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The correlation between working memory and students' mathematical difficulties

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Abstract. In the learning activities of mathematics in the classroom, thought processes occur in each. What has been remembered is what has been experienced, ever perceived, and it has been inserted into his soul and stored later at a time when the incident is reawakened in consciousness. The working memory of children in their ability to save and work with information in the brain, can provide predictions of success in all aspects of learning, regardless of IQ. This research is an ex-post facto descriptive research that aims to know how the correlations between working memory and student's mathematical difficulties in physical education students for basic statistics which have mathematical difficulties. The population in this study is all students of the first semester of physical education students and the samples are 30 students who have mathematical difficulties. The instruments used are questionnaires and documentation. The result of the research shows that there is a negative correlation between working memory with students' mathematical difficulties.

1. Introduction

In the learning activities of mathematics in the classroom, thought processes occur in each individual. What has been remembered is the thing that has ever been experienced, ever perceived, and it has been put into his soul and stored later at a time when the incident is reawakened in consciousness. Memory is the ability to receive and enter (learning), retention (retention) and re-create whatever happened (remembering). Someone is said to think when doing mental activities and people who learn mathematics always do mental activities. So in thinking, one can arrange relationships between parts of the information as understanding, then can be concluded.

In studying mathematics, as mentioned before, it will involve many aspects of cognitive, especially in working memory performance. This is much discussed in previous studies, such as Ashcraft [4] who examine the relationship of working memory, mathematics anxiety, and performance which results in an association of mathematics anxiety with performance specific to mathematical tasks that are a temporary disruption to working memory; Alloway [2] examined the working memory, reading, and mathematics skills of DCD (Developmental Coordination Disorder) children who investigated the relationship between working memory and math and reading skills. De Smedt [8] examines the working memory and individual differences in mathematics achievement which results in individual differences in the mathematical achievement of a person shown by the uniqueness of the working

memory components of the visuospatial and verbal parts. In addition, there is an article of John Munro [12], University of Melbourne which discusses "The role of working memory in mathematics learning and numeracy" which examines the role of working memory in particular mathematical tasks, the procedure for diagnosing the role of working memory in the difficulty of learning mathematics and strategy interventions to improve the working memory process in mathematics learning.

Then the research examined by Nurfadhilah [13] the result shows the difference between before and after training in the form of performance improvement. So in conclusion, based on these sources it is explained that mathematics is closely related to working memory, accessible, and can be used for cognitive tasks in varying intelligence [6, 7, 10, 14]. In the process of thinking, information obtained by someone will be processed and stored in memory. Atkinson and Shiffrin [3] proposed theory or model of information processing in human memory which states that information is processed and saved in 3 (three) stages: Sensory Memory, Short-term Memory, and Long-term Memory.

Based on the preliminary research, the researcher was founded that has a memory deficit in three components. The three components are phonological loops, visuospatial sketchpad, and episodic buffers. The shortcomings in these three components make it possible for students to have difficulty learning mathematics, because the student when observed and analyzed, still confused in determining the core questions, still do not understand the concept of the material being taught. Students who do not have the motivation to learn is not easy to learn math. Besides other factors are environmental factors such as: friends, teachers, parental supervision and technological developments. In this case, the teacher, the role of parents and all the school is very influential in providing input and motivation of students in learning mathematics and supported by teaching methods that are in demand by students and facilities that support the teaching and learning process. As mentioned earlier there is the term mathematical difficulty that leads to learning difficulties experienced by students when dealing with subjects of mathematics, especially when the learning process takes place.

Learning difficulties in mathematics have their characteristics. According to Lerner [11], the characteristics of students with learning difficulties in math are: (1) the presence of spatial disturbances, (2) visual perception abnormalities, (3) visual motor associations, (4) perseveration, (5) difficulty in recognizing and understanding of symbols, (6) disturbance of body appreciation, (7) difficulty in language and reading, (8) IQ performance is much lower than verbal score. The results of the research have shown, the ability in working memory of children in their ability to store and work with information in the brain can provide predictions of success in all aspects of learning, regardless of IQ. Working memory in children has a strong relationship with academic achievement and reading ability, according to a study from the University of Luxembourg and its Brazilian university counterpart. The study shows, children who have learning difficulties, will likely be better able to absorb the lessons if given a teaching method that prevents the use of working memory too much. Based on the description of the problems that have been submitted above, research was done to find out how the relationship between working memory with student learning difficulties.

2. Research Methods

This research is ex-post facto research that is correlational. Called as ex-post facto because the facts collected already existed before and correlational because that the researcher will investigate is the relationship between variables. In this study the population is all students' semester 1 health education courses and recreation in Universitas Singaperbangsa Karawang with samples taken as many as 30 students who were allegedly having trouble learning mathematics. Data collection is a very decisive stage in the process of researching to get good results. Data collection in this research is using documentation technique and questionnaire. Data analysis technique used is inferential analysis by using correlation and regression analysis.

3. Research Results

Linearity test is intended to determine the relationship between independent variables with dependent variables. The linear relationship illustrates that changes in predictor variables will tend to be followed

by changes in the criterion variable by forming a linear line. Test linearity of the relationship between working memory variables with student learning math difficulty variables can be seen from the following table:

Table 1. The results of anova test.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	347.631	1	347.631	16.417	.000[b]
	Residual	698.769	33	21.175		
	Total	1046.400	34			

The specified hypothesis is:
H0: no linear relationship exists between two variables.
H1: there is a linear relationship between two variables.
We use α=5%.
If Sig > α, then H0 is accepted.
If Sig < α, then H0 is rejected.
From the table 1, we find that sig. (0,000) < α (0.05). It means that H0 is rejected, meaning there is a linear relationship between two variables.

Table 2. Coefficients.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	54.749	7.850		6.974	.000		
Var_x	.413	.102	-.576	4.052	.000	1.000	1.000

Based on the results of table 2 obtained correlation coefficient of -0.576. The negative sign on the correlation coefficient indicates that the higher the working memory function, the lesser the students' mathematical learning difficulties. Conversely, the lower the working memory function, the higher the students' learning difficulties.

Furthermore, the regression equation generated is:
Y = 54,749 + 0,413x (note column B on Unstandardized Coefficients).
The meaning of the above equation is the variable working memory (Y) will decrease by 0.413 for each increase in mathematical difficulty variable.
Research Hypothesis: There is a relationship between working memory and students mathematical difficulties.

Table 3. Regression.

		Var_x	Var_y
Var_x	Pearson Correlation	1	-.576**
	Sig. (2-tailed)		.000
	N	35	35
Var_y	Pearson Correlation	-.576**	1
	Sig. (2-tailed)	.000	
	N	35	35

Based on the regression analysis which concluded that the regression is linear (significant) then the correlation table used is the Pearson correlation table. From the table 3, it is known that the correlation coefficient is -0.576 and the value of sig. (2-tailed) is 0.000. So we can concluded that there is a negative relationship between working memory and students mathematical difficulties.

4. Discussion and Conclusion

The result of hypothesis testing shows that there is a significant correlation between working memory with student learning difficulties is indicated by the correlation coefficient = -0.576 with sig. (2-tailed) = 0,000. The negative sign on the correlation coefficient indicates that there is a negative correlation between working memory and students' learning difficulties. The condition means that the higher the working memory function will be the lower the difficulty of learning mathematics students, and vice versa, the lower the working memory function will be the higher the difficulty of learning mathematics students. The value of significance is obtained at 0.000 and the significance value is less than 0.05. The value of significance indicates a significant relationship between working memory with the difficulty of learning mathematics students. Figures correlation coefficient of 0.576, explaining that the correlation relationship is in the category of medium.

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References

[1] Adam K C, Vogel E K and Awh E 2017 Clear evidence for item limits in visual working memory *Cognitive Psychology* **97** 79-97
[2] Alloway T P 2006 Working memory skills in children with developmental coordination disorder *Working Memory and Neurodevelopmental Disorders* 161-185
[3] Atkinson R C and Shiffrin R M 1968 Human memory: A proposed system and its control processes *Psychology of Learning and Motivation* **2** 89-195
[4] Ashcraft M H and Kirk E P 2001 The relationships among working memory, math anxiety and performance *Journal of Experimental Psychology: General* **130(2)** 224-237
[5] Cester I, Mioni G and Cornoldi C 2017 Time processing in children with mathematical difficulties *Learning and Individual Differences* **58** 22-30
[6] Cowan N, Towse J N, Hamilton Z, Saults J S, Elliott E M, Lacey J F, Moreno M V and Hitch G J 2003 Children's working-memory processes: a response-timing analysis *Journal of Experimental Psychology: General* **132(1)** 113
[7] Cowan N, Elliott E M, Saults J S, Morey C C, Mattox S, Hismjatullina A and Conway A R 2005 On the capacity of attention: Its estimation and its role in working memory and cognitive aptitudes *Cognitive Psychology* **51(1)** 42-100
[8] De Smedt B, Verschaffel L and Ghesquière P 2009 The predictive value of numerical magnitude comparison for individual differences in mathematics achievement *Journal of Experimental Child Psychology* **103(4)** 469-479
[9] Gruszka A and Nęcka E 2017 Limitations of working memory capacity: The cognitive and social consequences *European Management Journal*
[10] Hassin R R, Uleman J S and Bargh J A 2005 *The New Unconscious* (Oxford Series in Social Cognition and Social Neuroscience)
[11] Lerner J 1981 *Learning Disabilities: Theories, Diagnosis and Teaching and Strategies* (Boston: Ed)

[12] Munro J 2011 *The Role of Working Memory in Mathematics Learning and Numeracy* (Memory and Learning: What Works)
[13] Nurfadhilah L 2015 *Studi Kasus Mengenai Working Memory Dan Strategy Memory Pada Siswa Yang Mengalami Mathematical Difficulties – Case Study About Working Memory and Memory Strategy in Students Who Have Mathematical Difficulties* (Doctoral dissertation, Universitas Padjadjaran)
[14] Pickering S J 2006b Working memory in dyslexia *in: Working Memory and Neurodevelopmental Disorders* eds T. P. Alloway & S. E. Gathercole (Psychology Press, Hove) 740