

**A Brain-Based Learning Strategy for Developing
English Reading Comprehension of Primary
Stage Pupils**

Prepared by

Prof. Samah Mohamed Fahim El Sakka

Professor of (TEFL)

Curriculum, Instruction & Educational Technology Dept.

Faculty of Education Suez University

Dr. Rafaat Mustafa Salem

Lecturer of (TEFL)

Curriculum, Instruction & Educational Technology Dept.

Faculty of Education Suez University

Fatema Al-zahraa Magdy Ibrahim

A Teacher of English

المستخلص

تهدف هذه الدراسة الي التحقق من اثر إستراتيجية قائمة على التعلم المستند إلى الدماغ لتنمية الفهم القرائى باللغة الإنجليزية لدي عينة عشوائية من تلاميذ الصف الخامس الإبتدائى بمدرسة محد حافظ الإبتدائية بمحافظة السويس .اتبعت الدراسة المنهج شبه التجريبي. تكونت عينة الدراسة من (٧٣ تلميذ) تم اختيارهم عشوائيا. ثم تم تقسيم العينة الي مجموعة تجريبية (٣٧ تلميذ) ومجموعة ضابطة (٣٦ تلميذ) . واشتملت ادوات البحث علي اختبار الفهم القرائى قبلي /بعدي من تصميم الباحثة. تم تدريس البرنامج على مدار ستة أسابيع خلال الفصل الدراسي الأول من العام الدراسي ٢٠٢١-٢٠٢٢ . خلال هذه الفترة ، تعرضت المجموعة التجريبية لبرنامج قائم على التعلم المستند على الدماغ بينما تلقت المجموعة الضابطة تعليماتها التقليدية المنتظمة باستخدام الطريقة التقليدية للتدريس. و قد قامت الباحثة بإجراء اختبار فهم قرائى قبلى و بعدى و أجرت اختبار t للعينة المترابطة في البحث لمقارنة متوسطات درجات التلاميذ في الاختبار القبلي والبعدي. كشفت النتائج عن وجود فرق ذو دلالة إحصائية في متوسط درجات المجموعة التجريبية بين الاختبار القبلي والبعدي لمهارات الفهم القرائى لصالح الاختبار البعدي. تم إجراء اختبار t مستقل لعينتين لمقارنة متوسط درجات المجموعة الضابطة والمجموعة التجريبية و قد أظهرت النتائج وجود فرق ذو دلالة إحصائية بين متوسط درجات المجموعة الضابطة والمجموعة التجريبية في اختبار الفهم القرائى لصالح المجموعة التجريبية. وبناء على ذلك ، و تم استنتاج أن مهارات الفهم القرائى لتلاميذ المجموعة التجريبية قد تم تنميتها نتيجة لاستخدام استراتيجية التعلم المستند على الدماغ.

الكلمات المفتاحية : استراتيجية التعلم المستند على الدماغ –الفهم القرائى -تلاميذ الصف الخامس الإبتدائى.

Abstract

The purpose of this research was to investigate the effect of the brain-based learning strategy on primary pupils' reading comprehension skills. The participants of the research included 73 pupils who were randomly chosen from 5th year primary pupils at Mohamed Hafez Primary School during the first term of the 2021–2022 academic year. They were divided into two groups: experimental (N = 37) and control (N = 36). The present research entailed a reading comprehension pre/posttest designed by the researcher. The experimental group received instruction using the proposed program based on a brain-based learning strategy for developing their reading comprehension skills. On the other hand, pupils in the control group received their regular instruction using the traditional method of teaching. The reading comprehension test was administered pre- and post the experiment. A paired sample t-test was conducted to compare the means of the pupils' scores on the pre- and post-test. Results revealed a statistically significant difference in the mean scores of the experimental group between the pre- and post-test of reading comprehension skills in favor of the posttest. An independent sample t-test was conducted to compare the means of the control group and the experimental group. Results revealed a statistically significant difference between the mean scores of the control group and the experimental group in the reading comprehension post-test in favor of the experimental group. Accordingly, it was found that pupils in the experimental group have developed their reading comprehension skills as a result of using Brain-based learning instruction. It was concluded that the program based on a brain-based learning strategy, developed the 5th primary pupils' level of reading comprehension skills.

Key words: brain-based learning strategy, reading comprehension skills, 5th primary pupils

Introduction

Reading is viewed as the cornerstone of EFL learning, it is one of the most effective skills for pupils to gain knowledge in their fields of study (Mundhe, 2015). Reading has become a lifesaver for those who learn a foreign language because it exposes them to a boundless vocabulary and rich context that substitute for the learning experience they would have never had as native speakers. It indirectly supports them in fully understanding and learning the foreign language more effectively (Rojalai, 2021).

Hashemi (2021) considers reading one of the simplest and cheapest ways to obtain knowledge, as it can assist in understanding basic information to more sophisticated information. Hence, reading comprehension is the essence of reading, it is an active process where the reader can interact with the text. It is the process of creating meaning by coordinating a number of complicated processes such as word reading, word and world knowledge, and fluency (Hasan, 2018; Li & Clariana, 2019; Reis, 2020).

Reading comprehension is the process of extracting and constructing meaning through involvement and interaction with written language. Learners cannot understand without knowledge of words and interaction with the text. It includes three elements: the text that can be comprehended, the reader who is doing the comprehension, and the activity in which comprehension is a part (Ali, 2013). Although reading is an important skill for pupils (Trudell, 2019), they face many difficulties in reading comprehension in English, which constitutes an obstacle to their education and limits their activities and tendencies towards learning. Therefore, there is a need to find more effective methods to attract pupils' attention and excite them, as well as to eliminate the problems that they may face in reading comprehension (Rahimi & Babaei, 2021).

As asserted by Ali and Razali (2019), reading comprehension is regarded as one of the most strenuous language skills to be mastered by EFL

pupils as it requires them to subconsciously interact with the writers through various cognitive and metacognitive strategies such as predicting, analysing, and summarising. In view of this, many EFL pupils have been found struggling to read and comprehend simple sentences as they reach primary six, in spite of learning to read since the preschool stage (Chua & Sulaiman, 2021). Khasawneh (2021) sees that because of traditional methods in teaching reading in schools, a generation appeared that had reading difficulties, and thus many skills, including reading comprehension, that pupils must master in reading are missing. Thus, reading comprehension difficulties, if not addressed early, prevent pupils' progress and follow them into other grades (Khasawneh, 2021).

Many factors can cause the difficulties faced by EFL pupils in understanding the reading text, such as a lack of vocabulary, less grammatical understanding, an inadequate background of knowledge, and anxiety (Haerazi & Irawan, 2020). Thus, several studies have been conducted to investigate reading comprehension difficulties in the Egyptian context among pupils, such as El-Fattah and Mohamed (2021), Mohamed (2020), Bedeer (2018), and Abdel-Maksoud (2012). The results of most studies indicated that teaching methods for reading comprehension should be improved and updated to meet Egypt's 2030 vision and the principles of sustainable development in teaching reading. Also, the importance of reading comprehension in the primary stages must be highlighted.

As such, the majority of studies addressed the fact that brain-based learning strategy can be applied as an alternative solution to the previously mentioned problems. The brain-based learning strategy is a teaching strategy that considers the state of the brain when retrieving, processing, and interpreting information that has been absorbed and how the brain works to comprehend messages or information obtained. In short, this brain-based learning is a learning strategy that prioritizes brain development (Alshahrani, 2021; Rabbani; Sumarno, 2021). The brain-based learning strategy involves accepting and organising instructions by remembering the

rules about how the brain processes them to produce significant learning (Ahmad & Nasution, 2021; Rueda, 2020).

As a teacher of English at the primary stage, the researcher noticed that most primary pupils have weaknesses in English reading comprehension skills such as identifying the main idea, connecting the text meaning to their previous knowledge, and giving the appropriate meaning of key words. The researcher also interviewed a group of teachers and supervisors of English as a foreign language in the primary stage in Suez (N = 10), and the questions of the interview were as follows:

1. What are the reasons for poor reading comprehension skills in the primary stage?
2. What are the factors that affect reading comprehension skills in the primary stage?

The interviewees mentioned some reasons for pupils' weaknesses in reading comprehension skills, as follows:

1. The current method of teaching reading is not effective (60%).
2. The pupils also lack strategies to help them understand the essence of the text and learn about the main ideas.
3. The traditional teaching strategies are based on memorization and indoctrination, which do not take into account the abilities of the learners, their needs, or their multiple intelligences.

To assure the 5th primary pupils' weaknesses in reading comprehension, a pilot test has been designed by the researcher to assess their reading comprehension skills. It was piloted on a sample of pupils at the 5th primary stage (N = 64) out of the sample of the study at Mohamed Hafez Primary School during the first term of the academic year 2019–2020 to measure their reading comprehension skills. The results of the pilot study revealed that most of the participants (66%) in the 5th primary stage had problems with reading comprehension skills.

Table 1
Reading comprehension pilot test

Reading Comprehension test	Marks of pupils	Number of pupils	Percentage
	Below 13	42	66%
	Above 13	22	34%
total	26	64	100%

Statement of the problem

The problem of the present research was that there were some weaknesses in 5th year primary pupils' English reading comprehension skills. As a proposed solution to the present problem, the researcher suggested using a brain-based learning strategy. Thus, the present study tried to find an answer to the following main question:

1. What is the impact of using a brain-based learning strategy in teaching English on developing the reading comprehension skills of primary pupils?

From the aforementioned main question, some sub-questions were generated as follows:

1. What are the most important reading comprehension skills required for pupils in the primary stage?
2. What is the framework of a brain-based learning program?
3. What is the effect of brain-based learning program activities on reading comprehension?

Hypotheses of the research

The following hypotheses were tested

- There is a statistically significant difference at 0.01 level between the mean scores of the experimental group and the control group in the reading comprehension post-test in favor of the experimental group.
- There is a statistically significant difference at 0.01 level in the mean score of the experimental group between the pre- and post- test of reading comprehension skills in favor of the post-test of reading comprehension.

Significance of the research

The present research will hopefully be beneficial because

1. It draws the attention of curriculum designers to modify, organize, and enrich English curricula by employing the brain-based learning strategy.
2. It provides teachers with a suggested strategy based on brain-based learning that can be used to develop pupils` reading comprehension skills in the primary stage.
3. It draws teachers' attention to creating an effective learning environment by adopting a brain-based learning strategy in teaching English reading comprehension skills for the primary stage.
4. It provides pupils with a new way of thinking that helps them develop their reading comprehension skills.
5. It provides pupils with a strategy based on brain-based learning to help them energize their minds and foster optimal learning and long-term retention.

Delimitations of the research

The present research is delimited to:

1. Seventy-three pupils at the 5th primary stage were randomly selected in Mohamed Hafez primary school in Suez Governorate and were divided into two groups: (experimental group (N = 37) and (control group (N = 36).
2. The first term of the academic year 2021-2022.

3. Seven reading comprehension skills are as follows: identify the main idea of the text; identify the genre of the text; recognize related pronouns; guess the meaning of difficult words; identify specific information; infer specific information; and distinguish between relevant and irrelevant ideas.

Definition of terms

Brain-based learning strategy

Brain-based learning is operationally defined as a set of educational and learning procedures and steps used by both the teacher and the 5th year primary pupils. Based on the principles of brain-based learning, the teaching and learning processes include reading subjects for the primary stage. It follows the following steps:

1. Pre-exposure
2. Preparation
3. Initiation and Acquisition
4. Elaboration
5. Incubation and Memory Encoding
6. Verification and Confidence Check
7. Celebration and Integration

Reading comprehension

Reading comprehension is operationally defined as an internal mental process in which the 5th primary pupils interact with the readable text by linking the information stored in the brain to understand the explicit and implicit meaning of the readable text, as manifested in the primary pupils' ability to identify the main idea of the text, identify the genre of the text, recognize related pronouns, guess the meaning of difficult words, identify specific information, infer specific information, and distinguish between relevant and irrelevant ideas.

Review of related literature

A brain-based learning strategy (BBS) is effective for all pupils especially those facing learning challenges. According to Jensen (2008), if you are thinking about the learning process, then brain-based learning is the right way. Brain-based learning (BBL) should not be considered a program or cure, nor is it a solution to a problem. BBL is a set of principles, a guideline, or, in other words, a base for knowledge and skills on which one makes better decisions for the learning process in the pupil's life (Carman, 2019). According to Al-Tarawneh (2016), educators and psychologists must focus their efforts on the refinement of teaching and learning processes by using the neurocognitive concept to promote BBL (Shabatat & Al-Tarawneh, 2016).

Teaching through brain-based learning is very different from traditional methods of teaching. It stresses meaningful learning against the rote-learning style. BBL is more involved with hands-on activity-based learning and adopts a pupil-centred approach (Carman, 2019). According to Jensen, BBL is a model that considers how the brain learns optimally (Ritonga et al., 2021). Optimization is meant not by forcing the brain to accept as much learning as possible but by letting the brain learn and work according to its rhythm (Akmaliyah et al., 2021).

The BBS involves accepting rules about how the brain processes information and then organizing instructions by remembering these rules to produce significant learning (Ahmad & Nasution, 2021; Rueda, 2020). Thus, it is a learning concept that utilizes a single unit of the five natural learning systems of the brain, namely social, emotional, cognition, physical, and reflection. It provides a balanced portion of the five learning systems without favoring any one system (Bonomo, 2017). The definition implies that this strategy aims to develop the five natural learning systems of the brain to their maximum (Widodo, 2019). The five learning systems are emotional, social, cognitive, physical, and reflective. The five learning

systems influence each other and cannot stand alone (Belkacem & Lakas, 2021).

Uzezi and Jonah (2017) defined BBL as a pupil-focused and instructor-encouraged strategy that utilizes the intellectual abilities of pupils and focuses attention on the importance of learning, which is not only memorization. One of the BBL recommendations is that pupils must be submerged by educators in perplexing, intuitive encounters that are rich and genuine. From a personal perspective, pupils' minds can be stimulated through a meaningful challenge to the desired state of alertness that must be acquired.

Another definition of brain-based education is the application of strategies derived from the understanding of the different mechanisms of brain functions, to improve pupils' accomplishments (Marope, 2016; Mayer, 2017). According to Jensen (2016), BBL can be defined as the involvement of strategies established on the principles originating from an understanding of the brain to improve pupils' achievement. BBL is also defined by Assaf (2016) as a comprehensive and complete educational model that utilizes the fundamental functioning principles of the brain and, through its various developments, enhances the learning process for individuals and strengthens their ability to activate and utilize the acquired information.

BBL is a concept that creates learning that is empowering and strengthening for the human brain. In this regard, Tung (2015) stated that BBL is learning that is accompanied by the natural actions of the brain during learning. Rather than concentrating on repetition and regularity, focusing on the interests and love of learning is more important.

For Saleh (2012), BBL definition is an educational approach established on research in neuroscience. BCL (Brain-Compatible learning) is concerned with brain methods to naturally learn best, and the learning strategy originating from this type of research can easily be applied in any learning environment. In addition, Elwan (2012) defined it as a theory that is based on the building of the mind and provides a biological framework

for teaching and learning. It also aids in describing learning behaviors. Finally, Haghghi (2012) stated that a BBLS concentrates on using research about the brain's mechanisms (neuroscience) and the methods of educators to be able to utilize this knowledge to aid pupils in learning English speedily and competently.

Brain-based learning strategy

The brain-based learning strategy is a learner-centred and teacher-facilitated strategy that utilizes learners' cognitive endowments (Olaoluwa & Ayantoye, 2016). This strategy is based on the structure and functions of the brain in different aspects such as learning, assimilating, thinking, and remembering. A BBLS stimulates the whole brain for effective function, which results in greater academic progress. Research in neuroscience has established that each brain is wired differently, just as each fingerprint is distinct from the others (Jancke, 2018). Each person's brain is able to detect patterns, memorize, self-correct, learn from experience, and create knowledge. Therefore, as long as the brain is not prohibited from fulfilling its normal processes, learning will occur naturally (Wilson, 2018).

Jack and Kyado (2017) stated that BBL involves learners acquiring knowledge while applying a strategy that depends on how the brain functions. Accordingly, a BBLS is a way of thinking about the learning process. It is a set of principles and a base of knowledge and skills through which we can make better decisions about the learning process (Jensen, 2008).

Caine et al. (2005) grouped the 12 principles of BBL into three interrelated elements of brain-based learning as follows:

Relaxed Alertness: creating the optimal emotional climate for learning, the optimal condition for learning to occur, requires pushing the pupils beyond their comfort zone with challenge in a safe and caring learning environment. Perceived threat and stress in the learning environment cause downshifting and minimize the brain's capabilities. Teachers can create a state of relaxed

alertness, consisting of low threat and high challenge, by (a) lowering threat and promoting self-efficacy; (b) promoting collaboration and interaction; (c) engaging pupils' curiosity for meaning-making; and (d) facilitating the construction of emotional connections.

Orchestrated Immersion in Complex Experience: Creating optimal opportunities for learning orchestration refers to providing concrete and physical experiences that stimulate pupils to interact with knowledge and are aligned with pupils' developmental stages and prior knowledge. Exposing the brain to meaningful multisensory experiences in enriched environments stimulates neurons to grow dendritic branches and form neural networks where thoughts and memories are stored. Teachers can create a state of immersion by (a) engaging both brain hemispheres to establish a balance between generality and specificity; (b) engaging the entire physiology in learning with multisensory and authentic experiences; (c) fostering the pupils' capacity to make patterns and meaningful organization of information, and (d) acknowledging developmental steps in learning.

Active Processing of Experience: Creating optimal ways to consolidate learning, active processing refers to continuous consolidation that broadens and sustains knowledge and encourages pupils to internalize what they learn in a variety of ways to assure long-term retention. Teachers can create a state of active processing by (a) engaging both sensory memory and working memory; (b) promoting both focused attention and peripheral perception; (c) reinforcing both conscious and unconscious processing; considering pupils' styles and uniqueness; and (e) developing choice activities that allow pupils to choose how they process and store new knowledge.

Jensen (2008) provided the seven steps of brain-based learning strategy.

1. **Pre-exposure:** It provides the brain with an overview of the new learning before diving in. Pre-exposing pupils to new material in advance helps the brain develop better conceptualization. Alert

pupils' attention to new material to engage their brains in inquiring about it. The more prior knowledge pupils have, the greater the number of connections they'll make.

2. **Preparation:** It stimulates pupils to learn by creating curiosity and giving them a real-world motive. Discovering pupils' prior knowledge in the subject helps teachers customize their planning to the pupils' experience level and preferred learning style. Balance novelty and predictability. Consider pupils' characteristics when choosing learning materials and presentation strategies.
3. **Initiation and acquisition:** It attains immersion by providing an initial overload of ideas and details, followed by curiosity and determination to discover and construct meaning. Acquisition happens both formally and informally, so teachers need to provide learning experiences that reflect real life. Teachers should design a supportive and challenging classroom environment that prompts inquiry.
4. **Elaboration:** It involves pupils in processing the learning content. It requires pupils to think authentically to internalize learning. Learners need to think interdisciplinary to construct connections by relating the new learning of a subject to real life and other subjects. It is preferred to act cooperatively.
5. **Incubation and memory encoding:** It asserts the value of reviewing as the brain learns most effectively over time. Teachers should reinforce learners' ability to encode learning in their memory with appropriate use of downtime, emotions, real-life associations, and mnemonic techniques.
6. **Verification and confidence check:** It allows pupils to confirm their learning for themselves. Engage pupils with projects to demonstrate learning, reflective activities about what they've learned, and self-assessment and peer assessment activities to check and solidify what they have learned.
7. **Celebration and integration:** It instills the love of learning as it engages emotions and allows pupils to have fun and celebrate their success. Functional integration happens only over time and with repeated reviews. Integrate new learning into future lessons.

Brain based learning principles:

The principles of Brain-Based Learning theory create a general framework for effective and productive learning. These principles give educators a guide to improve the learning process and design the appropriate learning environment. BBL principles originated from neurological research, particularly during the 1990s. Educators and psychologists such as Caine and Caine (2006), Boyatzis, Goleman, and Rhee (2000), Jensen (2000, 2008), and Sousa (2016) are pioneers as well as forerunners in the BBL movement. These authors have participated in disseminating neurological research into research-based academic best practices. According to Caine et al. (2015), the following are the principles of brain-based learning:

1. The human brain is a parallel processor, meaning that it is capable of performing multiple tasks simultaneously. Therefore, teaching requires the orchestration of a wide variety of methods.
2. Learning engages the entire physiology, which implies that the brain functions according to physiological conditions (e.g., stress, nutrition, exercise, and health) that influence our ability to learn.
3. The search for meaning is innate, which implies that the ability to make sense of every experience is innate. It is the nature of the human brain to seek novelty, discovery, and challenge at all times.
4. The search for meaning occurs through patterning, which implies that the brain acquires knowledge by recognizing and categorizing information in a meaningful manner.
5. Emotions are critical to patterning, implying that emotions facilitate the storage and recall of information.
6. The brain simultaneously processes parts and wholes, implying that the two brain hemispheres work interactively to make sense of experience by perceiving both the big picture and the individual parts.

7. Learning involves both focused attention and peripheral attention, implying that as attention is important to learning, the brain can also learn from context that is not consciously attended to.
8. Learning involves conscious and unconscious processes, implying that much of what the brain learns lies beneath the surface and occurs through reflection, metacognitive questioning, and application of learning.
9. There are at least two types of memory systems: spatial instant memory and rote long-term memory. Spatial instant memory does not need memorization, while rote memory stores relatively unrelated information that needs practice and rehearsal. This implies the importance of immersing learners in experiences that engage them in multiple ways to remember.
10. The brain understands and remembers best when facts and skills are embedded in natural spatial memory, implying that embedding and immersing the learner in real and complex experiences invokes spatial memory and maximizes learning.
11. Learning is enhanced by challenge and inhibited by threat, implying that the brain is sensitive to stress as it learns better under challenge and downshifts under threat.
12. Every brain is unique, implying that learning something new helps the brain grow and changes the structure of the brain by building new neural pathways, dendrites, and connections, hence, the more one learns, the more unique his/her brain becomes.

Theoretical foundations of brain-based learning

Brain-based learning (BBL) has roots in foreign language theories. It is related to constructivism, which states that people's acquired ideas and experiences from the social and physical world provide them with knowledge and understanding (Burkett, 2014). More specifically, the study corresponds to Piaget's cognitive constructivism, which declares the role of

genetic factors, experiences, and the environment in controlling the development and formation of knowledge. Pupils and learners will be able to understand and construct what they have learned by incorporating brain-based learning strategies such as addressing memory, environment, senses, emotions, learning styles, attention, and reflection (Wills, 2009; Jenson, 2012; Burkett, 2014).

Constructive and cognitive theory creates various concepts, models, and learning strategies, one of them is BBL (Kapadia, 2014). Motivated by the general belief that if educators base how and what they teach on learning science, then learning can be accelerated and improved, not based on past practices of conventional education or assumptions about the learning process. McCabe (2018) stated that to consider the BBL as a pupil-centred learning strategy, we must utilize all brain tasks and recognize that all pupils can obtain knowledge in different ways as a serious need for learning that utilizes problems as a first step in gathering and integrating new information established on learner experience in activities.

People always seek for their experiences to be logical and make sense. Knowledge is constructed by people to assimilate their experiences. Knowledge is dependent on previous knowledge and experience and the application of language knowledge development. Practice and feedback are required by learning (Wang, Gong, Xu, & Hu, 2019), and when learning experiences are associated with the real world, learning increases (Hong, 2019). Thus, it is obvious that constructivist theory is the basis for BBL functions. The theory depended on the fact that the pupils must have the ability to utilize previous experience to construct new information and knowledge.

Research on brain-based learning

Several studies were carried out using brain-based learning strategy in EFL classrooms. Most of these studies proved that using the BBL helped develop reading comprehension skills. BBL is a teaching strategy that

considers the state of the brain when retrieving, processing, and interpreting information that has been absorbed and how the brain works to retain messages or information obtained. In short, this BBL is a learning strategy that prioritizes brain development (Alshahrani, 2021; Rabbani; Sumarno, 2021).

Şahin, Ökmen and Kılıç (2023) studied the effectiveness of the brain-based learning style cycle. The research sample consists of sophomore (2nd year) pupils studying at the Faculty of Education, Duzce University, for the academic year 2020–2021. There were 111 pupils: 84 girls and 27 boys. The course is structured around a brain-based learning style. At the end of the study, it was concluded that the pupils had a positive attitude towards the model. The model was found to make a significant difference in pupils' attitudes towards cooperative learning, teachers' self-efficacy, and metacognitive thinking skills.

Kohar (2022) aimed to investigate the effectiveness of the Brain-Based Learning Model on the level of reading comprehension based on the exposition reading structure in Indonesian Junior High Schools. This experimental study used a one-group pretest-posttest design. The Brain-Based Learning Model was found effective in developing reading comprehension in the seventh-grade pupils.

Kohar (2020) conducted a study to examine the effectiveness of reading comprehension practice via brain-based learning. The results of this study showed that (1) brain-based learning is effective, (2) brain-based learning can improve pupils' inferential comprehension, and (3) there are different influences of text structure on reading comprehension of exposition texts.

Nur, Hasyim, and Khalikin (2020) investigated the application of Brain-Based learning to be used in teaching reading comprehension to first-year pupils. Based on the findings and discussion of the research, the researcher came to the conclusion that the application of brain-based learning was good for teaching reading comprehension to first-year pupils.

Syhabandi (2018) carried out a study to discover the notable influence of brain-based learning on pupils' speaking skills at the second-grade senior high school in Praia. Brain-based learning, as one of the teaching techniques of Cooperative learning, was utilized by the researcher to reduce pupils' speaking problems. In this study, BBL was viewed as a technique of teaching speaking that made the pupils interested in learning the language and helped them speak.

Farrell (2016) concentrated on improving the learners' fluency by utilizing the three fundamental instructional strategies (relaxed alertness, orchestrated immersion, and active processing). The researcher concluded that using Caine and Caine's twelve Principles effectively developed pupils' oral communication fluency; all participants conquered their fears, raised their self-confidence, created strong bonds among the group members, and used their individual strengths to support each other.

Shabatat and Al-Tarawneh (2016) discovered that using brain-based learning has enhanced the level of achievement. Furthermore, the pupils who learned with brain-based learning had a tendency to be more active in class, especially when they were obliged to discuss in a group. They were encouraged by a challenging environment and rewards.

Jampamoon (2014) had an interest in scrutinizing the effects of brain-based learning on six pupils' speaking ability and studying the pupils' opinions towards brain-based learning activities via a questionnaire that clarified a practical opinion towards studying English through brain-based learning activities. The participants were guided to implement activities based on the 12 principles of brain-based learning. They practiced songs, games, and role-playing to reduce stress and anxiety, which in turn promoted their speaking.

Kiedinger (2011) examined the influence of brain-based learning on reading outcomes in elementary-aged pupils. There was a positive correlation between brain-based learning strategies and expected pupil achievement for these pupils.

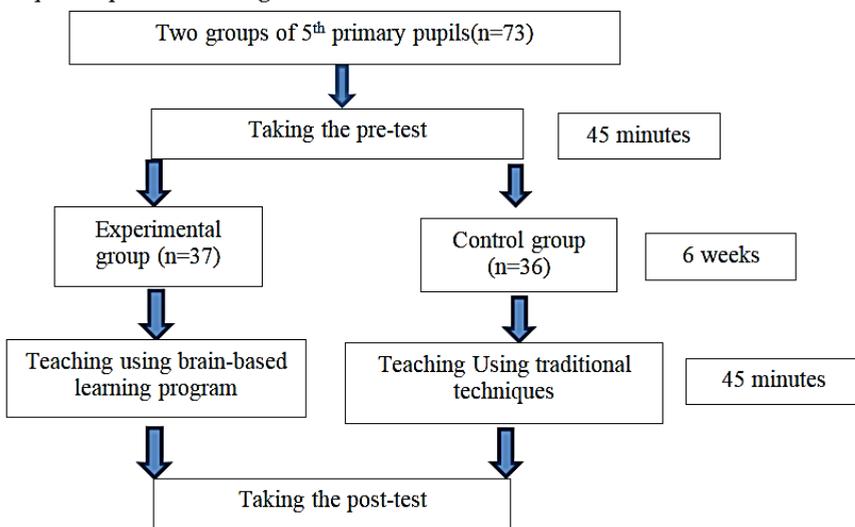
Methodology

Design

The present research used a quasi-experimental design. One intact class of fifth-year primary pupils at Mohamed Hafez Governmental School ($N = 73$) was randomly selected to represent a control group ($N = 36$) and an experimental one ($N = 37$). The experimental group received sessions through the proposed program based on brain-based learning to develop their reading comprehension skills. On the other hand, pupils in the control group were taught using traditional methods in the classroom. A pre-posttest was given to assess pupils' reading comprehension skills before and after the experiment. The design can be summarized in the following figure:

Figure 1

Pre-test-Post-test quasi-experimental design



Participants

One class was randomly selected from fifth-year primary pupils in Mohamed Hafez primary school ($N = 73$) during the first term of the academic year 2021–2022. It was divided into two equivalent groups. The pupils were aged between 10 and 11 at the time of the research. The first

group represented the experimental group ($N = 37$), and the second group represented the control group ($N = 36$). The pupils in the experimental group were taught by the researcher through the implementation of the study experiment, while pupils in the control group received regular instruction using the traditional method of teaching. An independent sample t-test was used to assure the groups' equivalence before the experiment. It was found that there was no statistically significant difference between the mean scores of the control group and the experimental group in their performance on the pre-test of reading comprehension skills ($t = 3.386$), as shown in the following table.

Table 2

T-test of the equivalence of the two groups before the experiment.

Reading Comprehension pre-test	Group	N	Mean	standard deviation	D F	T-value	Significance
	Con.	36	10.166	2.210	71	3.386	.124
	Exp.	37	11.270	5.047			

It is clear from the previous table that there was no statistically significant difference between the mean scores of the control group and the experimental group in the pre-test of reading comprehension skills ($t=3.386$), which indicates the equivalence between the two groups in the reading comprehension test before the experiment.

Instruments

To achieve the aim of the research, a pre-post reading comprehension test was designed by the researcher for assessing 5th year primary pupils' reading comprehension skills. To design the test, a checklist of reading comprehension skills was designed by the researcher to determine the most important reading comprehension skills to be developed for pupils at the primary stage.

The reading comprehension skills included in the checklist in its first form were determined through reviewing:

1. The procedural objectives are included in the Ministry of Education book.
2. The teachers' Guide as well as the pupils' book
3. Previous literature and related studies have concerned developing EFL reading comprehension skills at the primary stage.

The major aim of the English reading comprehension test was to measure the pupils' level in some reading comprehension skills before and after the experiment. The test consisted of 26 questions for 26 scores, one for each question. The test was made up of three texts chosen from the reading comprehension texts resource (www.k5learning.com), and each text will be read. After reading, participants have to choose a suitable answer for the accompanying questions.

The 26 questions of the reading comprehension test examined the following reading comprehension skills:

Questions 1, 10, and 19 examined the skill of identifying the main idea of the text; questions 2, 11, and 20 examined the skill of identifying the genre of the text; questions 3, 4, and 12 examined the skill of recognizing the related pronouns; questions 5, 14, and 24 examined the skill of guessing the meaning of difficult words; questions 6, 7, 8, 9, 15, 16, 17, 18, and 23 examined the skill of identifying specific information; questions 13, 22, and 25 examined the skill of distinguishing between relevant and irrelevant ideas.

Validity of the reading comprehension test

Considering the test's validity, the researcher used two ways to measure the degree of validity of the reading comprehension test.

1. Face validity: the jury members were requested to judge whether the test items were clear and appropriate to the research sample and whether the test items measure the EFL reading comprehension skills that they are supposed to measure. Reviewers suggested some modifications, and the researcher had taken them into account.

2. Internal consistency validity: To make sure of the validity of the EFL reading comprehension test, the researcher analyzed the data and measured the degree of validity between each item of the test and the overall test by measuring the internal consistency validity, and this was done through two stages:
- a. By calculating the correlation coefficient between each skill and the dimension to which the skill belongs.

Table 1

Reading comprehension skills test															
Identify the main idea of the text	Correlation with the skill dimension	Q	Recognize the genre of the text	Correlation with the skill dimension	Q	Recognize related pronouns	Correlation with the skill dimension	Q	Guessing the meaning of difficult words	Correlation with the skill dimension					
1	**0.532	2	**0.639	3	**0.560	5	**0.486	10	**0.644	11	**0.666	4	**0.601	14	**0.634
19	**0.534	20	**0.662	12	**0.542	24	**0.614	21	**0.610						
Identify information specific	Correlation with the skill dimension	Q	Infer specific information	Correlation with the skill dimension	Q	Distinguish relevant and irrelevant ideas	Correlation with the skill dimension								
6	**0.335	1	*0.761	2	*0.768										
		3	*	5	*										
7	**0.427	2	*0.766	2	*0.805										
		2	*	6	*										
8	*0.256														
9	*0.274														
15	*0.249														
16	**0.538														
17	*0.295														

Correlation coefficient between test skills and the degree of each domain of the total degree

* Statistically significant at 0.05. ** statistically significant at 0.01.

- a. By calculating the correlation coefficient between each skill and the overall score of the test.

Table 2

The correlation coefficient between each skill and the total score of the reading comprehension skills test

	Reading comprehension skill	Correlation with the overall score
First	Identify the main idea of the text	**، .٣٩٥
Second	Recognize the genre of the text	**، .٤٩١
Third	Recognize related pronouns	**، .٥٣٢
Fourth	Guessing the meaning of difficult words	**، .٣٥١
Fifth	Identify specific information	**، .٦٥٦
sixth	Infer specific information	*، .٣١٢
seventh	Distinguish between relevant and irrelevant ideas	**، .٥٨٤

* Statistically significant at 0.05. ** statistically significant at 0.01.

Reliability of reading comprehension test

The reliability of the reading comprehension test was evaluated by using the Cronbach's Alpha formulaas shown in Table5to demonstrate reliability coefficients of the reading comprehension skills test.

Table 2

Cronbach's alpha reliability coefficient of the reading comprehension test

Reading Comprehension skills	Cronbach's alpha reliability coefficient
Identify the main idea of the text	٠.٦٥٤
Identify the genre of the text	٠.٧٤١
Recognize related pronouns	٠.٧٠٠
Guess the meaning of difficult words	٠.٦٦٩
Identify specific information	٠.٥٣٥
Infer specific information	٠.٨٠٤
Distinguish between relevant and irrelevant ideas	٠.٨٢٢
The total score of the test	٠.٧٨٢

It is clear from the previous table that the test is characterized by high reliability with different reading comprehension skills (ranged from 0.535 to 0.804), this means that the test was reliable. So, it was applicable in its final version.

Reading comprehension test time

Test time was estimated that a period of 45 minutes would provide ample time for pupils to read to the three passages and answer the test. This was estimated using the following formula: -

$$\frac{\text{The Time taken by the fastest student} + \text{The Time taken of the slowest student.}}{2}$$

$$\frac{(33) + (57)}{2} = 45$$

Program and materials

This research included a suggested program based on a brain-based learning strategy to teach reading to EFL fifth year primary pupils in Mohamed Hafez primary school in Suez. The proposed program was intended to improve EFL pupils' reading comprehension skills. The program consisted of three main stages that included seven steps based on a brain-based learning strategy. The researcher prepared the suggested program based on brain-based learning strategy in light of the following:

- The objectives of teaching English in the primary stage
- The concept of brain-based learning and the factors affecting it
- The stages of brain-based learning
- The characteristics of brain-based learning
- The seven steps of the program are: pre-exposure, preparation, initiation, and acquisition; elaboration; incubation and memory encoding; verification and confidence check; celebration; and integration.

Objectives of the program

The objectives of this program are to develop the participants' following reading comprehension skills.

1. Identify the main idea of the text.
2. Identify the genre of the text.
3. Recognize related pronouns.
4. Guess the meaning of difficult words.
5. Identify specific information.
6. Infer specific information.
7. Distinguish between relevant and irrelevant ideas.

Content of the program

The suggested program based on a brain-based learning strategy consisted of ten reading passages from a reading comprehension passage resource (www.k5learning.com) that were

presented using the suggested brain-based teaching strategy. The passages revolved around the following topics: Playground, Grandpa's cooking, The camping trip, The clean park, Guitar or ballet, Cars' race, Playing catch, The washing machine box, The bee, Fire alarm

Duration of the program

The suggested program based on brain-based learning strategy lasted for six weeks (12 sessions), two sessions a week. Every session lasted for 90 minutes (two class periods). The first session was an introductory one; the researcher acquainted the learners with the fundamental information about brain-based learning, defined and explained the targeted reading comprehension skills, and also explained the stages of the suggested program. The researcher also clarified what the learners are expected to do. The rest of the sessions were devoted to presenting the 10 reading passages using the program based on a brain-based learning strategy prepared by the researcher.

Resources of the program

To design the program the researcher appropriately selected the resources as follows:

1. Previous literature and related studies, especially Şahin et al. (2023), Kohar (2020,2022), Nur, Hasyim, and Khalikin (2020), Caine et al. (2015), and Kiedinger (2011)
2. The content of the pupils' book and workbook for primary pupils
3. The teacher's guide
4. Aims and objectives of teaching English as a foreign language to 5th primary pupils

After reviewing these sources, the twelve sessions were devoted to developing some reading comprehension skills that were approved by jury members. In order to achieve successful participation in the classroom, various activities were used.

Program's activities

1. Looking at pictures and diagrams or graphs. This activity was used when pupils were unable to focus their attention on the topic. This activity helps pupils improve their skills in Identifying the main idea of the text and identifying specific information.
2. Reviewing vocabulary. The reviewed vocabulary was connected to what was used in the reading comprehension text. This activity helps pupils improve their skill at guessing the meaning of difficult words.
3. Completing part of the sentence. This activity was used to make pupils compare their answers with their classmates. This activity helps pupils improve their skill at inferring specific information.
4. Completing the following table. This activity was used to develop the ability to retain relevant points about the topic of the reading text. This activity helps pupils improve the skill of distinguishing between relevant and irrelevant ideas.
5. Answering the following questions: Pupils were allowed to go through the questions. They tried to answer the questions. It was important not to correct them, as they would get their feedback when they listened to the session. This activity helps pupils to improve the skills of identifying specific information and inferring specific information.

Stages of the program

The 12 principles of brain-based learning are grouped into three interrelated stages, and each stage is presented to the pupils through particular steps that follow the brain-based learning strategy

The first stage is relaxed alertness, creating the optimal emotional climate for learning.

The optimal condition for learning to occur requires pushing the pupils beyond their comfort zone with challenges in a safe and caring learning environment. Perceived threat and stress in the learning environment cause

downshifting and minimize the brain's capabilities. The teacher can create the optimal emotional climate for learning through the following steps:

Pre-exposure, this step helps the brain build a better conceptual map. It requires the teacher to:

- Show a concept map of the new material to be learned.
- Master the exciting learning environment.
- Convey learning objectives.
- Ask the pupils to bring drinking water as brain food.

Preparation, this step presents a framework for the new learning. It prepares the pupils' brains for all possible connections. This step includes a general idea about the topic and mental imagination for related topics. The more background the pupil has on the topic, the faster he or she will be at acquiring and processing the new data. This step requires the teacher to:

- Prepare the pupils' brains for the new topic by recognizing the connections between previous experience and the new topic.
- Provide a suitable and threat less classroom climate for pupils, the class should present a fearless educational environment.
- Establish the class environment with suitable enriching experiences to enable the pupil to absorb the new mental connections, thus making the new inputs reliable to reach deep thinking.
- Place the pupils in a real-life environment closely related to the target issue.

The second stage is orchestrated immersion in complex experience: creating optimal opportunities for learning. Orchestration refers to providing concrete and physical experiences that stimulate pupils to interact with knowledge and are aligned with pupils' developmental stages and prior knowledge. Exposing the brain to meaningful multisensory experiences in enriched environments stimulates neurons to grow dendritic branches and form neural networks where thoughts and memories are stored. Teachers can create a state of immersion by following these steps:

Initiation and Acquisition are mental processes to organise experiences and knowledge to make them suitable for the pupils' experiences, to form connections, or to continue with some neuroses. This can be achieved through environmental stimuli such as role play and group work. This step requires the teacher to:

- Activate the brain to recall the neural networks and help the pupil construct new mental connections.
- Strengthen the mental relations connected to the experience subject.
- Construct rich previous experiences before starting new learning experiences.
- Establish a stimulating environment for cooperation, interaction, and positive competition among pupils.

Elaboration, this step supports the depth of understanding and untangling the results of the new learning. This can be achieved by involving the pupil in different activities and reaching a neural balance state, which is reflected in acceptance of information and clarity of experience. This step requires the teacher to:

- Design expansion situations in interactive experiences that are mentally and neutrally related.
- Encourage pupils to apply the target learning in real and new situations. Supply feedback by using role-playing, trips, or life experiences.

Incubation and Memory Encoding, this stage concentrates on recess time and repeating an important thing. Here are the things to do:

- Give the stretches and relaxation by Brain Gym.
- Show videos that can train the brain's concentration and focus.
- Provide exercises.

The third stage is the active processing of experience: creating optimal ways to consolidate learning. Active processing refers to continuous consolidation that broadens and sustains knowledge and encourages pupils to internalize what they learn in a variety of ways to assure long-term

retention. Teachers can create a state of active processing by following these steps:

Verification and confidence check, in this step, the educator checks whether the pupil is already familiar with the material they have learned or not. Pupils also need to know if they have understood the material or not. Here are the things to do:

- Check whether the pupil is already familiar with the material they have learned.
- Prepare and give a quiz to the pupils, either verbally or in writing.

Celebration and Integration, this stage aims to construct a neural network directed to the identified learning objective, and when the pupil is aware of his objective, he becomes neutrally alert. This stage requires the teacher to:

- Organize experiences into webs or mental maps that suit the neural networks to learn.
- Supplying the pupil with instant and continuous feedback and clarifying the objective of the learning.
- Supply a relieving atmosphere and suitable neural stimulation.
- Involve pupils in positive emotions.
- Present exciting and active experiences to meet the pupils' needs to form memories.

The pupils' assessment

All the previous stages should include evaluation, aiming at giving interactive feedback about the pupils' performance to help them adapt themselves. Feedback takes place when the pupil makes a mistake in response to stimuli; the brain revises the stimuli before responding. It also processes the data again. This requires the teacher to:

- Give instant and continuous feedback on learners' performance.
- Give the learner the opportunity to make decisions. The teacher's role can be summarized as follows:

- Preparing the cooperative work to acquire social interaction methods and to supply a fertile and fearless learning environment
- Using comforting and joyful techniques to keep fear and stress away from pupils, like role-playing and games
- Encouraging the pupils to generate ideas and solutions freely and spontaneously as much as they can
- Giving pupils the chance to talk, discuss, and brain storm to discover the outer environment

The assessment was divided into three stages: Pre-assessment, which occurred at the beginning of every lesson to arouse the pupils' interest and direct their attention. It also helped in identifying any prior information they knew about the topic. Formative assessment was used during the lesson to follow the pupils' cooperation in answering the worksheets. Final assessment at the end of every lesson to make sure that the pupils have gained the target skills by asking questions and having discussions with them.

Results and Discussion

The analysis of the data in the present research included both descriptive and inferential statistics. The descriptive statistics were the arithmetic mean, standard deviation, and percentages. The inferential statistics used for data analysis were T-tests (two sample independent t test and two sample dependent (paired) t test). All of these statistics were computed using SPSS (Statistical Package for Social Sciences Version 22).

The results of this research would be presented in terms of the research hypotheses:

Results related to the first hypothesis

The first hypothesis of the research stated that "There is a statistically significant difference at the 0.01 level between the mean scores of the experimental group and the control group in the reading comprehension post-test in favor of the experimental group." To validate this hypothesis, the data were statistically processed using a t-test (v) in the case of two independent samples to show the significance of the differences between the mean scores of the two groups (control and experimental) in the reading comprehension skills posttest, and the statistical results are as shown in the following table:

Table 6

Differences between the control group and the experimental group mean scores in the reading comprehension skills posttest

Reading comprehension skills	Group	N	Mean	Std. Deviation	D.F.	T-value	Sig.	significance
Identify the main idea of the text	Con.	36	1.027	1.108	71	6.315-	***.000	significant
	Exp.	37	2.783	0.479				
Identify the genre of the text	Con.	36	1.416	1.002	71	7.334-	***.000	significant
	Exp.	37	2.783	0.417				
Recognize related pronouns	Con.	36	2.166	0.840	71	9.381-	***.000	significant
	Exp.	37	3.702	0.519				
Guess the meaning of difficult words	Con.	36	0.722	0.814	71	-	***.000	significant
	Exp.	37	2.621	0.639		11.101		
Identify specific information	Con.	36	4.833	1.732	71	9.044-	***.000	significant
	Exp.	37	8.216	1.400				
Infer specific information	Con.	36	0.666	0.717	71	7.078-	***.000	significant
	Exp.	37	1.706	0.494				
Distinguish between relevant and irrelevant ideas	Con.	36	0.861	0.798	71	6.044-	***.000	significant
	Exp.	37	1.810	0.518				
Total	Con.	36	12.194	3.028	71	13.611-	***.000	significant
	Exp.	37	23.670	3.674				

** statistically significant at 0.01.

According to the previous table, it is clear that:

There is a statistically significant difference between the control group and the experimental group in the first skill of reading comprehension skills (identify the main idea of the text), where the value of t (-6.315) is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 2.783, which is greater than the mean score of the control group of 1.527.

There is a statistically significant difference between the control group and the experimental group in the second skill of the reading comprehension skills (identify the genre of the text), where the value of T (-7.334) is a statistically significant value at 0.01, and this difference is in favor of the experimental group, where the mean score of the experimental group was 2.783, which is greater than the mean score of the control group of 1.416.

There is a statistically significant difference between the control group and the experimental group in the third skill of the reading comprehension skills (recognize related pronouns), where the value of t (-9.381) is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 3.702, which is greater than the mean score of the control group of 2.166.

There is a statistically significant difference between the control group and the experimental group in the fourth skill of the reading comprehension skills (guess the meaning of difficult words), where the value of t (-11.101) is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 2.621, which is greater than the mean score of the control group of 0.722.

There is a statistically significant difference between the control group and the experimental group in the fifth skill of the reading comprehension skills (identify specific information), where the value of t (-

9.044) is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 8.216, which is greater than the mean score of the control group of 4.833.

There is a statistically significant difference between the control group and the experimental group in the sixth skill of the reading comprehension skills (infer specific information), where the value of t (-7.578), which is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 1.756, which is greater than the mean score of the control group of 0.666.

There is a statistically significant difference between the control group and the experimental group in the seventh skill of the reading comprehension skills (distinguish between relevant and irrelevant ideas), where the value of t (-6.044) is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 1.810, which is greater than the mean score of the control group of 0.861.

There is a statistically significant difference between the control group and the experimental group in the overall degree of the reading comprehension skills scale, where the value of t (-13.611) is a statistically significant value at 0.01, and this difference tends in favor of the experimental group, where the mean score of the experimental group was 23.675, which is greater than the mean score of the control group of 12.194. In view of the above, the results indicated that there were statistically significant differences at (0.01) in the total mean score of the reading comprehension posttest in favor of the experimental group taught by Brain-Based Learning Strategy (BBL). Accordingly, the first hypothesis was accepted, and it was concluded that using a BBL was effective in developing pupils' English reading comprehension skills. This result can be attributed to both the features of the BBL and the benefits of the strategy

activities and tools when they are both used in an EFL class during the experiment. The researcher also attributed these results to the following reasons: using the BBLs facilitated learning English reading comprehension among the experimental group pupils as the strategy presented the reading skills required to be learned in an interesting and attractive manner that is suitable for the pupils' age as they are still young and need to be taught with fun. It also considered multiple intelligences and individual differences in presenting the reading skills required to be learned.

The strategy added various handlings of activities to lessons, which, of course, reduced the pupils' boredom resulting from seeing and doing the same things all the time. This could be seen through using different strategies and provoking questions in the classroom. These results can also be attributed to the styles used by the researcher in English reading comprehension learning through the strategy. The styles are using the activities that focus on analyzing the two hemispheres.

Results related to the second hypothesis

As for the second hypothesis, it stated that "There is a statistically significant difference at the 0.01 level in the mean score of the experimental group between the pre- and post-test of reading comprehension skills in favor of the post-test of reading comprehension." To verify the validity of this hypothesis, the data were processed statistically using the dependent samples t-test to show the significance of the differences between the mean scores of the two standards (pre- and post-) in the test of reading comprehension skills in the mean score of the experimental group, and the results were as shown in the following table:

Table 7

Reading Comprehension skills	Test	N	Mean	SD	DF	T-value	Sig	significance	effect size η^2 eta squared
Identify the main idea of the text	Pre	37	1.810	1.075	36	5.295-	**0.000	significant	0.438 Very large
	Post	37	2.783	0.479					
Identify the genre of the text	Pre	37	1.297	1.102	36	7.731-	**0.000	significant	0.624 Very large
	Post	37	2.783	0.417					
Recognize related pronouns	Pre	37	1.973	1.142	36	8.991-	**0.000	significant	0.692 Very large
	Post	37	3.702	0.519					
Guess the meaning of difficult words	Pre	37	0.594	0.797	36	11.557-	**0.000	significant	0.788 Very large
	Post	37	2.621	0.639					
Identify specific information	Pre	37	3.891	1.183	36	11.826-	**0.000	significant	0.795 Very large
	Post	37	8.216	1.455					
Infer specific information	Pre	37	0.918	0.759	36	6.668-	**0.000	significant	0.553 Very large
	Post	37	1.756	0.494					
Distinguish between relevant and irrelevant ideas to the text	Pre	37	0.783	0.750	36	8.185-	**0.000	significant	0.65 Very large
	Post	37	1.810	0.518					
Total	Pre	37	11.270	5.047	36	14.060-	**0.000	significant	0.846 Very large
	Post	37	23.675	3.674					

T-test of the differences between experimental group's mean scores on the pre- and post-test of reading comprehension skills

** statistically significant at 0.01.

According to the previous table it is clear that:

There is a statistically significant difference between the pre-test and the post-test in the first skill (Identify the main idea of the text) of the reading comprehension skills, where the value of t (-5.295) is a statistically significant value at 0.01, and these differences tend in favor of the post-test where the mean score of the post-test was 2.783, which is greater than the mean score of the pre-test, which was 1.810. In addition, the size of the effect was calculated using the ETA square, where it reached 0.438, which is a very large value.

There is a statistically significant difference between the pre-test and the post-test in the second skill (identify the genre of the text) of the reading comprehension skills, where the value of t (-7.731) is a statistically significant value at 0.01, and these differences tend in favor of the post-test, where the mean score of the post-test was 2.783, which is greater than the mean score of the pre-test, which was 1.297. In addition, the size of the effect was calculated using the ETA square, where it reached 0.624, which is a very large value.

There is a statistically significant difference between pre-test and post-test in the third skill (recognize related pronouns) of the reading comprehension skills, where the value of t (-8.991) is a statistically significant value at 0.01, and these differences tend in favor of the post-test, where the mean score of the post-test was 3.702, which is greater than the mean score of the pre-test, 1.973. In addition, the size of the effect was calculated using the ETA square, where it reached 0.692, which is a very large value.

There is a statistically significant difference between pre-test and post-test in the fourth skill (guess the meaning of difficult words) of the reading comprehension skills, where the value of t (-11.557) is a statistically significant value at 0.01, and these differences tend in favor of the post-test, where the mean score of the post-test was 2.621, which is greater than the mean score of the pre-test, 0.594. In addition, the size of the effect was

calculated using the ETA square, which was 0.788, which is a very large value.

There is a statistically significant difference between the pre-test and the post- test in the fifth skill (identify specific information) of the reading comprehension skills, where the value of t (11.826) is a statistically significant value at 0.01, and these differences tend in favor of the post-test, where the mean score of the post-test was 8.216, which is greater than the mean score of the pre-test of 3.891. In addition, the size of the effect was calculated using the ETA square, where it reached 0.795, which is a very large value.

There is a statistically significant difference between pre-test and post-test in the sixth skill (infer specific information) of the reading comprehension skills, where the value of t (-6.668) is a statistically significant value at 0.01, and these differences tend in favor of the post-test, where the mean score of the post-test was 1.756, which is greater than the mean score of the pre-test, 0.918. In addition, the size of the effect was calculated using the ETA square, where it reached 0.553, which is a very large value.

In view of the above, the results indicated that there were significant differences at (0.01) in the total mean score of the experimental group in favor of the post-test. It can be concluded that the results of this hypothesis proved the effectiveness of using a BBL in developing pupils' English reading comprehension skills. Therefore, the second hypothesis was accepted.

This could be interpreted as the BBL, which is one of the highest-level strategies that focus on the work of the mind, especially the skill of evaluation. That is to say, pupils are trained enough to make sense of what they read and evaluate the text or answer they produce. BBL trained pupils how to evaluate and assess what they read. This was reflected in their learning and, thus, in their results in the posttest. Consequently, the post-test showed higher results. The 37 pupils in the experimental group learned

some productive habits through participating with each other in decision-making. This means that they used their left and right hemispheres to think. Pupils in the experimental group used to be trained on skills that developed thinking skills. The researcher can attribute the results to the fact that the BBLs guides pupils to be active individuals who use their different parts of their bodies to serve their cognitive abilities in the brain.

The results of the present research were in line with the results of Kohar (2020,2022), Nur, Hasyim, and Khalikin (2020), Ali et al. (2020), Yunita (2020), Bedeer (2018), Syahbandi (2018), and Shabatat and Al-Tarawneh (2016), as they all proved the positive effect of using brain-based learning strategy in developing English reading comprehension skills. The results were revealed:

1. There was a statistically significant difference between the mean scores of the control group and the experimental group in the reading comprehension post-test in favor of the experimental group.
2. There was a statistically significant difference in the mean score of the experimental group between the pre- and posttest of reading comprehension skills in favor of the posttest.

Conclusion

Within the delimitations of the research as well as the findings, the researcher concluded that the suggested brain-based learning program was effective in developing the reading comprehension of EFL primary pupils.

Recommendations

In light of the findings of the research, the following recommendations have been formulated:

1. Brain-based learning strategies should be used by teachers in teaching classes.
2. Teachers should liberate themselves from the traditional ways of teaching and effectively apply the new approaches to teaching that depend on brain-based learning strategy.

3. Enough time should be allocated to developing primary pupils' reading comprehension.
4. English language teachers are advised to stay away from traditional assessment and instead use alternative assessment to assess the levels of thinking the pupils have.
5. Individual differences between students should be considered when developing a reading skill teaching strategy.

Suggestions for Further Studies

1. The BBLS (Brain-Based Learning Strategy) should be applied to other English skills and sub-skills.
2. A further study should be conducted to reveal the effect of using a brain-based learning strategy on developing other pupils' thinking skills in the English language and in other subjects.
3. A further study should be conducted to show the effect of using a brain-based learning strategy on developing reading comprehension skills among other graders.

Conduct descriptive studies that show the educational competencies of English language teachers in the light of brain-based learning.

References

- Abdel- Maksoud, M. (2012). *The effectiveness of the transactional teaching approach in developing EFL strategic reading and reading comprehension skills among secondary school students*. Unpublished PhD Dissertation. Faculty of Education, Benha University.
- Ahmad, & Nasution, M. D. (2021). Beliefs of mathematics teachers on motivation and action learning models in the classroom learning process, *Indonesian perspective. educational sciences: theory & practice*, 21(1), 155-166. <https://doi.org/10.12738/jestp.2021.1.01>.
- Akmaliah, Akmaliah & Hudzaifah, Yasir & Ulfah, Nisrina & Pamungkas, Muhammad. (2021). Child-friendly teaching approach for Arabic language in Indonesian Islamic boarding school. *International Journal of Language Education*. 5. 501. 10.26858/ijole.v5i1.15297.
- Al Afiah, F. (2022). The correlation student reading speed and reading comprehension achievement of the tenth-grade students in Indonesia. *Journal varidilka*, 33(2), 165-174.
- Ali, A. M., & Razali, A. B. (2019). *A review of studies on cognitive and metacognitive reading strategies in teaching reading comprehension for ESL/EFL learners*. *English Language Teaching*, 12(6), 94-111.
- Ali, M. Q., Kashif, N. U., & Shahzad, M. A. (2020). *Brain-based learning and Urdu EFL learners' academic achievement in English at secondary school level in district Vehari*. *Global Language Review*, 4(2), 135-144. [https://doi.org/10.31703/blr.2020\(V-II\).14](https://doi.org/10.31703/blr.2020(V-II).14).
- Alshahrani, S. T. (2021). Operating in a new paradigm: exploring workplace reconfiguration in the time of covid-19. *International Journal of eBusiness and Government Studies*, 13(2), 281-303. <https://sobiad.info/index.php/ijebe/article/view/886/105>.
- Amjadi, A., & Talebi, S. H. (2021). Extending the efficacy of collaborative strategic reading (CSR) in teaching reading strategies: *A sociocultural emotional perspective*. *Language Teaching Research*, Advance online publication. <https://doi.org/10.1177/13621688211011501>.
- Aprilia, N. (2015). *Improving reading comprehension of the eight grade students at SMP N 6 Yogyakarta through POSSE strategy in the academic year 2014/2015*. Thesis. English Education Program, State University of Yogyakarta.

- Assaf, M. (2016). *Impact of using two-side brain learning strategy on developing scientific concepts and science processes among fifth graders in Gaza*. (Unpublished Master Thesis). The Islamic University of Gaza, Palestine.
- Babayigit, Ö. (2019). The reading speed of elementary school students on the all text written with capital and lowercase letters. *Universal Journal of Educational Research*, 7(2), 371-380.
- Bada, A. A. (2022). Effectiveness of brain-based teaching strategy on students' achievement and score levels in heat energy. *Journal of Innovation in Educational and Cultural Research*, 3(1), 20-29.
- Bedeer, F. (2018). *The Effect of a brain – based learning program on developing primary stage students' English language critical reading skills*. (Unpublished doctoral thesis, Ain Shams University, Egypt).
- Belkacem, A. N., & Lakas, A. (2021). A case study on teaching a brain–computer interface interdisciplinary course to undergraduates. In V. L. Uskov, R. J. Howlett, & L. C. Jain (Eds.), *Learning Media Arabic* (pp. 215–228). Springer Singapore.
- Bonomo Ed. D., V. (2017). Brain-based learning theory. *Journal of Education and Human Development*, 6(2), 27–43. <https://doi.org/10.15640/jehd.v6n1a3>.
- Boyatzis, R. E., Goleman, D., & Rhee, K. (2000). *Clustering competence in emotional intelligence: insights from the emotional competence inventory (ECI)*. *Handbook of emotional intelligence*, 99(6), 343-362. Retrieved from http://www.eiconsortium.org/pdf/eci_acticle.pdf.
- Burkett, L. (2014). *Brain-based learning: A study on how teachers implement strategies in the traditional classroom (Doctoral dissertation)*. Capella University. Available from ProQuest Dissertations and Theses database. (UMI No. 3632931).
- Caine, G., & Caine, R. N. (2006). *Meaningful learning and the executive functions of the brain*. *The Neuroscience of Adult Learning: New Directions for Adult and Continuing Education*, Number 110, 81, 53. <https://doi.org/10.1002/ace.219>.
- Caine, R. N., Caine, G., McClintic, C., & Klimek, K. J. (2015). *12brain/mind learning principles in action: Teach for the development of higher-order thinking and executive function*: Corwin Press.
- Caine, R. N., Caine, G., McClintic, C., & Klimek, K. (2005). *12 brain/mind learning principles in action: The fieldbook for making connections, teaching, and the human brain*. Corwin Press.

- Carman, L. M. (2019). *A scoping review: Implication of the mirror neural system for early language education in the 21st Century*. School of Applied Educational Science and Teacher Education.
- Dhillon, B.P.S., Herman., Syafryadin. (2020). the effect of skimming method to improve students' ability in reading comprehension on narrative text. *Linguist: Journal of Linguistics and language Teaching*. 6(1).
- Duman, B. (2010). *The effects of brain-based learning on the academic achievement of students with different learning styles*. *Educational Sciences: Theory and Practice*, 10(4), 2077-2103.
- Durukan, E. (2020). Impact of speed-reading training on reading speeds and comprehension skills of secondary school students. *Cypriot Journal of Educational Sciences*, 15(2), 184-193.
- El-Fattah, H.A., & Mohamed, F. (2021). Utilizing inferencing strategy for developing EFL reading comprehension skills among faculty of education students. *Journal of Faculty of Education*, Benha University, No (127) July, Part (2).
- Elwan, Al. (2012). *The education of human brain and teaching thinking (1st edition)* Jordan: Dar El Safa for Publishing and Distribution.
- Farrell, T. S. (2016). Anniversary article: *The practices of encouraging TESOL teachers to engage in reflective practice: An appraisal of recent research contributions*. *Language teaching research*, 20(2), 223-247. <https://doi.org/10.1177/1362168815617335>.
- Fauzi, A., & Respati, D. K. (2021). Development of students' critical thinking skills through guided discovery learning (GDL) and problem-based learning models (PBL) in accountancy education. *Eurasian Journal of Educational Research* (95), 210-226. <https://ejer.info/index.php/journal/article/view/454/16>.
- Goodwin, A. P., Huggins, A. C., Carlo, M. S., August, D., & Calderon, M. (2013). *Minding morphology: How morphological awareness relates to reading for English language learners*. *Reading and Writing*, 26(9), 1387-1415.
- <https://doi.org/10.1007/s11145-012-9412-5>.
- Haerazi, H., & Irawan, L. A. (2020). The effectiveness of genre-based instructional model in the teaching of writing skills viewed from creativity. *Celt: A Journal of Culture, English Language Teaching & Literature*, 20(1). DOI: <https://doi.org/10.24167/celt.v20i1.2091>.
- Haghighi, M. (2012). *The effect of brain-based learning on Iranian EFL achievement and retention*. AkdenizLanguage.
- Hasan, A., Gushendra, R., & Yonantha, F. (2018). The influence of prior knowledge on students' listening and reading comprehension. *IJEE (Indonesian*

Journal of English Education), 4(1), 1-15.

<https://doi.org/10.15408/ijee.v4i1.4744>.

- Hashemi, A. (2021). The effects of using games on teaching vocabulary in reading comprehension: a case of gifted students. *Journal for the Education of Gifted Young Scientists*, 9(2), 181-191.
- <https://doi.org/10.17478/jegys.846480>.
- Hong, J. C., Tsai, C. R., Hsiao, H. S., Chen, P. H., Gu, J. J., & Sitthiworachart, J. (2019). *The effect of the "Prediction-observation-quiz explanation" inquiry-based e-learning model on flow experience in green energy learning. Computers & Education*, 133, 127-138.
- <https://doi.org/10.1016/j.compedu.2013.10.004>.
- Jack G. U. & Kyado J. J. (2017). Effectiveness of brain-based learning strategy on students' academic achievement, attitude, motivation and knowledge retention in electrochemistry. *Journal of Education, Society and Behavioral Science*, 21(3), 1- 13.
- Jampamoon, P. (2014). *The effects of using brain-based learning (BBL) activities on prathomsuksa 6 students' English-speaking ability*. Srinakharinwirot University, Thailand.
http://ir.swu.ac.th/xmlui/bitstream/handle/123456789/4140/Paiwan_J.pdf?sequence=1
- Jancke, L. (2018). *Every individual has a unique brain anatomy, study reveals*. Retrieved on 20/07/2019 from <https://neurosciencenews.com/uniquebrain-anatomy-9541/>
- Jegerski, J. (2013). *Self-paced reading. In research methods in second language psycholinguistics* (pp. 36-65). Routledge.
<https://www.taylorfrancis.com/chapters/edit/10.4324/9780203123430-8/self-pacedreading-jill-jegerski>.
- Jensen, E. (2016) "*Brain-Based Learning Strategies*". Retrieved from: <https://feaweb.org/brain-based-learning-strategies>.
- Jensen, Eric (2008) *Brain-Based Learning: The New Paradigm of Teaching*. (2nd ed.) Thousand Oaks, CA: Corwin.
- Jensen, E. (2000). Brain-Based Learning: *A reality check. educational leadership*, 57(7), 76-80.
- Kapadia, R. H. (2014). *Level of awareness about knowledge, belief, and practice of brain-based learning of school teachers in greater Mumbai region*. Procedia - Social and Behavioral Sciences.
<https://doi.org/10.1016/j.sbspro.2014.01.1402>.
- Khalil, A. H., El-Nagar, B. E. E., and Awad, M. A. E. (2019). The effect of Brain-Based Learning on developing some speaking skills of Egyptian EFL

- secondary school students. *International Journal of Environmental & Science Education* 14, 103–116.
- Khasawneh, M. A. S. (2021). *An electronic training program to treat errors of reading aloud in the English language among students with learning difficulties during the emerging covid-19*. EDUCATIO, 5(3).
 - Kiedinger, Rhonda. (2011). *Brain-Based Learning and its effects on reading outcome in elementary aged students*. Dissertation submitted to the Graduate School, University of Wisconsin-Stout.
 - Kohar, Dadun. (2020). *Examining the effectiveness of reading comprehension practice via the brain-based learning model at SMPN Unggulan Indramayu*. 10.2991/assehr.k.200402.033.
 - Kohar, D. (2022). *Measuring the effectiveness of the Brain-Based Learning Model on the level of reading comprehension based on exposition reading structures in Junior high school*. Educational Sciences: Theory and Practice, 22(1), 78-89. <http://dx.doi.org/10.12738/jestp.2022.1.0007>.
 - Li, P., & Clariana, R. B. (2019). Reading comprehension in L1 and L2: An integrative approach. *Journal of Neurolinguistics*, 50, 94-105. <https://doi.org/10.1016/j.jneuroling.2018.03.005>.
 - Mariam, S., Kepirianto, C., & Mardhiana, N. (2022). Utilizing quipper school for improving reading comprehension of recount text. *Indonesian EFL Journal*, 8(1), 127-136.
 - Marope, P. T. M. (2016). Brain science, education, and learning: Making connections.
 - Mayer, R. E. (2017). How can brain research inform academic learning and instruction? *Educational Psychology Review*, 29(4), 835-846.
 - McCabe, J. A. (2018). What learning strategies do academic support centers recommend to undergraduates? *Journal of Applied Research in Memory and Cognition*. <https://doi.org/10.1016/j.jarmac.2017.10.002>.
 - Mohamed, Fatma Sadeq. (2020). Using digital reading strategies for developing EFL reading comprehension skills among Faculty of Education students. *Journal of Faculty of Education*, Benha University, No (121) January, Part (1).
 - Mundhe, G. B. (2015). Teaching receptive and productive language skills with the help of techniques. *Pune Research an International Journal in English*, 1(2), 1-6.
 - Nanda, D. W., & Azmy, K. (2020). Poor reading comprehension issue in EFL classroom among Indonesian secondary school students: Scrutinizing the

- causes, impacts and possible solutions. English: *Journal of Language, Education, and Humanities*, 8(1), 12-24. <https://doi.org/10.22373/ej.v8i1.6771>.
- Nur, M. A., Hasyim, R., & Khalikin, A. (2020). The application of brain-based learning in teaching reading comprehension to the first-year students of MA As'adiyah Ereng-Ereng Bantaeng. *Qalam: Jurnal Ilmu Kependidikan*, 9(1), 43–46. <https://doi.org/10.33506/jq.v9i1.975>.
 - Oghyanous, P. A. (2017). *The effect of brain-based teaching on young EFL learners' self-efficacy*. *English Language Teaching* 10, 158–158. doi: 10.5539/elt.v10n5p158.
 - Olaoluwa, Samuel & Ayantoye, Catherine. (2016). Impact of brain-based instructional strategy on academic performance of deaf students in mathematics in Oyo school of handicapped, Nigeria. *World Journal of Educational Research*. 3. 447. 10.22158/wjer.v3n2p447.
 - Papatga, E & Ersoy, A. (2016). Improving reading comprehension skills through the scratch program. *International Electronic Journal of Elementary Education*. 9(1), 124-150.
 - Rabbani, S., Ruqoyyah, S., & Murni, S. *Development of basic school mathematic teaching materials to improve the analysis ability of primary teacher education students on innovative learning models*. 1315 (pp. 012011). IOP Publishing. <https://doi.org/10.1088/1742-6596/1315/1/012011>.
 - Rahimi, M., & Babaei, S. A. (2021). *The Relationship between reading strategy use and reading comprehension as mediated by reading rate: The Case of Eye Movement Training by Rapid Serial Visual Presentation (RSVP)*. *Teaching English with Technology*, 21(1), 94-111.
 - Rahmawati, E. Y. (2018). Analysis of students' English reading comprehension through KWL (Know-Want-Learn) learning strategies. *International Journal of Language Teaching and Education*, 2(3), 238-247. <https://doi.org/10.22437/ijolte.v2i3.5641>.
 - Reis, A., Araújo, S., Morais, I. S., & Faísca, L. (2020). *Reading and reading-related skills in adults with dyslexia from different orthographic systems: a review and meta-analysis*. *Annals of dyslexia*, 70(3), 339-368. <https://doi.org/10.1007/s11881-020-00205-x>.
 - Ritonga, M., Kustati, M., Budiarti, M., Lahmi, A., Asmara, M., Kurniawan, R., Putri, N., & Yenti, E. (2021). *Arabic as foreign language learning in pandemic COVID-19 as perceived by students and teachers*. *Linguistics and Culture Review*, 5(1), 75-92. <https://doi.org/10.37028/lingcure.v5n1.726>. 5. 75-92. 10.37028/lingcure.v5n1.726.
 - Rojalai, A., Susaie, J. S., Balaraman, L., Manoharan, S. R., Mustafa, Z., & Hashim, H. (2021). Language learning strategies used for enhancing reading

- skills among Year 6 pupils of a primary school in Selangor. *International Journal of Academic Research in Business and Social Sciences*, 11(6), 1186–1195.
- Rueda, C. (2020). Neuroeducation: Teaching with the brain. *Journal of Neuroeducation*, 1(1), 108-113. <https://doi.org/10.1344/joned.v1i1.31657>.
 - Şahin, Şeyma & Ökmen, Burcu & Kılıç, Abdurrahman. (2023). Effectiveness of the brain-based learning style cycle. *Excellence in Education Journal* Volume 12, Issue 1, Winter 2023
 - Saleh, S. (2012). The effectiveness of the brain-based teaching approach in enhancing scientific understanding of Newtonian Physics among form four students. *International Journal of Environmental and Science Education*, 7(1), 107-122.
 - Saleh, S., & Mazlan, A. (2019). The effects of brain-based teaching with i-think maps and brain gym approach towards physics understanding. *Indonesia Journal of Science Education*, 8(1), 12-21.
 - Sari, L. P., & Surip, N. (2020). The influence of school facilities service quality and teacher competency to the satisfaction of madrasah Aliyah Annajah students Jakarta. *International Journal for Educational and Vocational Studies*, 2(3). <https://doi.org/10.29103/ijevs.v2i3.2203>.
 - Shabatat, K., & Al-Tarawneh, M. (2016). *The impact of a teaching-learning program based on brain-based learning on the achievement of the female students of 9th grade in chemistry*. *Higher Education Studies*, 6(2), 162-173. <http://dx.doi.org/10.5539/hes.v6n2p162>.
 - Soto, C., Gutiérrez de Blume, A. P., Jacovina, M., McNamara, D., Benson, N., & Riffo, B. (2019). *Reading comprehension and metacognition: The importance of inferential skills*. *Cogent Education*, 6(1), 1565067. <https://doi.org/10.1080/2331186X.2019.1565067>.
 - Sousa, D. A. (2016). *How the brain learns*: Corwin Press.
 - Syahbandi, L. F. (2018). The effect of brain-based learning on students speaking skills. *Journal of Languages and Language Teaching*, 5(2), 52-56. <https://doi.org/10.33394/jollt.v5i2.349>.
 - Trudell, B. (2019). *Reading in the classroom and society: An examination of “reading culture” in African contexts*. *International Review of Education*, 65(3), 427-442. <https://doi.org/10.1007/s11159-019-09780-7>.
 - Tung, K. Y. (2015). *Pembelajaran Dan Perkembangan Belajar*. Jakarta Barat. Indeks.
 - Uzezi, J. G. and Jonah, K. J. (2017). Effectiveness of brain-based learning strategy on students’ academic achievement, attitude, motivation and

knowledge retention in electrochemistry. *Journal of Education, Society and Behavioural Science*, 1-13.

- Wang, Z., Gong, S. Y., Xu, S., & Hu, X. E. (2019). *Elaborated feedback and learning: Examining cognitive and motivational influences*. Computers and Education, 136, 130–140. <https://doi.org/10.1016/j.compedu.2019.04.003>.
- Wibowo, Y.E.W., Syafrizal., Syafriyadin. (2020). An analysis of English teacher strategies in teaching reading comprehension. *JALL (Journal of Applied Linguistics and Literacy)*. 4(1), 20-27.
- Widodo, H. (2019). Pendekatan brain-based learning sebagai basis pembelajaran dalam kurikulum 2013. *Tajdidukasi: Journal Penelitian Dan Kajian Pendidikan Islam*, 8(1). <https://doi.org/10.47736/tajdidukasi.v8i1.307>.
- Willis, J. (2007). Review of research: *Brain-based teaching strategies for improving students' memory, learning, and test-taking success*. *Childhood Education*, 83(5), 310-315.
- Wilson, L. O. (2018, October 2). *Brain-based education - An overview - The second principle*. Retrieved on 20/07/2019 www.thesecondprinciple.com/optimallearning/brain-based-education-an-overview.
- Yunita, Riska (2020) *Brain based learning method to improve reading comprehension of 8 grade students of SMPN 2 Tellu Limpoe Sidrap*. Undergraduate thesis, IAIN Parepare.
- Zuhriyah, Mukminatus & Agustina, Ria. (2020). Brain-based learning and high-order thinking skills affect students' writing abilities. *JEES (Journal of English Educators Society)* 5. 10.21070/jees.v5i2.778.