not.

Table 4. Multiple Linear Regression Analysis

Model	Unstandardized Coeff.		Standardized Coeff	t	Sig p-value
	B	Std Error	Beta		
Constant	78.587	26.869		2.925	0.005
FI/FD	0.405	0.782	0.054	0.518	0.606
WMC	0.312	0.149	0.225	2.100	0.039
Math Anxiety	-1.395	0.520	-0.289	-2.683	0.009

F=5.108 with Sig = 0.003 and R=0.407, R Square = 0.166 with the dependent variable: math score

From the ANOVA table tests, it was found that F=5.108 with Sig p-value = 0.003 < 0.05. So, the overall regression model is a good fit for the data. The model regression was: $y = 78.587+ 0.405x_1 +0.312x_2 – 1.395 x_3$, with y: math score, x_1: cognitive independence, x_2: WMC, and x_3: math anxiety. The Sig p-value of the two predictors, for WMC was 0.039 and for mathematics anxiety was 0.009. Both were less than 0.05; therefore, WMC and mathematics anxiety affect the advanced math skills, while cognitive independence did not.

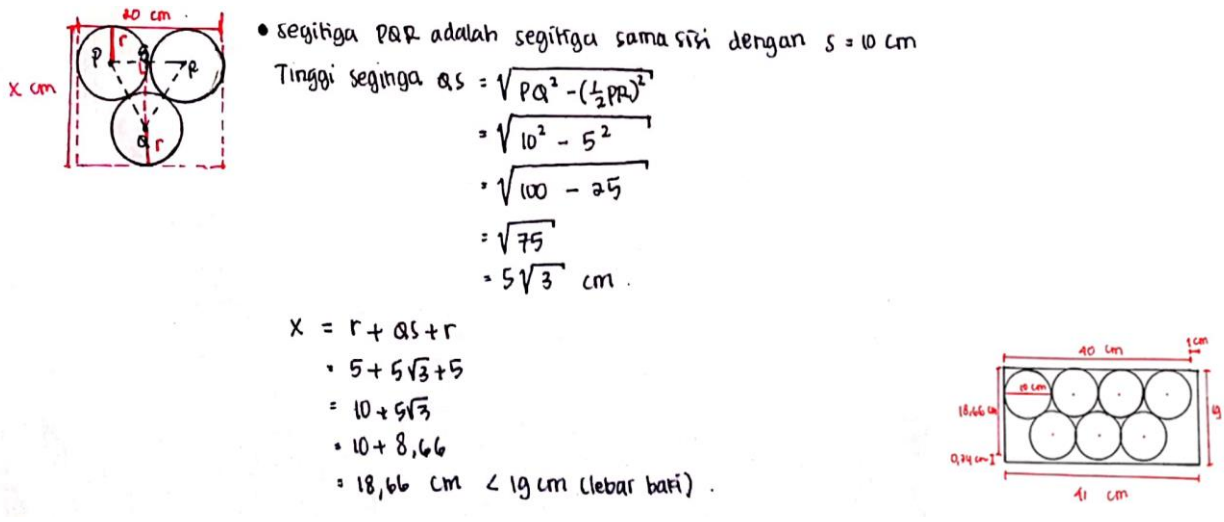
To determine the effects of these factor on problem-solving ability, qualitative research was conducted by giving two types of problems, namely a geometric problem and a non-geometry problem, to 10 participants. The participants were chosen such that they consisted of five subjects with low cognitive independence and five subjects with high cognitive independence, and also consisted of five subjects with low working memory capacity and five subjects with high working memory capacity, as well as consisting five subjects with low math anxiety and five subjects with high math anxiety.

Geometry problem

The geometry problem given was simple but there was no routine procedure to solve it. This question aimed to discern the subject's ability to apply the concept of area to the problems encountered around them. Subjects were asked to find the maximum number of circular cake tins with a diameter of 10 cm in a 19 cm x 41 cm tray.

Of the 10 participants, only three persons answered correctly; two of them used a strategy of drawing problems using a comparison scale and counting the number of circles they could draw, and the other made an analysis on the nature of the tangent to the circle It was surprising that only three persons answered this simple question correctly. Most of the subjects were in a hurry to answer, so they did not realize that the method used could not answer the given problem, such as dividing the area of a rectangular tray by the area of a circle, as was done by four participants. The other participants found that there was only one row of circles that could be arranged in the rectangle, because they thought they could not arrange two circles due to the width of the square being 19 cm while the diameter of the circle was 10 cm.

Figure 4 below shows a participant's work in solving a geometric problem that uses logical reasoning to determine the number of circles in a rectangle.



Translation:

Triangle PQR is an equilateral triangle with s=10 cm.

The height of triangle QS = $\sqrt{PQ^2 - (\frac{1}{2}PR)^2}$

$= \sqrt{10^2 - 5^2}$

$= \sqrt{100 - 25}$

$= \sqrt{75}$

$= 5\sqrt{3}$ *cm.*

$x = r + QS + r$

$= 5 + 5\sqrt{3} + 5$

$= 10 + 5\sqrt{3}$

$= 10 + 8,66$

= 18.66 cm < 19 cm (tray width).

Figure 4. The Student Work of Geometry Problem

If the correct answers are grouped based on high and low levels of cognitive independence, high and low WMC levels, and high and low math anxiety levels, the picture will be obtained as shown in Table 5 below.

Table 5. Classification of the Answer of Geometry Problem

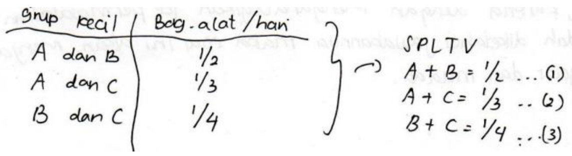
Group	FI/FD	WMC	Math Anxiety
Low	0	1	2
High	3	2	1

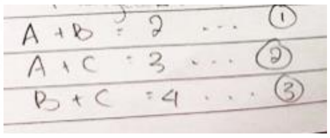
From the table above, it can be seen that there were no subjects with a low level of cognitive independence who answered the geometry questions correctly, while there were three participants who answered correctly. This shows that the level of cognitive independence affects the ability to solve geometry problem. Meanwhile, WMC and math anxiety levels also had an effect, but only slightly. The number of subjects with high WMC and the number of subjects with low levels of math anxiety who answered correctly were more than the other group, even though the difference was only one person.

Non-geometry problem

In a factory, it is known that to produce a tool if using machine A and machine B simultaneously takes 2 hours to complete. If using machine A and machine C simultaneously, the process can be completed in 3 hours. And if using machine B and machine C simultaneously, the time needed to complete the process is 4 hours. Determine the time required to complete the work if machine A, machine B and machine C are used simultaneously.

Six participants answered correctly by making a mathematical model correctly according to the existing problems, while the other participants made a mathematical model based on the existing sentences not adapted to the context of the problem. Figure 5 below shows the participant's work in solving non-geometric problems, (a) is a mathematical model that is made based on the context of the problem, while (b) is a mathematical model made based on sentences in the problem without being adjusted to the context.





(a). (b).

Translation

Small group	tool parts / hour	the system of linear equations
A and B	½	A+B = ½
A and C	1/3	A+C = 1/3
B and C	¼	B+C = ¼

A+B = 2	….. (1)
A+C = 3	….. (2)
B+C = 4	….. (3)

Figure 5. The Student Work of Non-Geometry Problem

When the correct answers were grouped based on high and low levels of cognitive independence, high and low WMC levels, and high and low math anxiety levels, the picture obtained is as shown in Table 6 below.

Table 6. Classification of the Answer of the Non-Geometry Problem

Group	FI/FD	WMC	Math Anxiety
Low	*3*	*2*	*5*
High	*3*	*4*	*1*

The number of participants who correctly answered non-geometry problems from the low and high cognitive independence groups was the same, namely three participants. This shows that the level of cognitive independence did not affect non-geometric problem solving. As in geometry problem solving, the level of WMC also affects non-geometric problem solving. Meanwhile, in groups with different levels of math anxiety, there was a significant difference, with only one participant with high math anxiety answering correctly, while participants with low math anxiety all answered correctly. This makes sense, because in non-geometry questions it is necessary to determine the right strategy according to the context of the problem, so anxious students will find it difficult to concentrate and determine the strategy correctly.

Discussion

Based on the results, it can be concluded that the level of math anxiety affects advanced math skills and problem-solving skills, although it does not affect basic math skills. It is possible that when they completed the basic math test, they did not feel very anxious because they expected the test to cover basic math skills, so it did not affect the test results. Mathematics anxiety negatively affects mathematical performance: the higher the individual's level of mathematics anxiety, the lower the performance. This is understandable because a strong feeling of anxiety when doing a math test often makes the mind get stuck, so that the student does not know how to determine strategies to solve the problems they are facing, especially when facing complex problems that require more thought and attention. These research results are consistent with Al Mutawah (2015), Ashcraft and Moore (2009) and Young et al. (2012), who showed that when facing math tests, individuals with high math anxiety tend to feel very anxious so that it affects their thinking as they complete the tests. Therefore, it is necessary to investigate further how to determine strategies to overcome or reduce mathematics anxiety so that prospective mathematics teachers can improve their performance.

Working memory capacity, then, positively affects math performance (basic math skills, advanced math skills and problem-solving skills). Individuals with high working memory capacity show better performance than those with low working memory capacity. This was consistent with the research of Juniati and Budayasa (2020b), Palengka et al. (2019), and Ramirez et al. (2013), who noted that individuals with high working memory capacity perform better by determining more advanced strategies in solving problems than individuals with low working memory capacity.

The level of cognitive independence only affects basic math skills, but does not affect other math skills (advanced math and problem-solving skills). These results are somewhat different from the results of studies on elementary to high school students which indicate the role of cognitive independence on mathematical ability (DeYoung et al., 2008; Onwumere & Reid, 2014; Singer et al., 2016). This could be because most of the prospective teachers have a relatively high level of cognitive independence, so it does not have much impact on their mathematical performance. Based on Zhang's research (Zhang, 2004), the cognitive independence scores were related only to students' achievement in geometry, but not to mathematics ability in general. This situation needs to be investigated further, to determine whether it also applies to prospective math teachers. Few studies discuss the effect of cognitive independence level on math performance at the university level. Further investigations also need to be carried out on individuals with low levels of cognitive independence.

Conclusion

The mathematics anxiety level of prospective mathematics teachers was quite high, and it negatively affects their advanced math skills and problem-solving skills. However, mathematics anxiety did not affect the basic math skills of prospective teachers.

Working memory capacity positively affected the performance of prospective mathematics teachers (basic math skills, advanced math skills and problem-solving skills): the higher the memory capacity, the higher their math performance. In contrast to math anxiety, cognitive independence only affects basic math skills but does not affect the advanced math skills and problem-solving skills of prospective teachers. There is little research on the effect of math anxiety, working memory capacity, and cognitive style on the math performance of prospective teachers, so these results will contribute to new knowledge in this regard.

Recommendations

Based on the results of this study, although prospective math teachers study math, their math anxiety level is high and this affect their math performance negatively, especially on advanced math skills and problem-solving skills. This result implies that prospective teachers with high math anxiety will have difficulty explaining how to solve math problems to students efficiently and effectively. Thus, it is important to study further the causes of math anxiety in prospective mathematics teachers, and find effective strategies or methods to reduce the math anxiety level.

Working memory capacity positively affects the mathematical performance of prospective teachers, so research on ways to increase working memory capacity will have a positive impact. In addition, further research on the effect of working memory capacity on pedagogical performance is likewise necessary.

In this study, cognitive independence (cognitive style) had no significant effect on the overall mathematical performance of prospective math teachers, but did have an effect on basic math skills. Thus, it is necessary to investigate more deeply whether the teacher's cognitive style affects the way they explain mathematical concepts and how to solve problems to their students.

Limitations

In this study, the affective factor studied was only mathematics anxiety. There were still several other affective factors such as attitudes, personality, motivation, and self-esteem which could be further investigated for their role on mathematics performance.

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Juniati: Conceptualization, design, analysis, writing. Budayasa: Conceptualization, design, statistical analysis, writing.

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