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The Role of Vocabulary Knowledge in Developing Working Memory in Early Childhood: An Egyptian Study

Eman Ahmed Ahmed Elmesalamy
Department of Psychology, Faculty of Arts, Cairo University, Cairo, Egypt

Rehab Mohamed Ahmed Abdeldayem
Department of Psychology, Faculty of Arts, Cairo University, Cairo, Egypt

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ABSTRACT: *Although studies confirm the relationship between vocabulary knowledge and working memory, the field remains open to questions about the qualitative nature of this relationship. So does language ability in its intermediate range contribute to relatively early developmental changes and changes in working memory, or does the necessary amount of language ability for this contribution exceed the middle limit? Objective: The current study aims to follow up the development of working memory in early childhood and examine the role of vocabulary knowledge in developing working memory among Egyptian children. Materials and Methods: One hundred Egyptian children of pre-school age(50 girls and 50 boys) aged between 3.5-5.5 years (Mean = 4.72, S.D =0.82). The children completed The Working Memory test (AWMA) vocabulary knowledge test (PPVT-R) of the Arabic language. Results: The current study indicated that working memory develops with age, and that vocabulary knowledge plays an important role in developing working memory, especially the phonological-verbal component.*

KEYWORDS: vocabulary knowledge, working memory, Egyptian children, early childhood.

INTRODUCTION

The developmental research and studies indicated an evolutionary sequence pattern for the components of working memory, specifically in childhood, where the results of these studies varied according to the criteria and tasks used, one of these studies conducted by Kokudom and his colleagues (Kokudom, Inagki, Gunji, Kobayashi, Ohta, Kajimoto & Kaga, 2012) which aimed to reveal the evolutionary changes that occur in visual spatiotemporal working memory (VSWM) during life on a sample of (94) participants aged

(6-28 years). The modified version of ATMT-C was used to fit periods Short attention that consists of two parts; The first part depends on numbers while the second part based on hiragana (Japanese audio recording). In the number-based ATMT test, children younger than 8 years of age showed a relatively rapid increase in VSWM efficiency while older children had (9-12 years old) had a gradual increase in VSWM efficiency, while hiragana-based ATMT-C results showed a relatively smaller increase pattern in VSWM efficiency compared to the pattern from number-based ATMT, whereas The results did not show a statistically significant difference in the efficiency of visuo- spatial working memory related to gender , Kokudom's findings are consistent with those of Kim and his colleagues (Kemps, De Rammelaere & Desmet ,2000), this study exploring the integration of his postulated working memory models (J.Pascual.-Leone.-A.D. Baddeley). Where children aged 5, 6, 8 and 9 years were assessed on two working memory tasks, the results showed an upward revision of the visual- spatial memory tasks.

As for the developmental differences, Huda Al-Malawi conducted a study aimed at revealing the evolutionary differences between the sexes in the factorial and functional structure of working memory in a sample of children aged 4-12 years based on the Baddeley-Hitch model (1974), which posits three components of working memory. The study included 400 boys and girls who completed various tasks from the children's working memory battery (AWMA). The findings revealed differences in the functional structure of working memory components based on age groups. The results also indicated variations in performance across all working memory components between the three childhood stages, along with gender differences in spatial and visual working memory tasks, while no such differences were observed in verbal and central compound tasks (Malwa, 2016).

Similarly, Buttelman and colleagues conducted a study to explore age-related developmental disparities in verbal and visual-spatial working memory (VWM and VSWM) during early and middle childhood. The study included 125 children aged 4-6 years and 101 children aged 8-10 years, who completed various verbal and visual working memory tasks. Multi-group modeling demonstrated that older children in middle childhood exhibited significantly better performance on extended verbal and visual-spatial tasks compared to younger children in early childhood. Both age groups performed notably better on verbal working memory tasks than on spatial vision working memory tasks (Buttelmann, Könen, Hadley, Meaney, Auyeung, Morey, Chevalier & Karbach, 2019).

With regard to the role of vocabulary knowledge in creating evolutionary differences in working memory, many studies that have studied both variables indicate the clarification and explanation of the correlational effect between them, as working memory with its components is a tool for self-learning. , allowing children to re-encode words that they have not previously represented or stored. This allows for clear mapping between the two domains (Jackson, Leitao, Claessen & Boyes,2021; Stanović, 1986; Tahira, Huma, Aatika, Mubarak , Sharmeen, Muhammad & Muhammad,2022).so, numerous studies have indicated that the detection and perception of syllables from spoken words is not directly related to the operation and activation of the phraseological unit itself, due to the poor possibility of automated and rapid processes that occur during perception or word production. From conscious and explicit access to the syllabic structure of speech often. Thus, an individual may be a skilled user of language, while still having significant difficulties in metacognitive processing to bring syllabic units into consciousness (Sawyer & Fox 1991; Shin,2022).On the other hand, Inefficient platforms lead to slow encoding, storage and retrieval of information, which hinders the individual's ability to retain large units of it in working memory, which in turn will affect and limit the processes of understanding and retrieval (wolf &Cohen, 2001).

In an attempt to understand the nature of the interrelationships between cognitive and linguistic variables, to determine whether differences in working memory push individual differences in language to the top, or vice versa, the results of a number of longitudinal studies that focused on studying the nature of the relationship between referred working memory and vocabulary volume indicated Child, indicates that working memory actually leads to the development and consolidation of their vocabulary, explained by the capacity of phonological working memory (a component of phonological working memory in the temporary storage of new words, prior to their incorporation into long-term phonological memory, however, strength of working memory as an indicator Vocabulary volume decreases with age (Marshall, Jones, Denmark, Mason, Atkinson, Botting & Morgan, 2015; Lee, Jessop, Bidgood , Peter, Pine, Rowland & Durrant,2023).

Moreover, non-verbal intelligence is directly related to the efficiency of visual spatial memory and its ability to encode and process symbols and visual information, and uses visual spatial coding more as “mental images” than verbal phonemic coding (Funahashi, 2017; Esposito.& Bradley,2015). This component consists of two subsystems: one concerned with the preservation and processing of visual information “such as those related to the attributes and characteristics of objects, such as color and shape” and the other concerned with the preservation and processing of spatial information and the locations of objects (Barbosa, Miranda, Santos & Bueno, 2007).One of the characteristics of this system is that it preserves images and information about objects and their locations in a mental image, so the person remembers that image, including the locations and physical properties of objects, when asked to remember them at a later time. . This part of working memory is located in the right hemisphere of the brain, and this system is completely different from verbal acoustic memory, which means that a person with a high ability to store verbal acoustic resources will not necessarily be high. The ability to store spatial visual materials and vice versa, This is true (kasemi, 2014).

In this regard, the model of Laberge and Samuels (1974) indicates that the improvement of the visual memory of words, would help the reader to process increasingly larger units by increasing exposure factors and repeated practice of the written word, and then the visual symbols become connected to the phonetic symbols, which in turn activates Semantic symbols in memory, which facilitates the process of recalling them automatically, which is consistent with both the perspective of verbal competence of Perfetti, 1985 and the perspective of the integrated construction of Kintsch (Walter Kintsch (1988, 1994, 1998), and it is reported that the size of vocabulary and memory capacity have a major role in improving efficiency Linguistics in general and reading fluency in particular (Cromley, 2005). Therefore, the current study seeks to answer an important question: How does the developmental path of working memory quantitatively categorize in individuals, by following the same individuals across different age points in the age range from three and a half to six and a half years?, and what role does vocabulary knowledge play in the development of working memory?

LITERATURE REVIEW

Working Memory

In general, working memory is defined as the cognitive system that allows individuals to retain a limited amount of information for use in the service of complex knowledge, because it integrates information between short-term memory and long-term memory. it is a multicomponent model of short-term memory or active memory that includes an phonological loop for retaining verbal information, a visual-spatial component for processing visual information, and a “Central Executive” for distributing attention between them (VandenBos , 2007:p. 1003).

The Baddeley and Hitch also assumes in their model that working memory has four sub-systems: (Baddeley and Hitch ,2001,p11), which are: **Central Executive**: It is responsible for monitoring and regulating attention and processing temporary information (Funahashi, 2017;Baddeley,2000; Baddeley, 2012), **Phonological loop**: responsible for the verbal component) those stores and processes verbal material and is part of working memory that deals with spoken and written materials, **Phonological store:** It can hold phonological or speech-based information for 1-2 seconds, along with the process of controlling articulatory, which is somewhat similar to internal speech, and it can hold the material inside the vocal store so that it does not fade or disappear by verbal repetition (self-auditory). **self-auditory or sub-vocal rehearsal**: It converts and encodes visually presented materials such as words or pictures into phonological information, and then it can be named and recorded within the phonological store by verbal repetition) Baddeley,1992: p558).

The Development of Phonological- Verbal Component Model

As for the evolutionary aspect, the capacity of working memory increases gradually from the age of 6 to 19 years, but the ability to store vocal (verbal component) begins in children who do not exceed three years of age, and then the ability of verbal Working memory develops significantly over the childhood years The average, with a two- to three-fold increase during the average age between (4: 11) years, without a change in the growth of the relationship between verbal working memory and verbal memory (Milwidsky,2008).

The Development of the Visual-Spatial Component Model

The results of a number of longitudinal studies indicated an improvement in children’s performance in tests of visual spatial working memory with age, which was associated with the development and improvement of the ability to re-record the information presented visually in audio form across age, where the use of this process begins at the age of approximately 8 years and mainly contributes In tasks that involve verbally naming stimuli. However, a number of other evidence indicated that the process of audio recording cannot explain all of the age-related changes in the performance of spatial working memory tasks. And that there are a number of other cognitive processes that contribute in one way or another to the interpretation of these changes (knowledge, processing strategies, processing speed, and attention capacity) in terms of their contribution to the development of children's spatial working memory(Pickering,2001).

Vocabulary Knowledge

The ability shown by the child to recognize the meaning of the words spoken to him (speech), which is represented in the receptive language) Nash, & Snowling, 2006; González-Fernández & Schmitt, 2020) . According to this definition, Gorman's model indicates the existence of a dynamic relationship between vocabulary knowledge, working memory, and phonological awareness in their impact on language acquisition in general. Where the model indicates that learning the skills of phonological awareness and strong vocabulary in the first language of the individual contributes to the development of PA skills in both his first and second languages, part of which depends on the efficiency of working memory, explaining that the volume of vocabulary is related to the storage and processing components of working memory and their role in developing the skills of Phonological awareness is in both languages and thus the model supports the strong relationship between both working memory and vocabulary knowledge (Gorman , 2012).

METHODOLOGY

The study relies, in its design, on the sequential method in studies of changes and evolutionary differences, and on this basis the design includes three age groups: born 2015, 2016, 2017, and their ages at the beginning of the actual study revolve around the averages: 3.5 years, 4.5 years, and 5 .5 years, and the three groups are tracked in a subsequent measurement after a full year of the first measurement, as the ages revolve around an average of 4.5 years, 5.5 years, and 6.5 years.

Sample

The current study was conducted on a sample of 100 boys and girls of (50 males, 50 females) with an mean age of (4.72) and a standard deviation of (0.82) and the sample was divided into three groups:

1- The first group included (32) boys and girls ranging in age from (3.5) years to 3 years and 9 months (mean age = 3.6 years, SD = 0.09)
2- The second group: its number was (34) boys and girls ranging in age from 4.5 years to 4 years and 9 months(mean age = 4.7, SD = 0. 09)
3- The third group included (34) boys and girls ranging in age from (5.5) years to 5 years and 9 months: mean age = 5.6 years, SD = 0.07)

3.2. Tools

The Working Memory test (AWMA)

The current study relied on the automated battery for children's working memory tasks (AWMA, prepared by Aloway (2007), which is one of the latest available tests for measuring working memory. It was translated and codified on an Egyptian sample of 600 boys and girls from early to late childhood, how many It was re-rationed on large samples of ordinary Kuwaiti children and people), and the rationing sample amounted to 4000 boys and girls, in addition to that this battery was used to test its standard efficiency across different cultures using structural modeling (Suleiman, 2010). This battery consists of 12 sub-tests designed to assess the performance of the three main components of working memory: (Audial Recall Test - Count Test and Variant Form Recall). The scales are reported to have good reliability (measured Test and Re-Test) (See; Table 1) and The validity of the developmental changes was calculated and it was found that there were differences between the three age groups in all the variables measured by the study tool in favor of the older age group.

A) Audial Recall Test

This test consists of 36 sentences, divided into 6 attempts. The child hears a series of statements on each attempt, and has to decide whether the statement is true or false. At the end of each attempt, the child is asked to remember the last word of each sentence he hears in the correct order, and the test begins by presenting the first group of them with one sentence in each attempt, and the number of sentences. The introduction to the child gradually increases.

Test correction: The paper correction available during the application is returned, and the child gets 1 point when he answers correctly after each sentence, but when he remembers a word that is not in the original sentence, or uses words other than their correct order, the answer is calculated incorrectly and takes (zero)) and the test is stopped immediately after 3 consecutive error attempts.

B) Count Test

This test consists of an item divided into 7 attempts. The child participating in each item is presented with a picture with the number of circles and triangles in each attempt, and their number increases gradually, so that the first attempt contains one set of pictures, and then moves to the second attempt, which contains two pictures. Then three groups of pictures and so on until you reach 7 groups, and the child is asked to remember the number of them only after he finishes showing the pictures in front of him. The child gets a score (one correct) if he remembers the number that follows it correctly, but if he remembers a number that is not in the original series or the ticket numbers in the incorrect order, then his answer is wrong and he gets a (zero).

C) Variant Form Recall

This test consists of 42 items, in which the participating child sees 3 geometric shapes in a row, between them one different shape, and he must determine which of them is different, and this is done on several attempts, and at the end of each attempt the child remembers the location of the different shape when he sees 3 empty squares on the screen, and he has to select the different shape after it disappears.

Where the test begins with one group in the first attempt and increases to reach 7 groups gradually and the child gets one score when he points to the correct different shape and when he remembers the correct place for the different shape (one), but when the child points to a wrong location or does not remember the places of the different shapes in their correct order, The result is calculated incorrectly and the child gets a (zero), then the test is stopped immediately after 3 consecutive wrong attempts**.**

PPVT-R

A word is given to the child and then the child is asked to choose the picture that corresponds to the meaning of the spoken word to him among the four pictures presented to him. Correction of the test: The test stops if the child makes a mistake in six consecutive words, and the Raw grade result is calculated by subtracting the number of mistakes the child made from the last word he reached (Abu Allam & Hadi ,1998, pp. 19-20). The scale is reported to have good reliability (measured Test and Re-Test) (See; Table 1) and The validity of the developmental changes was calculated and it was found that there were differences between the three age groups in all the variables measured by the study tool in favor of the older age group.

Table 1.Test and Re-Test Reliability (MWMA and PPVT-R)

Variable	Test-Retest Reliability (Pearson's *r*) N=45
Auditory recall test	0.932
Recall the different form	0.925
Count test	0.911
PPVT-R	0.843

Data Collection

The study sample included (100) boys and girls, they were distributed to three age groups (3.6 -4.6 -5.6 years) The first application started in February 2021 and took two months, and after a year (12) months we repeated the application on the same sample In February 2022, the second application took nearly two months. This sample was tested in such a way that all the basic sample characteristics are available in terms of (age, intelligence, and the type of nurseries and schools they belong to. The application was conducted in individual sessions, where there is good lighting and complete calm, in proportion to the application of audio and audio dimensions, and one session lasted from (30-40) minutes, according to the degree of comprehension and awareness of each child of the test instructions, and the speed of answering them.

RESULTS

T-Test for paired groups

The paired samples t-test was used to verify the significance of differences between the related groups in the components of working memory in the first and second measurements (see Tables 2,3 and 4)

Table.2 Shows The Differences Between The Related Groups In The Components Of Working Memory In The First And Second Measurements According To Age 3.5-3.9.

Variable	Measurements	N	Mean	S.D	T	Sig
phonetic-verbal component (Audial Recall test)	first measurement	32	1.1875	.73780	-12.605**	.000
	Second measurement	32	4.1250	1.12880		
phonetic-verbal component (Count Test)	first measurement	32	.9063	.68906	-15.933**	.000
	Second measurement	32	4.2188	1.00753		
Visual-spatial component	first measurement	32	3.6250	2.48544	-7.371**	.000
	Second measurement	32	6.0313	1.12119		

**. Correlation is significant at the 0.01 level (2-tailed).

It is clear from Table (2) that there are differences between the first measurement (2021) and the second measurement (2022) on the dimension of auditory recall, different shape recognition, and counting in the group of 3.5-3.9, in favor of the second measurement, at a significance level of 0.01.

Table.3 Shows The Differences Between The Related Groups In The Components Of Working Memory In The First And Second Measurements According To Age 4.5-4.9

Variable	Measurements	N	Mean	S.D	T	Sig
phonetic-verbal component (Audial Recall test)	first measurement	34	5.1471	.92548	-17.838**	.000
	Second measurement	34	6.8824	1.00799		
phonetic-verbal component (Count Test)	first measurement	34	5.3824	1.04489	-11.282**	.000
	Second measurement	34	6.9706	1.02942		
Visual-spatial component	first measurement	34	3.8824	2.61423	-9.714**	.000
	Second measurement	34	5.9118	1.78152		

**. Correlation is significant at the 0.01 level (2-tailed).

It is clear from Table (3) that there are differences between the first measurement (2021) and the second measurement (2022) on the dimension of auditory recall, different shape recognition, and counting in the group of 4.5-4.9 in favor of the second measurement, at a significance level of 0.01.

Table.4 Shows The Differences Between The Related Groups In The Components Of Working Memory In The First And Second Measurements According To Age 5.5-5.9

Variable	Measurements	N	Mean	S.D	T	Sig
phonetic-verbal component (Audial Recall test)	first measurement	34	6.0000	.92113	-15.317	.000
	Second measurement	34	7.6765	1.14734		
phonetic-verbal component (Count Test)	first measurement	34	6.4118	1.04787	-11.599	.000
	Second measurement	34	8.0882	1.23993		
Visual-spatial component	first measurement	34	3.6176	2.30959	-19.438	.000
	Second measurement	34	5.4118	2.25788		

**. Correlation is significant at the 0.01 level (2-tailed).

It is clear from Table (3) that there are differences between the first measurement (2021) and the second measurement (2022) on the dimension of auditory recall, different shape recognition, and counting in the group from 5.5-5.9, in favor of the second measurement, at a significance level of 0.01.

Variance analysis (ANOVA)

Two-way ANOVA were performed to reveal the examine the role of the vocabulary knowledge in effecting developmental differences of working memory in Egyptian children. The results are displayed in Tables 4, 5.

Table 4. Two-way analysis of variance for differences Between age and the Vocabulary Knowledge in Working Memory in first measurement (2021)

Independent variable	Dependent variable	Type \\\ sum of square	Mean square	F	Df	Sig
Age	*phonetic-verbal component (Audial Recall test)*	149.127	74.564	107.079	2	.000
Vocabulary Knowledge		3.422	3.422	4.914	1	.029
Age * Vocabulary Knowledge		3.904	1.952	2.803	2	.066
Age	*phonetic-verbal component (Count Test)*	181.093	90.546	106.119	2	.000
Vocabulary Knowledge		3.811	3.811	4.467	1	.037
Age * Vocabulary Knowledge		4.362	2.181	2.556	2	.083
Age	*Visual-spatial component*	186.257	93.128	132.353	2	.000
Vocabulary Knowledge		2.445	2.445	3.475	1	.065
Age * Vocabulary Knowledge		1.830	.915	1.300	2	.277

*. Correlation is significant at the 0.05 level (2-tailed).

The results of a two-way analysis of variance did not reveal an interaction effect between age and vocabulary knowledge in determining the level of working memory, However, it appeared that there was an effect of age and vocabulary knowledge (each separately) in identifying working memory, It is evident through:

1- Older children (5.5-5.9 years) show higher levels of working memory with its three subscales (Audial Recall test, Count Test and Visual-spatial component) compared to younger children.

2- Children who have a high linguistic vocabulary and know it well (regardless of their age) have high levels of working memory, especially the phonetic-verbal component only.

Table 5. Two-way analysis of variance for differences Between age and the Vocabulary Knowledge in Working Memory in second measurement (2022)

Independent variable	Dependent variable	Type \\\ sum of square	Mean square	F	Df	Sig
Age	*phonetic-verbal component (Audial Recall test)*	29.168	14.584	15.017	2	.000
Vocabulary Knowledge		7.473	7.473	7.695	1	.007
Age * Vocabulary Knowledge		7.447	3.723	3.834	2	.025
Age	*phonetic-verbal component (Count Test)*	42.324	21.162	21.023	2	.000
Vocabulary Knowledge		2.457	2.457	2.441	1	.122
Age * Vocabulary Knowledge		9.553	4.777	4.745	2	.011
Age	*Visual-spatial component*	33.677	16.838	14.794	2	.000
Vocabulary Knowledge		1.380	1.380	1.212	1	.274
Age * Vocabulary Knowledge		3.240	1.620	1.423	2	.246

*. Correlation is significant at the 0.05 level (2-tailed).

The results of a two-way analysis of variance did reveal an interaction effect between age and vocabulary knowledge in determining the level of working memory, As older children (6.5-6.9 years) who have a high linguistic vocabulary and good knowledge of it have high levels of working memory, especially the verbal audio component only, in contrast to the visual-spatial component, where its levels increased in older children (away from the level of their linguistic vocabulary).

DISCUSSION

In this study, working memory improves with age. Differences between the first measurement (2021) and the second measurement (2022) in auditory recall and recognition of differently processed forms were evident in the (3.5-3.9 years) group, favoring the second measurement (4.5-4.9 years). Notably, there were quantitative differences in the second measurement compared to the first. We attribute this to cognitive development, particularly in audio-visual representation processes linked to encoding and recall. Around age four, children significantly enhance working memory efficiency, increasing encoded storage units from three to four or five, improving access to linguistic lexicon, and enhancing receptive and expressive language skills.

In addition, differences appeared between the first measurement (2021) and the second measurement (2022) on the dimension of auditory recall, recognition of different shapes, and counting in the group from (4.5-4.9 years), in favor of the second measurement (5.5-5.9 years). This result agreed with the results of a number of follow-up studies. The results revealed quantitative differences in the components of working memory at the age of (5) years compared to the age of (4) years, but this is considered an insignificant difference (Kemps, et al., 2000; Malwa, 2016). While the result differed with the results of a number of follow-up studies (Smith, 2005; Milwidsky, 2008), which attributed the relative weight to the pace of growth of verbal and sub-visual working memory at the age of (5) years, which differed with the result of the current study, which was for visual working memory and recognition. The different form is the relatively largest difference among the components of working memory, which may also be due to the difference in the tools and measures used and the nature and systems of the learning processes.

The current study also showed differences between the first measurement (2021) and the second measurement (2022) on the dimension of auditory recall, recognition of the different form processing, and counting in the group from (5.5-5.9 years), in favor of the second measurement (6.5-6.9years), and this result agreed with most of the results of previous studies. We can return and explain this result according to the principle of steady growth with age. As age increases, the rates of growth and quantitative and qualitative advancement of cognitive, linguistic, social, and even emotional processes increase, especially in the early stages of life (early childhood years), in addition to the interaction and mutual influence of these processes with each other. This enhances the emergence and crystallization of the functional performance of the capabilities of these processes in the child, and this explains their apparent appearance in favor of the older age groups (5.5-6.5 years) compared to their younger counterparts (Buttelmann et al., 2019; kokudom, 2012; kemps et al., 2000).

Regarding the second hypothesis of the current study, which is to know the role of vocabulary knowledge in improving working memory in children:

1- it was found that there is no interaction between age and vocabulary knowledge in determining the level of working memory in the first measurement, while an effect of age and vocabulary separately in determining the level of working memory appeared and is evident. This is because older children (5.5-9-5 years) showed higher levels of working memory compared to younger children, and children who have a high linguistic vocabulary and know it well (regardless of their age) have high levels of working memory, especially the phonetic-verbal component.

We can discuss this result through two basic dimensions. The first dimension: according to the principle of steady growth with age. As age increases, the rates of growth and quantitative and qualitative advancement of cognitive, linguistic, and social processes increase, as well as the interaction and mutual influence of these processes with each other, which enhances the emergence and crystallization of functional performance. The capabilities of these operations in the child, and this explains why they appear clearly in favor of the older age groups (5-9-5.5 years) compared to their younger counterparts (Buttelmann et al., 2019; kokudom, 2012; kemps et al., 2000).

The second dimension is to reveal the role of vocabulary knowledge in improving working memory. This result is consistent with a number of studies (Engle, Nations & Cantor, 1990;; Gathercole, & Adams, 1993; Perez, 2020; Teng, 2023; Teng, & Zhang, 2021) Which indicated the existence of a direct and interactive relationship between each of the two variables. The greater the child's linguistic vocabulary and the greater the number of vocabulary he has, the greater the capacity of working memory, which is expressed in the verbal audio component, which is the component responsible for processing, encoding and storing verbal materials and information. The greater the efficiency of working memory, the greater the ability to understand and acquire. Vocabulary through the role of working memory in inhibiting and activating the phonological processing process based on the processes of encoding and phonological representation, in addition to the fact that working memory is one of the cognitive awareness processes necessary for the process of automatic recognition of spoken and written language in addition to both attention and self-monitoring (Milwidsky, 2008; Rezaei & Jeddi, 2020).

In an attempt to understand the nature of the correlational relationships between cognitive variables and language, to determine whether differences in working memory lead to language improvement, or vice versa; The results of a number of longitudinal studies that were concerned with studying the nature of the relationship existing between working memory and the size of a child's vocabulary indicated that working memory actually leads to the improvement of their vocabulary, explaining this by the ability to remember phonologically (through the components of phonological working memory in the temporary storage of new words, Before being integrated into phonological long-term memory, however, the strength of working memory as a predictor of vocabulary size decreases with age (Marshall etal., 2015).

This means that the relationship between PWM and acquired vocabulary takes place in an overlapping manner, and that learning new words involves transferring physiological information that is temporarily represented in the phonological loop, since recognizing words quickly and automatically requires ease of retrieving the linguistic vocabulary from the linguistic lexicon on the one hand and efficient working memory on the other. Retrieving these symbols quickly and with high quality (naming speed). On the other hand, whenever the basic (cognitive) systems are effective, the individual becomes able to free up cognitive resources and thus reach higher levels of linguistic proficiency. Although there is controversy about whether Working memory operates on verbal and non-verbal information in similar ways, or there is variation in the efficiency of each component

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separately. However, language comprehension depends critically on the presence of sufficient resources to process, inhibit, and continually update multiple sources of information over short periods of time. At the same time, variation in the efficient use of limited working memory resources is largely attributable to individual differences in processing speed, and developmental increases in children's working memory capacity are causally linked to age-related increases in information processing speed (Marchman & Fernald, 2008).

2- The second result related to knowing the role of vocabulary knowledge in improving working memory is the effect of an interaction between age and vocabulary knowledge in determining the level of working memory, as older children (5.6-6.9 years) who have high linguistic vocabulary and good knowledge of it have higher levels of vocabulary knowledge. High working memory, especially the audio-verbal component only, in contrast to the visual-spatial component, the levels of which increase in older children (away from the level of their linguistic vocabulary).

We discuss and explain this result according to Gorman's model, which pointed to the relationship between working memory and vocabulary knowledge and the extent of their influence in improving phonological awareness: The "Gorman" model (as a relational model) indicates the existence of a dynamic relationship and mutual influence between vocabulary knowledge, working memory, and phonological awareness in Their influence on language acquisition and perception in general; The model indicates that a strong vocabulary, in addition to learning phonological awareness skills in the child's first language, contributes to improving phonological awareness skills in both his first and second language, part of which depends on the efficiency of working memory, explained by the connection between the vocabulary and the components of storage and processing (representation). phonology for working memory, and their role in improving phonological awareness skills in both languages later, and thus the model supports the strong relationship between working memory, vocabulary knowledge, and phonological awareness (Gorman, 2012).

The results of the study by Ječmenica and his colleagues were also very supportive of the Gorman model. The study found a model that combines age, phonological awareness, verbal working memory, and rapid automatic naming of vocabulary, predicting 51% of the variance in achievement on expressive vocabulary assessment tasks and 38% in explaining performance differences on receptive vocabulary assessment tasks. In general, the results showed the contribution of phonological awareness, verbal working memory, and automatic naming speed to the growth and improvement of vocabulary in children before formal reading training (Ječmenica & Golubović, 2021).

As for the visual-spatial component, its levels increase in older children (apart from the level of their linguistic vocabulary), which is different. Perhaps this result may be due to the progressive nature of the process, as the process measures the visual-spatial component of working memory, which indicates a number of studies that concerned with the progression of Working memory indicates that visual-spatial working memory may follow verbal working memory in development, due to its dependence on the growth of a number of other cognitive processes related to it and influencing it, the emergence and advancement of which often requires later stages of life. The cognitive stereotyping of images and places follows the linguistic stereotyping of phonological memory and the verbal component, the increase of which is directly proportional to rapid linguistic growth in the first years of life, based on what Milwidsky's study (Milwidsky, 2008) indicated that working memory capacity increases gradually from the age of 6 to 19 years. However, the ability to store audio (the audio-verbal component) begins in children at the age of three (3 years), while the significant and significant improvement in visual-spatial memory crystallizes from the age of (6 to 8) years, where most of the ages of the samples were concentrated. Visual-spatial working memory in childhood between 5 and 6 years of age, as studied by (Kemps et al., 2000; Kokudom et al., 2012& Buttelmann et al., 2019). In addition, the visual-spatial memory system is a limited capacity system and its capacity increases progressively with age (Baddeley, 2000). This explains the appearance of his increase in the second older country study (5.6-6.9 years).

CONCLUSION

While studies have established the connection between vocabulary knowledge and working memory, there are still unanswered questions regarding the specific nature of this relationship. Accordingly, the purpose of this study was to shed light on development of working memory in early childhood (Using a longitudinal approach) and examine the role of vocabulary knowledge in developing working memory among Egyptian children. The results revealed that Working memory improves over age, and knowledge of vocabulary plays an important role in developing working memory, especially the phonetic-verbal component. The current results require further investigation and validation by revealing differences between males and females in the development of working memory, and determining the role of vocabulary knowledge in the development of working memory in both sexes. The results also suggest that there may be other variables that interact with vocabulary knowledge that would increase levels of working memory (e.g., home environment for learning the alphabet). It is recommended to explore this phenomenon in future studies.

Limitations and Future Research

Although the study contributes to the existing literature, it has two limitations. First, the results may not apply to other Egyptian children because a non-random sample was used. Second, various factors such as sex was not taken into account in this study. This factor may have influenced the results.

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