AUTHOR'S NARRATIVE

Dr. Rukminingsih, S.S., M.Pd. is a Lecturer at the Department of English Language Education, at PGRI Jombang University, Indonesia. In a career spanning 16 years, she is as an EFL lecturer, researcher, teacher trainer, international speaker and international journal reviewer. Her research areas dealing with brain and language, Neuroscience. She has disseminated her research findings dealing with Neoroeducation and Brain-Based teaching with Technology in ASIA International conference in Malaysia, 2017 and got the 4 best paper- selected and presented in Tokyo-Japan, 2018 funded by Ministry of Research, Technology and Higher Education Indonesia. She is also a competency certified-national teacher trainer. She widens her career in the research field as a reviewer of an international journal Q1 Scopus indexed and SciencePG, USA.

This book reference is based on her 6 research findings relate to Brain-Based Approach:

Rukminingsih(2022). *The effectiveness of combination brain- based targeted teaching and content schema activation strategy in teaching critical reading to the students with different motivation levels*. Dissertation. Doctor of Language Education Field of Semarang State University.

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BRAIN-BASED APPROACH FOR ENGLISH AS A FOREIGN LANGUAGE TEACHING IN HIGHER EDUCATION

DR. RUKMININGSIH, S.S. M.Pd.

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Brain-Based Approach for English as a Foreign Language Teaching in Higher Education

Writer: Dr. Rukminingsih, 5.5.,
M.Pd. Editor: Aang Fatihullslam
Cover: Ahmad Fatoni
Layout: Dyah Ayu Puspitasari
Size   : v, 144 hlm, UK: 15,5 x 23 cm

BRAIN BASED APPROACH FOR ENGLISH AS A FOREIGN LANGUAGE TEACHING IN HIGHER EDUCATION

Dr. Rukminingsih, S.S., M.Pd

FOREWORD

Brain-based education enhances learning, teaching, and training by leveraging psychology, neuroscience, and cognitive science insights to understand human brain processes, attention, memory, motivation, and knowledge acquisition. The brain-based learning approach, a new teaching paradigm, was developed through research. This approach focuses on the brain's fundamental function in learning, using current techniques such as MRI to investigate brain structure. Educators around the world are applying these discoveries into their teaching approaches, improving the learning experience. Researches show that the brain-based learning approach can improve student achievement in various teaching topics, such as a curriculum for higher education, assessment, and teaching strategies. Therefore, educators should review theories, evaluate learning methodologies, and select the most effective strategy for their classrooms.

Understanding brain function is crucial for effective teaching and learning. Teachers have a significant influence on students' minds, and understanding their brain's learning potential is essential. Advances in neuroscience allow scientists to examine cognitive activities like language and learning, identifying factors affecting them. However, the relationship between neuroscience insights and educational practice is not always clear. Currently, there is a lot of material available on neuroscience, but its application to language teachers remains unclear.

This book provides some teaching strategies based on brain-based approach as a new paradigm for English as foreign language teaching. It has 6 chapters involving (1) How the brain learns, (2) Teaching English for the rhythm of the brain, (3) brain-based learning, (4) brain-based teaching, (5) building executive function in brain-based teaching and (6) brain- targeted teaching model innovation brain- targeted teaching model innovation.

This book is primarily designed as a book reference which is constructed based on my 6 research findings which has been published by some reputable International Journals and national journals which all deal with brain-based approach. This book is recommended to be read by the EFL lecturers and students in higher education. It is expected that they implement brain-based approach as their teaching and learning strategies.

Jombang, 02 March 2024

Dr. Rukminingsih, S.S., M.Pd.

TABLE OF CONTENTS

CHAPTER I
HOW THE BRAIN LEARNS

The human brain has approximately 100 billion neurons and a large number of neuroglia that support and protect the neurons. Each neuron can communicate with up to 10,000 other neurons via as many as 1,000 trillion synapses. In the nervous system, a synapse is a structure that allows a neuron to send an electrical or chemical signal to another neuron or the target effector cell. Such signals accumulate as the membrane potential of the neurons, which triggers and passes the signal pulse (i.e., action potential) to other neurons when the membrane potential exceeds a precisely determined threshold voltage.

How the brain learns is involved as the following aspects (1) understanding of learning based on the structure and function of the brain, (2) knowing and understanding how the brain processes and remembers information learning will occur if the brain is not prohibited from fulfilling its normal process, so the teacher should ensure that her class is comfortable and fun to make the learning process effective.
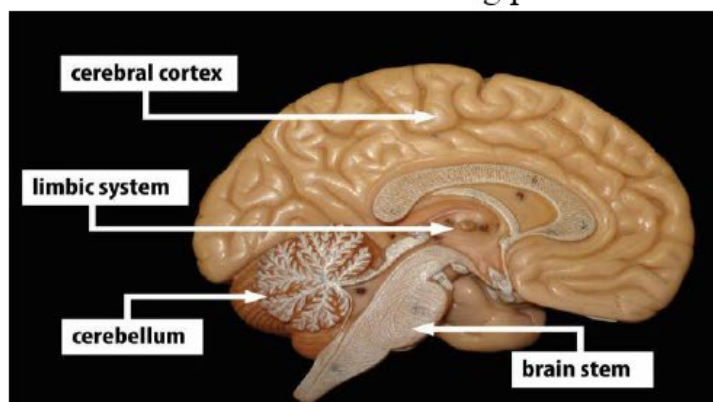

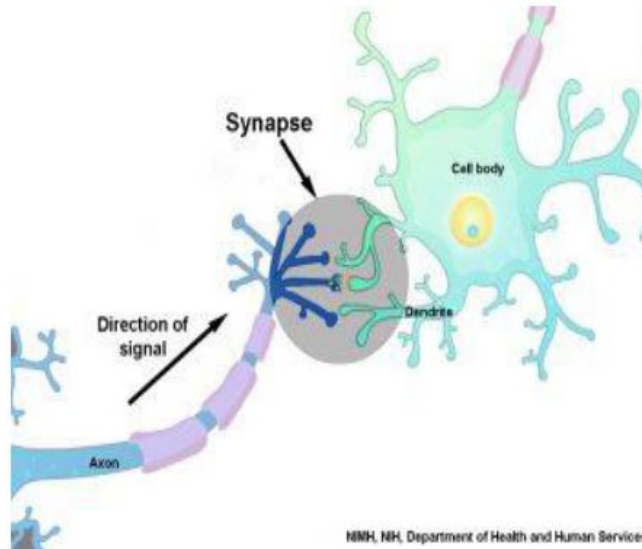Figure 1. The brain's structure in learning process (Sausa, 2017).

Figure 2. The connection among synapses in the brain works.
(Kweldju, 2019)

Our understanding of how the brain learns has progressed beyond the traditional idea that synapses increase through associative learning. Our brains are amazing learning machines that constantly establish and strengthen connections as we gain knowledge and skills. Beyond the conventional notion that associative learning leads to an increase in synapses, our understanding of how the brain learns is expanding that learning actually involves more intricate mechanisms (Allen, 2018), as the following:

1. Synaptic Changes: Previously, we assumed that when two neurons fired together, their synapses strengthened, leading to learning. This concept was represented by the term "Synapses that fire together wire together." However, this approach does not account for all forms of learning.

2. Emotions and novelty: What we remember isn't exclusively determined by reward or

punishment. Emotional responses, novelty, context, and attentiveness all play important roles. When synapses fire simultaneously, they do not always wire together. Memory formation is influenced by our brain's emotional response to an experience, its novelty, and our level of attention at the time.

3. Beyond Synapses: Learning causes significant changes across the brain, not only at individual synapses. Coherent memories combine emotions, sensory inputs, and stored experiences. Millions of neurons in multiple brain regions must connect to form a meaningful memory.

4. Gray Matter and Beyond: Unlike the prevalent "gray matter" image of the brain's outer surface, deeper areas contribute to learning. These regions, behind the recognizable gray surface, perform critical roles in establishing persistent recordings of information and experiences for later memory.

Learning in the brain is all about establishing and strengthening connections between brain cells known as neurons. With approximately 86 billion neurons in the brain, it is estimated that we have over 150 trillion connections, or synapses. This huge network of interconnections provides the brain with enormous processing power. Knowledge is believed to be stored in the brain as an interconnected network, with stronger connections between comparable or related objects and concepts. When a fact, memory, or

piece of knowledge is retrieved or remembered, it will spread activation and support in recalling other related and similar memories or information. Our brain learns by establishing and strengthening links between objects in memory through connection and context.

Learning and memory have an inextricable connection in the brain. We have only learned something when it has been encoded in our memory for future recall or usage as a skill. Neuroscience defines learning as the acquisition or strengthening of information in memory. In the brain, memory is not a single entity. Different parts of the brain are involved in different types of memory for information related to skills, events, and knowledge from our lives. To summarize, learning is a complicated interaction between neuronal connections, emotions, and brain areas. It's not only about synapses; it's about the coordination of millions of neurons working together to produce coherent memories. (DeBettencourt et al., 2018 & Norris, 2017)

Learning and memory in the brain

We may broaden the definition of learning to encompass the acquisition of knowledge or abilities (by instruction, study, or experience), then the gained knowledge or skills must be stored in the brain for subsequent recall and use. This, of course, is the function of memory. Thus, learning and memory are inextricably intertwined in the brain. Memory is not just one thing in the brain. Rather, memory is classified into multiple types, each with its own set of operations that rely on different parts of the brain. We observe this

clearly in persons who have brain damage in certain locations and suffer from various types of memory loss.

There are two kinds of memory. Short-term and long-term memory. First, we distinguish between long-term and short-term memory. Short-term or working memory is based on the frontal lobes of the brain and is used when we need to remember something quickly while working on a task or problem. When we think about learning, we primarily emphasize long-term memory. It is memory for knowledge or skills that is gained, stored, and recalled for later use and is divided into numerous categories.

According to Sousa (2017), recent discoveries on the brain have:

- Shown how emotions affect learning, memory, and recall

Short-term memory consists of two types: immediate memory and working memory. Immediate memory is where we save information until we determine what to do with it. Our immediate memory functions either subconsciously or consciously. Working memory is where we construct, disassemble, and revise information for later storage. Working memory helps us focus and pay attention.

Long-Term Storage: The working memory examines two questions: does this make sense? and does this have meaning?, to decide what information to store. Does this make sense? is the first question, and it asks about understanding information based on prior knowledge. Does this

have meaning, the second inquiry, asks if the knowledge is important to the student. It takes both sense and meaning for information to be more likely to be stored.

- Challenged the understanding that the brain can multitask

The myth of multitasking - The brain cannot do two cognitive activities at once. Although people can quickly switch between tasks, they can only concentrate on one at a time. Multitasking is more accurately defined as task switching. Moving attention sequentially from A to B to C or back and forth between A and B can lead to cognitive decline. This occurs when knowledge from the present task is replaced by fresh information in working memory.

Task Switching and Complex Text - Eight to eighteen year olds spend an average of seven hours per day using digital media. Students' ability to understand complicated texts is hindered by their tendency to switch between tasks. Constantly wired students struggle to develop the required abilities for interpreting complicated texts. The three skills required for this activity are:

- Illustrate a desire to explore both literal and implied meanings in readings, as well as pause and reflect on the story's progression.
- Show ability to think continuously and retain sufficient information in working memory for comprehension of text.

- Show openness to deep thinking by deciding whether to agree or disagree with the author's premise and considering different perspectives.

Technology is a tool that helps improve, enrich, and give material to students more effectively. Nonetheless, because it is crucial for social development, elementary and middle school students still require face-to-face communication and interaction. These exchanges are occurring less frequently due to technology, which is lowering the need for certain abilities

Knowledge versus skills: Declarative and procedural memory

Long-term memory is divided into two types: declarative memory, which stores facts and knowledge that we can consciously obtain and "declare," and procedural memory, which stores unconscious or automatic skills that we learn, such as how to ride a bicycle or form readable characters when writing.

When learning to read, we do not focus about how to figure out the patterns of letters on the page (procedural memory), but rather about retrieving the meanings of the words (declarative memory). Math involves both procedural and declarative memory. Number theory necessitates a concept of place value and the relationship between operations when solving equations (procedural memory), whereas number facts are simple equations learned by heart, such as 3 x 4 = 12.

Knowledge coded in the brain: Grandmother cells

Now that we have a fundamental understanding of learning and memory, we may examine theories regarding the coding and storage of knowledge in the brain. The brain is composed of neurons, which are brain cells with a great deal of interconnectivity between them via connections called synapses. Through synapses, a single neuron in the brain can be linked to hundreds or thousands of other neurons. We estimate that there are roughly 150 trillion connections, or synapses, among the approximately 86 billion neurons in the brain. The brain's enormous computing capacity is derived from this vast web of connections. Learning and experience cause these synaptic connections between neurons to constantly change.

Building and maintaining connections between brain cells is the foundation of learning in the brain. So how does the brain encode knowledge?. Theoretically, these brain cells send a signal to the rest of your brain whenever you see or think about your grandmother—whether she's there in person or in a picture, imagined or recalled, or even just by name or another abstract form. Thus, in your brain, these cells stand in for or encode the idea of your grandma. You would lose all recollection of your grandmother if we could locate and remove every single grandmother cell from your brain. This does not imply, however, that certain cells are limited to acting as your grandmother's code.

The importance of connections: Learning by association and context

Our brain contains individual concepts coded in unique neurons, linked through synapses, which constantly change with learning and experience, forming interconnected networks. Memory recall occurs when a specific memory or idea is triggered by a specific place, person, object, or event. This is due to connections formed between the memory's cells and other associated concepts, such as the smell of lavender, which codes the memory.

The well-known phrase "neurons that fire together wire together" defines Hebbian learning, which occurs when neurons form and strengthen connections between linked things. When two linked neurons fire their signals at the same moment, the connection between them strengthens, making it more probable that activation of one will automatically result in activation of the other. Associative learning in psychology involves the formation and strengthening of connections between neurons that are encountered and activated together. This process, similar to the natural process of forming connections between common items, leads to automatic or easier recall of the other, representing most learning in the brain.

Implications for education and learning

Two immediate implications of this understanding of learning and memory in the brain are:

1. Rote learning of disconnected data is tough since it is not the typical way the brain learns. Rather, the brain learns by creating and strengthening connections between connected concepts, allowing

for more effective learning in context and through connecting and association with relevant knowledge. This is well demonstrated by the advantages of adopting mnemonics, which can considerably aid learning by establishing meaningful associations between items. The phrase "never believe a lie" is an example of a mnemonic to remember the correct order of the 'i' and 'e' in the word 'believe.'

2. Activities that foster recall or re-evaluation of knowledge are extremely advantageous to learning because they reinforce and improve the links between related items that are recalled together. Exams and assessments should be designed to aid in the recall of connected concepts, reinforcing brain connections between these objects and consolidating learning. In this sense, a well planned exam can be a vital part of the learning process. How much should we help remember during an exam, and how much should we push it by not providing clues?

Knowledge is encoded in the brain by unique patterns of activity across different neurons, which are linked to other associated concepts or memories. This concept applies to education. Learning strengthens connections between concepts as they are encountered or recalled.

Education should be able to provide learners with brain experiences. The neuroscience approach is the umbrella of brain experiences. There are some

developing countries, such as America, German, Japan, and the United Kingdom which have implemented neuroscience as one of the curricula approaches from elementary to higher education levels (Hardiman, 2012; Parr, 2016; and Seegers 2020).

However, in Indonesia, neuroscience has been recommended learning approach for elementary education and middle education as in Permendikbud 2018 to welcome innovative curriculum for the 21st century. Based on the curriculum of higher education from KKNI based on UU no 12, 2012, SN –Dikti based on higher educational national standard (SNPT) 2015, and MBKM curriculum based on Permendikbud no 3 2020 of higher education national standard, unfortunately, there has not been recommended the implementation of neuroscience for higher education in Indonesia. While Trolian (2018) stated that the neuroscience of learning and development can enhance creativity, compassion, critical thinking, and peace in higher education.

CHAPTER 2
TEACHING ENGLISH TO THE RHYTHM OF THE BRAIN

Efficient language teaching and learning is becoming increasingly crucial, particularly in English. Education systems should be equipped to provide students with the tools and skills they need to succeed in this world. However, they still have space for improvement in order to attain that goal. This essay aims to better the teaching-learning process of English by considering neuroscience discoveries. It is a bibliographic review that presents neuroscience-based research to aid teachers boost foreign language learning. Advances in neurotechnology have enabled neuroscientists to directly watch the working of the human brain. In this context, there is the interdisciplinary field of neuroeducation. It specializes in supporting teaching by giving relevant brain evidence.

The education system and educational institutions must achieve their goal of effectively teaching English. They must be able to prepare their students to meet the challenges of a globalized environment. Especially in the case of high school kids who are about to reach adulthood and leave school to pursue further education and/or employment. Adolescents' brains are still evolving, and they may struggle to regulate their emotions and behaviors. The teaching-learning process must meet their needs by assisting, motivating, and encouraging them to acquire English.

A poor learning experience can influence both current and future learning processes. It may cause students to avoid

exposing themselves to a similar situation. That is, in this case, to avoid learning English or another foreign language. The students then grow into young adults who are frustrated and have mental blockages about learning languages. However, if the experience is favorable, it can lead to successful and gratifying language learning activities.

The human being has a tendency to learn. We are endowed with a complicated, fascinating, and powerful organ: the brain. It permits us to learn throughout our lives. It provides the ability to succeed in completing complex tasks such as learning a second language. However, its potential is realized when its functioning and rhythm are considered. in a developing countries, such as in USA, UK, Japan, Spain, German etc , the language teachers may need to teach English while understanding how the brain learns.

As a consequence, understanding brain function becomes increasingly important. Understanding how the brain learns allows you to know what to avoid and what to stimulate in order to create a successful teaching-learning process. Teachers have a huge influence on their students' minds. They are at the vanguard of the teaching system, directly influencing and developing students' minds. Language teachers must be aware of this influence and understand the tools they might employ to maximize the brain's potential. Understanding how the brain learns leads to neuroscience. Advances in neurotechnology have enabled scientists to investigate the brain and its function. More specifically, they can now examine how cognitive activities like language and learning occur in the brain. They can identify what is affecting them. These comments can considerably enlighten teachers about what to consider to

facilitate students' learning. However, the relationship between neuroscience insights and educational practice is not always evident or easy to make. Recently, the developing discipline of neuroscience has received a lot of attention. There is a great deal of material available on the subject. Currently, it may not be clear what language teachers can take from the large subject of neuroscience.

The purpose is not to eliminate traditional teaching, but to improve it. Neuroscience findings may give light on best practices while also highlighting areas for improvement. Teachers who understand essential facts about the brain will not only be able to teach languages more effectively. However, they also respect the individual by respecting how their brain functions. Teachers would educate according to the rhythm of the brain. They would contribute to the development of young adults. The latter would be prepared to face the realities of the world, equipped with proper tools to continue learning and blossoming in areas of their lives other than their language learning journey.

Based on how the brain learns, it will determine which aspects should be stimulated to optimize students' learning outcomes. Then, it will emphasize key things to consider in the adolescent brain. Furthermore, it will examine second language acquisition from a neurology perspective. Highlighting the key brain regions involved in language processing. Next, the memory mechanisms underlying second language acquisition will be investigated. In light of this conclusion, it will include neural-based language teaching methodologies, as well as a guide demonstrating how teachers can combine neuroscience findings into a standard English lesson.

NEUROSCIENCE AT THE SERVICE OF EDUCATION

The latest developments in neurotechnology have allowed researchers to observe brain function. With these developments, neuroscientists were able to understand more about how the brain learns. "Educational neuroscience," also known as "Neuroeduc-tion" or "Mind, Brain, and Education science"3,4, is a growing subject that investigates how neuroscience discoveries might impact education5. It tries to apply neurological research to educational practices. Neuroscience research has demonstrated that the brain is full of possibilities. However, when it interacts with its surroundings, its natural biological identity transforms into a distinct brain. Educational neuroscience tries to investigate whether learning environments allow the brain to be in its most efficient state for a beneficial learning process.

Neuroscience research has proven that the brain is full of possibilities. However, when it interacts with its surroundings, its natural biological identity transforms into a distinct brain7. Educational neuroscience tries to investigate whether learning environments allow the brain to be in its most efficient state for a beneficial learning process. As a result, it would achieve its goal of improving learning outcomes by providing tools and approaches those teachers and student can utilize to enhance the learning process. It investigates not just how to improve cognitive skills, but also how other elements influence learning. They include port, sleep, stress, and diet
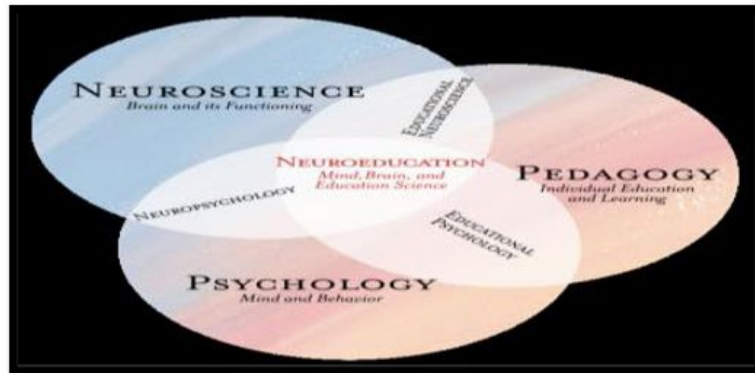
Figure 3. Interpretation of Tokuhama-Espinosa's transdisciplinary field redrawn by Bramwell (Kweldju, 2019) Neuroeducation (Mind, Brain and Education)

As showed in Figure 3, neuroeducation is an interdisciplinary approach that combines neuroscience, education/pedagogy, and psychology. It draws on neurological, cognitive, and behavioral factors.

Psychology has long enhanced education. What more can neuroscience offer the field of education, as questioned by Thomas et al. He explained that neuroscience investigates the "brain mechanisms underlying behavior," whereas psychology concentrates on behavior. Neuroscience enables deeper exploration of the mind through observation of the nerve system and the brain. It has a direct impact on education. Learning more about the brain and how it functions best can lead to better learning outcomes. It offers a comprehensive perspective on learning and the brain. It is capable of researching every external and internal aspect that affects it.

Learning involves also some neuroscience processes, such as some memory processes or the evaluation of new situations and information by the limbic system, which can be influenced indirectly through an appropriate setting in the

classroom. How to influence learning and memory is the main research question of neurodidactis (Thomas, 2018 & Rueda, 2020). Moreover, learning and memory are interwoven involving many conscious and unconscious learning processes. We can say the more we know about how the brain and memory work, the better we can enhance the techniques of the teaching and learning process. Unfortunately, the teachers often neglect the key to effective learning and a good long-term memory which are very essential in the process of learning. It means that the teacher has to give some attention to the opening mind, style of learning, concentrating, and focusing on the learning process. One of the strengths of the brain-targeted teaching model method has long-term memory in students' recall.

The National Scientific Council on the Developing Child identifies two types of motivations: approach motivation, which is linked to reward expectation, and avoid motivation, which leads to withdrawal due to fear and disgust. Language teachers should intentionally promote students' motivation by creating positive learning experiences, providing constructive feedback, outlining relevant objectives, and helping them find intrinsic motivation.

In this book, it shows how the brain-based approached based on Neuroscience can support teaching English to the rhythm of the brain. The following highlights more specific strategies to improve the language per se.

- **Speaking**

  Adults typically have trouble pronouncing words correctly. Their native tongue and second language being apart in Broca's area could be the cause of this.

Consequently, emphasis should be placed on speaking exercises like dialogues

- **Pronunciation and Grammar**
  Because of the brain's flexibility, productive skills are linked to perceptive abilities. This means that pronunciation is tied to grammar. Grammar improves as well as pronunciation. This means that when studying grammar, emphasis must also be placed on pronunciation.

- **Listening**
  Using technology can assist adult enhance their listening abilities. Furthermore, it promotes drive and involvement. Students frequently prefer receiving feedback from a machine rather than from a teacher. Listening skills can be developed by blending listening and vocalization.

- **Vocabulary**
  Vocabulary is essential for developing all parts of the language (reading, writing, listening, and speaking). The brain creates networks that contain a set of linked words. Words from the same network can be activated quickly, whereas words from separate networks take longer. Teaching and acquiring vocabulary by connecting words across categories using mind maps, webs, and clusters can assist the brain in expanding its vocabulary33.Students may also correlate words with visuals or mental visualisations. Similarly, teaching idioms and lexical phrases, which refer to larger chunks of words, is vital. They are also stored across a network.

Furthermore, using expressions activates the basal ganglia, which are involved in learning.

- **Reading**

  To read, the brain has to associate a sound with a letter. This is not a natural process. The brain needs to be trained how to do this. Second language learners frequently encounter the problem of being unable to recognise a word. This could be a phonological challenge. Teachers can help their kids by teaching phonological features and word identification. Students can practice reading and pronouncing words by filming themselves and receiving feedback. Teachers and computer apps can provide feedback.

- **Syntax and Writing**

  Language learners should also understand how the syntax differs from their native language. They must comprehend how a sentence is constructed in English. In Indonesia language, for example, descriptive adjectives are frequently put after the nouns they describe, but in English, they are typically placed before. For example, "Gadis cantik" in Indonesia is **Gadis** as noun and **Cantik** as adjective, while in English, "a beautiful girl" is **Beautiful** as adjective and **Girl** as noun. Sometimes transfer occurs, which is when a person uses their original language to comprehend the grammar of the target language. Identifying both similarities and differences helps students understand syntax. Teachers may lead children to practice sentence formulation through mapping, graphs, and charts.

Many scientists, educators, and linguists throughout the world continue to study the contribution of neuroscience to education, especially second language teaching. A neuroscience boom has occurred, particularly within the previous decade. Researchers have attempted to use neuroscience results to both schooling and foreign language instruction. For example, Kwedju wrote a paper investigating the application of educational neuroscience to the teaching of foreign languages.

CHAPTER 3
BRAIN-BASED LEARNING

Brain-Based Learning (BBL) is an educational theoretical framework based on principles derived from important findings about the structure and function of the brain from biology, psychology, and neuroscientific research, and it serves as a holistic context for designing a comprehensive instructional approach. It is widely acknowledged that the teaching process in a school classroom is one of the most important and essential environments in which the brain interacts, through sensory, cognitive, emotional, and social experiences that promote people' learning. A complex and ever-changing school and social environment necessitates the development and optimization of educational methods and programs in order to meet the learning needs of all students.

Neuroscience is the original source of brain-based learning. The most innovative and modern approaches for studying brain anatomy, such as MRIs, have helped neuroscientists in their investigation of "how the brain learns." Certain stereotypes about the "left" and "right" brains—that is, that the left brain is rational and the right brain is creative—are no longer true, even if each side of the brain functions differently. According to Caine and Caine (1995), brain-based learning and teaching employs a holistic approach, highlighting the significance of the brain's learning process for the generation of meaningful learning.

When the brain creates memories or learns a new task, it encodes the information by tailoring neural connections. Neuroscientists at MIT have uncovered a novel

process that helps to strengthen these connections, known as synapse. Learning more about how synapses modify their connections could help us better understand.

Figure 4. Neurons allow humans to learn with unlimited potential. Listening to the brain is a good starting point in optimizing learning (Sausa, 2017).

Neuroscientific research findings are crucial in school instruction, and the Organization for Economic Co-operation and Development launched a project to promote cooperation between education and brain research. This book aims to bridge the gap between neuroscience and education by applying contemporary knowledge about brain anatomy and learning processes to improve instructional practices. The achievement of a functional combination of neuroscience, psychology, and education has been characterized by relatively diverse approaches, which are mentioned with various terminologies, such as brain-based learning, educational neuroscience, neuroeducation, and mind-brain and education (Cane & Caine, 1996; Jansen, 2008; Sausa, 2017).

Many educators have highlighted the challenge of effectively translating neuroscience discoveries into classroom practice, emphasizing the necessity for additional research and testing in a real-world classroom situation. To address this challenge, they synthesized an enormous number of neuroscientific findings, focusing on a core set of neuroscience concepts that could enrich and support teachers' understanding of the learning process, allowing them to make pedagogical choices based on this understanding when designing courses (Tan & Amiel. 2019; Schwartz et al., 2019).

Brain-Based Learning (BBL) is an educational theoretical framework based on principles that derives from important findings about the structure and function of the brain through biology, psychology, and neuroscientific research, and it provides as a holistic context for the design of a comprehensive instructional approach (Caine & Caine, 1994; Jensen, 2008). It suggests the most effective use of diverse learning activities and instructional strategies to maximize the capitalization of students' innate cognitive capacities by strengthening natural brain function mechanisms. Furthermore, BBL ensures an enhanced learning environment that enables the brain to learn in a natural way, while also allowing each student to participate in the learning process in her/his own unique way. Citations: (Caine & Caine, 1994; Jensen, 2008; Sousa, 2017).

Brain-based learning is a learning paradigm that draws on research into how the brain learns to develop new guiding principles for learning, teaching, training, and education. It examines student learning and learning outcomes from the perspective of the human brain. Here are

several important aspects Brain-based learning optimizes learning holistically, focusing on neuroplasticity and remapping of brain connections. Factors like exercise, diet, stress, and emotional state influence this ability, aiming for efficient, speedy learning. This approach does not always involve intelligence testing, aptitude testing, or other standardized tests1. It can be regarded as highly flexible because it includes anything beneficial or evidence-based.

The Brain-based learning framework was originally founded on 12 principles that Caine and Caine ([1994](#)) and Sausa (2017) have formulated:

1. Brain is a parallel processor,
2. Learning engages the entire physiology,
3. The search for meaning is innate,
4. The search for meaning occurs through patterning,
5. Emotions are critical to patterning,
6. Every brain simultaneously perceives and creates parts and wholes,
7. Learning involves both focused attention and peripheral attention,
8. Learning always involves conscious and unconscious processes,
9. We have at least two types of memory systems: spatial and rote learning,
10. The brain understands and remembers best when facts and skills are embedded in the natural spatial memory,
11. Learning is enhanced by challenge and inhibited by threat,
12. Every brain is unique.

The prior concepts support three pedagogically significant teaching factors, which are utilized as a guide for selecting and developing learning environments: i) Relaxed alertness: achieving an optimal state of mind/brain by creating a tranquil learning environment with low feelings/sense of threat and high challenge. ii) Orchestrated immersion: an enriched learning environment that exposes students to a variety of instructional strategies, learning tasks, and modalities of accessing knowledge in general, allowing for participation and elaboration. iii) Active processing: the process of internalizing, making sense of, and consolidating learning experiences and information through reflection and creatively combining techniques (Caine & Caine, 1994).

Brain-Based learning
- **Definition**: Brain-based learning is a **paradigm of learning** that considers student learning and outcomes from the perspective of the human brain.
- **Approach**: It involves designing specific **learning strategies** based on how human attention, memory, motivation, and conceptual knowledge acquisition work.
- **Guiding Principles**: Brain-based learning aims to create a new set of guiding principles for learning, teaching, training, and education by leveraging research from psychology, neuroscience, and cognitive science.

- **Focus Areas**: Attention, memory, motivation, and conceptual understanding become central aspects of teaching and learning.
- **Example**: The **construal level theory** highlights that understanding an overview without getting lost in minute details can engage a larger network of concepts and promote creativity.
- **Testing**: Brain-based learning doesn't necessarily rely on standardized tests but considers individual cognitive abilities and needs.

The Biology of Learning, as defined by Jensen (2000), refers to learning based on the brain's natural learning process. This approach, involving various disciplines, is biologically driven and subject to ongoing research. While not a universal solution, it can be used to develop effective teaching strategies based on current research. Jensen (2008) highlights the importance of teachers being aware of major factors when handling the class, highlighting the need for a keen interest in these areas.

a) Movement and Learning

There are strong connections between physical education, movement, breaks, break time, energizing activities, and increased cognition. Research shows that movement can (1) enhance learning, memory, and recall, (2) Improve memory and retrieval, (3) Increase student motivation and morale. Exercise may stimulate brain chemicals like norepinephrine and dopamine, which are known to energize and elevate mood (Sausa, 2017).

b) Emotion States

Emotions, mind, and learning are inextricably intertwined. Emotions organize and shape our reality. A student experiences multiple emotional states as the following:

- Feelings of fear
- joy
- disappointment,
- anticipation, and curiosity.

These emotions are a necessary and vital component of every student. Teachers should evaluate these feelings before entering the classroom.

c) Physical Environment

Numerous educational institutions are now developing classrooms using government subsidies. However, some institutions struggle to provide a positive educational climate. According to research, our physical environment might alter our brain. Educators should examine at least certain aspects in the physical environment that have the greatest impact on academic progress, such as sitting, temperature, lighting, noise, and architectural design.

d) Motivation and Engagement

Many educators understand the importance of encouraging students. First, we must identify the cause of low motivation. The primary factors for feeling discourage are:

- Lack of meaningful relationships

- Learned helplessness
- Awareness of disrespect
- Perception of threats
- Brain abnormalities
- Drug use

e) Critical Thinking Skills

Lower-order brain systems, such as sensory motor, auditory and language, attention and executive processes, social and emotional, memory, behavioral, and reward systems, provide the foundation of all cognition. We do not inherit a completely developed system from birth; instead, we develop it via experience and our surroundings. The distinctive brain, the problem-solving brain, the growing brain, the adaptable brain, and the emotional brain are some of the main brain-based elements that support critical thinking in our intelligent brain. All children, whether classified as "gifted" or "struggling," require instruction in critical thinking techniques.

f) Memory and Recall

Memory and recall are essential components of learning. A teacher can only evaluate a student's learning based on what they can recall or remember from memory.

Brain-Based Education

Brain-based education is a learning technique that incorporates neuroscience into teaching methods, lesson plans, and educational activities. It is predicated on the

notion that the brain can adapt, remap, and restructure itself while acquiring new information. It explores how students learn differently based on their cognitive, social, and emotional development. It also employs specialized tactics for improving attention, memory, motivation, and conceptual knowledge acquisition.

Brain- based learning has some meaningful principles which represents how our brain works and learns in education setting. Brain -based learning is considered as a novel approach to teaching based on scientific findings. It entails a teaching technique that minimizes lectures and promotes activity breaks, team learning, and peer teaching. Brain-based learning is based on neuroplasticity, which is the remapping of the brain's connections when new concepts are learned.

The latest teaching and learning strategies which employ brain-based learning include an eclectic teaching technique as the following:

a. Mastery learning
b. Experiential learning
c. Learning styles
d. Multiples intelligence
e. Cooperative learning
f. KWL
g. Problem-based learning

Table 1. Learning activities based on brain-based learning

Time Zone	Phase	Learning Activities
Prime time 1 period of	1. Introduction- Activation	• use of discreet perfume in the

optimum attention		• class • brief experiment conduction • cartoon, picture, animation projection • learning objects introduction
	2. Preparation	• brainstorming • short essay writing • graphic organizer completion • questionnaires
	3. Exposure— Immersion Meaning creation	• audiovisual material • simulations • discussion • models • analogies • working sheets
Down time period of reduced attention	4. Process- Application of instructional activities	• kinesthetic approach and experience • information classification • pattern recognition • concept map construction • Similarities and dissimilarities identification

	5. Incubation—Memory encoding.	• kinesthetic approach and experience • information classification • pattern recognition • concept map construction • Similarities and dissimilarities identification
Prime time 2 period of good attention	6. Corroboration—Self-confidence check	• problem solving • knowledge transfer to daily situations and phenomena
	7. Integration-Digestion	• quiz games • assessment tests • reflection on worksheets

CHAPTER 4
BRAIN-BASED TEACHING

Brain-based teaching uses practical strategies based on neuroscience and behavioral principles, promoting activities like exercise breaks, team learning, and peer teaching. It emphasizes neuroplasticity, the brain's ability to rewire connections during learning new concepts. In summary, brain-based learning focuses on the overall learning process, while brain-based teaching emphasizes practical strategies informed by neuroscience. Both approaches aim to enhance education by aligning it with our understanding of the brain's functioning.

In the Covid 19 pandemic, teachers and students must integrate virtual education through online learning. The digital world presents new challenges for teaching and learning, but also encourages innovative approaches. This study explored the difference effect of applying online instruction combined with brain-based teaching. During the Covid-19 epidemic, all higher education students are studying online. Educators must explore ways to maximize learning. Students' brains learn through online learning. Integrating ICT technologies facilitates brain-based teaching and learning. Making learning meaningful.

The brain-based education approach focuses on promoting learning. Brain-based teaching promotes motivation and positive learning (Rukminingsih et al., 2022). This study used brain-based strategies with online instruction, including engaging students, increasing multi-modal sensory learning, using online brain breaks, synchronous and asynchronous learning, starting with what

learners already know, and using stories and metaphors to connect their brains. It's difficult to teach English to speakers of other languages. Educators of English as a foreign language need to constantly adjust to the ways in which the minds of students function. Reading is one of the linguistic skills. Teachers may put in more effort in EFL reading classrooms to determine which teaching strategies may motivate students to read. Teaching techniques can also increase students' involvement in the learning process. Reading is now a crucial component of the EFL teaching and learning process.

They found reading English materials to be tedious and challenging. It deters students' motivation to study English, particularly when it comes to reading.Tahir (2012) argues that a significant number of students struggle with vocabulary, making it difficult for them to comprehend English texts. In actuality, reading classes may cause students to become bored. Furthermore, some teachers might simply tell the students to read the text without checking to figure out if the students comprehend what the teachers are teaching.

To meet educators' expectations for effective teaching and learning, it's important to understand how students' brains function. According to Jensen (1998), the human brain possesses the biggest area of cortex without a recognized purpose. Educators should consider how the brain learns other languages. Conboy (2013) suggests that studying the impact of second language learning on brain function is crucial for motivating foreign language learners and informing educational strategies. According to Weber et al. (2015), learning a new language is challenging. It requires

the ability to memorize new words, as well as knowledge of grammar and linguistics. Understanding how the brain processes and stores information can assist educators in developing effective teaching strategies (Srikoon et al., 2017). A brain-based approach can enhance students' motivation, attitudes, and academic performance. The majority of research focuses on measuring motivation, attitudes towards learning, and academic accomplishment through quantitative methods.

While some scholars have undertaken studies on brain-based teaching, few have explored its integration with online instruction. Researchers often focus on implementing brain-based teaching and learning in classrooms, but this is not always applicable to virtual classes (Srikoon et al., 2017; Srikoon et al., 2017; Rukminingsih, 2018, 2021). This project aims to overcome gaps in prior research by merging brain-based teaching with internet learning. Online training varies in quality based on student motivation, which should be considered while implementing technology.

Brain-based teaching, which is part of the wider concept of brain-based learning, involves a three-phase process as the following:

1. **Orchestrated Immersion**: This phase focuses on establishing immersive learning environments for learners.
2. **Relaxed Alertness**: This phase tries to reduce fear in learners while providing a challenging environment.
3. **Active Processing**: During this phase, learners consolidate and internalize information through active processing. This includes extending, implementing, and finding. significance in new information.

These phases contribute to the creation of an atmosphere in which students can learn and develop their talents. The ultimate goal is to improve learning in a stimulating environment to explore and activate numerous sensory systems and further develop brain connections.

Table 2. Teaching English as a Foreign Language (EFL) writing using brain-based teaching can be an effective approach. Here are some scenarios that illustrate this method:

Scenario	Dimension of Brain-Based Teaching	Activity and Description
Scenario 1	**Orchestrated Immersion**	• **Activity**: Storytelling • **Description**: The teacher shows students a photo or a set of pictures and asks them to develop a narrative based on them. This practice engages students in the language and encourages them to apply their imagination.
Scenario 2	**Relaxed Alertness**	• **Activity**: Peer Review • **Description**: Students give and get comments on each other's written work. Students can learn from their peers in a supportive and

		challenging context created by this activity.
Scenario 3	**Active Processing**	• **Activity**: Revision and Reflection • **Description**: After getting feedback, students edit their work and reflect on what they have learned, which helps them comprehend and improve what they have learned.
Scenario 4	**Online Instruction Integrated with Brain-Based Teaching**	• **Activity**: Online Guided Writing • **Description**: In an online setting, teachers offer prompts or guides to students, which can boost their motivation in writing.

These scenarios intend to create a stimulating learning environment that improves neural connections, therefore increasing EFL writing skills.

In addition, teaching scenario of brain-based teaching (BBT) involves creating an environment and designing activities that align with how the brain naturally learns. Here's a typical scenario:

1. **Start with a Hook**: Begin the lesson with an engaging activity or question that piques students' curiosity and prepares their brain for learning.
2. **Active Learning**: Incorporate activities that require students to move, discuss, and interact. This could be group work, experiments, or physical activities related to the lesson.
3. **Use of Visuals**: Use images, videos, and other visual aids to present information. The brain processes visual information more effectively than plain text.
4. **Real-world Connections**: Connect the lesson to real-world scenarios. This makes the learning meaningful and allows students to apply their knowledge in practical situations.
5. **Reflection**: At the end of the lesson, allow time for students to reflect on what they've learned. This could be through a group discussion, a writing activity, or a self-assessment.
6. **Feedback**: Provide timely and constructive feedback. This helps students understand their progress and areas of improvement.

The goal of BBT is not just to impart knowledge, but to create an optimal environment for brain-compatible learning. This involves understanding the brain's rules for meaningful learning and applying them in the classroom.

CHAPTER 5
BUILDING EXECUTIVE FUNCTION IN BRAIN-BASED TEACHING

Executive function (EF) skills enable sustained attention, remembering goals and information, resisting distractions, coping with frustration, considering consequences, reflecting on past experiences, and planning for the future. Over the past two decades, research in psychology, neurology, and education has emphasized the importance of EF skills for learning in schools. Teachers and parents are increasingly aware of their importance. Executive functions, which are top-down processes in goal-directed behavior, are associated with academic achievement from early childhood to adolescence. They are adaptable and can be enhanced with educational curriculum, structured exercise, and computer-based training. At-risk adolescents make the greatest increases, but evidence of transfer to academic achievement is minimal.

Executive function refers to a set of cognitive processes that enable us to manage our thoughts, actions, and emotions effectively. Executive function is a set of mental abilities that includes working memory, flexibility, and self-regulation.(Miyake & Friedman 2017). As educators, fostering executive function skills in students is crucial for their overall development. Here are some brain-based teaching strategies to enhance executive function:

1. **Provide Opportunities to Apply Learning**:
    - Encourage students to actively apply what they've learned through **authentic, personally meaningful activities**. When

students engage in real-world tasks, facts move from rote memory to become part of their long-term memory bank.

- o Formative assessments and feedback throughout a unit help consolidate learning into neural networks. These networks integrate new information when activated simultaneously and recognize patterns in common.
- o By prompting students to use new learning to solve problems or create new products, we promote network activation and construct long-term memory.

2. **Introduce Activities to Support Developing Executive Function**:
   - o Explicitly teach and provide practice opportunities for executive functions such as **learning, studying, organizing, prioritizing, reviewing, and active participation**.
   - o Activities that support executive function network development include:
     - ▪ **Comparing and contrasting**: Encourage students to analyze similarities and differences.
     - ▪ **Providing new examples of a concept**: Expand their understanding.
     - ▪ **Spiraled curriculum**: Reinforce learning over time.
     - ▪ **Group collaboration**: Foster teamwork and communication.

- **Open-ended discussions**: Encourage critical thinking.
- **Summarizing and symbolizing new learning**: Use arts or writing to consolidate knowledge.

3. **Activate Awareness and Self-Regulation**:
   - Help students become aware of their cognitive processes.
   - Teach them to **cue, direct, and coordinate** these skills for moment-to-moment functioning.
   - Encourage goal-setting and long-term planning.
   - Foster a self-image of being in charge of their learning and actions.

Executive function refers to a set of cognitive processes that help us manage our thoughts, actions, and emotions effectively (Caine & Caine. 1996; Jansen, 2008 &Sausa, 2017) Here are some examples:

1. **Working Memory**:
   - The ability to hold and manipulate information in our minds over short periods.
   - For instance, remembering a phone number while dialing it or following multi-step instructions.

2. **Inhibition**:
   - The capacity to suppress impulsive responses or distractions.
   - Example: Refraining from interrupting someone during a conversation.

3. **Task Initiation**:

- o   Starting a task without procrastination.
- o   For instance, beginning homework promptly after arriving home from school.

4. **Planning and Organization**:
   - o   Creating a strategy to achieve a goal.
   - o   Examples: Outlining steps for a project or planning a study schedule.

5. **Time Management**:
   - o   Allocating time effectively for various tasks.
   - o   Example: Prioritizing assignments based on deadlines.

6. **Flexibility**:
   - o   Adapting to changes or shifting between tasks.
   - o   For example, adjusting plans when unexpected events occur.

7. **Emotional Regulation**:
   - o   Managing emotions appropriately.
   - o   Example: Remaining calm during a stressful situation.

8. **Self-Monitoring**:
   - o   Reflecting on one's performance and adjusting behavior accordingly.
   - o   For instance, evaluating whether study strategies are effective and making necessary changes.

Executive functioning involves some aspects such as 1) the command-and-control center of the brain, 2) the conductor of cognitive skills, 3) the connective process that

connects learned experiences with present action, 4) the place that encodes, retrieves and manipulates information. Executive functioning occurs when such activities are performed as the following:

a. Planning
b. Organizing
c. Strategizing
d. Sustaining attention
e. Remembering details
f. Managing time and space
g. Regulating, thoughts and actions

How does executive function affect learning:

a. Making recalling, recording plans and assignment
b. Staying focused in class
c. Keeping materials organizing
d. Showing up to class or appointment on time
e. Multi-tasking
f. Turning in assignment
g. Pairing post and new knowledge
h. Reflecting on work
i. Finishing work in time
j. Thinking about problems
k. Estimating time to complete a task

Brain based teaching strategies to help build executive function in your students developed by Caine & Caine (1990, 2012), Jensen (1996) and Sausa (2001) as the following:

1. **Create A Positive Emotional Environment in online Classroom.**

Schools in Indonesia have closed their doors in corona virus pandemic, so there is one thing that teachers and students cannot meet face to face in the classroom. Research supports the conclusion that a positive school environment increases students' achievement. To replace a positive environment in offline classroom, educators can build a positive classroom environment virtually by greeting students when they enter a video conference call, going live on Telegram and Google Classroom every meeting.

A positive learning environment depends on classroom management / structure and a climate for student success. Teachers who establish classrooms that are caring, supportive, safe, challenging, and academically robust help define a positive learning environment. In addition to feedback and appreciation, another way to establish a positive and effective learning environment is to celebrate the learners' success. This will also act as a guide for others to use the same learning strategy and to improve their performance in learning strategies.

Students learn through interacting with online learning contents (texts, images, animations, videos, interactive games, etc.) and through participating in online course activities (discussions, quizzes, hands-on activities). Students are also engaged in individual or group interactions through synchronous or asynchronous communication. In the instructor-provided scaffolding, generally the course instructor is responsible for providing students with emotional scaffolding by means of asynchronous

communications. For example, when a student shares his/her anxiety or frustration on a certain part of the online course, the course instructor provides possible interventions to reduce students' negative emotions. If a student reports pride, satisfaction, or gratitude, the course instructor further reinforces the positive emotions. The drawback with this approach is that emotional scaffolding is often not provided in time when a student experiences unconstructive emotions because the student has to wait until the course instructor responds to his/her emotional states with emotional scaffolding strategies

2.   Provide Opportunities to Apply Learning.

Students needs to be given opportunities to apply learning authentically, personally meaningful activities. Then educators must provide formative assessments and feedback on their students' work. good feedback may lead memory to become part of a memory bank. These opportunities activate the isolated small neural networks of facts or procedures, which then undergo the cellular changes of neuroplasticity that link them into larger neural circuits of related information. These extensive neural circuits integrate new information when they are a) simultaneously activated and b) when they recognize patterns in common (Miyake and Friedman 2012).

The expanding of related categories of information (Piaget's schema) through executive function activities will consolidate learning into networks. These networks can be activated when students are prompted to use new learning to solve problems or create new products. This is the transfer process that further promotes network activation with the resulting neuroplasticity to construct long-term memory

(Caine & Caine, 2012). Without these opportunities for strengthening, any memories learned by rote are simply pruned away from disuse after the test.

3. Introduce Activities to Support Developing Executive Function

Students need to be explicitly taught and given opportunities to practice using executive functions such as how to learn, study, organize, prioritize, review, and actively participate in class. Activities that can support executive function network development include comparing and contrasting, giving new examples of a concept, group collaboration, open-ended discussions. Additionally, executive function is developed when students summarize and symbolize new learning into new formats, such as through the arts or writing across the curriculum.

This type of student-prompted information and skill seeking strengthens students' attitude about the value of learning. When motivated to solve problems that are personally meaningful, students apply effort, collaborate successfully, ask questions, revise hypotheses, redo work, and seek the foundational knowledge you need them to learn. And they do this because they want to know what you have to teach.

When students acquire desired facts, skills, or procedures to achieve authentic, valued goals, the information has a template (neural circuit) to which it can link. Foundational knowledge is not isolated. Learning is consolidated into related patterns, connected in neural networks of long-term conceptual memory, and available for retrieval and transfer to solve future problems and investigate new ideas.

4. Model Higher Thinking Skills

Implementing higher order thinking skills provides students to activate their developing executive function networks through planning instruction in teaching and learning process by considering some aspects of the following:

Judgment

This executive function, when developed, promotes a student's ability to monitor the accuracy of his or her work, and to analyze the validity of information heard or read. Techniques such as estimation with feedback and adjustment, editing and revising one's own written work using rubric guidance, or evaluating websites using criteria to separate fact from opinion are examples of promoting the development of networks for judgment.

Prioritizing

This executive function helps students to separate low relevance details from the main ideas of a text or topic of study. Prioritizing is the executive function that guides students when they plan an essay, select information to include in notes, and evaluate word problems in the text for the relevant data. Prioritizing also promotes one's ability to combine separate facts into a broader concept with recognition of degrees of relevance and relatedness. Prioritizing networks will be activated as you guide students to organize, plan ahead, keep records of their most successful strategies, and use this information to make the most efficient use of their time.

Prior Knowledge Activation and Transfer Opportunities

Plan activities where students can relate what they know from past experiences to their current learning and tie it to the larger concept. When you provide learning experiences by which students can apply new learning to multiple applications, you promote the neural construction.

Five executive function skills
1. Paying attention
2. Organizing and planning
3. Starting tasks and staying focused on students
4. Managing emotion
5. Keeping track of what students are doing

The three areas of executive function

The five executive function skills above are subset from three umbrellas in the following:
1. Working memory
   The ability to store information in mind and then use it in some ways.
   Example: A student uses the working memory to store the information to be used for doing her tasks, discussion, and presentation.
2. Cognitive flexibility (Flexible thinking)
   The ability to think about something more than one ways or out of the box.
   Example: A student uses this cognitive flexibility to solve the problems in various ways with different concepts.
3. Inhibitory control(self-control)

> This student affords ignore distractions and resist temptation.
>
> Example: A student can use his skill of inhibitory control to keep focusing on the class which also keeps students from acting impulsively.

In short, executive functions work as the conductors of our cognitive orchestra, orchestrating our ideas, behaviors, and goals.

Lecturers prepared a task and activities before, during and after reading

Table 3. Teaching strategies experimental and control Class

Brain- Based Teaching Strategies by Building Executive Function with Technology Support in EFL Reading	Online instruction integrated with flipped classroom in EFL Reading
Pre-Reading • Ask the students to read some articles or video from Youtube related to the same topic which will be discussed then make a brief summary on it at home • Lecturers built a positive classroom environment virtually by by greeting students when they entered	**Pre-Reading** • Ask the students to read some articles or video from Youtube related to the same topic which will be discussed then make a brief summary on it at home. • Ask students to vsist Google classroom or Telegram to have reading class. • Ask students some

a video conference call, going live on Telegram and Google Classroom every meeting. • Activating student's schemata by asking some opinions about the topic will be discussed based on their background knowledge • Making mapping through KWL	opinions about the topic will be discussed based on their background knowledge
During Reading • Conducting synchronous and asynchronous in telegram and Google Classroom to discuss the text given by the lecture. • Asking the students to expand the students' knowledge about the topic through brief discussing related to the topic to attract students' attention. • Asking the students to comprehend the text by answering the questions about the main idea, explicit information,	**During Reading** • Conducting synchronous and asynchronous in telegram and Google Classroom to discuss the text given by the lecture. • Asking the students to expand the students' knowledge about the topic through brief discussing related to the topic to attract students' attention. • Asking the students to comprehend the text by answering the questions about the main idea, explicit information,

author's thesis and purpose, identify all main ideas then restate by students' own sentences. • Students need to be explicitly taught and given opportunities to practice using executive functions such as how to learn, study, organize, prioritize, review, and actively participate in class.	author's thesis and purpose, identify all main ideas then restate by students' own sentences.
Post Reading • Giving various of tasks such as quiz online, problem solving, project based • Giving assignment to students by giving deadline for submission to evaluate the strength and weakness of the text (article) and make some note summarizing and elaborate with students' opinion based on their background knowledge • Then the lecture gave feedback and	**Post Reading** • Answer the questions provided in the text. • Giving assignment to students by giving deadline for submission to evaluate the strength and weakness of the text (article) and make some note summarizing and elaborate with students' opinion based on their background knowledge • Then the lecture assessed the students' work.

assessed the students' work.	

CHAPTER 6
BRAIN- TARGETED TEACHING MODEL INNOVATION

The Brain-Targeted Teaching Model for 21st-Century Schools connects theory and implementation by providing a complete, proven, and practical framework for instructional design. It was created by Dr. Mariale Hardiman. She is a Professor and Director of the Johns Hopkins Neuro-Education Initiative (NEI) in the United States. The NEI is known as an innovative cross-disciplinary program that provides educators with research from the learning sciences via the Mind, Brain, and Teaching master's and doctorate courses, as well as professional development programs. Johns Hopkins University is one of the world's most prestigious universities. The institution was established with the goal of becoming a research centre.

This model explains how to utilize educational and cognitive neuroscience principles in classroom settings using a pedagogical framework and is suitable with a variety of professional development programs. The most recent neuroscience and psychological research present us with new insights into how we learn. There is no such thing as a unique manner of learning, even while learning a foreign language. Each learner has a unique learning style or method. If we could detect how our brain learns and grasp the learning mechanism, we might greatly improve the teaching and learning process.

Many types of study have demonstrated and highlighted the existence of neuro-functional networks that are only specialized in processing specific language

components during the language learning process. The brain is uniquely organized. Every learner is unique, with a unique set of abilities, skills, and anxieties. A smart instructor can detect each student's strengths and work on them to motivate and assist the student in acquiring a foreign language, even if the class is made up of varied abilities.

Teachers who use the brain-targeted teaching-learning model can be confident that they are implementing research-based effective teaching strategies as well as what the neurological and cognitive sciences tell us about how the brain thinks and learns and how the brain should be taught, resulting in higher levels of teaching efficacy for developing a brain-targeted pedagogy (Hardiman et al. 2012). Once completed, they can concentrate on lesson execution, encouraging more creative and original teachings rather than planning for a two or three-week learning unit time frame. In other words, teachers actively improve skills as they implement them in the classroom. They have also stated that the methodology challenges them to think more deeply about instructional implementation, which encourages more creative and inventive classes. By using the brain-targeted teaching model, teaching and learning not only becomes more effective but it becomes more fun.

The brain-targeted teaching model framework encourages teachers to consider how teaching influences learning, allowing students to learn by merging students' schema with the brain-targeted teaching model EFL Reading. Relevant literature shows a substantial association between brain-based learning settings and academic achievement (Seegers, 2020; Rukminingsih, 2018; Rukminingsih et al., 2021, Rukminingsih et al., 2022), establishing neuroscience

as a valuable profession in the field of education. As new insights emerge, the learner's position in the classroom must be constantly assessed and advanced (Jensen, 2010; Rukminingsih et al., 2024).

The Brain-Targeted Teaching Model's pedagogical framework is organized around six key parts of the teaching and learning process. Although these are presented as separate topics, the model is not a formal framework for education. Instead, it represents an organic structure for guiding pedagogy based on solid scientific evidence. The descriptions of each of the six "brain targets" below highlight some relevant research for each target and lay out teaching strategies based on this research that might be used in higher education classrooms.
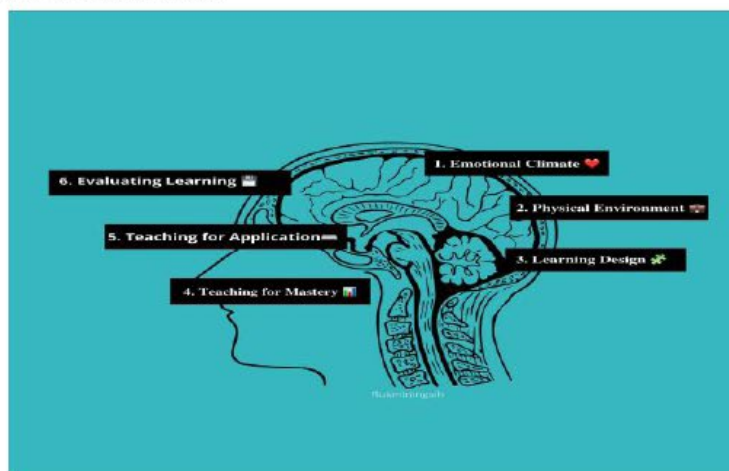

Figure 5. Brain targeted teaching model presents six stages (Hardiman, 2012)

Brain targets one (The emotional Climate for learning)

The brain target one is dealing with interaction of the emotional and cognitive brain systems. According to research, our emotional responses are controlled by the

brain's limbic system, which is positioned right above the brain stem at the base of the brain. According to neuroscientists, information enters the brain and is processed first in the emotional center before moving on to the cognitive or thinking center situated in the frontal lobe of the cerebrum. Chronic stress, which short-circuits information processing first to the emotional center, may damage long-term memory and deep learning abilities. The impact of stress and threat on learning has direct implications for educators. According to Hardiman (2012), "it is important for educators to understand the influence of emotional arousal, both positive and negative, on attention, memory, and higher-order thinking". Teachers should minimize threat-causing practices within the classroom. At the same time, teachers should maximize strategies that promote positive emotions.

According to research, threats affect learning, while positive emotional experiences cause the brain to release particular chemicals or neurotransmitters that contribute to long-term memory. The brain-targeted education style encourages instructors to design for good emotional connections. Understanding how emotions can influence learning would benefit educators (Jensen, 2008). Thus, when positive emotion is activated, the brain interprets the incoming information as worth remembering, whereas negative emotion can cause resistance to learning.

Brain target two (Physical Learning environment)

While brain target one focuses on creating an optimal emotional environment, brain target two encourages careful planning of the physical learning space. "We know that our

eyes detect about 36,000 visual impressions per hour, and visual stimuli account for approximately 90% of the brain's sensory input. With its enormous visual capacity, the active brain is constantly scanning the world for inputs" (Hardiman, 2012). Studies compared the effects of plain, unchanging surroundings to classrooms that provided pupils with excitement by constantly modifying and changing classroom displays. Sound, lighting, and scent all appear to influence learning. Soft background music can help pupils relax and create a conducive learning environment. However, executing things that require a high level of focus is the most efficient.

Researchers has been investigating the effects of lighting found that students who were taught in classrooms with the most natural and full-spectrum lighting outperformed those in dark classrooms or schools with cool-white fluorescent lights. Scent can also be utilized to improve memory because all factory input goes straight to the limbic system, or emotional center. This accounts for the intense memories that an encounter with a familiar scent can elicit. Frequent movement in a learning environment can boost the brain processes that control attention and motivation. To sum up, In the brain-targeted teaching model, teachers carefully plan the physical learning environment by deliberately planning for novelty, order, and beauty within each learning unit.

Brain target three---Designing the learning experience

Brain target three encourages teachers to build learning experiences that align with the brain's inherent learning systems. The third brain targeted teaching paradigm

involves constructing the learning environment with the goal of incorporating novelty, order, and beauty within each learning unit. While it may appear natural for teachers to create lesson plans that provide knowledge to students systematically until all of the topic has been covered, this strategy may inhibit learning. According to neuroscientists, the brain categorizes new information into concepts in order to create new patterns of thinking and understanding, which is known as patterning. To make sense of new information, the brain filters it via the lens of prior experience and knowledge. New information, then becomes integrated into a holistic pattern of cognition.

Brain-Target Three encourages teachers to plan learning experiences based on what is known about how the brain learns. Learners frequently ask, "Why do I need to know this?" Helping learners grasp the relationship between learning goals and daily real-life tasks may assist in skill development and concept comprehension (Hardiman, 2012). According to Piaget et al. (1971) and Vygotsky (1978), learning happens when prior knowledge and new knowledge combine to shape thinking. Designing learning experiences based on big-picture ideas helps with abstract thinking and chunking information to make and develop long-term meaning. The brain-targeted teaching methodology encourages teachers to establish overall goals and concepts based on content standards and curriculum rules, which are subsequently displayed to students.

Teaching strategies are then designed to allow students to the objectives they will learn during the unit relate to the big picture concept.

Brain Target Four (mastery of skills, content, and concepts)

Students get involved in tasks at this level that will allow them to show that they have mastered the material, concepts, and skills. Brain Target Four involves organizing several tasks to engage the brain's memory system, which facilitates mastery of learning targets and goals. In order for students to develop and maintain new memory patterns, teachers must give them learning activities as part of teaching for mastery. Brain-Target Four emphasizes the value of instructional strategies that foster both mastery and long-term memory of knowledge, abilities, and ideas. A large portion of this process is dependent on memory functions (Caine & Caine, 1997). In order for students' long-term memory systems to retain the material, brain target four of the BTT model requires teachers to schedule frequent practice of concepts, skills, and content. If the same exercises were given repeatedly in the same manner, it would be extremely repetitive for teachers as well as students. Rather, teachers are encouraged to provide multiple learning opportunities that enable students to modify knowledge using several modalities. Integrating artistic teaching into topic training is the most effective approach to achieve this.

Teachers are encouraged to match linguistics learning exercises with visual, kinesthetic, and musical thinking when integrating the arts into their lessons, since this fosters meaningful connections to the idea. A meaningful connection to the arts can enhance cognitive learning and higher-order thinking through activities like role-playing, creative movement, drama, poetry, and creative writing. The abilities involved with the visual arts, sculpture or painting, drama,

mime, and use of the body, as well as with music, all represent separate sets of cognitive skills. We can infer that by giving students a variety of access points to knowledge, skills, and concepts, teachers are not only helping students develop long-term memory but also giving them the chance to differentiate their instruction according to the emotional needs, academic objectives, and engagement levels of their students.

Brain Target five (extending and applying knowledge)

The core of any effective educational program is knowledge acquisition. Brain research confirms what educators already know to be the hallmark of effective instruction: lifelong learning happens best when students are able to apply procedures, information, and skills to activities that call for higher order thinking and problem-solving abilities. Students must extend their thinking to examine concepts in deeper, more analytical ways in order to use knowledge meaningfully. This requires the brain to use many, complicated retrieval and integration processes. Teachers give students the chance to switch between being information consumers and producers of material, with the latter function being more important in order to expand learning in real-world.

Brain Target Five encourages students to apply their analytical, problem-solving, and inductive and deductive reasoning skills. It enables students to put what they've learned to use in assignments with practical implications. The brain targets five in the brain-targeted teaching-learning unit are investigating, creating experiments, evaluating

viewpoints, and using the visual and performing arts to foster creative thinking.

Brain target six (Evaluating Learning)

Brain target six is the final level in the brain targeted teaching methodology. Each stage of the model involves evaluation activities. This area emphasizes two major elements: the range of evaluation methods and the importance of feedback. According to Hardiman (2012), using different evaluations and rubrics gives students with clear criteria that encourage the growth of creativity.

The purpose of assessment is to offer students with useful feedback on their performance so that they can change their learning habits and the teacher can make sound instructional decisions. Providing feedback is an important part of the learning process. Jensen (2014) highlights feedback as having the biggest impact on student progress, stating that goal-oriented, timely feedback is ideal. Cognitive science backs up what teachers know from experience: rapid feedback improves learning and memory processes. The brain-targeted education paradigm encourages the use of an evaluation measure for objectives and activities. In addition to typical grading methods (quizzes, tests, essays, etc.), assessment measures should use a variety of tools, such as scoring rubrics, grading keys, self-grading tools, and student-generated reflections.

In this teaching strategy,I adapted a sixth of the brain targeted teaching from (Seegers, 2020; Parr, 2016, Bertucci, 2013, and Hardiman, 2012;) which adjusted the implementation of BTT with online instruction as the following:

1.   The first BTT, **creating an emotional climate** includes
     assisting students in taking ownership of the subject they
     are learning. This starts with clear instructions or
     procedures. students are given options to foster a sense of
     responsibility, but the options are well-defined, so
     students are not lost in the dark.
2.   The second BTT, **physical environment** concerns what
     a teacher must do to make the lesson alive and exciting
     for the students. By seeing a video that is relevant to the
     text that will be discussed in class.
3.   The third BTT, **teaching design** guarantees that students
     understand the "big idea" of the session. It entails
     recognizing what adolescents already know after each day
     and continually asking what students want to learn more
     about.
4.   The fourth target, **teaching for mastery**, Teaching for
     mastery needs further investigation or study of the
     subject. In this lesson, the brain's memory system is
     activated through the provision of numerous tasks. When
     teaching for mastery, educators need to give students
     learning exercises that will help them establish and
     maintain new memory patterns after they search the
     internet for different sources from around the globe and
     discuss what they find with their peers and the lecturer in
     an online class.
5.   The fifth target, **application**, which lets students use
     what they've just learned to broaden their understanding.
     Students completing the assignment assigned by the
     lecturer and representing what they have just learned is
     the learning activity appropriate for this particular course.
     Students must extend their thinking in order to apply

knowledge meaningfully. This involves looking at ideas in more in-depth, analytical ways, which calls for the employment of numerous, intricate retrieval and integration mechanisms in the brain by having the pupils assess, dissect, summarize, and synthesize the information or texts.

6. The target six, **evaluating learning** which students can see how much they have learnt through assessment. All it takes to achieve this is for students to be able to view each other's assignments, notes, and models. It's crucial to remember that this kind of examination needs to be carried out often. Responses obtained after a significant amount of time have been compared to actions taken a few days prior.

Table 3. Teaching Scenario of Brain-targeted teaching strategy for teaching Critical Reading Course

Meetings	Teaching Phases	Implementations
Meeting I	a. Pre- test of critical reading b. Reading Motivation Questionnaire	a. Students were asked to do the critical reading test b. Students were asked to answer the questionnaire
Meeting II	Introducing rules and policy	The students were exposed to rules and policy including the attendance, assignment, accomplishment, syllabus and

		evaluation.
Meeting III	Identifying an argument include issues, conclusions, and reasons in the text. Brain target one: Emotional climate Brain target two: Physical environment Brain target three: Learning design Brain target four: teaching for mastery Brain Target five: teaching for application Brain target six: teaching for evaluation learning	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text by watchimg Video from Youtube d. Ask the

		students discuss what the students have written and ask the students to check their comprehension about the text.
		e. Ask the students to comprehend the text by answering the questions about identifying an argument & issue and identify conclusion & reasons in the text
		f. Discuss the answers together in order to enlarge students' comprehension (formative assessment)
		Post Reading
		g. Giving feedback to students' opinion.
		h. Giving

		enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting IV	Interpreting between facts and opinions on texts	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge about the topic

		through brief discussing related to the topic of the text by watchimg Video from Youtube
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about interpreting opinion and facts
		f. Discuss the answers together in order to enlarge students' comprehension
		Post Reading
		g. Giving feedback to students'

		opinion.
		h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting V	Interpretting assumption, bias, stereotypes and author's point of view	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question wordsby allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students'

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<tr><td></td><td></td><td>knowledge about the topic through brief discussing related to the topic of the text.by watchimg Video from Youtube

d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text

e. Ask the students to comprehend the text by answering the questions about Interpretting assumption, bias, stereotypes and author's point of view

f. Discuss the answers together in order to enlarge students'</td></tr>
</table>

		comprehension
		Post Reading
		g. Giving feedback to students' opinion.
		h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting VI	analyzing the impact of fallacies in an argument	**Pre Reading**
		a. Greeting students warmly in virtual platform.
		b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources

		(internet) **While Reading** c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text by watching video from Youtube. d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text e. Ask the students to comprehend the text by answering the questions about analyzing the impact of fallacies in an argument f. Discuss the answers

		together in order to enlarge students' comprehension **Post Reading** g. Giving feedback to students' opinion. h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting VII	Assessing the accuracy of evidence given in support of an author's argument	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them

		to searching the same topic from other sources (internet)
		While Reading c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text. d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text. e. Ask the students to comprehend the text by answering the questions about assessing the accuracy of evidence given in support of an author's argument

		f. Discuss the answers together in order to enlarge students' comprehension **Post Reading** g. Giving feedback to students' opinion. h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting VIII	Synthesizing ideas on related issues from intertextual sources	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question

		words by allowing them to searching the same topic from other sources (internet)
		While Reading
		c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about Combining ideas and information selected from

| | | different texts. Looking for patterns among your sources, possibly supporting or refuting their ideas or those of other sources
f. Discuss the answers together in order to enlarge students' comprehension

Post Reading
g. Giving feedback to students' opinion.
h. Giving Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer. |
| Meeting IX | Evaluating the text | **Pre Reading**
a. Greeting students warmly in virtual platform. |

		b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading
		c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text

		e. Ask the students to comprehend the text by answering the questions about *evaluating information by confirming, extend or change their personal view based on the topic of the reading. They should explain when they do not agree with information in the text.*
		f. Discuss the answers together in order to enlarge students' comprehension
		Post Reading
		g. Giving feedback to students' opinion.
		h. Giving enforcement the comprehension of the text by

		asking the students to conclude the lesson today and confirming by the lecturer.
Meeting X	Summarizing the text	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge about the topic through brief discussing

		related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text.
		e. Ask the students to comprehend the text by answering the questions about *b*riefly presenting the main idea of the text. Write a paragraph or more that presents the main ideas in their our word.
		f. Discuss the answers together in order to enlarge students' comprehension
		Post Reading
		g. Giving feedback to

		students' opinion. h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XI	Paraphrasing the text	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. Ask the

		students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about restating and clarifying the meaning of a few sentences from the text. Reread the passage to be paraphrased by combining students' background knowledge.

		f. Discuss the answers together in order to enlarge students' comprehension **Post Reading** g. Giving feedback to students' opinion. h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XII	Reading critically an article provided by the lecturer	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question

		words by allowing them to searching the same topic from other sources (internet)
		While Reading
		c. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about the text critically .
		f. Discuss the

		answers together in order to enlarge students' comprehension. **Post Reading** g. Giving feedback to students' opinion. h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XIII	Reading critically an article provided by the lecturer	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by

| | | allowing them to searching the same topic from other sources (internet)

While Reading
c. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
e. Ask the students to comprehend the text by answering the questions about the text critically .
f. Discuss the answers |
| --- | --- | --- |

		together in order to enlarge students' comprehension

Post Reading
g. Giving feedback to students' opinion.
h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer. |
| Meeting XIV | Reading critically an article provided by the lecturer | **Pre Reading**
a. Greeting students warmly in virtual platform.
b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them |

		to searching the same topic from other sources (internet)
		While Reading
		c. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about the text critically .
		f. Discuss the answers together in

		order to enlarge students' comprehension **Post Reading** g. Giving feedback to students' opinion. h. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XV	Post test	Students were asked to do the critical reading test
Meeting XVI	a. Open response questionnaire b. Close ended questionnaire	Students were asked to answer open responses concessionaire
Meeting IX	Evaluating the text	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will

		be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading
		c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the

		text by answering the questions about *evaluating information by confirming, extend or change their personal view based on the topic of the reading. They should explain when they do not agree with information in the text.*
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to

		students' opinion.
		i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting X	Summarizing the text	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the

		students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text.
		e. Ask the students to comprehend the text by answering the questions about *b*riefly presenting the main idea of the text. Write a paragraph or more that presents the main ideas in their our word.
		f. Discuss the answers together in

		order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.
		i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XI	Paraphrasing the text	**Pre Reading**
		a. Greeting students warmly in virtual platform.
		b. Brain storming by asking the students the

		topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading c. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text e. Ask the students to comprehend the

		text by answering the questions about restating and clarifying the meaning of a few sentences from the text. Reread the passage to be paraphrased by combining students' background knowledge.
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.

		i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XII	Reading critically an article provided by the lecturer	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. Ask the students to expand the students'

		knowledge about the topic through brief discussing related to the topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about the text critically .
		f. Discuss the answers together in order to enlarge students' comprehension.
		g. Ask the students to integrate students' knowledge into a greater schema by

		comprehending text.
		Post Reading h. Giving feedback to students' opinion. i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XIII	Reading critically an article provided by the lecturer	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from

| | | other sources (internet)

While Reading
c. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
e. Ask the students to comprehend the text by answering the questions about the text critically .
f. Discuss the answers together in order to enlarge students' |

		comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text. **Post Reading** h. Giving feedback to students' opinion. i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XIV	Reading critically an article provided by the lecturer	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the

		topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text e. Ask the students to comprehend the

		text by answering the questions about the text critically .
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.
		i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.

Meeting XV	Post test	Students were asked to do the critical reading test
Meeting XVI	c. Open response questionnaire d. Close ended questionnaire	a. Students were asked to answer open responses concessionaire

Table 4. Teaching Scenario Combining Brain-Targeted Teaching and Content Schemata Strategy with Online Instruction

Meetings	Teaching Phases	Implementations
Meeting I	Pre- test of critical reading Reading Motivation Questionnaire	b. Students were asked to do the critical reading test c. Students were asked to answer the questionnaire
Meeting II	Introducing rules and policy	The students were exposed to rules and policy including the attendance, assignment, accomplishment, syllabus and evaluation.
Meeting III	Identifying an argument include issues, conclusions, and reasons in the	**Pre Reading** a. Greeting students warmly in virtual platform.

	text. Brain target one: Emotional climate Brain target two: Physical environment Brain target three: Learning design Brain target four: teaching for mastery Brain Target five: teaching for application Brain target six: teaching for evaluation learning	b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text by watchimg Video from Youtube d. Ask the students discuss what the students have written and ask the students to check their comprehension

		about the text.
		e. Ask the students to comprehend the text by answering the questions about identifying an argument & issue and identify conclusion & reasons in the text
		f. Discuss the answers together in order to enlarge students' comprehension (formative assessment)
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.
		i. Giving enforcement the

		comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting IV	Interpreting between facts and opinions on texts	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge

		about the topic through brief discussing related to the topic of the text by watchimg Video from Youtube
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about interpreting opinion and facts
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by

		comprehending text.
		Post Reading h. Giving feedback to students' opinion. i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting V	Interpretting assumption, bias, stereotypes and author's point of view	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question wordsby allowing them to searching the same topic from

		other sources (internet)
		While Reading
		c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text.by watchimg Video from Youtube
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about Interpretting assumption, bias, stereotypes and author's point of view
		f. Discuss the answers

		together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.
		i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting VI	analyzing the impact of fallacies in an argument	**Pre Reading**
		a. Greeting students warmly in virtual platform.
		b. Brain storming by asking the students the topic which will be discussed in

		the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text by watching video from Youtube. d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text e. Ask the students to comprehend the text by

		answering the questions about analyzing the impact of fallacies in an argument
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.
		i. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting	Assessing the	**Pre Reading**

VII	accuracy of evidence given in support of an author's argument	a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text. d. Ask the students discuss what the students have written and ask the students to check their

		comprehension about the text.
		e. Ask the students to comprehend the text by answering the questions about assessing the accuracy of evidence given in support of an author's argument
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		h. Giving feedback to students' opinion.
		i. Giving enforcement the comprehension of the text by

		asking the students to conclude the lesson today and confirming by the lecturer.
Meeting VIII	Synthesizing ideas on related issues from intertextual sources	**Pre Reading** a. Greeting students warmly in virtual platform. b. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** c. ask the students to expand the students' knowledge about the topic through brief discussing related to the

		topic of the text
		d. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		e. Ask the students to comprehend the text by answering the questions about Combining ideas and information selected from different texts. Looking for patterns among your sources, possibly supporting or refuting their ideas or those of other sources
		f. Discuss the answers together in order to enlarge students' comprehension
		g. Ask the students to integrate students'

		knowledge into a greater schema by comprehending text. **Post Reading** h. Giving feedback to students' opinion. i. Giving Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting IX	Evaluating the text	**Pre Reading** j. Greeting students warmly in virtual platform. k. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them

| | | to searching the same topic from other sources (internet)

While Reading

l. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text

m. Ask the students discuss what the students have written and ask the students to check their comprehension about the text

n. Ask the students to comprehend the   text by answering the questions about *evaluating information by confirming, extend or change their personal view based on the topic of the* |

		reading. They should explain when they do not agree with information in the text. o. Discuss the answers together in order to enlarge students' comprehension p. Ask the students to integrate students' knowledge into a greater schema by comprehending text. **Post Reading** q. Giving feedback to students' opinion. r. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer
Meeting X	Summarizing the	**Pre Reading**

	text	j. Greeting students warmly in virtual platform.
		k. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading
		l. ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		m. Ask the students discuss what the students have written and ask the students to check their

		comprehension about the text.
		n. Ask the students to comprehend the text by answering the questions about *b*riefly presenting the main idea of the text. Write a paragraph or more that presents the main ideas in their our word.
		o. Discuss the answers together in order to enlarge students' comprehension
		p. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		q. Giving feedback to students' opinion.
		r. Giving

		enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XI	Paraphrasing the text	**Pre Reading** j. Greeting students warmly in virtual platform. k. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet) **While Reading** l. Ask the students to expand the students'

		knowledge about the topic through brief discussing related to the topic of the text
		m. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		n. Ask the students to comprehend the text by answering the questions about restating and clarifying the meaning of a few sentences from the text. Reread the passage to be paraphrased by combining students' background knowledge.
		o. Discuss the answers together in order to enlarge students'

		comprehension
		p. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		q. Giving feedback to students' opinion.
		r. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XII	Reading critically an article provided by the lecturer	**Pre Reading**
		j. Greeting students warmly in virtual platform.
		k. Brain storming by asking the students the topic which will be discussed in the text generally with

		(what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading l. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text m. Ask the students discuss what the students have written and ask the students to check their comprehension about the text n. Ask the students to comprehend the text by answering the questions about the text critically . o. Discuss the

		answers together in order to enlarge students' comprehension. p. Ask the students to integrate students' knowledge into a greater schema by comprehending text. **Post Reading** q. Giving feedback to students' opinion. r. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XIII	Reading critically an article provided by the lecturer	**Pre Reading** j. Greeting students warmly in virtual platform. k. Brain storming by asking the students the

		topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading
		l. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		m. Ask the students discuss what the students have written and ask the students to check their comprehension about the text
		n. Ask the students to comprehend the text by answering the

		questions about the text critically .
		o. Discuss the answers together in order to enlarge students' comprehension
		p. Ask the students to integrate students' knowledge into a greater schema by comprehending text.
		Post Reading
		q. Giving feedback to students' opinion.
		r. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.
Meeting XIV	Reading critically an article provided by the lecturer	**Pre Reading**
		j. Greeting students warmly in virtual

		platform.
		k. Brain storming by asking the students the topic which will be discussed in the text generally with (what, why and how) question words by allowing them to searching the same topic from other sources (internet)
		While Reading
		l. Ask the students to expand the students' knowledge about the topic through brief discussing related to the topic of the text
		m. Ask the students discuss what the students have written and ask the students to check their comprehension about the text

		n. Ask the students to comprehend the text by answering the questions about the text critically .
		o. Discuss the answers together in order to enlarge students' comprehension
		p. Ask the students to integrate students' knowledge into a greater schema by comprehending text.

Post Reading

q. Giving feedback to students' opinion.

r. Giving enforcement the comprehension of the text by asking the students to conclude the lesson today and confirming by the lecturer.

Meeting XV	Post test	Students were asked to do the critical reading test
Meeting XVI	e. Open response questionnaire f. Close ended questionnaire	d. Students were asked to answer open responses concessionaire

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GLOSSARY

B

Brain-Based Approach: A brain-based approach to learning and education seeks to understand student learning through the lens of the human brain. It uses studies from psychology, neurology, and cognitive science to develop effective teaching and learning practices, 21, 38

Brain- Based Learning: Brain-based learning is a paradigm that examines how the brain receives information, retains knowledge, and motivates students, 33

Brain-Based Teaching: Brain-based teaching is an innovative approach to education that draws on findings from neuroscience and cognitive science. It focuses on designing successful learning environments by matching instructional methods to how the brain processes information, 36, 38, 39, 40, 42

Brain-Targeted Teaching Model: The Brain-Targeted Teaching Model emphasizes pleasant emotional and physical learning environments, the development of "big picture" concepts, mastery of skills and processes, "real world" application of learning, and ongoing evaluation of student growth. This model has been created by Hardiman in 2012. It has six targets involving: Brain Target One: Establishing the emotional climate for learning, Brain Target Two: Creating the physical learning environment, Brain Target Three: Designing the learning experience, Brain Target Four: Teaching for mastery of content, skills, and concepts, Brain Target Five: Teaching for the extension and application of knowledge-creativity and innovation in education, Brain Target Six: Evaluating learning, 56, 59

E
Executive Function: Executive function is a set of mental abilities that includes working memory, flexibility, and self-regulation, 42, 43, 44, 46, 48, 49, 50, 51, 52, 54

Emotional Regulation: Emotional regulation refers to the capacity to manage and respond to the continuous demands of experience with a range of emotions in a socially acceptable and sufficient manner, 45

N
Neuroscience: Neuroscience studies the functioning of the nervous system, which comprises around 100 billion nerve cells in the human brain, 8, 15, 16, 17, 18, 19, 20, 21, 24, 25, 26, 27, 29, 32, 36, 55

Neuroeducation: Educational neuroscience is a growing field involving researchers from cognitive neuroscience, developmental cognitive neuroscience, educational psychology, educational technology, and education theory to study the relationship between biological processes and education, 16, 20, 26

O
Orchestrated Immersion: Orchestrated Immersion is a learning approach that aims to create a fully immersive and complex educational experience for learners, 29, 38, 39, 140

Online Instruction: Online instruction is a virtual learning model where students and instructors communicate and review lectures, assignments, and readings. It differs from traditional face-to-face learning, as it is delivered entirely online, 36, 38, 40, 52, 63, 106

R

Relaxed Alertness: Relaxed alertness is a mental state where the brain is fully aware and focused, yet calm, with alpha waves dominating, 29, 38, 39

S

Synapse: is a small gap at the end of a neuron that permits messages to be transmitted from one neuron to another. Neurons are the cells that transmit information between the various sections of the central nervous system, including the brain. These synapses are found where neurons connect with each other, 5

W

Working Memory: Working memory is a short-term, limited cognitive system that stores information. It is crucial for logic as well as for directing behavior and decision-making, 9, 10, 11, 42, 44, 51

INDEX

S
Synapse, 5

W
Working Memory, 9, 10, 11, 42, 44, 51

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