

READING COMPREHENSION PROCESS AS PRECURSORY TO MEMORY PROCESSES; INCORPORATING THE RELEVANCE OF ATKINSON AND SHIFFRIN'S (1968) MULTI-STORE MODEL

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Abstract

Reading comprehension is an activity that combines text features and the reader's psychological variables of prior knowledge and attention. Comprehension and recall of textual information can only occur on a deeper level when information is transferred from the sensory memory and processed in the short term memory. Keen attention and observance of key elements of reading comprehension is instrumental to the desired domicile of information in the long Term Memory (LTM). The clear explanation of memory processes by Atkinson and Shiffrin in the multi-store model (1968) does not only pioneer the emergence of studies in this field, but also stresses the invaluable nature of prior knowledge and other variables of reading comprehension. Based on the centrality of reading in learning, it is precursory to the initiation of memory processes. As a result, the semantic memory (LTM) of an individual which is often a product of the connectivity of pre-existing information with new information is better enhanced through the series of activities which define the reading comprehension process.

Keyword: Reading comprehension, Memory, Sensory Memory Long Term Memory (LTM, Short Term Memory (STM) and Multi-store Model.

Introduction

Reading is a vital language skill. As a receptive skill, reading is the centre of every human learning. It is almost impossible to engage in learning activity without the knowledge of word recognition and the ability to deduce meanings from words. Raza (2019) defines reading as a skill that involves a number of related complex and interactive processes that involve decoding written symbols to arrive at meaning. The search for meaning is therefore the onus of every effective reading and for the reader to arrive at the author's intended meaning, a variety of skills need to be deployed as the reader reads. Ari (2017) reiterates the complex nature of the reading process by defining reading as a complicated process that covers an array of physical and cognitive activities. These physical and cognitive activities function together to ensure that the reader arrives at the meaning the writer intends to communicate. For the reader to arrive at this intended meaning of print, he or she needs to possess the different cognitive and physical skills that define a good reader. These skills, when combined, help the reader to comprehend the text and retain it in the long term memory.

For reading to be effective, the individual needs to remember the content days, weeks or years later. Memory is the mechanism that makes this possible. The information processing activities that occur in the memory has often been likened to the operational mode of a computer as memory has an input device which receives the information through ending, a storage device and an output device through which information is accessed when needed.

Reading Comprehension Process

The reader uses different skills to comprehends the text. Comprehension as used here is the goal of every reading exercise. It is a process that involves word reading and the understanding of language. It is the combination of these two aspects that justify the success or otherwise of the search for meaning. Meaning is often not explicitly stated in print. As a result, for one to arrive at meaning, he or she has to engage in a number of psychological activities which typically start with word recognition, comprehension of recognized words and committing same to memory. The reader's primary goal is to coordinate words so that reading is automatic and productive (Leipzig in Reading Rockets, 2024). This can only happen if there is a link between the learners' background or previous knowledge and the reading content.

The presence of relevant background knowledge is a factor that cannot be undermined in reading. Background knowledge (either a product of the reader's prior direct or vicarious experiences) determines the level the reader comprehends the text. This helps the reader make intelligent guesses about the meaning of difficult words based on the context the word appears. These guesses make reading to be spontaneous and automatic without the constant stress of consulting the dictionary at the sight of every unfamiliar words. Also, to ensure that reading is meaningful and interesting, the reader constantly asks questions as he or she reads.

The pathway to comprehension is the ability of the reader to interact with the writer through the cues that are presented in the text. For this to be possible, the reader constantly asks himself purpose setting questions as the reading progresses. For reading to be productive, effective questioning should be practiced before, during and after reading (Reading Horizon, 2024). Before reading, one should be able to ask purpose-setting questions often by converting each heading to questions and subsequently reading the text to get the answers to these questions. During reading, the reader is expected to constantly maximize the skill of metacognition. Metacognitive skills are vital at this stage because the metacognitive process gives the learner the awareness of how they learn by alerting them when comprehension is breaking down or improving (Karbalaee, 2011). The success or otherwise of this process is tested at the end of the reading through the use of evaluative questions.

Aside the purpose setting questions that the reader asks at the beginning of the reading, coupled with the constant metacognitive questions that he or she asks himself as the reading progresses, the reader should ask summative or evaluative questions to test how well the text is understood. These questions are often drawn from the objectives that were set at the beginning of the reading (mostly through the headings that were converted to questions). The answers to these questions, when in line with the crux of the text, may determine the level the reader comprehends the text. In addition, the skill of asking the right questions before, during and at the end of the reading is helps the reader to make cogent predictions as he or she reads.

Reading is not a passive skill but an active and interactive process of constructing meaning. By implication, prediction is an invaluable skill in reading. For one to be active while reading, the skill of constant prediction is necessary. As one reads, he or she makes predictions that are confirmed as the reading progresses. Bailey (2015) opines that prediction is a vital reading strategy as it helps the students to use information

form text, such as headings, pictures and diagrams to anticipate what will happen next as the reading progresses. In most cases, proficient readers do phrasal reading by predicting the word that may appear after a particular word. If these predictions are successful, it indicates that the reader is conversant with the linguistic load of the text. On the other hand, if the reader constantly gets the predictions wrong, this indicates that there is a gap between the linguistic load of the text and the reader's knowledge. When these predictions are correct, they give the reader clues on the writer's thought processes, an information that helps the reader to make inferences.

Inferring while reading is predicated on the fact that reading comprehension is not an exercise that stops at the level of word recognition. The words the writer uses are clues that experienced readers use to arrive at the meaning the writer intends to communicate. Since it is impossible for the writer or author to directly teach his ideas directly to the reader due to physical barriers, the reader arrives at this meaning by making inferences. Bayat and Cetinkaya (2020) opine that inferences make it possible for the reader to access information that are implicit in the text. It is a higher order thinking that is actualised by connecting textual clues with the reader's background information. Inference-making has often been referred to as reading between the lines. This description of the skill is predicated on the fact that inference –making is the process of arriving at textual information that could be found by considering the gap left between two separate ideas expressed in the text. It should be stressed that reading comprehension is the synergy between texts based factors and cognitive processes and prominent among cognitive variables are activation of background knowledge and making inferences (Graessatr, 2015). A conscious and dedicated attempt to constantly make productive inferences may lead to the identification of main idea, a skill that promotes comprehension.

The reader's ability to arrive at the main idea as he reads is core in the reading comprehension

process. Main idea refers to the central message the author is trying to get across to the reader (Roell, 2019). Main ideas are usually accompanied by supporting details which provide more information about the paragraph. The supporting details that precede (when the main idea is stated at the beginning of the paragraph) or proceed (when the main idea is stated after a successive explanatory sentences) help the reader validate the brief details in the topic sentence that suggests the main idea. Reading is therefore a continuous process of extracting information from paragraphs in order to arrive at the main idea (Alfaki, 2013).

Models of Reading

The teacher needs to understand the implicit and explicit activities that surround the reading comprehension process in order to improve the reading ability of learners. Scholars and theorists (Rumelhart, 1977; Gough, 1972; Smith, 1971; Goodman, 1967) for years presented explanations on what it entails to read. These views were summed up under the models: Bottom-up Model, Top-down model and interactive model.

Bottom-up Model

The proponents of the bottom-up believe that reading is text-driven. The bottom-up model is described as a procedure that incorporates perceptual accuracy, sound, the ability to discover a series of texts, words, spelling patterns, and other language units (Nadia & Nasrulah, 2021). The model specifies that reading is entirely a bottom-up process that begins with word and proceeds to stringing words together to make sentences and extensive discourse. This entails that the reader constructs meaning from smallest to the greatest elements of the text. Prominent proponents of the bottom-up model are, Samuels and LaBerge (1974), Gough, (1972) and Flesch (1955). According to Gough (1972), the reading comprehension process involves a complex process that begins when graphemes enter the visual system and as the

reader commences the reading activity. Phonemic representation is further transformed to sound through the phonic method and the meaningful units or words then pass to the third level; this, according to the proponents of this model, leads to the assimilation of meaning into the knowledge system.

The bottom-up model suggest that reading is only possible when the reader is conversant with text-based features. This implies that, according to the proponents of the model, meaning resides in the text. As such, the reader's prior knowledge about the text plays minimal or insignificant role. Hence, the bottom-up model focuses on a single-direction and a part-to-whole conception of reading (Shahnazari & Dabaghi, 2014). This is a major criticism that validated the view of the top-down proponents of reading comprehension.

Top-Down Model of Reading Comprehension.

The top-down model of reading comprehension became prominent due to the gaps left unfilled by the bottom-up model. The model was based on what Goodman in Hopkins (2019) refers to as "psycholinguistic guessing game". According to this model, minimal text clues are needed for the reader to arrive at the meaning the author intends to pass across. Goodman proposes that children learn by guessing the meaning of words with the help of the context they appear. The proponents of the top-down model disregard the relevance of text factors and uplift the ability of the reader to construct meaning from the text with the help of minimal text clues and maximal cognitive factor like background knowledge. The top-down model submits that the reading comprehension process is not mechanical, but actively controlled by the reader (Grab, 2009). Based on this explanation, readers only identify letters and words just enough to confirm their assumptions of the meaning of the text. This implies that the crux of reading is to generate meaning rather than concentrating on how letters combine to form words and word to form sentences and discourse.

The neglect of word recognition by the top-down model entails that the model is one sided like the bottom-up model. Since reading is a complex process of meaning-making that combines text information with the reader's cognitive processes, the model was also criticised. This culminated to the interactive model by Rumelhart (1977).

The Interactive Model

The major proponent of the interactive model is Rumelhart. According to Rumelhart (1977), the interactive model of reading is a combination of both top-down and bottom-up models of reading comprehension. The interactive model agrees with the top-down conception that reading does not reside in the text and also allies with the bottom-down model view that meaning cannot be constructed without the due consideration of text-based variables.

The interactive model is neither in support of the view that the text is the sole source of meaning nor that the reader's cognitive processes is all that counts in reading. Rather, the model holds that meaning is the product of the writer's text and the reader's mind (Nadia & Nasrulah, 2021). The process of reading, according to the proponents of the model, starts with the recognition of text based features and then proceeds to linking these features with the background knowledge of the reader.

Though the interactive model seems exhaustive in explaining cogent variables that interplay in the meaning-making process of reading, it fails to address some issues. Specifically, the model does not address what happens when an individual has the needed knowledge of text features but with little or no background knowledge. This gap necessitated the emergence of the interactive and compensatory model of reading comprehension.

Interactive and Compensatory Model

The interactive and compensatory model is a more comprehensive conception of the nature of reading. The model was proposed by Stanovich (1980) and is an improvement of the interactive model. The model is based on the principle that the reading process can compensate for deficiency at any other level (Nadia & Nasrulah, 2021). This implies that a deficit in any knowledge results to greater reliance on other knowledge source. Simply put, a reader that has problem with word recognition, may largely rely on background experience to arrive at the meaning of the text and vice-versa.

The interactive and compensatory model acknowledges the place of individual difference in the reading process. It is a fact that readers adopt different processes as they read. While some are good at processing text based features like letters, words and sentence due to their possession of impressive knowledge of vocabulary, others remedy weaknesses pertaining to inadequate knowledge of vocabulary by relying on their ability to use background knowledge in creating meaning. This compensatory nature of the model has aided researchers (Ekwati, 2010; Carol, 2009) to help students who find it hard to read and comprehend. Specifically, Ekwati found that the interactive compensatory model positively and significantly affects students' reading comprehension as it helped them to discover the best reading strategy to adopt while reading.

Memory Processes

The ability to remember is crucial in every learning exercise. This is exclusively the function of the memory. Memory is at the centre of every human learning. It is a mechanism that determines if stored or encoded information will be recalled when the need arises. Memory is core in of learning, decoding and recalling. The American Psychological Association (APA, 2011) explains that memory is vital not only within the purview of students' performance in

school but also their personal and social lives; as such, it is often defined as the application of learning overtime. As humans, it will be difficult to accomplish our daily activities of reading, writing, taking a medication, going to work, caring for our family and having a conversation without maximizing the functions of memory. While it is tempting to oversimplify the processes and procedures that are involved in the formation of memory, due to the often automatic process of information storage, memory is a complex and systematic system that is comprised of procedures that combine diverse levels of mental organization and various Interconnected brain regions which allow us to recall information, actions and past experiences and apply them in our daily life (Damasceno, 2020). The memory process is a combination of mental and social factors in forming a memory. While the social elements of the memory process may emanate from reading a book, meeting an individual for the first time, going on a vacation, interacting with peers in school and at home and attending to work related matters, the mental or psychological aspects of memory processes are covert brain activities that initiate and sustain memory processes.

The memory process encompasses three major stages of encoding, consolidation, storage and retrieval (Burton & Lorelle, 2014). Encoding entails transforming information into codes that the brain understands (Allen, 2024). It is the first stage in the memory process and a major determinant of recall. For information to be properly encoded, it must be presented in a meaningful form to the individual. For a reading text, the more complex the text, the less the reader decodes. In this scenario, the best way to properly encode such information is to recoding, which refers to a process of converting the information from the form it was presented into a form that the individual best understands (Kathleen, McDermott & Roediger, 2014). The effectiveness of encoding or recoding actively predicts the next stage in the memory process.

The mental and physical stimuli that actively interact during encoding are inalienable at the consolidation or storage stage of memory process. The consolidation of new information proceeds encoding. Successfully encoded information needs to be stored in short and then long term memory for the memory process to progress. Information consolidation primarily refers to transforming encoded information to a stable and long lasting form (Squire, Genzel, Wixted & Morris, 2015). For this to be possible, the individual has to find a connection between existing information with the just encoded one. The success or otherwise of this process shapes the accuracy of the recall process

The memory process is cumulative and only ends when the information is successfully recalled when needed. Recall is therefore the true test of the memory process. As a crucial aspect of memory, recall is a process that is dependent on the earlier processes of encoding and consolidation. It refers to the act of retrieving information from the past (Britanica, 2024). Recall is a terminal stage of memory process that is often influenced by the depth at which a content was learned and the complexities associated with the content (Cowen, 2016). While these are major and general factors that may affect the recall of learning contents, personal factors like the individual's mental capabilities relating to intelligence and social factors like interference from the environment are issues to be considered when accounting for intervening variables in recall.

Memory is made up of systematic processes that have both psychological and social factors. By implication, for reading to be productive, the individual should be able to successfully encode the reading text and relating same to pre-existing knowledge. The success or otherwise of the memory process and learning in general is, according Atkinson and Shiffrin (1968), determined by the proper storage of information in the brain

The Multi-store Model by Atkinson and Shiffrin (1968)

The multi-store mode of memory was proposed by Atkinson and Shiffrin in 1968 to address core issues in the domains of memory formation and by extension, leaning. The theory asserts that human memory have three different modes and separate control processes accompany each mode. The major assumptions of the theory are:

1. the memory has three major stores which include the sensory, Short Term Memory (STM) and Long Term Memory (LTM)
2. each of the memory stores differ in the manner information is encoded and the capacity of information that is encoded
3. the memory stores also determine how long information will be stored (duration).
4. Information progresses from store to store in a linear way. This process is similar to how the computer operates, with an input, process and output.

The first memory store according is the sensory memory (Atkinson & Shiffrin, 1968). This memory holds information till it either decays or passes to the short term memory. The possibility of an information progressing to the short term memory is majorly dependent on attention. The higher the attentiveness on the path of the listener, reader or learner, the higher the chances of the information making it to the short term memory.

The sensory memory stores information for a limited amount of time. Atkinson and Shiffrin pegged this duration at one fourth ($\frac{1}{4}$) to half ($\frac{1}{2}$) a second. In consonance with the name, sensory stores constantly receive information from the five sense organs and only information that receives the needed attention is passed to the Short Term Memory (STM).

The Short Term Memory (STM) proceeds the sensory store. The STM is a major store of information, especially auditory messages. The

STM, according to Atkinson and Shiffrin can hold information for a duration of 30 seconds. Due to the relevance of the short term memory and the fact that information can only pass through this store to the long term memory, maintenance rehearsal (often through constant repetition) is a technique that is often used to extend the time information stays in this memory. The lack or inefficient maintenance rehearsal makes information storing to retrograde and as a result, decays or forgotten. Only well retained and rehearsed information moves to the long term memory.

The major store house of information is the long term memory. The multi-store model espouses that the storage capacity of the long term memory is unlimited. As a result, information can be stored in the LTM for a life time. Information that makes it to the long term memory are often semantically encoded (associated with existing knowledge). Also, Atkinson and Shiffrin suggest that elaborate rehearsal which entails a process of linking new information to existing ones is the best way to ensure that information gets to the LTM and remain there for the longest period of time.

Precursory Role of Reading Comprehension in Memory Processes

The multi-store model vividly explains the memory stores and the conditions that dictate the progress of information from one memory store to another. While the condition for retaining information in the short term memory could be met through maintenance rehearsal, which is an elementary form of remembering an information through rote, verbal and constant repetition, encoded and consolidated information passes from the short to long term memory only when such information is linked to existing knowledge through elaborate rehearsal (often accomplished by reading).

The place of reading comprehension in the upgrading of information from the short STM to LTM deserves the right attention. According to

Berns, Blain, Prietula, and Pye (2013), reading lights up the entire brain. This is mostly because it improves the knowledge association that promotes the movement of information from short to long term memory. As a result, for information to be retained in the long term memory and recalled when needed, there should be a fusion between text features and cognitive or psychological processes of attention, inference, prior knowledge and metacognition.

Based on the centrality of reading in learning and its tendency to promote elaborative rehearsal, it could be generalised that reading precedes the consolidation of information to long term memory. Researchers at the Beckman Institute (2022) investigated the potential benefits of reading in improving memory in adults and found that regular and engaged reading helps to strengthen memory skills in older adults. Similarly, Otache (2020) submits that reading is at the centre of knowledge acquisition. These viewpoints do not only advance the inalienability of reading in the memory process but also project the relevance of the multi-store model.

Conclusion

Memory and reading comprehension play complementary roles in the learning of new contents. It is impossible to retain textual information without recourse to memory processes. The transfer of information from sensory memory and the processing of same in the short term memory before getting to the long term memory is better achieved through effective reading skills. Since Atkinson and Shiffrin espoused in the multi-store model that memory is a linear process that starts with sensory memory, this paper concludes that the best sensory memory that guarantees the documentation of information in the long term memory is the eye and through reading.

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