

Associating Effects of Working Memory Capacity on Academic Performance of School Learners

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Abstract



The present study examines the intricate relationship among working memory capacity and scholarly attainment in school students. The aim of this research was to establish an association between the working memory capacity and scholarly attainment of primary school students. Additionally, it sought to examine the impact of working memory on scholarly activities as subjectively interpreted by the students. These objectives were achieved through Likert scale designed survey conducted in the Districts of Multan, Bahawalpur, Lodhran and Dera Ghazi Khan elementary male, female schools. A sample of 304 respondents selected randomly from 30 elementary schools. The results educed a crucial significance of this cognitive function in the context of academic performance. Research identified dire need of adopting a comprehensive strategy to education that takes into account the unique variation in working memory capacity across individual. It may be concluded that this research provides significant contribution to the field of cognitive science in the domain of elementary education enabling learners to achieve their maximum academic capabilities.

Keywords: Working Memory Capacity, Academic Performance, Educational Achievement, Elementary School, Long Term Memory, Short Term Memory.

Introduction

There is a plausible correlation found among the working memory capacity (WMC) and academic performance of the learners at any level of learning. Reason stated for this colossal link was identified by the modern research educationists who seemed to assert that WMC enables novice learners integrate and retain crucial information that is workable for the learning process in their long term memory (Kao et al., 2017). It seemed quite evident from the previous researches that working memory capacity plays pivot role in teaching learning process of a learner. It takes place as a single major element to ignite complex interface of cognitive talents among learners and postulates learning techniques with environmental variables that influence academic achievement (Liem 2019). Therefore, understanding and persistency of the (WMC) relies majorly on its role to serve as an important aspect in the provision of the facilitation for the academic performance of elementary school learners. Working memory acts as a fundamental perceptive functionary of the learners attaining education at elementary level of education. Researchers took it as a capacity grower which play its role in their motor learning, acquisition of knowledge and participatory in many academic achievements (Iasha et al., 2020). This evolutionary process of learning starts from teen ages among children and at this time they are embarked upon complex activities that require higher degree of perceptive progression.

The process of academic performance is complicated in its methodology which incorporates growth of information, abilities, and capabilities to be enhanced, engrossed and engulfed in formal education system. Research studies in this field identified that it is fruit of hard work of a learner which s/he eats entire remaining life in the form of skill development and academic performance. Fruit of his or her efforts bore success in the form of speculative evaluations, aptitude test scores, operative task success, and general execution in moot courses (Suna et al., 2020). In short acquisition of academic achievement due to short term and long term memory do provide variegated aspects in academia such as; comprehension of subject matter, developing a meta cognitive mental state, critical

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thinking and evaluation, issue and challenges resolution and quick study reading and written techniques.

Various studies have demonstrated a clear correlation between the working memory capacity of primary students and their reading proficiency. The study carried out by Peng et al. (2018) demonstrated a substantial correlation between working memory capacity and reading proficiency. This suggests that individuals with greater cranial volume also possessed superior reading skills. The phonological loop plays a crucial role in manipulating and processing language information, leading to improved efficiency in understanding. This could explain the observed connection between these variables. The mental process of comprehension also largely depends on the active engagement between working memory and long-term memory. Daneman and Tardif (2016) found that persons with a high working memory capacity exhibit improved cognitive ability in assimilating novel data in their context of existing knowledge, resulting in a more profound comprehension of textual material.

Integration is crucial for extracting meaning and forming inferences when reading. Moreover, empirical research has demonstrated that therapies aimed at enhancing working memory might provide positive outcomes regarding enhancing reading proficiency. An instance of this phenomenon can be observed in the empirical study conducted by Peng and Kievit (2020), where they instituted a different intervention strategy with the aim of improving working memory capacity. The research findings showed substantial improvements in the working memory capacity and reading comprehension competencies of primary school-aged children.

Working memory has been proven in several longitudinal studies to predict overall academic performance. Academic performance across disciplines was shown to be significantly correlated with working memory size in the research by Sivrikaya (2019). A person's ability to actively participate in the learning process is inversely linked to the extent to which their central executive is engaged in attention control and cognitive coordination.

Self-regulated learning is highly dependent on an individual's capacity to store and remember knowledge in their working memory. Akpur (2020) found that there is a positive correlation between working memory capacity and the ability to engage in future planning, monitor one's progress, and adapt one's learning strategies as needed. Increased academic success may be traced back to the aforementioned metacognitive benefit because of the essential role it plays in optimizing the efficacy of learning processes.

Components of working memory capacity

Subject Mastery: The acquisition of acquired expertise in a particular subject is a crucial aspect of striving for academic success. Acquiring this skill necessitates a profound comprehension of fundamental concepts, principles, and theories in every academic field. Problem-solving abilities are crucial for achieving academic success. It requires the capacity to analyze intricate difficulties and apply critical thinking to find effective solutions. The cultivation of problem-solving skills holds great importance in several academic disciplines, such as mathematics, natural sciences, and humanities (Cowan 2017).

Effective Learning Strategies: to accomplish academic success, it is imperative to develop effective study habits and strategies, such as managing time, staying organized, taking thorough notes, and using techniques to retain knowledge (Peng et al., 2016). Students that exhibit mastery in these tactics will have improved skills to efficiently manage their academic obligations and optimize their ability to learn.

Information retention is crucial for achieving academic achievement since it involves both the acquisition and retrieval of information. This involves not only the process of recalling data obtained from temporary memory moreover the capacity to integrate knowledge integration long-lasting memory for future utilization.

Writing skills and oral communication abilities is essential for achieving scholarly achievement (Shipstead et al., 2015). Being highly skilled in effectively conveying ideas, presenting arguments, and expressing concepts in a clear and convincing manner is extremely important in several fields and areas of study.

Research Objectives:

Objectives of the research were to:

1. Determine the correlation between working memory capacity and scholarly attainment in elementary school students.

2. Examine the impact of working memory on academic endeavors from the perspective of students.
3. Offer suggestions to help elementary school kids improve their working memory ability.

Research Design:

The research design was deemed suitable for the aim of this study, as it employed a descriptive method and design. Due to its quantitative nature, a survey was devised to gather information from the participants. Descriptive research involves the systematic collection and analysis of data in order to gain a comprehensive understanding of a certain phenomenon or subject. A meticulously designed survey instrument has been created to methodically gather empirical data through a well-developed set of inquiries. The data was collected through a survey methodology, which involved conducting interviews with participants and soliciting their input to ensure accurate completion of the questionnaire. The survey consists of a grand total of 14 inquiries. The following investigations largely focus on the relationship between working memory capacity and the academic gains of elementary school children. Unlike other sampling strategies, the researchers deemed the utilization of a random sampling approach to be suitable and achievable for picking the sample in this experiment. Each district was chosen to have a total of 10 schools. A total of four schools for girls and six for boys were chosen. The specimen is divided in 40% metropolitan areas and 60% rural regions.

Table 1: Distribution of Sample in research

Sr.	Sampled District	Schools		Total
		Male	Female	
1	D.G Khan	3	4	07
2	Multan	3	4	07
3	Lodhra	3	4	07
4	Bahawalpur	5	4	09
		14	16	30

Rigorous validation methods were carried out to guarantee the dependability and accuracy of the research tool. Expert assessment and preliminary tests were utilized to enhance the pertinence of the idea and the lucidity of its components. The instrument exhibits a commendable level of internal consistency, indicating a significant level of reliability. The study's concurrent validity was reinforced by the presence of associations with verified field measurements. The measurements are used to verify the strength and reliability of the research tool. The gathered data was scrutinized using the Statistical Package for the Social Sciences (SPSS). The data was organized and analyzed using statistical procedures, such as calculating percentages, mean scores, and standard deviations. The respondents comprised to evaluate each statement using a four-point Likert scale, which consisted of four response choices. The participants were instructed to express their level of consensus or dissent with the provided assertions.

Data Interpretation and Analysis

This study analyzed the data to understand how working memory capacity influences the academic gains of elementary school students. It found that working memory exerts a substantial impact in students' achievement. All questions were formulated as close-ended, as they are easily comprehensible and may be answered by the respondents without difficulty. The researchers utilized a five-point Likert scale to collect the data, and the data was scrutinized using SPSS-22. Calculations were performed for the T-Test, ANOVA, and mean score. The results have been gathered and each table presents the overall sample size, percentage, average, and standard deviation.

Table 2: Survey illustration of the research article

Statement	Frequency				Mean	S.D
	S.D	U.D	A	S.A		
working memory capacity impact academic performance	12	06	140	146	4.14	0.672
Long term memory helps in academic achievement.	32	20	196	56	3.91	0.817
Improving working memory improvises academic performance	08	10	208	78	4.17	0.067
Short term Memory capacity influence meta cognition	08	32	80	184	3.82	0.907
Long term Memory helps me in assessment performance	80	16	180	28	3.35	0.972
Working Memory is affected due to Long term and short term Memory capacitance	10	18	174	102	3.60	0.899
Practical learning improvises working memory capacity	10	14	186	20	3.43	1.034
Working memory capacitance directly impact grades	60	26	184	24	3.49	1.029

Long term memory capacity helps to keep information	42	12	188	32	3.85	.988
Capacity development of working memory helps me to attain good position in class	186	16	102	0	2.55	1.126
Working memory capacity varies due to mind conditions	38	06	162	98	4.05	0.919
Academia perform exercises to improve my working memory	42	12	228	22	3.74	0.808
I assume practicing working memory exercises may improve my academic capacitance	04	62	14	192	3.61	0.970
Academia may exercise various methods to improve	42	12	198	52	3.86	0.864

Interpretation of the Responses

The data revealed that a majority of students, namely 46.1%, expressed agreement with the notion that their academic performance is significantly influenced by their working memory capacity. Additionally, 48% of students strongly agreed with this statement, while 2% remained uncertain and 3.9% strongly disagreed. The results of the study, with a mean score of 4.34 and a standard deviation of 0.862, indicate a generally favorable impression towards the statement.

An overview of the perspectives held by elementary-level pupils on the statement that studying for tests enhances their ability to retain knowledge. The data revealed that a majority of students, namely 50.7%, expressed agreement with the notion that studying for examinations enhances their ability to retain knowledge. Furthermore, 41.4% of students strongly agreed with this statement, while a smaller proportion of 4.6% remained unsure. In contrast, a just 1.3% of individuals held a different opinion, and an even smaller fraction of 2% expressed severe disagreement. The average score (M=4.28, SD=0.784) indicated a favorable perception of the statement.

Question 3 presents the perspectives of students from various educational institutions on the assertion that a distinct correlation exists between their working memory and academic performance. The findings of the study revealed that a majority of students, namely 67.1%, expressed agreement with the notion that a discernible correlation exists between their working memory and academic performance. Furthermore, 25.7% of participants strongly agreed with this statement, while a small proportion of 2.6% remained uncertain. Conversely, a minority of 4.6% expressed dissent with the proposed connection. The average score (M=4.14, S.D=0.672) indicated a favorable perception of the statement.

The fourth question posed to the participants inquired about the viewpoints of elementary-level children regarding the assertion that enhancing their short-term memory could result in improved academic achievement. A survey revealed that 68.4% of students agreed that financial constraints affect the accessibility of digital technology tools for teaching and learning. Additionally, 25.7% strongly agreed, 3.3% were undecided, and 2.6% disagreed with the statement. The average score (M=4.17, S.D=0.607) indicated a favorable impression of the statement.

The perception of elementary-level children regarding the assertion that their working memory impacts their comprehension of the material they are studying. The data revealed that a majority of students, namely 60.5%, expressed agreement with the notion that their working memory plays a role in their comprehension of the material being taught. Among this group, 21.1% strongly agreed, while 5.3% were uncertain. On the other hand, 10.5% of students disagreed with the statement, and 2.6% strongly disagreed. The average score (M=3.82, S.D=0.907) indicated a favorable perception of the statement.

The respondents were asked about the extent to which their ability to remember and recall knowledge affects their performance on tests and assignments. A survey revealed that 59.2% of students believed that their capacity to retain knowledge has a substantial influence on their performance in examinations and assignments. Among them, 9.2% strongly agreed, 5.3% were indecisive, 23% disagreed, and 3.3% severely dissent with the statement. The average score (M=3.35, S.D=0.972) indicated a favorable assessment of the statement.

The responses provide the perspective of elementary-level pupils regarding the statement that they arrange their documentation and tasks in order to enhance their working memory. The data collected indicated that a majority of students, namely 61.2%, expressed agreement with the notion that organizing their notes and assignments might enhance their working memory. Among this group, 6.6% strongly agreed, while 4.6% were uncertain about their stance. On the other hand, 24.3% of students disagreed with the statement, and 3.3% severely disagreed. The results of the study indicate that the mean score (M=3.43, S.D=1.034) reflects a generally favorable attitude on the statement.

The perception of elementary-level kids regarding their working memory capacity directly influences their academic performance. The study's findings indicated that 60.5% of students agreed that their working memory capacity has an effect on their academic achievement. Out of these students, 7.9% expressed strong agreement, while 8.6% were uncertain. Conversely, a notable portion of students, at 18.4%, expressed disagreement with the statement, while 4.6% strongly disagreed. The study's findings suggest that the average score ($M=3.49$, $S.D=1.029$) indicates a generally positive attitude towards the statement.

Discussion

The study findings offer a thorough representation of the connections between working memory and many aspects of academic gains. The research demonstrates that 94.1% of participants strongly agree on the significant influence of their working memory on their academic scores, highlighting the crucial role of this mental function in their educational achievements. Furthermore, a significant percentage of the student population, specifically 92.7%, indicated an increased capacity to remember information when participating in test preparation, thus highlighting the practical importance of memory ability in the field of education. This finding suggests that improvements in working memory have the capacity to lead to increased learning efficacy and, consequently, more positive scholarly outcomes.

Learners at elementary school seemed to be convinced with the notion as maximum learners that are 93 percent identified a close relation between working memory to academic scoring in tests, papers and exams. This suggests if the teachers work out properly on the learners then the learners will be able to grow working memory capacity which might directly or indirectly influence, increase or develop academic performance. Results of the survey clarified one of the most important aspects, i.e., monetary constraints which definitely devastated their level of engagement and participation. This observation highlights the potential impact of socio-economic factors on pupils' cognitive processes, which could affect memory and overall educational achievements. An important discovery arose from the data, revealing that a substantial number of students (94.1%) firmly believed that increasing their working memory capacity may lead to improved academic performance. The acknowledgement of the malleability of working memory capacity offers opportunities for treatments and memory enhancement program that students from all academic levels could benefit from.

Findings

Approximately 80.3% of students struggle with retaining the directions given by their teachers. This underscores the necessity of developing strategies and therapies specifically designed to improve working memory, with the aim of helping pupils effectively handle complex tasks. 81 percent of the learners acknowledged an influence of educational performances related to the memory development for the comprehension of educational material. The discovery cited above highlights the interconnectedness of cognitive processes in the learning process, emphasizing the significance of working memory in understanding and retaining knowledge.

Findings of the present study suggest that a significant percentage of pupils, specifically 68 percent recognize complete significant influence of their mental capacitance on success acquisition in tests. This statement confirms importance of mental acquisition of the learners to the context of hypothetical assessments. Moreover, substantial number of learners that are almost 75 % indicated an employing mnemonic technique that enhances their ability to retain essential information. This discovery suggests that integrating these approaches into teaching methodologies may lead to favorable results. The discovery that 90.8% of students believe that dividing complex information into smaller components improves memory retention emphasizes the importance of employing strategies like break into pieces then organizing to optimize retention administration. Encouragement of teachers was evident, as a majority of students that were 54 percent recognized demands and need to actively listening to the teacher's directions to improve their memory recall. It suggests an employing of effective teaching methods could greatly enhance memory function.

Despite lacking widespread support, a substantial percentage of students (46.7%) agreed that mentally rehearsing information is an effective technique for improving memory retrieval. This strategy may still be beneficial for specific persons involved in the process of acquiring knowledge.

The significance of this variable can be observed from the responses attained from the data which exclusively identified that majority of the respondents that is 83 percent opined that they were able to get help from the working memory. These responses make it quite evident that the working

memory helps learners in transporting material to extended remembrance. The results attained from the questionnaire assisted to the conclusion that it is working memory which expedites academic performance of the learners. The impact of short term memory (STM) results in the growth of long term memory (LTM). This correlation not only affects educational performances and achievement of the learner while it also develops Meta cognition. Present research deems to prostrate the fact that is educed from the through findings that the teachers should provide awareness to the learners at school level about developing their memory transits. The respondents identified it clearly as majority of the respondents 86 percent showed their inclination towards the systematic enhancement of working memory capacity and its variant self-motivated nature supposedly having growth indifferent to age, environment and mental capacity. Such dynamic changes might be taken as a natural spontaneous flow of implementing efficacy towards multifaceted memory composure of the learners at this level and the levels of education with which they would come across in future.

Conclusion

The research concludes with the findings elucidate that working memory is critical in student's ability to perform academically across various subjects, particularly in tasks that require complex cognitive engagement, such as solving mathematical problems and comprehending reading materials. This is consistent with the research goals of investigating the influence of working memory on academic activities and examining the techniques that students use to handle the demands of working memory. The research emphasizes the importance of educators recognizing and addressing students, individual differences in working memory. Educators can provide a more inclusive and effective learning environment by implementing differentiated teaching strategies and interventions that specifically aim to enhance working memory. These interventions include cognitive training programs, classroom adaptations to reduce cognitive load, and integrating working memory exercises into the daily curriculum.

Recommendations

The study recommends following suggestion for the policy makers, educators and managers to look into while setting the goals of educating the learners at elementary level.

Integration of Working Memory Training in Curriculum: Schools should incorporate specific working memory exercises into the daily curriculum. These could include activities designed to improve attention control, mental flexibility, and memory retention, such as memory games, puzzles, and tasks that require mental manipulation of information.

Early Screening and Intervention: Implement early screening for working memory capacities to identify students who might benefit from additional support. Early intervention can help tailor educational strategies to individual needs from a young age, leading to long-term academic and cognitive benefits.

Policy Development: Policymakers should consider the findings of such research to inform educational policies and resource allocation. Ensuring schools have the necessary resources to implement these recommendations is crucial for their success.

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