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Research Article

Working Memory Capacity and Mathematics Anxiety of Mathematics Undergraduate Students and Its Effect on Mathematics Achievement

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Abstract

This quantitative study aimed the first to investigate the working memory capacity and mathematics anxiety of mathematics undergraduate students based on differences in sex and grade. The second to know the effect of working memory capacity and mathematics anxiety on mathematics achievement. The t-test and MANOVA-test were used to answer the first aim of the study and the multiple linear regression test was used to answer the second aim. A total of 90 students participated in this study which was obtained by cluster random sampling. The results showed that the working memory capacity of male students was greater than female students. The working memory capacity of first-year students was greater than the second and the third-year students. While there was no difference in students' mathematical anxiety seen from the difference in sex and grade. Based on multiple linear regression test, there was a significant negative effect of mathematics anxiety on mathematics achievement. This result illustrated that the higher mathematics anxiety the lower the mathematical achievement. The results of this study indicated that one importance factor to improve the mathematics achievement of mathematics undergraduate students, can be done by finding a strategy to reduced the level of mathematics anxiety.

Keywords:

working memory capacity, mathematics anxiety, mathematics achievement, mathematics undergraduate students

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Introduction

Research in the field of higher education is generally carried out to produce theories, methods, models and strategies that all lead to quality improvement, which is characterized by improving student performance. The construction of strategies to teach group theory by incorporating cultural and technological elements to improve student performance was carried out by Juniati & Budayasa (2017) and they developed the teaching materials of fractal geometry using the experiment-based problems to upgrade students' competencies (2017b). However, it cannot be denied that the factors that play an important role in the success of students in addition to learning resources that support effective learning are cognitive and mental factors of students. Enormous progress in the field of neuroscience in the last decade had a significant impact on the cognitive related field of research, namely by allowing one to observe how a person's brain activities when learning, experiencing difficulties, and when they were on the verge of being able to do an activity. The progress of this field made an important contribution to educational research, related to the information processing model which was related to working memory. Working memory is a term that refers to a person's cognitive system that maintains and processes information to complete the task being performed (Bayliss, Jarrold, Baddeley, Gunn, & Leigh, 2005). Working memory also involves processing information other than storage so that it differs from short-term memory which only refers to temporary storage of information (Baddeley, 2000). Memory capacity is a measure of how much information can be stored. Meanwhile, the duration of memory states the length of time information can last in a memory storage (McLeod, 2007). Conway used the term one's working memory capacity as the amount of information that could be stored in working memory when that person was processing information, and this capacity was generally limited. (Conway & Engle, 1996). Engle (2002), in his research, showed that working memory capacity played a very important role to support cognitive abilities in understanding problems, reasoning and problem solving and found that everyone has a different working memory capacity. Several studies on working memory had been produced. Frisco, Sanne, Kroesbergen, & Johannes (2013) conducted a research in elementary school and found that all components of working memory were related to mathematical performance, especially verbal updating. Korovkin (2018) investigated the dynamics of working memory systems during problem solving. He stated that the functioning memory storage was needed when solving a problem and just before finding the solution the control system played an important role.

As we know, anxiety causes a person to be disturbed, unable to concentrate so that affects cognitive performance. Something that is usually easy for someone can be difficult because of excessive anxiety, this condition also occurs due to mathematical anxiety. Because anxiety can inhibit cognitive activity. When we ask students about what subjects they are afraid of, they will generally answer mathematics. Mathematics anxiety is an anxious feeling caused by a thing related to mathematics, that is when studying mathematics matter, facing a math test or when attending a mathematics class. Over the years and until now, educational researchers have paid great attention to the anxiety of learning mathematics by students. Mutawah (2015) found that the level of mathematics anxiety correlated negatively with mathematics achievement of middle and high school students in Bahrain. Meanwhile, Pantaleon (2018) in his research found that the proving skills of subjects with high mathematical anxiety were less systematic and less logical in providing arguments, even though the ideas put forward in the proofs were accompanied by arguments and were less accurate in formulating assumptions. The relations between working memory, mathematics anxiety and various measures of mathematical skill have been studied extensively. But most subjects of the study were children or elementary school students, not much research among undergraduate students especially explore the mathematics anxiety and working memory capacity of mathematics undergraduate students. Therefore, knowing how the working memory capacity and mathematics anxiety of mathematics students and their effects on mathematics achievement is interesting to investigate.

Working Memory Capacity

The term "working memory" was introduced by referring a theory that equates thought with computers. According to Baddeley (2003), working memory was a cognitive system that has the task of temporarily storing information to be processed and had the limited capacity. Working memory also involved processing information other than storage so that it differed from short-term memory which only refered to temporary storage of information. Many models had been produced in describing working memory functions, but the most widely used model in research of cognitive psychology was influenced by the multi-component working memory model proposed by Baddeley and Hitch. Baddeley and Hitch's initial model contained three main components, namely the central executive, phonological loops and visuo-spatial sketches. The central executive component is in charge of overseeing and controlling information, while the phonological loop is in charge of storing verbal content and the visuospatial sketch component controls visuo-spatial information. Then, Baddeley added a third component to his model, the episodic buffer, which holded and integrated phonological, visual and spatial information, and possibly other information that had not been included in the three components (for example, music information) and this component was a connector between working memory and long-term memory (Baddeley, 2000). Working memory had a limited capacity. The initial measurement of the capacity associated with short-term memory was carried out by Miller in 1956, who was famous for the "magic number seven" (Miller, 1994). Based on the results of his research, he claimed that the information processing capacity of young adults regardless of whether in the form of words, numbers, letters, or the others was the same, which was about seven elements. After, it turns out furthermore that it was known that a person's capacity to remember digits was as much as 7, while for letters as much as 6 and for words as much as 5.

Methods for measuring the capacity of working memory had been the concern of cognitive psychologists from then it was known until now and many methods have been produced so far to measure the capacity of working memory. The initial method of measuring memory capacity was a simple method, measuring the number of digits, letters or words that can be remembered. The complex span method, which was measuring working memory capacity (WMC) with concurrent processing tasks, was known after. The method for measuring the working memory capacity most often used was the complex span task. Danemon and Carpenter (1980) proposed a complex span task with their Reading Span Task and after, Conway, Kane, Bunting, Hambrick, Wilhelm & Engle (2005), proposed Operation-Word Span Test. There are several variants of complex-span tasks. Some of these are the Reading Span Task, the Operation-Word Span Task, the Symmetry Span Task. Reading Span Task is a method of measuring WMC with a concurrent processing task that was in addition to remembering some number of digits, letters or words, reading text to see the plausibility was given. Operation-Word Span Task uses concurrent tasks in the form of operations that will be counted when remembering a number of words. Meanwhile, the Symmetry Span Task is a measurement of WMC by adding tasks simultaneously by remembering a number of digits, letters or words in the form of some geometry objects and must be determined to be symmetrical or not. All of these complex span tasks have the same structure which is to measure how many letters, digits or words can be memorized, in addition to simultaneously completing the given task, the difference is the type of task given. The tasks are designed to force WM storage in the face of processing (or distraction), to engage executive attention processes. In the reading span task, adapted from Kane in Wilhelm, Hildebrandt, & Oberauer (2013), participants recalled letters or digits in a simple reading comprehension task. For each sentence, a single letter or a number was displayed simultaneously after the sentence. Participants had to memorize the letters or the numbers. Additionally, they evaluated the meaningfulness of the sentences. After assessing the meaningfulness of the last sentence of each trial, subjects recalled the letters or the numbers of that trial in their order of presentation. The example of reading span task with 2 letters to be recalled, given in the following image in Figure 1.

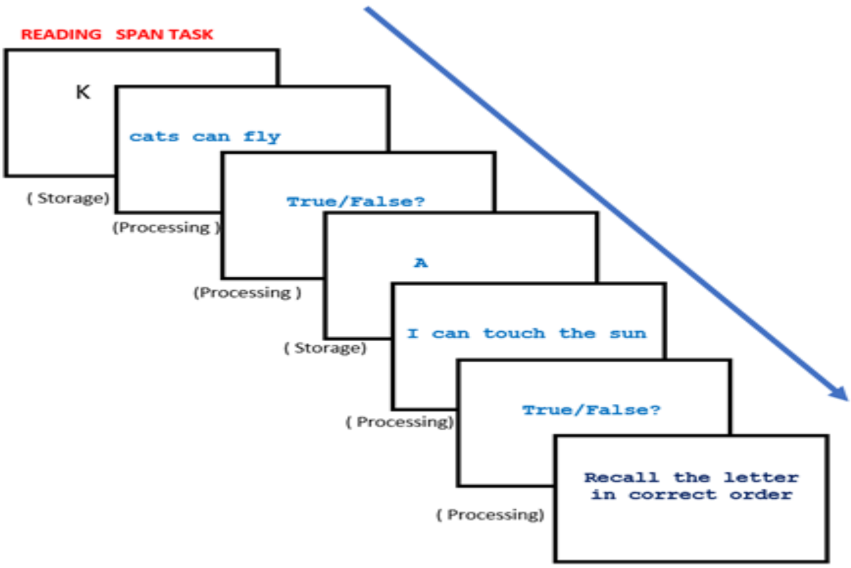

Figure 1.
Reading Span Task with 2 Letter to be Recalled

The structure of the Operation Range task is similar to the Reading Span task, instead of reading, participants are given some relatively easy arithmetic operations to calculate and evaluate the truth of the results and the digits or letters or words are displayed to be memorized in sequence. The task required is to remember all digits or words given in the order in which they are presented after evaluating the results of arithmetic operations. The test normally consists of two parts, the first part is for the trial so that the subjects have a better understanding the intent of the test and are familiar and the second part is the real test which the results show the working memory capacity of the subject. For the second part, Conway (2005) considered the range from two to five elements per item to be recalled was adequate for most college student populations and repeated three times, so the total is 12 items. This means the test contains three items for each of two, three, four or five numbers or letters that must be remembered.

Working memory tasks designed for children usually present trials in order of ascending difficulty, with testing discontinued when the child fails a particular level. Gonthier, Aubry, & Bourdin (2018) proposed the adaptive testing that dynamically adjusts the level of difficulty as the task progresses to match the participant's ability. Stone and Towse (2015) created the memory span task java-based provided were; digit span, matrix span, arrow span, reading span, operation span, rotation span, and symmetry span that was open source that could be downloaded from the project website. Ma, Chang, Chen, & Zhou (2017) developed a test for WMC measurement based on computerized tests and using a scoring system that suitable for young adult users.

Mathematics Anxiety

As we know, most students from elementary to high school will give a "math" answer if asked them what subjects they are afraid of and make them anxious when learning them. This also happens in Indonesia, many students who are afraid and worried when they have to finish math problems that make them not confident. Feelings of anxiety, fear and discomfort experienced when a person has to solve a math problem or when facing a math test and when taking a math class is known as mathematics anxiety. Many studies had been conducted related to mathematics anxiety, some show that mathematics anxiety had a negative influence on students' mathematical performance. The research of Hoffmann (2010) investigated the role of self-efficacy beliefs and mathematics anxiety in solving mathematical problems from Pre-service teachers. Gurefe & Bakalım (2018) found a significant positive relationship between mathematics anxiety and helpless learning, a significant negative relationship was also obtained between self-efficacy and mathematical anxiety. Wu, Barth, Amin, Malcarne, & Menon (2012), Mutawah (2015), Hunt, Bhardwa, & Sheffield (2017) and Pantaleon (2018) had the results that indicated the negative effect of mathematics anxiety on arithmetic skills and mathematics performance of the students.

Measurements of mathematical anxiety had been produced, some of which were: The Mathematics Anxiety Rating Scale (MARS) with 98 items introduced by Richardson (Richardson & Suinn, 1972). The MARS has been widely used for research and clinical studies. However, because there were quite a lot of items on this instrument, some experts made a simpler instruments. The Revised Mathematics Anxiety Rating Scale (RMARS) with 25 items, The Abbreviated Math Anxiety Scale (AMAS) contained 9 items, and the Mathematics Anxiety Scale (MAS) had 12 items (Baloglu & Zelhart, 2007). The RMARS measure the level of mathematics anxiety of students consisting of the mathematics test anxiety (15 items), the mathematics course anxiety (5 items) and the numerical task anxiety (5 items). The AMAS measure the anxiety about learning and evaluation in mathematics, use a 5-point Likert scale from 1 = low anxiety to 5 = high anxiety. The Mathematics Anxiety Scale measure the anxiety associated with mathematics classes, courses, problems, and tests (Fennema & Sherman, 1976).

Problem of Study

This study investigated whether WMC and anxiety mathematics of mathematics undergraduate students depend on differences of gender and grade (the year of students). The effect of WMC and mathematics anxiety on mathematics achievement was studied also. Therefore, the questions that will be answered in this study are:

- Are WMC and mathematics anxiety of mathematics undergraduate students dependent on the year of students?
- Are WMC and mathematics anxiety of mathematics undergraduate students dependent on gender?
- Whether WMC and mathematical anxiety affect mathematics achievement of mathematics undergraduate students?

Methodology

Research Design

The type of this research was quantitative research. This quantitative study aimed to investigate the differences of WMC and mathematics anxiety based on different sex and the years of students, so for this reason the t-test and Manova test (multivariate test) were used. In addition, this study tried to know the effect of WMC and mathematics anxiety on mathematics achievement so the multiple linear regression test have been used.

Participants

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. Then from each cluster, one class was chosen randomly, because the classes were homogeneous. A total of 90 mathematics students of Universitas Negeri Surabaya with 20 male students and 70 female students, aged 18-23 years old were participating in this study. From participants, 27 were first-year students, 28 second-year students and 35 were third-year students.

Instruments

Working Memory Capacity Scale

The instrument to measure the memory working capacity, Operation span test with the numbers to be recalled was used. The test consists of two parts, the first part is to familiarize students and the second part to look at the working memory capacity which consists of tests with the number of digits to be recalled from two to five. Computer-based test was used with automatic timing, where each number that must be remembered and the operations that must be counted were displayed for 4 seconds and at the end of the process, subjects were given 10 seconds to write down all the numbers that must be remembered. The following figure shows the Ospan test with 2 numbers that must be remembered.

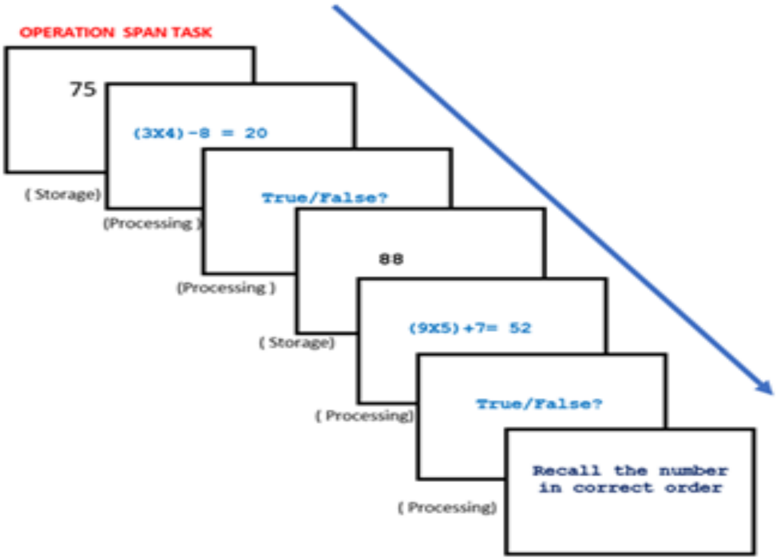

Figure 2.
Operation Span Task with Two Numbers to be Remembered

The scoring of Conway with partial-credit load memory was used. Working memory capacity scores were obtained by added the number of digits that recalled correctly in the correct order in which the percentage records of the correct answers for the operation must be at least 80%. This means that for the example on the item with four digits to be recalled, if the subject gave a wrong answer in the operation calculation process, so even though the subject could recall the correct number in correct order, the score for this item was zero. For item with five digits to be recalled, it will be given five operations to answer true or false. If a subject answered just four correct answers in operation it meant the subject could answer 80%, so the score for this item was the number of digits that the subject recalled correctly in correct order. If the subject answered every item correctly, and recalled all the digits correctly, the total score is 3×14 = 42. The score was changed in the range of 0-100 so the score of the working memory capacity subject was the total score divided by 42 multiplied by 100. This instrument is standard, meaning that it is almost the same as the existing instruments, but differ only on the operations and the numbers that must be remembered. Therefore, to get a valid instrument was done by an expert validity test. The Pearson correlation of test and retest were used to have the reliable instruments.

Mathematics Anxiety Scale

The mathematics anxiety test was developed by referring to existing instruments and adapted to the research subjects, namely university student level. The items of the instrument were arranged based on the anxiety-related situation found in the field. The instrument consisted of 15 items, 4 items about anxiety in learning mathematics, 5 items about anxiety in taking mathematics lecture, and 6 items about anxiety to mathematics tests. The fifteen items of mathematical anxiety instrument developed, as follows:

Four items related to anxiety in learning mathematics:

- I feel uneasy if there is mathematical material that I did not understand when studying.
- I feel anxious when I have to study math with complex mathematical formulas.
- I have a thought that learning mathematics is not as easy as I imagined before.
- I feel uncomfortable when I have to study mathematics using a computer.

Five items related to anxiety taking mathematics courses:

- When my friend is asked to answer a question, I feel happy because I was not chosen.
- I panicked when I got a lot of assignments and it wasn't easy for me.
- I'm afraid to ask things that I don't understand to the lecturer.
- I feel anxious if my friend knows I don't understand the material or can't answer the question.
- I feel anxious when asked to work on math problems and explain them in front of the class.

Six items related to the anxiety of mathematics test/quiz:

- I panicked when there is a math quiz without prior notice.
- When I study for a math exam, I worry that I will not remember the material during the exam.
- I lost focus on the math exam time, and I can't remember the material that I understood before the exam.
- After the math exam, I worried whether I was good enough on the exam.
- I am not confident when taking math tests.
- I was afraid to know the results of my math exam scores.

In this study, the subjects research were mathematics students so all subjects studied are mathematics, therefore the Likert scale used to indicate how often they feel anxious. Responses were rated on a 4-point Likert scale from "never" with a score of 1, "rarely" with a score of 2, "often" with a score of 3 and '"always" with a score 4. So, the score of mathematics anxiety was from 15 to 60. The Product Moment Validity test and the Cronbach alpha test were used to have the valid and reliable instruments.

Mathematics Achievement Test

The math test used to determine mathematics achievement consisted of 5 questions that constructed such that that the first-year to third-year students can answered it. The selected mathematics test material was adjusted to the lecture material, namely algebra, geometry, calculus, and mathematical modeling. The test consists of questions about integrals and derivatives, problems of inequality of exponential shapes, questions related to geometric sequences, and a strategic problems of maximum determination. Integral problem was the problem of determining the integral of a function if the derivative of the function was given. The geometry problem was the problem of determining the circumference of the snowflake curve in the tenth iteration if the circumference of the first iteration was equal to 1. The problem of maximum strategy was the problem of determining the maximum number of apples (in kg) sent to the store on the hill using a cart under certain conditions, subjects were asked to determine the strategy so that the apple sent to the store was maximum. The range of the score was 0-100. The validity test was done by the experts.

Design and Procedure

This research was conducted by developing three instruments first, then testing the instruments to get a valid and reliable instrument. The time period for tests and re-tests in obtaining reliable instruments was between 10 to 15 days. After the instrument met the validity and reliability criteria, the next step was to determine the sample of research using the cluster random sampling method. The collecting data was carried out in the following stages. Retrieval of working memory capacity data for 90 mathematics students conducted for 3 weeks, then the mathematics anxiety test was given and the following week the mathematics test was given to all participants at the same time. After the data was collected, inferential statistical tests were carried out. Manova test was used to see the differences in WMC and mathematics anxiety based on the year of the student. Meanwhile, to see whether there are differences in WMC and mathematics anxiety based on differences in sex was done by t-test. The multiple linear regression was done to know the effect of WMC and mathematics anxiety on mathematics achievement.

Results

The validity criteria of WMC scale were met through expert validity test, and the test and retest was done with 86 students. The correlation of Spearman of test and re-test was 0.423 with Significant score=0.001, this value was less than 0.05 (the alpha used). This result indicated that the positive correlation between the score of test and the score of re-test was significant. This test was stable or consistent across time so this instrument was reliable. Therefore, WMC scale test was valid and reliable.

The mathematics anxiety test was tested on 122 students to get the reliable instrument. The Cronbach 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 done with correlate the score of each item with the score total of mathematics anxiety. The item is valid if the score of this item and the total score have a significant positive correlation. The result calculation of correlation showed that all correlation value was positive with the significance value was 0, this indicated that each item significantly positively correlated with the total score, so each item meets the valid criteria. The following table show the result.

Table 1.
Product Moment Validity Table

Item	Correlation	Sig	Conclusion
1	0.367	0.000	Valid
2	0.581	0.000	Valid
3	0.512	0.000	Valid
4	0.494	0.000	Valid
5	0.349	0.000	Valid
6	0.561	0.000	Valid
7	0.628	0.000	Valid
8	0.547	0.000	Valid
9	0.619	0.000	Valid
10	0.553	0.000	Valid
11	0.579	0.000	Valid
12	0.540	0.000	Valid
13	0.586	0.000	Valid
14	0.646	0.000	Valid
15	0.566	0.000	Valid

A total of 90 mathematics students were participating in this study. Each participant completed two parts of the Operation Span task. After students complete the task in the first part (trial) there was a short discussion to make students better understand the purpose of the test. The second part consists of 42 tasks presented in random order. After the three tests given to all research subjects, the data were assessed, an overview of working memory capacity, mathematical anxiety and mathematical abilities of the mathematics students were obtained as shown in the following table.

Table 2.
WMC, Math Anxiety and Math Achievement of Students

	WMC	Math Anxiety	Math Achievement
Mean	83.35	40.56	48.01
Std dev	12.238	6.209	18.10
Min	38	25	20
Max	100	55	95

From the table above, it was known that the average working memory capacity of mathematics students was 83.35, this means that students remembered about 83%

of the numbers given in sequence correctly while completing number operations correctly.

From the results of the Mathematical anxiety test, it was found that the average was 40.56. If this number was divided by the number of the items of the test that was 15, then 2.704 was obtained. The score of 2 means "rarely" and a score of 3 means "often", then these results indicated that the average mathematical anxiety of students was quite high. This was also supported by the data, which was 68% of mathematics students had the mathematical anxiety score more than 37. This meant that 68% of mathematical students answered more than half of the statements about anxiety mathematics by choosing "often". While the math ability score was not high enough, the average was 48.01.

To see the differences in working memory capacity and mathematical anxiety among students of different years, the Multivariate Anova (MANOVA) test was conducted. There were two independent variables studied and there were also three differentiating groups so the multivariate Anova-test was used. The table 3 for MANOVA processing below was obtained using the SPSS program.

Table 3.

Descriptive Statistics and Homogeneity of Variances based on Difference Year

	WMC			Math. Anxiety		
Year	1	2	3	1	2	3
Mean	88	83.52	79.71	42.33	38.90	40.59
Std dev.	9.33	12.51	13.16	7.35	6.73	4.44

	WMC	Math Anxiety
Levene Stat.	0.733	2.994
Sig. value	0.484	0.055

The table above describes the descriptive statistic of working memory capacity, and mathematics anxiety of mathematics students of first-year students, second-year and third-year students. The mean of WMC of the first year students was the highest one, that was 88. But the level of mathematics anxiety of the first year students was the highest also. The variance of WMC and math anxiety were homogenous (with alpha used = 0.05) based on the Levene Stat, because the Significant value were 0.484 and 0.055 that greater than 0.05.. The next step to see the difference from the mean group, Wilks' Lambda test was used. This is a multivariate test of significance to see the difference among the group.

Table 4.
Multivariate Table based on Difference Year.

	The test	F	Sig
Eq. of covar. matices	Box's test	1.501	0.097
Eq. of error variances	Levene's test:		
	WMC	0.558	0.574
	Math. Anxiety	2.911	0.060
Multivariate test	Wilks' Lambda	2.847	0.026

The F score of Box's test was 1.501 with the Significant score (p value) =0.097 was greater than 0.05, so the null hypothesis accepted, this means that the observed covariance matrices of the dependent variables are equal across groups. The Significant scores of Levene's test for WMC and Math. Anxiety was 0.574 and 0.060 respectively. Both of them were greater than 0.05, these indicated that the error variance of the dependent variable was equal across groups. The F score of multivariate test by Wilks' Lambda was 2.847 with the Significant value equal 0.026 (less than alpha used), this showed that there was difference means between the groups viewed from the difference years of the students. To further see which one was different, the LSD test was used, the results was given in the following table.

Table 5.
Tests of Equality of Group Means by LSD

		F	Sig
The tests between groups:	WMC	4,232	0.018
	Math. Anxiety	1.366	0.261
LSD:	WMC		
	1-2		0.169
	1-3		0.005
	2-3		0.237

From the test between groups of multivariate variable in Table 4, it was found that the Significance value for WMC was 0.018, less than 0.05. So, this indicated that there were differences working memory capacity among students with different years. However, for mathematics anxiety, because its Significance value was 0.261 greater than 0.05, there was no difference in mathematics anxiety between students with different years.

LSD for WMC variable showed that the Significant value that was less than 0.05 only for 1-3 that meant that the WMC of the first year students was difference with the third year students. While WMC of second-year students were not different from first-year students or third year students. This situation was supported by the following mean plot of these two variables.

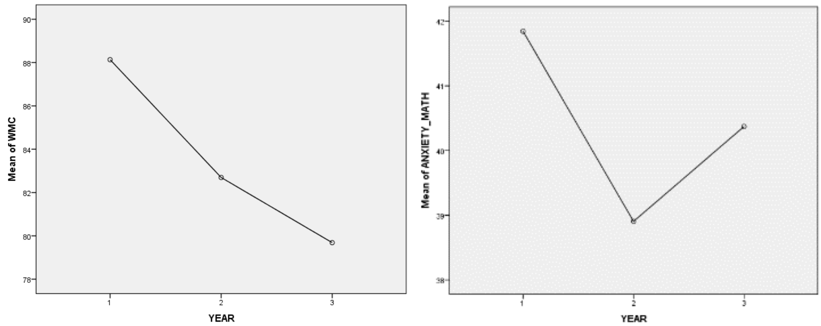

Figure 3.
Mean plot of WMC and Math. Anxiety based on Different Year

Next, the t-statistical test was used to see the differences in WMC and mathematics anxiety among female and male students. The results of the statistical t-test used were given in the following table. Table 6 illustrates the descriptive of WMC and Math. Anxiety of female and male students.

Table 6.
Descriptive Statistic and ANOVA Table based on Gender

	WMC		Math Anxiety	
Gender	F	M	F	M
Mean	81.45	90.26	40.32	41.35
Std dev.	12.77	6.57	6.45	5.37

Table 7.
ANOVA Table of WMC and Math Anxiety based on Gender

	F	Sig	t-value	Sig
WMC	5.291	0.024	4.092	0.000
Math. Anxiety	2.074	0.153	0.648	0.519

Based on the results of the calculation above (Table 7) and by using an alpha value of 0.05, it was found that the significant value was less than alpha, only for WMC. So, it can be concluded that only WMC differed between female and male math students, namely WMC male students were higher than WMC female students. While in mathematics anxiety, male and female students were the same.

Meanwhile, to see the effect of WMC and mathematics anxiety on mathematics achievement, a multiple linear regression test was used and several assumptions are needed to use this test. The assumptions of normality, linearity, homoscedasticity, and absence of multicollinearity were needed.

The residuals of the regression should follow a normal distribution and this condition can be done by using a normal Predicted Probability (P-P) plot. The figure 4 show the normal Predicted Probability (P-P) plot of the data.

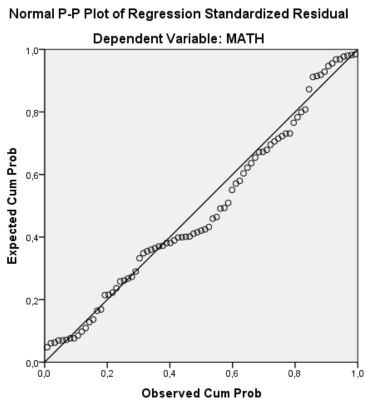

Figure 4.
Normal Predicted Probability Plot

The figure showed that they conform to the diagonal normality line indicated in the plot, this indicated that normality requirement was met.
Homoscedasticity refers to whether these residuals are equally distributed and this condition can be checked with the scatterplot of the residuals. The figure 5 showed the scatterplot of the residuals.

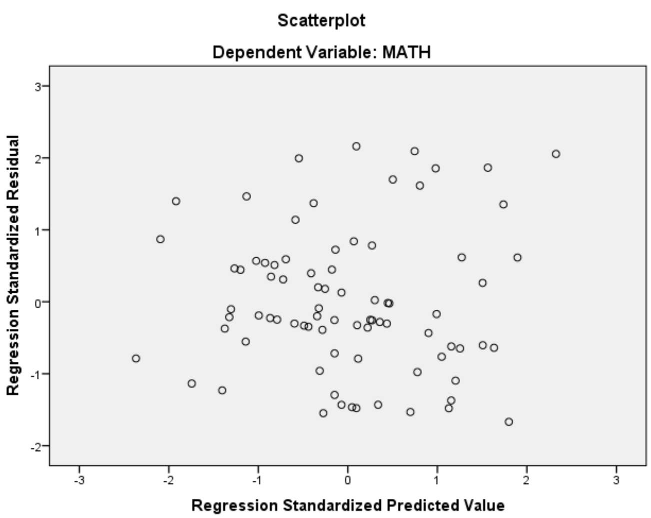

Figure 5.
The Scatter Plot of the Residual

The above figure showed there is no special pattern, and the points were equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis. So the homoscedasticity requirement was fulfilled. The residuals were normally distributed and homoscedastic, then 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, this is not expected in multiple linear regression. The correlation between two independent variables and variance inflation factor (VIF) can be used to know this condition.

The Pearson correlation value between WMC and mathematics anxiety was -0.048, this indicated that the two predictor variables were not correlated. From the collinearity statistics calculation, the VIF value was 1.005 that less than 5 indicating that the assumption was met. So there was no multicollinearity. The next step is to determine the regression model, examine the suitability of the model, and investigate the variables that affect mathematics achievement. The below table showed the coefficients and the significant values of multiple linear regression analysis.

Table 8.

Multiple Linear Regression Analysis.

Model	Unstandardized Coeff.		Standardized Coeff	t	Sig p-value
	B	*Std Error*	*Beta*		
Constant	*94.907*	*19.063*		*4.979*	*0.000*
WMC	*-0.237*	*0.158*	*-0.164*	*-1.502*	*0.137*
Math Anxiety	*-0.662*	*0.314*	*-0.230*	*-2.107*	*0.038*

F=3.153 with Sig = 0.048 and R Square = 0.075.

From the ANOVA table tests, it was found that F=3.153 with Sig p-value = 0.048 < 0.05. So, the overall regression model is a good fit for the data. The model regression was: $y = 94.907 - 0.237x_1 - 0.662 x_2$, with y : mathematics achievement, x_1 : WMC, and x_2: mathematics anxiety. The Sig p-value of the two predictor, only for mathematics anxiety was less than 0.05, therefore mathematics anxiety affect the mathematics achievement, while WMC did not.

Discussion And Conclusion

The working memory capacity of male mathematics students was higher than the working memory capacity of female math students, and the working memory capacity of first-year math students higher than the working memory capacity of second-year math students and the working memory capacity of third-year math students. Although working memory capacity was negatively related to mathematics achievement but it was not significantly. The resuts obtained about WMC was in line with the research of Hertzog, Dixon, Hultsch, & MacDonald (2003) stated that working memory is among the cognitive functions most sensitive to age.

From this result, of course, if we will determine the strategy in an effort to improve WMC, it needs to be distinguished between male and female students, likewise for first-year students differing from second and third-year students. From the variables studied, only mathematics anxiety was significantly negatively correlated with mathematical achievement, this showed that the higher the level of mathematics anxiety, the mathematical achievement of mathematics students was lower. This is similar to the results of research by Dada (2019), where the intelligence factor cannot be used to predict mathematical abilities, another factor that has more role is self-efficacy. Kurtoğlu (2018) also had similar results. He said that individuals with high stress management and compliance will be able to make decisions in a calm and controlled manner without giving any panic in the decision-making process. This effected their achievement. The result of Budayasa & Juniati (2019) also showed that anxiety factor caused difficulty for mathematics students to communicate their thoughts so that they made many mistakes in writing answers.

The level of mathematics anxiety among female and male math students was the same, as well the mathematics anxiety among students with different years also the same. From the data that showed the average mathematics anxiety of mathematics students was quite high was surprising, because it turned out even though they were daily in contact with mathematics did not make their math anxiety low. Such results can be followed up with the determination of strategies that can reduce the level of mathematical anxiety of mathematics students without differentiating gender or the level of years of students so that the mathematical achievement will be increase.
So far, there have not been many studies that discuss the WMC and Mathematics anxiety of mathematics undergraduate student subjects, it is necessary to conduct more extensive and deeper research to produce important theories.

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