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Research Paper

A Study of Relationship Between Working Memory and Academic Performance Among Adolescents

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ABSTRACT

Memory and academic results are often used in the same breadth when talking about a student's performance. As teachers and as parents, the emphasis is always to ensure that the students utilize their maximum abilities in their studies, as this will lead to future success. ***Objective*** **-** The aim of this study is to discover the relationship between working memory and academic performance among adolescent students. ***Research Methodology*** **-** The study sample consists of 200 adolescents. Working memory is measured using a standardized working memory sub-test, while academic performance is assessed based on students' grades in their respective previous classes/courses. ***Analysis and conclusion*** **–** The results indicate a positive association between working memory and academic performance. These findings suggests that academic performance can be improved by using interventions/practices which can enhance the working memory.

Keywords: *Working Memory, Academic Performance, Adolescent Girls and Boys, Education*

Working memory (WM) is an important cognitive function that plays a crucial role in academic performance. It refers to the ability to temporarily store and manipulate information in the mind. Students with strong working memory are more likely to be successful in their academic endeavours, as they are better equipped to process and retain information.

The ability to retain information in one's working memory is a dynamic cognitive ability that is necessary for academic achievement. It is the ability of the mind to temporarily retain information and exercise control over that information. Students that have strong working memory tend to have greater academic performance because they are better able to absorb and recall the information they learn. The aim of this study is to investigate the relationship between working memory and academic performance among adolescent students.

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Working memory is a cognitive mechanism that facilitates the retention and manipulation of information during the execution of a task or the resolution of a problem. Alternative terms for it include the "cognitive workspace" or the "working memory." Working memory is a crucial component for numerous routine activities such as reading, listening, critical thinking, and decision-making. It is crucial for academic achievement and knowledge acquisition, particularly in fields such as mathematics and science that require data manipulation. In fact, working memory is a complex cognitive process that encompasses the active maintenance of information in short-term memory, as well as its modification and integration with long-term memory and prior knowledge.

***Working Memory and Academic performance*:**
Working memory is an essential element of academic performance because it enables students to retain and manipulate information, such as recalling instructions, recalling key details, and solving problems. Alloway, Gathercole, and Pickering (2006) discovered that WM was an essential indicator of academic performance in multiple subject areas, including reading, mathematics, and writing. In addition, the study discovered that students with superior WM tended to perform better in school, indicating that WM plays a crucial role in academic achievement.

***Working Memory and learning*:**
Working memory is also essential for learning, especially in subjects that involve the recall and implementation of intricate information, such as math and science. According to the research conducted by Kyttala and Lehto (2008), WM is substantially associated with math and science academic achievement. The research indicated that the capacity to store and manipulate information in working memory is crucial for success in these subjects. In addition, studies have shown that students with deficient WM are at a disadvantage when acquiring new information because they struggle to retain it in their minds, making it more difficult to adapt it to new contexts.

REVIEW OF LITERATURE

A synopsis of the research that has been done on the topic of the connection between working memory and academic performance:
Research has demonstrated time and time again that working memory, often known as WM, is an important factor in determining academic achievement in a variety of subject areas, including reading, mathematics, and writing. For instance, Kyttala and Lehto (2008) discovered that working memory capacity was strongly connected to academic accomplishment in both mathematics and science, with greater WM capacity being associated with better performance in both of these fields of study.

In addition, studies have demonstrated that working memory is essential for the process of learning and remembering new knowledge. Studies have shown that students with low WM have trouble acquiring new knowledge. This is because they struggle to maintain the information in their thoughts, which makes it more difficult for them to apply it in new circumstances. Students with strong WM have an easier time learning new material. Students with a greater WM capacity, on the other hand, have a stronger ability to remember and modify knowledge, which in turn gives them a better ability to apply it to new circumstances.

Last but not least, WM is connected to other cognitive abilities such as concentration, processing speed, and reasoning, which makes it an essential component of total cognitive

functioning. People who have a larger capacity for working memory often have stronger attentional control, which enables them to better concentrate on activities and disregard distractions. Additionally, those who have a greater capacity for working memory also tend to have quicker processing rates, which enables them to process information in a more expedient and effective manner. In conclusion but not least, working memory is connected to reasoning ability, with a larger working memory capacity being related to improved problem-solving abilities.

The amount of research available implies, on the whole, that working memory (WM) is an important cognitive ability that plays an important part in both academic success and cognitive functioning. It is possible that interventions designed to improve working memory capacity will have major positive effects on academic achievement as well as overall cognitive functioning.

Research has also been conducted on college students to investigate the connection that exists between working memory and academic achievement. A quick summary of some of the most important discoveries is as follows:
There is a correlation between college students' levels of working memory and their academic performance: The amount of information that can be held in an individual's working memory is positively correlated with their academic achievement, according to a number of studies conducted on college students. For instance, Cowan et al. (2005) conducted a research in which they discovered that the capacity of a person's working memory was a predictor of academic achievement among college students.

When it comes to academic activities that need higher cognitive functions, working memory is very important. Working memory is especially necessary for academic tasks that demand higher cognitive processes, such as critical thinking, problem-solving, and understanding, since these activities all need the student to be actively engaged in the subject at hand. Working memory capacity was shown to be a predictor of academic achievement on tasks that required complicated reading, according to research carried out by Hannon and Daneman (2001).

Shipstead et al. (2012), from their research showed training for the working memory may increase the overall academic performance of attention deficit hyperactivity disorder (ADHD) and dyslexia kids.

Working memory seems to be a predictor of academic achievement among college students as a whole, especially for activities that demand higher cognitive functions. This is shown by the research that has been done on the topic. Working memory deficiencies are correlated with scholastic problems; nonetheless, these deficiencies are trainable and may be overcome with practise. However, the academic achievement of college students is also affected by other aspects, such as their level of motivation and the study habits they develop.

Objective

The objective of this study is to find the relationship between level of working memory and academic performance of students in the age group of 15-20 years.

Hypothesis

There is no significance relationship between working memory and academic performance.

RESEARCH METHODOLOGY

The study sample consisted of 200 participants, which included both boys and girls in the age group of 15-20 years from schools and colleges of Udaipur, Rajasthan. For this the participants were engaged through convenience sampling. Working memory was measured using a standardized working memory test called Digit Span test (subtest of WISC) The distribution of the data was analysed using Pearson coefficient of correlation.

Sample

The research study was carried out by collecting information from a representative sample of two hundred students (male and female) between the ages of 15-20 years old who were enrolled in various educational institutions (schools and colleges). The universities and schools of Udaipur (Rajasthan) were used to compile the sample, and it was selected using a random sampling method.

Variable

- **Independent variable:** School students & College students
- **Dependent Variable:** Working Memory & Academic performance

Tools Utilized

To measure the working memory among students the **Digit Span test,** a subtest of WISC was administered.

The digit span test is a cognitive evaluation tool that measures an individual's ability to retain and recall a sequence of digits that is given to them either orally or visually. The test may be administered either orally or visually. It is a straightforward and common method for evaluating one's working memory, which is defined as the capacity to temporarily store and manipulate information in one's mind.

Procedure

Firstly, the participant was asked to comfortably sit in a quiet room without distractions and was explained the process of conducting the test. In forward series, the participant was asked to remember a sequence of digits (numbers) in the proper order immediately after the examiner has read out the numbers or series in a monotone voice. The length of the sequence is raised progressively (1 digit at a time) until the subject can no longer remember the sequence correctly. This continues until the individual fails the test. Once the participant fails to answer two consecutive numbers, the test is stopped.

The test is also given in reverse order following same protocol as done for forward sequence.

In backward series, the examiner reads out the digits aloud clearly in a monotone voice. After listening to the numbers, the participant is asked to repeat the numbers or series in reverse order. An example is illustrated to the participant for better understanding of the test.

In contrast, students' Academic performance in school and college was evaluated according to the grades which are converted into marks they earned in the last exam of the classes/courses for which they registered.

Reliability and Validity of The Test: It has been shown that the digit span test has a high test-retest reliability and strong construct validity. The digit span test, in its entirety, is a reliable

and valid measurement of working memory capacity that has been frequently used in a variety of clinical and research situations.

Statistical Techniques

The coefficient of correlation using SPSS version 21.0 was calculated.

DATA ANALYSIS & INTERPRETATION

In this study, we wanted to find out the relationship between the working memory and academic performance of students from school and college.

Normality Testing for Academic Performance & Digit Span (Working Memory) through Kolmogorov-Smirnov Test

Results of the Lilliefors test indicated that for Academic Performance there is a significant difference from the normal distribution, (D(200) = .082, p = .00215).

Results of the Lilliefors test indicated that for Working Memory (Digit Span) there is a significant difference from the normal distribution, (D(200) = .08, p = .00342).

Parameter	**Academic Performance**	**Working Memory (Digit Span)**
p – value	0.002145	0.003422
D	0.08239	0.07991
Sample size (n)	200	200
Average ($\bar{x}$)	75.025	114.49
Median	75.5	116
Sample Standard Deviation (S)	7.2469	9.7264
Sum of Squares	10450.875	18825.98
K	1.1652	1.1301
Skewness	-0.1095	-0.1585
Skewness Shape	Potentially Symmetrical (p val=0.524)	Potentially Symmetrical (p val=0.356)
Excess kurtosis	-0.8136	-0.5996
Kurtosis Shape	Platykurtic, negative kurtosis, short thin tails (p val=0.017)	Potentially Mesokurtic, normal like tails (p val=0.08)

Even though result is statistically significant, since the effects level is very small i.e. the difference between the sample distribution and the normal distribution is very small, we may practically assume that the distribution is normal.

Correlations			
		Academic Performance	**Digit Span**
Academic Performance	Pearson Correlation	1	0.199**
	Sig. (2-tailed)		0.005
	N	200	200
Digit Span	Pearson Correlation	0.199**	1
	Sig. (2-tailed)	0.005	
	N	200	200
** Correlation is significant at the 0.01 level (2-tailed).			

The above table indicates that there is significant Pearson coefficient of correlation between academic performance and working memory is found to be 0.199 which is significant at 0.01

level ($p=0.005$, $p < 0.01$). It infers that that there is significant positive correlation between academic performance and working memory. Furthermore, it can be depicted that by increasing working memory, academic performance can be enhanced and vice-versa also. It is mainly because with good working memory students develop better cognitive skills (for example – critical thinking, analytical thinking and reasoning) and hence can retain information for a longer time leading to better performance in the academic activities. These results are well supported by Holmes, J., & Gathercole, S. E. (2014) and Alloway, T. P., Gathercole, S. E., & Kirkwood, H. (2020). The results of these studies suggested that working memory played a crucial role in the academic achievement in adolescents.

DISCUSSION

The findings of this study indicate that working memory is a significant predictor of academic performance among adolescent students. Students with a robust working memory are better able to comprehend and retain information, which is crucial for academic success. It is possible that the stronger relationship between working memory and academic performance among adolescents is a result of the increased demands imposed on working memory in higher education. The findings of this study have significant implications for educators and policymakers, as interventions aimed at enhancing working memory have the potential to improve students' academic performance.

CONCLUSION

This study provides evidence of a positive relationship between adolescent students' working memory and academic performance. The findings emphasise the significance of working memory to academic achievement and imply that interventions aimed at enhancing working memory could have significant positive effects on students' academic performance. Further research is required to investigate the underlying mechanisms of this relationship and to devise effective interventions for enhancing students' working memory.

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Conflict of Interest
The author(s) declared no conflict of interest.

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