Contribution of working memory and pseudowords to pupil›s reading comprehension: predictive study

(دراسة تنبؤية لإسهام كل من الذاكرة العاملة وقراءة الكلمات الزائفة فى الفهم القرائى لدى تلاميذ المرحلة الابتدائية فى مادة اللغة الإنجليزية)

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The research aimed at identifying the role of working memory in predicting reading comprehension for fourth - grade primary pupils، Identify the role of pseudowords in predicting reading comprehension of fourth grade primary pupils.

Identifying which factors (working memory- pseudowords) is more important in predicting of reading comprehension for fourth - grade primary pupils.The research sample including 120 fourth grade primary stage. the three main instruments were used:working memory scale ،pseudoword scale ،reading comprehension scale.

The main finding of study revealed that: working memory tasks phonological loop sentence span - meaning span) and central executive (digital task)can be predicted reading comprehension in English language. pseudowordscan be predicted reading comprehension in English language، pseudowords are more predictive than working memory in predicting reading comprehension in English language.

Key words**:** working memory - pesudowords - reading comprehension

المستخلص

هدف البحث الى التعرف على دور الذاكرة العاملة فى التنبؤ بالفهم القرائيلدى تلاميذ الصف الرابع الابتدائى ، التعرف على دور قراءة الكلمات الزائفة فى التنبؤ بالفهم القرائيلدى تلاميذ الصف الرابع الابتدائى ، التعرفعلى أى منالمتغيرات (الذاكرة العاملة - قراءة الكلمات الزائفة) أكثراسهاما فى التنبؤ الفهم القرائى لدى عينة من تلاميذ الصف الرابع الابتدائى فى مادة اللغة الانجليزية. وأجرى البحث على عينة قوامها 120تلميذ وتلميذة من تلاميذ الصف الرابع الابتدائى ، وطبقت الباحثة ثلاثه مقايس و وهى مقياس لقياس الذاكره العاملة ومقياس للكلمات الزائفة ومقياس لقياس الفهم القرائى ، وأسفرت النتائج أن مهامالذاكرة العاملة المكون اللفظى (مدى الجمله - مدى المعنى) والمنفذ المركزى (مهمة الأرقام) لها قدرة فى التنبؤ بالفهم القرائى فى ماده اللغة الأنجليزية ،كما أن الكلمات الزائفة بمهاراتها كلمات قصيره ومتشابهه للكلمه الحقيقيه - كلمات طويلة ومشابهة للكلمة الحقيقيه - كلمات قصيرة وغير مشابهه للكلمة الحقيقية، ومقياس لقياس الفهم القرائى وتكون من ثلاثة مستويات مستوى الكلمه - مستوى الجمله - مستوى المعنى ، وأسفرت النتائج أن الكلمات الزائفه أكثر تنبؤا من الذاكرة العامله فى التنبؤ بالفهم القرائى فى مادة اللغة الأنجليزية.

الكلمات المفتاحيه: الذاكرة العامله - الكلمات الزائفه - الفهم القرائى

:Introduction

English learner (EL) takes towards English literacy and oral language proficiency is a critical one. Acquiring high levels of English literacy has the power to lift an individual out of their current circumstances transforming the future for themselves، their families and their communities. Many elementary - age students are charged with the difficult tasks of learning to read، write، and speak in English. This literacy journey is likely to be complex and influenced by a variety of factors. Proficient reading requires the successful utilization and coordination of a number of cognitive processes. (Espin، 2007).

Reading comprehension plays a crucial role in everyday activities. Reading is vital for education: for children the ability to read is، for example، the key to success in school، and this success is critical for success in adulthood. More generally، reading permits a person to realize his/her self، and also to be integrated in the social context. Bad or inaccurate comprehension in everyday situations may have consequences that can be insignificant (misunderstanding a newspaper article)، or extremely serious and severe (misunderstanding instructions for taking medications). Reading comprehension can، indeed، influence the quality of an individual’s life..

Reading comprehension involves the extraction of meaning from written language and it would generally be agreed that comprehension is the ultimate goal of teaching children to read independently. However، even though there is a large literature on children’s reading comprehension and its development، there is no general agreement regarding which skills are the most important contributors to reading comprehension. While some research on children's reading comprehension has included children with poor word reading skills (Perfetti، 2000).

Working memory plays an important role in the development of a coherent representation of information being read in text، which is necessary for adequate reading comprehension. Individual differences in working memory are significantly impacted by functions of the central executive، the controlling mechanism of working memory.

Indeed، the ability to understand a text depends on the integrity of one's mental representation of relevant idea and concepts، and on the ability to access this information. in order to manipulate it. Information must be held in memory while the individual simultaneously carries out processing operations، such as storing the information from one sentence while reading the following ones in order to build an integrated representation of the text meaning. Hence، the role o f working memory in this complex skill has been highlighted in various studies and with different age groups.

Statement of the problem**:**

Children's reading comprehension has been shown to be influenced by their verbal working memory، their rapid، automatic decoding of words phonological skills (Shankweiler، 2002); and a range of cognitive and metacognitive strategies، such as monitoring comprehension، activating background information، integrating multiple strategies of questioning، clarifying and searching for information، identifying story themes، summarizing main points، and predicting outcomes (Bryant، 2003)

Reading comprehension is a critically important ability that is needed in a host of situations، including educational and professional settings. Given the importance of reading comprehension to many daily activities، researchers have long been interested in examining individual differences in reading comprehension and examining what potential factors might account for variation in reading comprehension.

comprehension requires the coordination of processing components in order to transform phonological or orthographical code into a representation of the text meaning: from the processes operating at the word - level to the ones needed to create a more global model of what the text is about. These types ofprocesses place different requirements on the cognitive system، which actively interacts with the reader. However a simple generalization of the developmental trajectory of the text comprehension as a whole is not possible Sesma،.. (2009).

WM has been shown to be significantly related to both decoding and reading comprehension، with deficits in WM evident in poor readers whose poor reading skills stem from either decoding or comprehension difficulties (Christopher et l.، 2012 }Students with poor reading comprehension skills perform more poorly on WM tasks، relative to those with good comprehension skills

In the current study we continue this tradition by examining how normal variation in a number of factors is related to variation in reading comprehension for an academic text. In particular، we examined how working memory and pseduowords influence in reading comprehension.

The problem is summarized in following questions**:**

1 - Can reading comprehension be predicted from some of the working memory tasks (sentence span task- meaning range task- digits task) of fourth grade pupils?

2 - Can reading comprehension be predicted by pseudowords of a sample fourth - grade primary pupils?

3 - Which one is more important working memory or pseudowords in predicting reading comprehension for fourth - grade pupils?

The research aims**:**

Identify the role of working memory in predicting reading comprehension for fourth - grade primary pupils.Identify the role of pseudowords in predicting reading comprehension of fourth grade primary pupils.

Identifying which factors (working memory - pseudowords) is more important in predicting of reading comprehension for fourth - grade primary pupils.

Significance of the research**:**

This research may contribute in**:**

Directing the attention of English teachers towards the role of working memory in reading comprehension.

Providing researchers with statistically significant results upon which they can start developing remedial programs for developing reading comprehension skills among primary school pupils.

Directing the attention of curriculum developers to the importance of developing reading comprehension skills in English at primary stage..

The research hypotheses

Reading comprehension can be predicted in the English language through some working memory tasks for fourth - grade primary pupils.

Reading comprehension can be predicted in the English language through pseudowords for fourth - grade primary pupils.

Which variables is more important in predicting reading comprehension in English language، working memory or pseudowords?

Delimitations of the research**:**

This research is restricted to:

Aim: Predicting of Contribution of working memory and pseudowordsto pupil's reading comprehension:.

Place: The research will be applied at EL - Canal language school at El - Maadi Educational zone.

Duration: The research data was gathered during the academic year 2020.

Tools of the research**:**

The research made use of three main tools:

Reading comprehension test.

Working memory test (phonological loop، central - executive)

pseudowords test.

Definitions of terms**:**

1 **-** Working memory**:**

18WM facilitates the reader's ability to recognize، retain، and manipulate words and their meaning in the context of the text، in order to construction a coherent، meaning - based representation of the information being read **(**Cain، 2006**)**

2 - Pseudowords pseudowords have been a useful technique in psycholinguistic research for decades. (words that are not real but resemble real words in a language).theyare pronounceable nonwords (e.g.، bave) and have been shown to correlate highly with real word recognition and reading comprehension(Rack، Snowling، & Olson، 2002).

3 - Reading Comprehension is understood as an interactive process involving both input and individual variables. Consequently، researchers have discussed a number of input and learner factors that

might influence what and/or how learners process linguistic form during comprehension. Lee (2008).

Reading comprehension is understanding a text that is read، or the process of constructing meaning from a text. Pulido (2004).

Theoretical Background**:**

1 **-** working memory

1 - 1* The component of working memory:

According to the model of Baddeley and Hitch، it comprises at least three components: the visuospatial sketchpad for visuospatial information، the phonological loop for verbal information، and the central executive، a limited - capacity circuit responsible for the control of attention and manipulation of information Working memory is composed of a central control element، the central executive that supervises and coordinates the activities carried out by subsidiary peripheral systems that are specific to each sensory modality. These slave systems are called the visuospatial sketchpad and the phonological loop The phonological loop is responsible for temporary storage of auditory/verbal material، and for the translation of visual stimuli into a phonological format (Baddeley، 2000).

The visuo - spatial sketchpad is responsible for both the processing and storage of mental images، and/or the visual or spatial information. The two slave systems، each initially conceived of as a unitary structure that passively stores information، were revised later. The phonological loop was divided into the passive phonological storage that stocks information in phonological code for a limited time، and the rehearsal process، that allows to refresh information، thus avoiding its decay.The rehearsal process is particularly crucial in language perception and production. The visual - spatial sketchpad was specified by a visual cache، which passively stocks information، and the inner scribe that refreshes visuo - spatial information. The central executive، a control system، is above the two slaves systems. It works as a supervisory structure that selects voluntary strategies and coordinates activities in order to process the stimuli that was stored by the two slaves systems.

The central - executive is one of three functional components in Baddeley’s multiple - component model of WM that act together for the production of the moment - by - moment monitoring، processing، and maintenance necessary for information processing associated with reading comprehension (Baddeley ، 2000).

In addition to a central executive controlling mechanism، two subsidiary systems are responsible for the processing and maintenance of verbally encoded information (phonological loop) or visual/spatial information (visuospatial sketchpad). The phonological loop and visuospatial sketchpad act as slave systems to the central executive. A key function of the central executive is the allocation of attentional resources (Barrett، Tugade، & Engle، 2004).

The central executive’s control of attention aids in the resistance of irrelevant distracters، whether they be from the external environment or from internal thoughts and/or feelings. Individual differences in WM are significantly impacted by individual differences in the ability to control attention. This attentional control (AC) process is crucial for the control of cognitive processes supporting language and reading comprehension (Baddeley، 2000).

Central executive (CE): A flexible، supervisory attention system that is responsible for the control and regulation of all cognitive processes. The CE is necessary for the control functions of WM resources، based on cognitive processing demand. The CE is responsible for shifting LTM، retrieval strategies and has the following functions during complex cognitive reasoning:

- Binding information into coherent episodes
- Coordinating the two slave systems
- Shifting between tasks or retrieval strategies
- Selective attention and inhibition

The phonological loop contains a phonological store to retain speech - based information and a rehearsal or articulatory loop that serves to maintain decaying representations in the phonological store. The phonological loop plays an important role in language skills in early years، for instance in learninto read، in comprehension of spoken language، and in vocabulary acquisition).The main function of this component is to provide temporary storage of the unfamiliarsound structures of new words (Conner، 2009).

1 - 2* Working Memory and Skilled Text Comprehension:

Text comprehension involves the formation of a meaning - based representation of the text، often called a mental model or a situation model. The processes of integration and inference are important to the construction of an integrated and coherent model of a text. Integration between adjacent clauses is necessary to establish local coherence، and inferences about different events، actions، and states are required to make the text cohere as a (Chong، 2001).

These processes require that the relevant information، either from the text or world knowledge، is both available and accessible. Working memory serves as a buffer for the most recently read propositions in a text، enabling their integration to establish coherence، and holds information retrieved from long - term memory to facilitate its integration with the currently active Working memory capacity is correlated with college students' performance on standardized assessments of comprehension skill. In addition، working memory capacity is related to skills important for comprehension، such as the resolution of pronouns،memory for facts، and the inference of unknown word meaningsfrom context (Daneman & Carpenter، 2000)

1 - 3***Working Memory and Children's Reading Comprehension:**

There is a strong relation between working memory (i.e.، those tasks that require the simultaneous storage and processing of symbolic information) and children's reading comprehension. In contrast، comprehension does not correlate with tasks that simply involve the passive storage of information (Leather & Henry، 2000). The relation between working memory and comprehension skill has been found with tasks that require the processing and storage of words، sentences (Seigneuric، Ehrlich، & Yuill، 2000)، and numbers (Yuill et al.، 2001).

This variability in choice of task raises the issue of which type of task is more appropriate in such investigations. A word - or sentence based task is likely to be predictive of reading comprehension because these tasks are demanding of linguistic skills. A number based task، which does not require the processing of words and sentences، can be used to determine whether there is a moregeneral relation between working memory and comprehension skill. Children's verbal and numerical working memories are both related to reading comprehension (Oakhill، Cain، & Bryant، 2003). However، children's performance on working memory tasks that require the manipulation of shapes and patterns does not explain variance in reading comprehension (Nation،2000).

Word - ، sentence - ، and number - based working memory tasks are readily amenable to verbal coding (unlike spatial tasks)، which might explain their association with comprehension skill. We refer to working memory tasks that require the processing of either linguistic or numerical materials collectively as verbally mediated working memory tasks، to differentiate them from tasks that require spatial processing.

Nation (2000) suggested that the reported relation between children’s working memory and their text comprehension is underpinned by verbal and semantic skills. They argued that poor comprehend have a specific semantic weakness that restricts their ability to store verbal information in short - term memory. This weakness impairs performance on the types of verbally mediated. working memory tasks used in previous research. Similarly، Stothard and Hulme (2002) proposed that working memory differences between good and poor comprehend would disappear if differences in verbal IQ (VIQ) were controlled، though they did not present evidence to support this prediction.

Working memory capacity assessed by verbally mediated tasks explains individual differences in children’s reading comprehension over and above other well - established predictors of comprehension، such as decoding، word recognition skill، and vocabulary knowledge (Yuill et al.، 2000).

working memory resources seem to be an important and specific determinant of children’s reading comprehension level. However، these working memory tasks may tap into verbal resources (see above)، and both vocabulary knowledge and verbal intelligence are strong predictors of reading comprehension level (Oakhill et al.، 2003).

2**:** Reading Comprehension**:**

*****2 **-** 1 Component Skills of Reading Comprehension**:**

Many skills may contribute to a child’s reading comprehension level. Taxonomies of comprehension abilities often categorize the component skills and processes as ones that occur higher or lower in the language processing chain. For example، word recognition skills are considered a lower level processing skill. In contrast، inference making is considered a higher level processing skill because it aids the construction of the meaning - based representation of the text (Hannon & Daneman، 2001).

Working memory resources are clearly important in the execution of inference and monitoring skills. A crucial question is whether individual differences in working memory capacity underlie individual differences in specific comprehension skills that require the integration of information، such as inference making and comprehension monitoring (Seigneuric et al.، 2000)، or whether deficiencies in these skills exist in the presence of adequate working memory (and lexical processing).

A brief summary of each skill and the theoretical basis and empirical evidence for its relation to reading comprehension and working memory follows:

1 - Inference Making**:**

Inferences that were necessary to make sense of a text and that required either the integration of information among individual sentences in the text or the integration of general knowledge with information in the text. The ability to generate these types of inference is related to both age and reading Comprehension skills (Oakhill، 2003)

working memory capacity alone may not be sufficient to ensure that a crucial inference is generated. The reader must possess the relevant world knowledge from which an inference can be drawn، Children's inference making improves when they are trained to focus on key words in the text ، children's reading comprehension benefits when children are trained to generate questions to promote the interpretation of text and to facilitate prediction from text (Palincsar & Brown،2002).

2 **-** Comprehension Monitoring**:**

Comprehension monitoring is one aspect of metacognition that concerns the comprehension of connected prose. Measures of comprehension monitoring usually assess a reader's ability to detect inconsistencies in text، such as scrambled sentences، contradictory sentences، or statements that conflict with external information (world knowledge). These error - detection tasks require readers to evaluate their understanding of the text and to regulate their reading to resolve any reading problems and to facilitate their understanding. Hacker (1998) proposed the term self - regulated reading، rather than comprehension monitoring، to highlight the importance of both processes.

3 **-** Understanding Text Structure**:**

Perfetti(2004) proposed that a possible source of comprehension failure is inadequate knowledge about text structures and genres، which may arise because of insufficient reading experience. Explicit awareness about text structure and the expectations engendered by certain common features of text may be useful aids for readers، helping them to invoke relevant background information، older readers and better comprehend were better able to explain the sorts of information that may be provided by the introduction and ending of a text. Children with specific comprehension.

*****2 **-** 2 The levels of reading comprehension**:**

Three levels of text comprehension have been identified (Johnson، 2006). The first level is that of surface language at which the child is concerned with decoding the language and structure of the text. A younger child in the early stages of learning to read will frequently be concerned with this level of reading to situational models from the text that involve the from text. One way is to identify the underlying propositions contained in the text and understand their relationships. The other level requires the reader to build mental models or reader in the on - line development of models that integrate the text with the reader's existing knowledge. It is expected that secondary stage students are reading at the two more advanced levels and are accomplished at the surface structure level.

*2 - 3 Theories of reading comprehension:

1 - Schema Theory:

Schema Theory is a constructivist theory that explains how knowledge is created And used by the learner. According to schema theory، people organize everything they know into schemata، or knowledge structures. People have schemata for every topic in their lives، and each person's schemata is different depending on his/her life experiences. This theory suggests that the more elaborate a person's schema is on a topic، the more easily he or she will be able to learn new information in that topic area.

Schema theory has been influential in highlighting the role that existing knowledge (schemata) plays in the processing of new knowledge. The importance of activating and building a student's background knowledge prior to reading in order to increase comprehension is directly related to schema theory (Tracy & Morrow، 2012).

2 - Transactional /Reader Response Theory:

According to this theory، every individual is unique with regard to what constitutes his or her schema in any particular area and therefore every reading experience and way that they comprehend a text is unique (Tracey & Morrow، 2012). No two people will comprehend the text in the exact same way since each person has unique sociocultural experiences that influence the way they make meaning and interpret the text. Pearson explains this about comprehension: Meaning (or comprehending) is something that resides neither in the head of the reader (as some had previously argued) nor on the printed page (as others hadargued). Instead، meaning (or comprehending) is created in the transactionbetween reader and document. This meaning resides above the reader - text interaction. Meaning is therefore، neither subject nor object nor the interaction of the two. Instead، it is transaction، something new and different from any of its inputs and influence.

*****2 **-** 4 Reading comprehension and individual differences in children**:**

During development the basic reading processes have a strong impact on reading comprehension. For children، the development of a certain level of automaticity in reading has been considered essential to the development of reading comprehension; before higher - order processes can be performed accurately، sub - skills such as word recognition must be performed effortlessly (Samuel & Flor، 2007).

It is well documented، however، that reading not only depends on the ability the decode words and understand sentences، but also on adequate vocabulary. Children must learn how to use these skills in order to understand written language (Carroll، 2006). Indeed، reading comprehension is the understanding of the relationship between the words، sentences، and paragraphs within the text، and between the text and the information the reader knows. There are three individual differences in reading comprehension at three main levels: the word level، the sentence، and at the text level (inferential processes).

1 **-** Word level**:**

The word level can be considered as a first step of comprehension. Indeed، one method to identify individual differences in reading comprehension is to focus on single words. In childhood one major difference between successful and less successful comprehend is that successful comprehenders tend to possess better decoding skills - i.e.، they are faster and more accurate at letter and word identification than are less - successful comprehenders Automatic word recognition processes have been shown to be linked to higher reading comprehension levels. Slow and inaccurate word recognition may affect comprehension because it uses up limited processing resources، leaving little resources for higher order processing like integration processes (Hagtvet، 2003)

2 **-** Phonological Skills

Phonological skills are another source of individual differences in reading comprehension associated with word reading development. Impairment in the phonological representation of words may potentially be another cause responsible for reading comprehension difficulty in children. poor readers differ from good ones in the ability to maintain and process verbal information in a verbal form. Indeed، short - term memory in children with decoding problems becomes saturated، and their ability to comprehend sentences affected. no difference has been found between skilled and less skilled comprehenders in the storage of phonological stimuli (Cain، Oakhill & Bryant، 2000b)

3 **-** Word knowledge**:**

reading comprehension ability is also highly correlated with word knowledge in both children and young adults. Many studies have indicated that word decoding skills and vocabulary knowledge are the best predictors of reading comprehension in 9 to 11 year - old children. Thus، vocabulary expansion helps children become independent reader. Some authors have concluded that individual differences in semantic representation of word meaning are related to comprehension performance. Perfetti، 2000that both word knowledge and processing skills can affect comprehension Some research has shown that vocabulary knowledge is essential for comprehension skills children، and of course adults، with rich knowledge of vocabulary may better comprehend texts. The richer the representation in semantic memory for word meaning is، the more the concepts will be interconnected during comprehension in order to build a coherent text representation.

3**:** Pseudoward**:**

Early incarnations of pseudowords were developed by Herman Ebbinghaus in his groundbreaking research on human memory in 1885. Ebbinghaus created consonant - vowel - consonant (CVC) nonsense syllables in an effort to develop lists of novel stimuli to be memorized (Benjamin، 2006). The fact that these syllables were novel was paramount as it was believed that the rate of memorization would differ between familiar and unfamiliar stimuli. It has been well known that the meaningfulness of otherwise novel nonsense syllables impacts their rate of memorization for nearly a century (Glaze، Hull، 2003).

In addition to their lengthy history in cognitive psychology research، pseudowords have been a useful technique in psycholinguistic research for decades. A prominent example is the work by Berko (2000) which examined the morphological knowledge of children by asking them to manipulate pseudowords into alternative forms (e.g.، more than one ‘wug’ becomes ‘wugs’). As was the case in memory research، pseudowords were used due to their lack of familiarity، thus allowing researchers to examine whether or not children had learned the rules guiding language rather than just memorized alternate forms of real words.

pseudowords have been involved in clarifying a number of mental capabilities. Pseudowords have been used in assessing the amount of information that can be held in temporary storage in adults. Research has also demonstrated thatthe quality of this information is subject to both primacy and recency effects with subjects more likely to repeat the syllables at the beginning and the end of the pseudoword more correctly than those in the middle(Gupta، 2005). The correct repetition of a pseudoword has become a popular test of the phonological loop component of WM. Furthermore، resulting from the use of pseudowords، the phonological loop has been posited as a cognitive sub - system that is uniquely active in learning new verbal information as opposed to merely storing all incoming verbal information (Baddeley، Papagno، & Vallar، 2012). Pseudowords have also been critical for demonstrating that the phonological loop is active when verbal information is presented visually، not just auditorily

A pseudoword consists of a stimulus within the structural rules of a natural language، i.e.، it can be read، written and repeated but has no conceptual meaning or semantic value in the current lexicon of that language. Because the phonological form of a pseudoword is necessarily unfamiliar، subjects have to rely heavily upon the capacity of their phonological memory system to encode and keep the novel phonological sequence in a nondegraded form for subsequent articulatory output (4). However، nonword repetition skills influenced by the extent to which the stimuli resemble words; repetition is easier for nonwords that have a phonological or morphological structure close to real words Laws G (2004).

3 - 1Pseudo word properties

The manipulation of pseudoword properties may offer a pathway to incorporate theory from cognitive psychology and psycholinguistics into item construction and to create assessments that cover a greater portion of the verbal Gf construct while keeping construct - irrelevant variance due to prior familiarity at a minimum. Research has demonstrated that subtle changes to cognitive ability items can produce notable changes in item properties (including difficulty)، even if the changes are believed to be isomorphic(Koch، McCloy، Trippe، & Paullin، 2012).

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Pseudoword repetition has been found to be a strong predictor of vocabulary development early in life (Gathercole، 2005) and the ability to learn new words in one's native language and in a second language Pseudoword span (i.e.، the number of pseudowords that can be recalled correctly) predicts learning new words better than simple STM span tests (e.g.، digit span) and Gf measures for those individuals with smaller vocabularies (though it is not necessarily predictive for those with a larger vocabulary Likewise، pseudoword repetition is often more predictive of word learning than simpler tests of STM. Through pseudowords it has been possible to demonstrate that familiar and novel stimuli differentially activate cognitive sub - systems as well as the importance of subvocalization for reading and rehearsal. Subvocalization is a process whereby individuals (intentionally or unintentionally) move the muscles used in speechproduction without producing audible sounds

- Participant:

The research sample:

The sample represents the verification of the psychometric properties of the tools used in the research، the determination of the placement of the phrases، their readability، and the time required to answer them،. The research sample consists of fourth grade pupils of elementary school at Canal Language School and it consists of 120 pupils، whose average age is 10 years with a standard deviation.324 degree.

Research design

The research followed the analytical descriptive method: This approach fits with the nature of the research، as this approach provides information of the predictive relationship between the study variables { working memory - pseudoword - reading comprehension}

* Instrument of research:

1 - Working memory battery

The researcher prepared a set of sub - tests to measure the efficiency of working memory in light of Baddeley's model and each test consists of a set of tasks.

Aim of WM battery: The tasks of measuring working memory efficiency used in the current research aim to measure both storage capacity and processing capacity together in an automated way.

Measuring and determining the storage capacity of working memory (verbal / non - verbal) through the participants' ability to retain or recall the largest number of words، numbers.

Measuring the processing capacity of working memory (verbal / non - verbal) through the respondent's response to a simple question related to the information kept.

First test: (The verbal component or the phonological loop): This test consists of two tasks، namely the sentence span and the meaning range task

Sentence span task: This test consists of five levels of sentences، and each level has two attempts. The teacher displays a series of sentences; each sentence includes a missing word. The participant must find it and pronounce it loudly، then keep it in his memory so that it can be remembered as soon as he finishes the series.

Grade Rating: One score for each returned and ranked word

The meaning range task: It consists of four series of a group of words starting from a series of two groups of words up to five groups of words and each group consists of four words، three of them have the same connotation، while the fourth is an extraneous word (it does not have the same connotation with Others).

The teacher displays a series of words that include a group of 4 words، and the examiner has to find the extraneous word among the other words that have no relation to the other three words. Then he keeps it in his memory and at the end of each sequence he remembers extraneous words in order.

Grade Rating: One score for each extraneous word retrieved and ranked

Secondtest: This test measure the centralexecutive،

Digital task: it consists of six levels، each level has two attempts، the teacher reads a group of numbers، the subject listens well and then re - reminds them، but vice versa. If the subject succeeded، he was given a succession of the same attempt. And if he succeeds، he is presented with another series of sequences.

Grade Rating: One score for each returned numbers.

Psychometric Properties of the Working Memory Test، Prepared by Researcher:

1 - Test Stability**:**

The researcher verified the stability of the test using several methods: split half coefficient، and Cronbach's alpha، as shown in table (1).

Table **(**1**)**

of the coefficient of the stability of the working memory test

alpha coefficient	Gutmann invariance	length correction. Spearman - Brown.	Split - half reliability coefficient
0.81	0.71	0.71	0.56

It is evident from the table (1) that the test has high stability coefficients، which confirms the validity of the test for application.

2 - Test validation**:**

Factor analysis exploratory factor analysis to the working memory test، prepared / researcher.

The researcher conducted an Exploratory Factor Analysis using the Statistical Package Program in Educational and Psychological Sciences ((SPSS v.20) on a sample of (120) male and female students، as indicated in the description of the primary sample of the study.

It was based on the Kaisr Criteria criterion، using the Principle Component method، and the Promax Rotation.

The results of the exploratory factor analysis: The results of the exploratory factor analysis of the test items showed that the two factors whose latent root is greater than the correct one، and these factors are saturated with (2) sub - skill، and these factors explained 68.61% of the total variance explained، and table (4) shows the extracted factors and their underlying roots. ، The ratio of variance for each factor، and the cumulative ratio of variance.

Table **(**2**)**

the extracted factors، their latent roots، the ratio of variance for each factor، and the cumulative ratio of variance**.**

Factor	Igen value	ratio of variance	cumulative ratio of variance
Phonological loop	1.068	35.60%	35.60%
Central executive	1	33.009%	68.61%

1 - First factor{phonological loop}

The first factor explains 35.60% of the total explained variance، and two sub - tests were saturated on it، which are the sentence span test and the meaning task، as shown in Table (3).

Table **(**3**)**

items saturation coefficients for the first factor**{**phonological loop**}.**

First factor **{**phonological loop**}**	Saturation coefficient
Sentence span	0.880
Meaning task	0.48

2 - Second factor{ central executive}

The second factor explains 33.009% of the explained total variance، and saturated on one sub - test 0.882 t، which is the digital range test.

= (internal consistency):

The correlation coefficients between items، the degree of distance، and the total score of the test were calculated on a sample of (120) male and female students in the primary stage; To identify the extent of homogeneity of the test items، and whether it measures one feature or multiple features، and table (4) shows the correlation coefficients between the terms and the degree of dimension، and the total score of the test.

Calculation of the correlation coefficients between the degrees of the dimensions and some of them، and the total score of the test:

Correlation coefficients were calculated between the dimensions of the scores and some of them، the total score of the test، and a table () showing the correlation coefficients between the dimensions of the degrees and some of them، and the total score of the test.

Table **(5)**

Correlation coefficients between dimensional scores and some of them، and the total score of the working memory test

factors	First factor	Second factor	Total score
Phonological loop	1		
Central executive	0.54**	1	
Total score	0.85**	0.51**	1

Final image of the working memory test، Preparation by Researcher.

The test consisted of (41) items distributed over two main components، as shown in Table (6).

Table **(6)**

Final image of the working memory test، prepared **/** researcher

<table>
<tr><th>items</th><th>numbers</th><th>tasks</th><th>factors</th></tr>
<tr><td>1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12</td><td>12</td><td>Sentence span</td><td rowspan="2">Phonological loop</td></tr>
<tr><td>13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25 - 26 - 27 - 28 - 29 - 30 - 31 - 32</td><td>20</td><td>Meaning range</td></tr>
</table>

33 - 34 - 35 - 36 - 37 - 38 - 39 - 40 - 41	9	Digital task	Central executive

The aim of the test: measuring the pseudoword properties of length and wordlikeness (how much a pseudoword resembles a typical or common word in English) led to changes in item difficulty.

It consisted of three sets of pseudowords were developed - short and wordlike، long and wordlike، short and un - wordlike،

Psychometric Properties of the Pseudoword Test، Prepared by Researcher:

1 - Test Stability**:**

The researcher verified the stability of the test using several methods: split half coefficient، and Cronbach’s alpha، as shown in table (7).

Table **(**7**)**

of the coefficient of the stability of the pseudoword

alpha coefficient	Gutmann invariance	length correction. Spearman - Brown.	Split - half reliability coefficient
0.56	0.43	0.52	0.36

It is evident from the table (7) that the test has high stability coefficients، which confirms the validity of the test for application.

2 - Test validation**:**

Factor analysis. exploratory factor analysis to the pseudoword test، prepared by researcher.

The researcher conducted an Exploratory Factor Analysis using the Statistical Package Program in Educational and Psychological Sciences ((SPSS v.20) on a sample of (120) male and female students، as indicated in the description of the primary sample of the study.

It was based on the Kaisr Criteria criterion، using the Principle Component method، and the Promax Rotation.

The results of the exploratory factor analysis: The results of the exploratory factor analysis of the test items showed that the three factors whose latent root is greater than the correct one، and these factors are saturated with (19) items، and these factors explained 23.806% of the total variance explained، and table (8) shows the extracted factors and their underlying roots. Also، (8) items words were deleted، namely: 3 - 15 - 16 - 17 - 18 - 23 - 24 - 29 for lack of symmetry between the common factors، and the saturation of others in a negative way.

The ratio of variance for each factor، and the cumulative ratio of variance.

Table **(**8**)**

the extracted factors، their latent roots، the ratio of variance for each factor، and the cumulative ratio of variance

Factors	Igen value	ratio of variance	cumulative ratio of variance
Short and wordlike	2.628	8.761%	8.761%
Long and wordlike	2.372	7.905%	16.666%
Short and un wordlike	2.142	7.141%	23.806%

1 **-** First factor**{** short and wordlike**}:**

The first factor explains 8.76% of the explained total variance، and (8) items are saturated with it، namely: 1 - 2 - 4 - 5 - 6 - 7 - 8 - 9، respectively، as in Table (9).

Table **(**9**)**

saturation coefficients for the first factor **(**Short and wordlike**).**

Saturation coefficient	items
0.36	1
0.45	2
0.364	3
0.459	4
0.528	5
0.504	6
0.463	7
0.321	8

2 **-** second factor**{** Long and wordlike**}**

The second factor explains 7.907% of the explained total variance، and (5) items are saturated with: 19 - 20 - 21 - 22 - 26، respectively، as in Table (10).

Table **(**10**)**

saturation coefficients for the second factor **(**long and wordlike**).**

Saturation coefficient	items
0.519	9
0.575	10
0.616	11
0.436	12
0.459	13

3 **-** Third factor **{** Short and un wordlike**}:**

The second factor explains 7.907% of the explained total variance، and (6) items are saturated with: 10 - 11 - 12 - 25 - 27 - 28، respectively، as in Table (11)

Table **(11)**

saturation coefficients for the third factor **(**short and un word like**). -**

Saturation coefficient	items
0.328	14
0.456	15
0.615	16
0.439	17
0.449	18
0.459	19

= (internal consistency):

The correlation coefficients between items، the degree of distance، and the total score of the test were calculated on a sample of (120) male and female students in the primary stage; To identify the extent of homogeneity of the test items، and whether it measures one feature or multiple features، and table (12) shows the correlation coefficients between the terms and the degree of dimension، and the total score of the test

Table (12)

shows the correlation coefficients between the terms and the degree of dimension، and the total score of the test

Relation with total score	Relation with dimen-tion	items	factor	Relation with total score	Relation with dimen-tion	items	factor
.238**	.588**	9	Long and wordlike	.399**	.618**	1	Short and wordlike
.156	.635**	10		.343**	.426**	2	
.338**	.639**	11		.180*	.420**	3	
.284**	.519**	12		.202*	.462**	4	
.233*	.524**	13		.185*	.520**	5	
.177	.462**	14	Short and un word-like	.378**	.535**	6	
.307**	.483**	15		.416**	.504**	7	
.187*	.607**	16		.296**	.446**	8	
.471**	.572**	17					
.194*	.476**	18					
.357**	.479**	19					

2. Calculation of the correlation coefficients between the degrees of the dimensions and some of them، and the total score of the test:

Correlation coefficients were calculated between the dimensions of the scores and some of them، the total score of the test، and a table (12) showing the correlation coefficients between the dimensions of the degrees and some of them، and the total score of the test.

Table **(**13**)**

Correlation coefficients between dimensional scores and some of them، and the total score of the pseudoword test

factors	Short and word-like	Long and wordlike	Short and un wordlike	Total score
Short and wordlike	1			
Long and wordlike	0.625**	1		
Short and un wordlike	0.587**	0.495**	1	
Total score	0.602**	0.42**	0.563	1

Final image of the pseudoword test، Preparation by Researcher.

The test consisted of (19) items distributed over three main components، as shown in Table (13).

Table **(**14**)**

Final image of the pseudoword test، prepared by researcher

factors	numbers	items
Short and wordlike	8	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8
Long and wordlike	5	9 - 10 - 11 - 12 - 13
Short and un wordlike	8	14 - 15 - 16 - 17 - 18 - 19

2 - Reading comprehension test:

The aim of the test: measuring the fourth grade pupils’ possession of reading comprehension skills.

Table **(**15**)**

The test consists of three levels**:** word level، sentence level، text level، and each level consists of a group of sub - skills as in the table**.**

Sub skills	Main skills
Identifying the synonyms of the word. Identifying the Antonym of the word. Knowing the collocations of a word.	Word level
Sentence' that is appropriate - Reading for selecting "picture for the meaning. Reading for completing the sentence with suitable word according the meaning.	Sentence level
Reading to put a suitable title to the text. Reading to extract main idea. Reading for specific information.	Text level

Psychometric Properties of the Reading comprehension Test، Prepared by Researcher:

1 - Test Stability:

The researcher verified the stability of the test using several methods: split half coefficient، and Cronbach's alpha، as shown in table (14).

Table **(**16**)**

of the coefficient of the stability of the Reading comprehension test

alpha coefficient	Gutmann invariance	length correction. Spearman - Brown.	Split - half reliability coefficient
0.64	0.632	0.813	0.685

It is evident from the table (14) that the test has high stability coefficients، which confirms the validity of the test for application.

1. Test validation:

= Criterion - related validity:

Concurrent validity methods: The correlation coefficient between the reading comprehension test، prepared by researcher، and the reading comprehension test prepared byHeba Kamel،201 its value was 0.94، which is a high value that indicates the validity of the test for application.

Final image of the reading comprehension test، Preparation by Researcher.

The test consisted of (55) items distributed over three main components، as shown in Table (15).

Table **(**17**)**

Final image of the reading comprehension test، prepared by researcher

Factors	numbers	Items
Word level	29	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18. 20 - 21 - 22 - 23 - 24 - 25 - 26 - 27 - 28 29 - 30
Sentence level	20	31 - 32 - 33 - 34 35 - 36 - 37 - 38 - 39 - 40 - 41 - 42 43 - 44 - 45 - 46 - 47 - 48 - 49 - 50 -
Text level	6	51 - 52 - 53 - 54 - 55 - 56

Result and Discussion:

Reading comprehension can be predicted in the English language through some working memory tasks for fourth - grade primary pupils

Table **(**18**)**

correlation coefficient between reading comprehension and working memory components

Correlation Coefficient	Variables
0.22	Sentence span
0.82	Meaning task
0.494	Phonological loop
0.523	Central executive Digits task
0.558	Working memory

And to verify the predictability of reading comprehension in the English language on some components of working memory for fourth grade of primary school. Progressive multiple regression analysis or sequential analysis was used. the table (16) shows the results of the gradual regression analysis according to the importance of the influence of the independent variable (components of working memory) on the dependent variable (reading comprehension)، and the table (17) shows the results of the analysis of variance for the significance of the regression coefficients.

Table **(**19**)**

shows the results of the analysis of variance for the significance of the regression coefficients

Sig	T	Adjust R square	R2	R	B	Std error	Beta	con-stant	independent factors	predic-tor
0.01	6.074	.266	.273	0.525	2.221	0.366	0.523	23.351	Central executive Digits task	First predic-tor
0.01	4.735	.373	.386	.621	1.703	0.360	0.401	15.969	Central executive Digits task	Sec-ond predic-tor
0.01	4.220				0.344	0.082	0.357		Phonological loop{sentence span + meaning}	

Table **(**20**)**

Results of the analysis variance for the significance of the regression coefficient

Dependant variable		Sum of square	df	Mean square	F	sign
Central executive Digits task	regression	862.148	1	862.148	36.888	0.01
	residual	2290.442	98	23.372		
	Total score	3152.590				
Phonological loop{sentence span+meaning}	regression	1217.382	2	608.691	30.510	0.01
	residual	1935.208	97	19.951		
	Total score	3152.590	99			

According to two tables (17)، (18)، can be found:

that the first predictor، the reading comprehension in the English language can be predicted by knowing the performance of the sample on the central executive (the digits task) by 27.3%، or in other words، the central executive (the numbers task) has a predictive value of 27.3% in explaining the total variance of reading comprehension. Accordingly، the equation for predicting reading comprehension can be formulated by knowing the individual's score on the central port variable (the digits task) as follows:

y = regression constant + (beta value x central executive).

Reading comprehension = 23.351 + 0.523 x Central executive (digits task).

It is clear from Table (18) that the possibility of predicting reading comprehension with the knowledge of the performance of the sample on the central executive (the digits task) in the previous equation is statistically significant; Where the values of (P) were statistically significant at the 0.01 level، and this predictive value is high.

As for the second predictor**:**

Reading comprehension in the English language can be predicted with the knowledge of the performance of the sample in two components: the central executive (the numbers task)، the verbal component (the meaning task + the sentence span) at a rate of 38.6%، or in other words، the central executive(the digits task) and the verbal component (the meaning task + Sentence span) had a predictive value of 38.6% in explaining the overall variance of reading comprehension. Accordingly، the equation for predicting reading comprehension can be formulated by knowing the individual's score on the components of working memory: the central executive(digits task) and the verbal component (meaning task + sentence span) as follows:

y = regression constant + (beta value x central executive) + (beta value x verbal component).

Reading comprehension = 15.969 + (523. x central executive) + (357. +verbal component).

It is clear from Table (18) that the possibility of predicting reading comprehension by knowing the performance of the sample members on the central executive (the digits task) and the verbal component (the meaning task + sentence span) in the previous equation are statistically significant; Where the values of (P) were statistically significant at the 0.01 level، and this predictive value is high.

Barbara، C &Erika ،B.{2008}. Approved that working memory is related to reading comprehension ability. However، its role in explaining specific reading comprehension difficulties is still under debate: the issue mainly concerns whether the contribution of working memory is dependent on task modality (verbal tasks being more predictive than visuo - spatial tasks) and/or on the attention control implied in working memory tasks (tasks requiring storage/manipulation being more predictive than storage - only tasks، regardless of task modality). Meta - analysis is used here to examine the relevance of several working memory measures in distinguishing between the performance of poor and good comprehend in relation to the modality of the working memory task.

These studies show a clear link between working memory and text comprehension in children. As in adults، the question about general vs. specialised resources has been posed. The study by Siegel and Ryan (2003) demonstrates that the children with a specific reading deficit show poor performance on the verbal and numerical working memory tests. Similarly, Yuill, Oakhill and Parkin (2004) showed that children with a specific comprehension deficit (not a general reading problem) performed more poorly on a numerical working memory task. In general, as was the case with adults, the predictive power of tasks requiring the manipulation of linguistic materials tends to be higher than that of tasks using numerical ones. This pattern is clearly evident in Leather and Henry's (1994) data. They showed that text comprehension is predicted by both verbal and numerical tasks, with an advantage for verbal tasks. Un fortunately, they did not include a spatial working memory task, which would be expected to show a much weaker correlation with text comprehension.

Swanson and Berninger's (2000) data showed the same magnitude of correlations between visuo - spatial working memory and comprehension skill، and verbal working memory and comprehension skill، but groups of good and poor comprehend were differentiated only by their performance on verbal، not on visuo - spatial، working memory tasks. Thus،the issue of whether skilled reading comprehension in children is associated with a general working memory deficit remains equivocal

Jacqueline (2005) said that Pronunciation of the alphabet is a skill necessary for reading that requires phonological articulation and verbal working memory (WM) Verbal WM is a general cognitive resource that is necessary for reasoning and comprehension tasks، and its allocation is based on attention and cognitive demand ، Reading comprehension، therefore، is a complex cognitive process that requires central executive control for the allocation of limited WM resources. WM provides a medium for processing the contents of verbal STM during reading، WR develops through phonological processing، when words and letters become familiar or recognizable to the reader. WR is necessary for fluent reading because it allows WM resources to process text for meaning

Reading comprehension can be predicted in the English language through pseudowords for fourth - grade primary pupils.

Table **(** 21**)**

Correlation coefficients between reading comprehension and pseudowords

Correlation Coefficient	Variables
0.572	Reading comprehension - pseudoword

table (19) shows that there is a statistically significant relationship at the level of 0.01 between reading comprehension and reading pseudo - words for fourth grade of primary school.

And to ver ify the predictability of reading comprehension in the English language with the knowledge of performance in reading pseudo - words among fourth - grade pupils. Simple regression analysis was used، and the table (20) shows the results of the simple regression analysis according to the importance of the influence of the independent variable (reading pseudo words) on the dependent variable (reading comprehension)، and the table () shows the results of the analysis of variance for the significance of the regression coefficients.

Table (22)

Results of simple regression analysis according to the significance of the influence of the independent variable (pseudo - words) on the dependent variable (reading comprehension).

Sig	T	Adjust R square	R2	R	B	Std error	Beta	constant	predictor
0.01	6.90	.320	.327	0.572	1.178	0.171	0.572	20.754	pseudoward

Table (23)

Results of the analysis variance for the significance of the regression coefficient

Dependant variable		Sum of square	df	Mean square	F	sign
Reading comprehension	regression	1030.705	1	1030.705	47.603	0.01
	residual	500.326	98	5.105		
	Total score	743.360	99			

Reading comprehension in the English language can be predicted with the knowledge of the sample performance on pseudo words by 32.7%، or in other words،pseudo words has a predictive value of 32.7% in explaining the total variance of reading comprehension. Accordingly، the equation for predicting reading comprehension can be formulated by knowing the individual's score on the variable reading false words as follows:

$y = w + a \times x.$

Reading comprehension = 20،754 + 0.572× pseudo - words.

Table (20)shows that the possibility of predicting reading comprehension by knowing the performance of the sample on pseudo words in the previous equation is statistically significant; Where the values of (P) were statistically significant at the 0.01 level، and this predictive value is high

Santos (2003).result showed thaygeneral، 4 - and 5 - year - old children performed worse than older children. For all ages، more accuracy was observed for short pseudowords than for long ones. Children repeated high similarity pseudowords better than low similarity ones، and more errors occurred in medium similarity pseudowords.. There was no significant age effect on test scores Also، no interaction between age and length was observedchildren made more mistakes in pseudowords with medium wordlikeness than in pseudowords with high or low wordlikeness، and more mistakes in pseudowords with low than high wordlikeness. No interaction between age and wordlikeness was found

Paul Agnello(2018result showed that items containing longer pseudowords will be more difficult than items containing shorter pseudowords when controlling for orthographic probability، items containing un - wordlike pseudowords will be more difficult than items containing wordlike pseudowords when controlling for orthographic probability، pseudoword properties would interact such that items featuring both long and un - wordlike pseudowords will be more difficult than other pseudoword combinations.

Which variables is more important in predicting reading comprehension in English language، working memory or pseudowords?

Table **(**24**)**

Correlation coefficients between reading comprehension andworking memory and pseudowords

Correlation Coefficient	Variables
0.572	- pseudoword
0.558	Working memory

table (21) shows that there is a statistically significant relationship at the level of 0.01 between reading comprehension and working memory for fourth grade of primary school.

And to verify the predictability of reading comprehension in the English language with the knowledge of performance in working memory among fourth - grade pupils. Simple regression analysis was used، and the table (22) shows the results of the simple regression analysis according to the importance of the influence of the independent variable (working memory) on the dependent variable (reading comprehension)، and the table () shows the results of the analysis of variance for the significance of the regression coefficients.

Table **(**25**)**

Results of simple regression analysis according to the significance of the influence of the independent variable **(**working memory**)** on the dependent variable **(**reading comprehension

Sig	T	Adjust R square	R2	R	B	Std error	Beta	constant	independent factors	predictor
0.01	6.900	.320	.327	0.572	1.178	0.171	0.572	20.754	pseudoward	First predictor
0.01	4.939	.438	.450	.671	.844	0.171	0.410	13.095	pseudoward	Second predictor
0.01	4.652				0.339	0.730	0.386		Working memory	

Table **(**26**)** Results of the analysis variance for the significance of the regression coefficient

Dependant variable		Sum of square	df	Mean square	F	sign

pseudoward	regression	1030.705	1	1030.705	47.603	0.01
	residual	2121.885	98	21.652		
	Total score	3152.590				
Working memory	regression	1417.804	2	708.902	30.510	0.01
	residual	1734.590	97	17.884		
	Total score	3152.590	99			

According to two tables (22)، (23)، can be found:

McBride - Chang، C.، (2005). We found that even from a young age، children's skills that foster meaning construction make an important contribution to the determination of comprehension level over and above the contribution made by word - level and verbal skills. These findings lead us to conclude that working memory should be regarded as one of several factors that can influence comprehension ability and comprehension development. Clearly، neither good verbal skills nor good working memory resources are in themselves sufficient for the application of processes such as inference making and comprehension monitoring that are used in the construction of representations of text. Instead، further research is needed to establish which particular aspects of the comprehension - fostering skills need to be taught and included in future curricula Kate، C&Jane ،O. (2004). Results showed that verbal working memory، RAN، and onset- rime segmentation were highly and positively correlated at around.4 to.6 (all ps _.01; see Figure 1). However، despite their close positive relations، they had disparate effects on text comprehension and pseudoword reading. In general، with the exception of a very small positive effect (__.11، ns) of RAN on pseudoword reading، RAN and onset- rime segmentation did not have any appreciable effect on text comprehension or pseudoword reading (all paths were nonsignificant). Verbal working memory، however، had much stronger effects. Children with better verbal working memory performed much better in pseudoword reading (_b.62، p _.01) and text comprehension (_ b.83، p _.01). Though it is speculated that pseudoword reading might play the mediating role in the effect of verbal working memory on text comprehension، there is not much empirical support. If pseudoword reading had been the mediating factor، the path between pseudoword reading and text comprehension would have beenmuch stronger (it was only.06، nonsignificant). Thus، verbal working memory helped children's text comprehension performance quite independently and directly، rather than through improving their pseudoword reading competence، at least for the tasks used in the present study.

Recommendations

Based on the findings of this research، the following recommendations were suggested:

Training teachers on strategies that develop working memory In the English language.

Providing samples of working memory tasks and psedowords to be part of the curriculum for its role in developing reading comprehension.

More Arabic studies of the role of reading false words in developing reading comprehension.

Suggestions for further study:

Investigating the effect of using working memory on developing reading comprehension of primary school pupils.

The effect of training on reading pseduowords in developing reading comprehension.

References

- Jane، O & Nicole ،L (2000). Working Memory Resources and Children’s Reading Comprehension، Reading and Writing: An Interdisciplinary Journal 13: 81 - 103، 2000. @ 2000 Kluwer Academic Publishers. Printed in the Netherlands
- Candice، N (2012). THE CONTRIBUTION OF ATTENTIONAL CONTROL AND WORKING MEMORY TO READING COMPREHENSION AND DECODING، The Faculty of the Department of PsychologyUniversity of Houston.
- Meredyth،D (2000). Individual differences in working memory and reading ،Journal of verbal learning and verbal behavior ،450 - 466
- Kate،C، & Jane،O(2004). Children’s Reading Comprehension Ability: Concurrent Prediction by Working Memory، Verbal Ability، and Component Skills، Journal of educational psychology،2004،vol95
- Haskins،L(2014). Low working memory capacity is only spuriously related to poor reading comprehension، journal homepage: www.elsevier.com/locate/COGNIT
- Beborah،A(2005). The relations between children«0092»s reading comprehension، working memory، language skills and components of reading decoding in a normal sample، La Trobe University، Melbourne، Australia
- Hohn،V&Alison،F(2006). Phonological and syntactic processing and the role of working memory in reading comprehension among secondary school students، School of Psychology، Edith Cowan University، Joondalup، Western Australia، Australia

- Michael،L(2007). Learner - Based Factors in L2 Reading Comprehension and Processing Grammatical Form: Topic Familiarity and Working Memory، Language Learning 57:2، June 2007، pp. 229 - 270 C_ 2007 Language Learning Research Club، University of Michigan
- Chkan،L&Kittai،H(2008). Text Comprehension in Chinese Children: Relative Contribution of VerbalWorking Memory، Pseudoword Reading، Rapid Automatized Naming، andOnset - Rime Phonological Segmentation، Journal of Educational Psychology Copyright 2008 by the American Psychological Association 2008، Vol. 100، No. 1، 135 - 149
- Paola،P(2001). Working memory and updating processes in reading comprehension. University of Padua، Padua، Italy
- Suzanne،N(2000) Adults'reading comprehension: effects of syntactic complexity and working memory ،
- Berbara،C(2009). Role of working memory in explaining the performance of individuals with specific reading comprehension difficulties: A meta - analysis، journal homepage: www.elsevier.com/locate/lindif
- Catheriene،W(2004). Transfer of reading comprehension skills to L2 is linked to mental representations of text and to L2 working memory.
- Yuill، N.M.، Oakhill، J.V.، Garnham، A. & O'Donovan D. (2001). The relation between working memory abilities and children's reading.
- Baddeley، A (2000). Working memory: The multiple - component model. In A. Miyake & P. Shah (Eds.)، Models of Working Memory، (28 - 61). Cambridge: Cambridge University Press.

- Barrett، L.، Tugade، M. & Engle، R. W. (2004). Individual differences in working memory capacity and dual - process theories of the mind. Psychological Bulletin، 130(4)، 553 - 573.
- Cain، K. (2006). Individual differences in children's memory and reading comprehension: An investigation of semantic and inhibitory deficits. Memory، 14(5)، 553 - 569
- Christopher، M. E.، Miyake، A.، Keenan، J. M.، Pennington، B.، DeFries، J. C.، Wadsworth، S. J.، … Olson، R.K. (2012). Predicting word reading and comprehension with executive function and speed measures across development: a latent variable analysis. Journal of Experimental Psychology: General، 141(3)، 470 - 487.
- Perfetti، C. A. (2000). Reading ability. New York، NY: Oxford University Press.
- Seigneuric، A.، & Ehrlich، M. (2005). Contribution of working memory capacity to children's reading comprehension: A longitudinal investigation. Reading and Writing، 18، 617 - 656.
- Shankweiler، D.، (2002). Comprehension and decoding: patterns of association in children with reading disabilities. Scientific Studies of Reading، 3(1)، 69 - 94.
- Yuill، N.، Oakhill، J.، & Parkin (2001). Working memory، comprehension ability and the resolution of text anomaly. British Journal of Psychology، 80، 351 - 361.
- Oakhill، J.، Cain، K.، & Yuill، N. (2003). Individual differences in children«0092»s comprehension skill: Toward an integrated model. In C. Hulme & R. M. Joshi (Eds.)، Reading and spelling: Development and disorder (pp. 343«0092»367). Mahwah، N.J: Lawrence Erlbaum Associates.

- Seigneuric, A., Ehrlich, M. F., Oakhill, J., & Yuill, N. (2002). Working memory resources and children«0092»s reading comprehension. Reading and Writing, 13, 81«0092»103.
- Sesma, H., (2009). The contribution of executive skills to reading comprehension. Child Neuropsychology, 15, 232 - 246.
- Conners, F.A. (2009). Attentional control and the simple view of reading. Reading and Writing, 22, 591 - 613.
- Lee, J., (2008). The relationship of verb morphology to second language reading comprehension and input processing. The Modern Language Journal, 82, 33 - 48.
- Pulido, D., (2004). The relationship between text comprehension and second language incidental vocabulary acquisition: A matter of topic familiarity? Language Learning, 54, 469 - 523
- Laws G (2004). The use of nonword repetition as a test of phonological memory in children with Down syndrome. Journal of Child Psychology and Psychiatry, 39: 1119 - 1130.
- Barbara, C &Erika ,B.{2008}.Role of working memory in explaining the performance of individuals with specific reading comprehension difficulties: A meta - analysis, Department of General Psychology, University of Padova, Italy.
- Siegel, L.S. & Ryan, E.B. (2003). The development of working memory in normally achieving and subtypes of learning disabled children, Child Development 60: 973 - 980.
- Swanson, H.L.& Berninger V.W. (2000). Individual differences in children's working memory and writing skill, Journal of Experimental Child Psychology 63: 358 - 385.
- Yuill,.M., Oakhill, J., & Parkin, A. (2004). Working memory, comprehension ability and the resolution of text anomaly, British Journal of Psychology 80: 351 - 361.

- Kate, C&Jane ,O. (2004). Children's Reading Comprehension Ability: Concurrent Prediction by Working Memory, Verbal Ability, and Component Skills, Journal of Educational Psychology, Inc. 2004, Vol. 96, No. 1, 31 - 42
- McBride - Chang, C., (2005). Predictors of beginning reading in Chinese and English: A 2 - year longitudinal study of Chinese kindergartners. Scientific Studies of Reading, 9, 117 - 144.
- Santos C., (2003). Validation of the Brazilian Children's Test of Pseudoword Repetition in Portuguese speakers aged 4 to 10 years, BBrraazziilliiaann JCohuirlndarel no'fs MTeesdt icoaf l Pasnedu dBoiowloogrdic aRle Rpeesteitaiorcnh (2003) 36: 1533 - 1547
- Paul Agnello., (2018). Reasoning with Pseudowords: How Properties of Novel Verbal Stimuli Influence Item Difficulty and Linguistic - Group Score Differences on Cognitive Ability Assessments, The Graduate Center, City University of New York
- Jacqueline, B(2005). The Contribution of Working Memory Components to Reading Comprehension in Children,B.Sc., University of Lethbridge.
- Perfetti, C (2000). Reading ability. New York, NY: Oxford University Press.
- Carrell, P. (2006). Three components of background knowledge in reading comprehension. Language Learning, 33, 183 - 207.
- Bryant, P (2003). Children's reading problems. Oxford, UK: Blackwell.
- Gathercole,S.. (2005). Differentiating phonological memory and awareness of rhyme: reading and vocabulary development in children, British Journal of Psychology 82: 387 - 406.

- Daneman، M. & Carpenter، P.A. (200). Individual differences in integrating information between and within sentences، Journal of Experimental Psychology: Learning Memory and Cognition 9: 561 - 584
- Johnson، D. (2006). Cognitive characteristics of treatment resistant children with reading disabilities: A retrospective study. Journal of Psychoeducational Assessments، 29(2)، 137 - 149.
- Nation، K. (2001). Reading and language in children: Exposing hidden deficits. Psychologist، 238«0092»242.
- Hannon، B.، & Daneman، M. (2001). A new tool for measuring and understanding individual differences in the component processes of reading comprehension. Journal of Educational Psychology، 93، 103 - 128
- Johnson، P. (2006). Effects on reading comprehension of language complexity and
- cultural background of text. TESOL Quarterly، 16، 169 - 181..
- Carroll، P.. (2006). The relationship between prior knowledge and topic interest in second language reading. Studies in Second Language Acquisition، 285 - 309.
- Guthrie، J (2007). Reading motivation and reading comprehension growth in the later elementary years. Contemporary Educational Psychology، 32، 282 - 313. doi:10.1016/j.cedpsych.2006.05.004
- Baddeley، A. (2012). Working memory: Theories، models، and controversies. Annual Review of Psychology، 63، 1 - 29.
- Chong، J. A (2001). Children’s working memory: Investigating performance limitations in complex span tasks. Journal of Experimental Child Psychology، 90، 303 - 317.

- Espin, L. (2007). Grapheme - phoneme knowledge is essential for learning to read words in english. In J. L. Metsala, & L. C. Ehri (Eds.), Word Recognition in BeginningLiteracy (pp 3 - 40.
- Koch, A., McCloy, R. (2012). “Hello, Dolly!”: Parameter variation in cloned ability items. In C. J. Paullin (chair), Practical IRT: Applications in real - word situations. Paper presented at the Annual Conference of the Society for Industrial & Organizational Psychology, San Diego, CA.
- Hagtvet B. (2003). Listening comprehension and reading comprehension in poor decoders: Evidence for the importance of syntactic and semantic skills as well as phonological skills. Reading and Writing, 16, 505 - 539.