# An Investigation of Brain-Based Learning Principles in Today's Current Conditions

## Günümüzün Değişen Koşullarında Beyin Temelli Öğrenme İlkeleri Üzerine Bir İnceleme

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**ABSTRACT:** The increasing prevalence of brain research and the fact that the findings reveal important arguments about the learning process have led to the proliferation of brain-based learning studies. Brain-based learning principles, introduced by Caine and Caine in 1991, are frequently used in the literature and shed light on educational research. However, in today's current conditions, educational environments have remarkably differentiated, the opportunities for learners have increased more than ever before, threats such as the Covid-19 pandemic and natural disasters have directly affected education, and technological advances have made a breakthrough with artificial intelligence. There are studies evaluating 12 accepted and frequently used brain-based learning principles in the literature, but there is no review study that addresses brain-based learning principles in today's current conditions. Therefore, this article aims to examine the principles of brain-based learning in today's current conditions. Increasing threats in the rapidly changing world pose a risk to brain-based learning. Also, increasingly common helicopter parenting and artificial intelligence hinder brain-based learning, although they have some advantages. However, on the other hand, the fact that technological developments make educational environments richer and increase the opportunities for learners greatly facilitates brain-based learning. Thus, brain-based learning principles have become much more meaningful and gained great importance in today's world.

**Keywords:** Brain, education, brain-based learning, generation Z, helicopter parenting, artificial intelligence

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**ÖZ**: Beyin araştırmalarının günümüzde giderek yaygınlaşması ve elde edilen bulguların öğrenme sürecine ilişkin önemli argümanlar ortaya koyması beyin temelli öğrenme çalışmalarının çoğalmasına neden olmuştur. Caine ve Caine tarafından 1991 yılında ortaya konulan beyin temelli öğrenme ilkeleri ise literatürde sıklıkla kullanılmakta ve eğitim araştırmalarına ışık tutmaktadır. Fakat günümüzün değişen koşullarında eğitim ortamları büyük oranda farklılaşmış, öğrenenlerin sahip olduğu olanaklar hiç olmadığı kadar artmış, Covid-19 pandemisi ve doğal afetler gibi tehdit unsurları eğitimi doğrudan etkilemiş ve teknolojideki ilerlemeler yapay zekâ ile birlikte büyük bir çığır açmıştır. Beyin temelli öğrenme ilkeleri ile ilgili literatürde birçok çalışma yer almaktadır. Fakat 12 tane beyin temelli öğrenme ilkesinin günümüzün değişen koşullarında ele alındığı herhangi bir derleme çalışması bulunmamaktadır. Bu nedenle, bu makale beyin temelli öğrenme ilkelerinin günümüzün değişen koşullarında incelenmesini amaçlamaktadır. Hızla değişen dünyada artan tehdit unsurları beyin temelli öğrenme için risk teşkil etmekte, giderek yaygınlaşan helikopter ebeveynlik ve yapay zekâ bazı avantajlara sahip olmakla birlikte beyin temelli öğrenmeyi sekteye uğratmaktadır. Fakat diğer taraftan, yaşanan teknolojik gelişmelerin eğitim ortamlarını daha zengin hale getirmesi ve öğrenenlerin imkanlarını büyük oranda artırması beyin temelli öğrenmeyi kolaylaştırmaktadır. Sonuç olarak beyin temelli öğrenme ilkeleri günümüz dünyasında çok daha anlamlı hale gelmiş ve büyük bir önem kazanmıştır.

**Anahtar sözcükler :** Beyin, eğitim, beyin temelli öğrenme, z kuşağı, helikopter ebeveynlik, yapay zeka

# 1. INTRODUCTION

The process of learning has been the subject of numerous studies over the years. Recently, these studies have taken into consideration the findings of brain research to better organize the teaching and learning process (Şen et al., 2015). At this point, the rapid development of functional imaging techniques like Magnetic Resonance Imaging and Positron Emission Tomography has provided an opportunity to observe the brain in detail (Crafton & Kido, 2000; Yoganathan et al., 2023). In today's rapidly changing world, the brain is under research as never before because significant technological advancements are taking place, and these greatly affect scientific research by facilitating innovative opportunities, such as detailed observation of the human brain (Grillner et al., 2016; Seymour et al., 2017; Weinstein et al., 2017). In this regard, advancements in technology have allowed scientists to observe how the brain responds to various stimuli and how different parts of the brain work together. This new understanding of the brain has radically changed our definition of learning (Menon & D'Esposito, 2022; Ozar, 2014; Yang, 2022).

Currently, societies are commonly referred to as "knowledge societies," and the learning process of individuals in the societies is recognized as lifelong and not limited to a specific environment (Steffens, 2015). In today's knowledge-based societies, individuals are expected to possess the necessary skills in order to identify, transform, share, use, and apply knowledge effectively (Alshehri, 2021). In parallel with the increasing need for these skills, new learning theories have emerged with the development of technology (Kulhanek, 2022). Thus, investigating together the latest learning techniques and current changing circumstances is a worthwhile effort to decide how to structure the learning environments.

Brain-based learning suggests that the brain is naturally inclined to learn different kinds of information (Bada & Jita, 2022; Čoh, 2021; Guyer et al., 2016). This means optimizing learning experiences depends on using brain-based learning in learning environments (Sele, 2019; Skidmore, 2015; Zardetto-Smith, 2006). Accordingly, numerous studies have proven that brain-based learning is positively associated with academic achievement (Haghighi, 2013; Noureen et al., 2017). Furthermore, there is a positive correlation between brain-based learning and various factors related to learning, including second language acquisition, academic attitude, and self-confidence (Iranmanesh et al., 2021; Jayasankara Reddy et al., 2021; Meral & Akgül, 2022; Sharma & Sharma, 2013). Because brain-based learning has a significant impact on various factors related to learning, applying brain-based learning is suitable for addressing the complex needs of today.

The current era has unique challenges as well as various advantages thanks to the advancement of science and technology (Iberahim et al., 2023; Kalpakian & Marzouk, 2023; Schenarts, 2020). That is why Generation Z faces rapidly changing conditions that require rethinking traditional learning approaches (Mandau & Lakulu, 2022). Also, inter-generational differences are huge, so culture clash appears between generations X, Y, and Z (Bjursell, 2020; Marshall & Wolanskyj-Spinner, 2020). At this point, Generation Z is expected to adapt to change and live harmoniously with other generations. Their tasks may seem more challenging compared to other generations. Nevertheless, the changing world has substantially affected generations X and Y because the world they were born into and the world they live in are completely different (Iswani, 2023; Rogers & Cohen, 2020; Srivastava & Srivastava, 2017). At least, Generation Z experiences some harmony between their birth world and their current world (Evci, 2022). In other words, they feel control over what they can do (Gupta, 2020). Before the digital era, access to information was difficult, and the world was not changing that fast (Agarwal, 2021; Mas'adi et al., 2022). Today's current conditions require the learner position of generations X and Y as well as

Generation Z. Therefore, lifelong learning has gained importance for each generation (Aemmi & Karimi Moonaghi, 2017; Gul & Bilgin, 2021; Sinanovic & Becirovic, 2016).

Brain-based learning can be used for lifelong learning of individuals, including preschool (Tekerci, 2022), school levels (Oktaviani et al., 2023), and adult education (Jang et al., 2022). Brain-based learning offers a critical and innovative paradigm for the multifaceted skills required for learners in the 21st century (El-Henawy, 2020). Teacher-centered instruction has been replaced by self-organized learning, and educational environments have already undergone a significant change in the 21st century (Sabitzer & Antonitsch, 2012). Increasing brain studies have emphasized the importance of lifelong learning by showing that individuals have the ability to learn lifelong and also revealed the importance of strategies such as brain-based learning for learners to be successful (Dwyer, 2002; Sibomana et al., 2020). There are concerns about the emergence of misinformation as a result of the rapid spread of knowledge about brain-based learning (Geake, 2008; Goswami, 2006; Shaheen, 2014; Xu et al., 2022). At this point, the principles of brain-based learning provide an essential framework for shedding the light the emergence of an effective learning process (Aina & Olu, 2018; Bada & Jita, 2022; Williams & Ziegler, 2022). The learning process has undergone a great change currently. Therefore, there is a need to examine the principles of brain-based learning in today's current conditions. Despite the growing importance of brain-based learning, there is no review study that assesses its principles by considering rapid changes in the world. Thus, this study aims to investigate the principles of brain-based learning in today's current conditions.

## 2. THE PRINCIPLES OF BRAIN-BASED LEARNING

The principles of brain-based learning are well-established in the literature because the majority of related studies prefer to use the same framework (Aina & Olu, 2018; Al-Zaidi & Shahat, 2023; Ghrmay, 2018; Haghighi, 2013; Khalil et al., 2019; Malik et al., 2012; Steffens, 2015). The principles of brain-based learning are categorized into twelve groups, as initially proposed by Caine and Caine (1991). These principles can be seen in Figure 1.

**Table 1:** *Twelve Principles of Brain-Based Learning (Caine & Caine, 1991)*

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|---|---|
| **1.** | The 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.** | The brain processes parts and wholes simultaneously |
| **7.** | Learning involves both focused attention and peripheral perception |
| **8.** | Learning always involves conscious and unconscious processes |
| **9.** | We have at least two different types of memory: a spatial memory system and a set of systems for rote learning |
| **10.** | We understand and remember best when facts and skills are embedded in natural, spatial memory |
| **11.** | Learning is enhanced by challenge and inhibited by threat |
| **12.** | Each brain is unique |

Each brain-based learning principle has a different importance for the learner. Each study in the literature has emphasized and focused on the importance of a different principle. For example, one study focused on retention, learning process, attitude, and achievement in brain-based learning principles (Tüfekçi & Demirel, 2009), while another study highlighted the importance of 8 principles (Chaijaroen & Samat, 2018). Today's current conditions may have affected some principles more, but this study aims to provide a general perspective by considering each principle. This study focused on today's dominant concepts, which are life-threatening disasters, technological developments, artificial intelligence, and parental attitudes. Therefore, all brain-based learning principles will be discussed under separate headings.

## 2.1. The Brain Is a Parallel Processor

According to this principle, the human brain is capable of simultaneously carrying out multiple activities (Llera & Sánchez, 2011; Pratt, 2008; Shahsavani et al., 2020). Nevertheless, today's conditions are far from supporting this principle of the brain because things that require more than one activity simultaneously gradually decrease with technological developments. Currently, artificial intelligence (AI) robots like Chat gpt have entered the field of education more rapidly than anticipated (Penprase, 2018; Yang, 2019). Chat GPT is an example of AI technology that can quickly generate summaries and reports by accessing a vast database (Imran et al., 2023). While AI-driven tools have many advantages, they also have some disadvantages (Wu et al., 2023). At this point, Fuchs (2023) claims that students' over-reliance on technology while using these AI robots significantly reduces their critical thinking skills, and this causes them to become passive learners. The rapid advancements in technology, which were introduced to enhance students' learning, can have a negative impact by making students lazy. In this sense, the uncontrolled development of technology can also lead to less use of multitasking due to decreased responsibilities with AI-driven tools.

Without AI plagiarism detectors, AI tools have become widespread and started to be used in an uncontrolled way. These plagiarism detectors may have the possibility to be misled as well (Goedde et al., 2023; Ibrahim et al., 2023). Concerns related to AI robots are numerous, and less simultaneous use of skills operated by the brain can be seen as the main problem stemming from AI-driven tools. Thus, the use of AI robots in education should be disseminated as long as they are employed to support brain-based learning, not prevent it.

With the rapid and significant advancement of technology, the learning styles of today's learners have also changed (Ho et al., 2019). In the past, there were fewer and limited learning environments because individuals had difficulty even leaving their city. Therefore, learning for individuals was limited only by the opportunities in their environment. On the other hand, many more dynamic learning environments are available for today's learners. For example, social media has emerged as one of the most critical learning environments today (Joseph & Mathew, 2019). New learning environments, such as social media, differ from traditional learning environments in that they are more dynamic. Social media continues to change with different developments every day (McCorkindale & DiStaso, 2014). This change also creates small difficulties for individuals (Choudhary et al., 2021). New learning environments that encourage brain-based learning, with their dynamic structure, direct today's learners to challenge themselves every day and use their brains as parallel processors. Creativity is one of the most fundamental skills for today's learners (Israel-Fishelson & Hershkovitz, 2022). This creativity does not only remain at the intellectual level; it also involves the individual processing more than one stimulus at the same time. Stimulants in schools are no longer based solely on textbooks because they have begun

to be used frequently in visual and audio materials. More importantly, learners are no longer solely dependent on schools because out-of-school learning environments have become important (Joseph & Mathew, 2019). Increasing learning environments, diversified learning materials, and new learning methods show that more opportunities have emerged for using the brain as a parallel processor.

## 2.2.    Learning Engages the Entire Physiology

Learners and educators should focus on both mind and physiology at the same time (Bada & Olusegun, 2015). Focusing solely on the intellect during learning would be insufficient (Sarita, 2017), as physiology plays a crucial role in regulating and impacting individuals' learning. For example, the circadian rhythm, which is related to the sleep-wake cycle over a 24-hour period, is crucial for the ideal functionality of organisms (Basolo et al., 2021; Pines, 2016). In today's modern societies, jet lag, 24-hour access to high-energy foods, shift work, and artificial lighting have largely increased, and these factors appear as significant factors that disrupt the circadian rhythm (Amanpour et al., 2021). Nowadays, many people use technological devices at night, and this can create artificial lighting (Correa et al., 2022). Additionally, it has become normal to be awakened by mobile phones or alarms (Fobian et al., 2016; Li et al., 2023). Thus, preparing the brain physiologically for optimal learning is getting more challenging day by day with the changes in modern life and the development of technology.

The brain is a physiological organ located in the human body (Altman, 2015). At this point, the brain is expected to function naturally, such as breathing. Just as breathing is regular and a habit for the individual, the brain also depends on a certain working principle. In today's competitive world, learners are expected to function at the maximum level (Anthony et al., 2019; Srivastava, 2019). However, school burnout and various psychological disorders, which are rapidly spreading in learning environments today, hinder the learning of individuals (Vansoeterstede et al., 2023; Wilcha, 2020). Compared to the past, new problem situations, such as cyberbullying, endanger the physiological conditions of learners (Watts et al., 2017), and this may make brain-based learning more challenging. Physiological readiness for learners under stress is almost impossible. Therefore, intervention programs and psychoeducation are crucial for coping with stress, providing physiological readiness for learners, and creating an environment conducive to brain-based learning.

Each generation should be understood within itself regarding learning styles (Hart, 2017). In this regard, Generation Z attracts attention from both the media and scientific research in terms of their significant differences from previous generations. Since Generation Z started to live directly in the digitalized world, this generation uses smart tools at every stage of life. It is very easy for these digital natives to use the possibilities of today's world. However, it may be difficult for them to adapt to today's education system (Jawad & Tout, 2021). Because schools have not experienced major changes since compulsory schooling began, old habits continue today (Horvatek & Baker, 2019). Although today's education system cannot adapt to changes quickly, an understanding that centers on physiology in learning has begun to emerge. For example, novel studies suggest the positive effects of later school start times on sleeping quality and academic outcomes (Marx et al., 2017). Similarly, schools started to apply new arrangements, like restricting the smartphone use of students (Brown et al., 2022; Hadad et al., 2020). Therefore, the understanding that centers on the physiology of today's learners is more likely to become more visible as relevant research increases and the positive results of the applications are reported.

## 2.3.     The Search for Meaning Is Innate

According to this principle, curiosity facilitates the learning of individuals as a driving motivational-emotional state (Kashdan & Silvia, 2009). In this regard, it is crucial to take into account what today's learners spend the majority of their time on in order to understand better how to accomplish an environment promoting brain-based learning. According to the literature, today's learners prefer to spend their time on various technological devices, such as Xbox, mobile phones, games, iPod, and TV, but also their aims mainly are watching videos, playing games, communicating with their friends, and browsing various websites (Al Sagr & Al Sagr, 2020; Gul & Demirci, 2022). A potential risk here is that helicopter parents, who are increasingly prevalent, tend to develop plans for their children without considering the wishes of the children (Breithaupt, 2018). If today's learners are forced to study subjects that do not interest them and are pushed towards paths that do not suit their wishes, there may appear a conflict between their desired and actual selves. Thus, ignoring today's learners' interests is a prevalent mistake made by today's parents.

Advancements appear with the consumption of resources, so how the future of the new generation will be shaped is a much more complex question than in the past (Clark et al., 2020). This uncertainty can be considered as an opportunity for learners to make much more meaning because uncertainty is one of the effective factors triggering curiosity. When there is low uncertainty, learners tend to consider related past experiences, while in situations where uncertainty is high, the focus shifts to contextual factors (Osman, 2010). At this point, as the frequency of major problems like the Covid-19 pandemic and natural disasters dramatically rise (Man et al., 2018; Suwalowska et al., 2021), and countries cannot cope with them effectively (Klose & Tillmann, 2023), learners can be expected to consider contextual factors rather than past experiences due to the high uncertainty stemming from these events. In this sense, the role of meaning-making of learners is dominant in today's world because experiences are numerous and leave a mark on every individual differently.

Today's learners are called digital natives because they were born into the digitalized world (Boyraz & Ocak, 2021). The digital age provides many opportunities for today's learners. A faster flow of information compared to the past has also affected the learning process and the learner's position in this process. In addition to easier access to information, immediate feedback is another critical development (Ambreen, 2020). Previously, learning environments were limited to certain places, and the learning process progressed depending on a person or material. On the contrary, today, learning can occur without waiting and without depending on a single source. The opportunities for the search for meaning were not many. Meaning-making was quite complex for learners because feedback was not always available. Today's increasing opportunities promote the search for meaning. The opportunities of the digital age, which are always ready for the learning process and trigger the learner at any time, can also provide motivation for the search for meaning.

## 2.4.  The Search for Meaning Occurs Through "Patterning"

During learning, the brain tends to process information as unique and relevant pieces rather than isolated pieces (Caine & Caine, 1995). However, the information given in schools has been created to equip students with a single type of information in the same style for all students (Schank & Szegö, 1996). At this point, it is crucial to consider the generational differences, especially since Generation Z is widely discussed as an entirely distinct generation shaped by current circumstances in which advanced technologies and the internet are dominant (Hanifah et al., 2018; Pouyakian, 2022). Generation Z is

known for their multitasking abilities and desire for much more freedom than other generations (May & Elder, 2018; Syaodih & Handayani, 2018). It can be thought that Generation Z, which performs more than one activity at the same time, gains different experiences with the tendency to move freely, and is exposed to the increasing stimuli of today's conditions, has many relevant experiences for patterning the information they have acquired. However, it is necessary for schools to change their paradigm for the use of brain-based learning in Generation Z. In this regard, constructivism can be considered a promising approach to preparing learning environments as appropriate for brain-based learning owing to the active participation of learners. This approach, which envisages that the learners construct the information instead of receiving the information solely (Ayman et al., 2022; Ben-Ari, 1998; Nurhalimah et al., 2022), is crucial in terms of obtaining unique and relevant pieces of information for the learners in learning environments.

While in the past, learners merely stored information as passive recipients, today's learners are expected to shape the information according to their context and organize their learning (Boyraz & Ocak, 2021). Today, the number of learning individuals has increased and learning environments have become quite diversified, so individual learner characteristics have gained great importance (McMillian-Bohler & Tornwall, 2023). The opportunities for today's learners to learn through patterning in their own way have significantly increased. New methods, such as e-learning, enable individuals to learn at their own pace and in a personalized way (Madaki et al., 2021). Today's conditions make patterning more possible, allowing individuals to direct their own learning without being dependent on a single person or material.

## 2.5. Emotions Are Critical to Patterning

The emotions of learners are essential as they trigger motivation, which is a key aspect of learning (Kim & Pekrun, 2014). Today's conditions make it very difficult for learners to stabilize emotionally. Today, psychiatric illnesses have increased tremendously (Si-zhen et al., 2023). Similarly, school burnout has significantly increased, revealing that the emotional state of students in schools is at risk (Salmela-Aro, 2017). Taken all together, providing the emotional readiness necessary for learning is more challenging compared to the past. Moreover, current conditions considerably force learners emotionally, so they require more emotional support to be prepared for brain-based learning. Thus, the sensitivity and support of psychological services, educators, and families can be critical in students' learning.

Divorce rates have recently increased, and single-parent families have become more common in society (Azer et al., 2022; Sabour Esmaeili & Schoebi, 2017). Furthermore, children growing up in such families may face challenges in forming emotional connections and maintaining emotional stability by receiving sufficient support from their families (McGuirk & Mai, 2016). This is a significant obstacle for children because they are already at risk of school burnout and mental health disorders. Today's current conditions have not only been experienced by technological developments, but also the differentiation of family dynamics has affected this. Hence, for effective brain-based learning, it is essential to consider not only the learners but also the individuals around them.

Today's children grew up in an environment where they had fun with computer games, and as a result, gamification has entered the education system (Kučak & Kučak, 2022; Swacha, 2021). It is seen that today's students, most of whom are Generation Z, are searching for innovative and alternative learning methods (Aktaş & Baykara, 2023). In this sense, gamification and similar methods increase the motivation and engagement of learners in education (Bozkurt & Durak, 2018). Compared to the past,

today's education system, which aims to appeal to many emotions of learners, such as excitement, joy, expectation, sadness, and curiosity, has created opportunities for brain-based learning. In this regard, learning environments attract attention because they are more dynamic (Haleem et al., 2022). Thus, this dynamism can facilitate patterning by triggering different emotions of the learners.

## 2.6.  The Brain Processes Parts and Wholes Simultaneously

Different hemispheres of the brain have various functions, and these hemispheres are designed to function simultaneously (Ceylan & Saka, 2022). Advanced technology is an elusive opportunity for learning environments in which learners can experience both whole and parts simultaneously. Educational environments, which used to have limited opportunities, are now richly equipped to enable brain-based learning in various ways providing an insight into parts and wholes at the same time. For example, VR technology is a valuable educational tool that is able to simulate the display of both part and whole information (Gong & Georgiev, 2020; Graeske & Sjöberg, 2021). Besides, gaming, an innovative tool for educational environments as well as virtual learning environments, is a valuable opportunity that enables learners to access rich content in many different ways (Tan et al., 2017). These innovations, which facilitate brain-based learning in educational environments, may allow learners to see the interaction between parts and the position of the whole. As an example of educational settings, Papanastasiou et al. (2017) claim that even preschool-aged children can learn the basics of complex subjects like geology through interactive video games, such as Minecraft. Thus, today's advanced technology points out that it is the ideal time to incorporate brain-based learning into educational settings.

In the past, education was primarily based on the knowledge of the country in which the learners lived. Nowadays, this situation has changed because globalization has become very evident. Globalization has made it possible for countries to develop in many different areas, such as education, by spreading information among countries (Fontdevilla et al., 2021). In addition, the reflections of globalization on today's learners are another critical issue that should be taken into consideration. For example, global citizenship education has gained great importance in terms of strengthening the global identity of today's learners as well as their national identity (Singh et al., 2023). Today's learners are expected to associate poverty in the city they live in with global poverty and to look for evidence of global climate change in the depletion of water resources in their country. Today's learners, who are expected to be global citizens and who also live within national boundaries, are encouraged to make sense of the part and the whole together.

## 2.7.  Learning Involves Both Focused Attention and Peripheral Perception

Although peripheral perception may be quite limited compared to focused attention, it is worth considering how it contributes to brain-based learning (Yunchao et al., 2023). The impact of the whole society, including the family and the city, on the learning of the individual is undeniable (Weinstein, 2015). Unlike previous generations, Generation Z tends to have a strong individualistic trait, which leads them to prefer solitude over socializing (Magano et al., 2021). On the other hand, globalization has made it possible to be in many parts of the world in a short time, and individuals living today have started to establish a wide variety of relationships in numerous and different places compared to the past (Maletz, 2017). Even if their preferences are different, Generation Z is necessarily affected by the globalizing world. For example, there has been a significant increase in the number of international students in schools (Paulino & Castaño, 2019). As technology advances and the world becomes more globalized,

learners face overwhelming stimuli to process. Furthermore, the new learning environments and innovative learning methods include more interactions and stimuli. Thus, brain-based learning has more environmental possibilities today but is also a more challenging process.

Peripheral perception needs to be supported for learners who receive information with focused attention. In this sense, today's opportunities greatly improve peripheral perception in terms of the rich, stimulating, and diverse learning environments it provides. For example, social media has become a significant learning tool (Ho et al., 2019). Nowadays, the information received through focused attention enters the peripheral perception at any time in other learning environments and through various tools. Today's learners can use these new learning environments and tools effectively because they are digital natives (Boyraz & Ocak, 2021). Environmental stimuli have increased today, thus creating more opportunities for brain-based learning.

## 2.8. Learning Always Involves Conscious and Unconscious Processes

Conscious learning happens when individuals intentionally pay attention to the stimulus, while unconscious learning is a more complex process that facilitates conscious learning (Kuldas et al., 2013). In this regard, Caine and Caine (1991) highlight that what individuals peripherally perceive affects conscious learning, and this unconscious learning allows individuals to maximize their learning process. At this point, brain-based learning extends beyond conscious learning because this conscious learning occurs simultaneously with unconscious learning. In other words, brain-based learning requires more than simply receiving stimulus. According to Zardetto-Smith (2006), learning can be improved by ensuring that a child gets enough sleep, regular meals, and consistent routines, but, more importantly, maximizing learning depends on providing a considerable number of opportunities for actual experiences in order to associate the stimulus with prior learning. In this sense, the more experiences learners have with new stimuli, the more unconscious associations can be achieved. At this point, the problem is that today's children attempt to gain experience in families with helicopter parents. These parents are highly dedicated to safeguarding their children from any risks or negative experiences hindering their growth and development (Leung & Busiol, 2016). Hence, today's children are much more likely to have less amount of experience than in the past. In today's conditions, the lack of diverse experiences may limit learners' ability to make connections and apply brain-based learning techniques.

In present times, various opportunities have emerged in the field of education, and this enables the implementation of diverse learning techniques effectively (Edlin, 2016). Currently, there are many technological developments that can be used to make learning more meaningful. VR technology and 3D models are some of these opportunities making learning more meaningful (Sampaio et al., 2010). Innovative methods such as computer simulations have been used for learning, and a significant change has begun in learning environments (Samuel & Rahman, 2018). They are especially beneficial in terms of improving the experiences of the learners (Clinciu & Clinciu, 2021). Thus, these innovative methods can be considered a unique opportunity for brain-based learning today, as they provide the development of learners' experiences that stimulate learning. Quality of connections is crucial in learning (Carey, 2014), so the deepening of experiences with today's advancing technology supports brain-based learning with both conscious and unconscious processes.

## 2.9. We Have At Least Two Different Types of Memory: A Spatial Memory System and A Set of Systems for Rote Learning

Rote learning is a system in which new information is stored and recalled when necessary (Wang et al., 2009). Memorizing subjects through rote learning does not facilitate student-centered learning and restricts students from engaging in critical analysis (Widodo, 2023; Zulfikar, 2010). Today, rote learning occupies a large place in the school curriculum (Phirom, 2022; Sibanda & Young, 2020). Nonetheless, there are efforts to create more meaningful learning instead of route learning in educational environments (Irvine, 1995; Shrivastava & Shrivastava, 2022). Bringing this deep learning into focus requires a change in educational environments (Fahmy & Lagowski, 2011). At this point, there is a paradigm shift thanks to an increasing number of innovations in today's conditions (Poudel, 2022). On the other hand, spatial memory is based on individuals' use of spatial information in daily life (Llana et al., 2022). Rote learning involves memorizing isolated information through repetition, while spatial memory is based on experiences and does not require repetition (Caine & Caine, 1991). Spatial memory is crucial for daily life because it helps individuals remember things that happen in their environment (Arce & McMullen, 2021; Khakpour-Taleghani et al., 2021). As a result of the paradigm shift in educational settings, the student-centered approach may promote spatial memory by allowing them to engage with more environmental information in which students make connections with their prior learning without the restrictions of the teachers.

The literature emphasizes that learning for today's students should not be limited to classrooms and schools (Joseph & Mathew, 2019). It has been accepted that learning should take place in out-of-school environments, and lifelong learning has gained importance. In this sense, certain features have become more prominent for today's learners. These are creativity, communication, critical thinking, and collaboration (Rapti & Sapounidis, 2023). Since rote learning only involves individual learning alone and through repetition, today's emerging new learner features support the spatial memory system. The new understanding that supports collaboration focuses learning on factors outside the individual and rich experiences. Today's learner characteristics, which prioritize critical thinking instead of memorization, aim for the individual to perceive knowledge through shaping and base it on experiences. Thus, learning based on experiences is becoming more permanent for today's learners.

## 2.10. We Understand and Remember Best When Facts and Skills Are Embedded in Natural, Spatial Memory

Today, students' motivation is promoted to move beyond rote learning and enable them to embrace a deeper understanding of their subjects (Cake, 2006). Advancing technology and changing the understanding of education may be a valuable chance to enhance students' spatial memories. Thanks to technological advances, museums have become significant learning spaces due to the advanced equipment available (Chang et al., 2015; Pavlović, 2022). Places such as museums that allow learners to encounter real problems are crucial (Xu et al., 2021) because they can be considered a valuable opportunity to focus on students' spatial memories. Spatial memory has come to the forefront compared to rote learning, not only by equipping learning settings such as museums with technology but also by increasing the opportunities of individuals. For example, today, it is possible for individuals to reach many different places in a much shorter time (Panchani et al., 2022). Opportunities have increased for today's learners because they can travel to different countries to experience cultures, and this can facilitate their learning by promoting stimulus for spatial memory. For example, instead of memorizing the words of any language by reading from a book, an individual who wants to learn a language can

strengthen their remembering with direct experiences in the country where that language is spoken and then recall this memorization more easily. In addition to traveling, which has been popular until today, different possibilities for internationalization have emerged. Now with the digital era, technology has connected the whole world, and internationalization is possible at home (Alvares & Steiner, 2019). Furthermore, cyber traveling currently has become a significant alternative to real traveling (Safira & Badaruddin, 2021). Increased mobility has improved the conditions of learners to apply numerous opportunities triggering their spatial memory. Taken all together, spatial memory can be used more today as ordinary experiences have dramatically increased with various possibilities.

New learning technologies have emerged as essential tools that reveal real-life experiences for today's learners and appeal to multiple senses (Okpala, 2022). In the past, only a single sense was used when learning took place through memorization. Today's technologies have significantly enhanced the learning experience. With e-learning, personalized content specific to individuals' experiences has emerged (Madaki et al., 2021). The need and necessity to go out of school for real-life experiences has decreased as technology has brought real-life experiences into the classroom. Supporting spatial memory at all times in every learning environment is an important development for today's learners.

## 2.11. Learning Is Enhanced by Challenge and Inhibited by Threat

In today's world, the threat poses a major obstacle to individuals' performance (Lamichhane, 2023). Furthermore, the threat is likely to bring about frustration and feelings of insecurity for learners (Böhm et al., 2020). That is why the threat is one of the most critical factors that undermine the learning process. Similarly, Osborne and Jones (2011) claim that when individuals are threatened, it not only reduces their performance but also negatively impacts their motivation to learn because this creates an unpleasant learning environment. Currently, numerous studies indicate a rise in environmental hazards like earthquakes (Cabello et al., 2021; Rojas Aravena, 2020). At the same time, potential risk factors appeared along with advancements in technology, especially in online spaces, discussed by a substantial number of studies (Kurebwa, 2021; Tao et al., 2021; Zaimy et al., 2023). The impact of increasing threats may have intensified due to the emergence of the Covid-19 pandemic. This is because the pandemic has affected all aspects of learners' lives. Not only has it disrupted educational environments like schools, but it has also posed a threat to the continuation of the learning process (Huck & Zhang, 2021; Katz & Nandi, 2021; Montenegro-Rueda et al., 2021). At present, there are numerous distractions and potential dangers that can make it challenging for students to concentrate on the learning process. Thus, what today's learners need most is the creation of conditions in which they can safely perform the learning process.

Increasing threat situations have revealed protective parents. These family members who act overprotective to prevent the dangers of the outside world from reaching their children are called helicopter parents (Vigdal & Brønnick, 2022). These parents, who try to control their children's environment, unintentionally prevent their children from encountering new experiences and learning about the world (Awiszus et al., 2021). Discussions continue about these parents who use an unhealthy coping strategy for today's threat conditions their children face (Seki et al., 2023). On the other hand, Lee et al. (2014) indicate both advantages and disadvantages of helicopter parenting. By reducing the threat as much as possible, helicopter parents can support children's learning as long as they are with them. In the short term, brain-based learning can be relatively supported by these parents. However, It is not feasible for parents to have complete control over every aspect of their child's life. Even the slightest

perceived threat can be overwhelming for an inexperienced child. Instead of overprotectiveness, it may be beneficial to strengthen learners in the face of threats and increase their resilience skills.

In recent years, there has been a significant increase in competitiveness among students (Dorismond et al., 2021; Komoldit et al., 2018; Ono, 2020). This high competitiveness is associated with stress and threat sensitivity (Gilbert, 2020). At this point, the realization of brain-based learning does not occur in a healthy way because today's learners are more likely to feel threatened in an increasingly competitive atmosphere compared to the past. On the other hand, competitiveness provides more challenging tasks in today's education system (Konst & Kairisto-Mertanen, 2020; Mirmoghtadaie et al., 2016; Newbury et al., 2020), and this high-challenge educational atmosphere is rather appropriate for brain-based learning. In other words, if there are no threats, today's conditions are ideal for brain-based learning thanks to the high challenge derived from the competitive learning environment.

## 2.12. Each Brain Is Unique

Offering multiple options is necessary for optimal brain-based learning since each student has unique learning styles (Caine & Caine, 1991). The more learners, the more ways to learn. It is essential to multiply different learning environments in order to support different learning styles. In this regard, many different types of schools have emerged in today's world (Kim, 2015; Mao et al., 2021). The rise in available opportunities has facilitated the growth of education equipment in learning environments (Alzakyan et al., 2022; Yeigh et al., 2020). In the past, learners were limited to textbooks, but now they have access to diverse learning materials (Adamu, 2021), and this allows learners to benefit from various learning styles. Hence, today's learners can continue their education in the learning style that is most ideal for them with the learning materials suitable for them. Today's increasing possibilities support brain-based learning by creating many different options for learners in every sense. Although classes are crowded in some underdeveloped societies (Agbor & Ashabua, 2018), most schools have started to provide education with fewer students in today's developing conditions (Alfaraidy, 2020; Béteille et al., 2012; Kingdon, 2020). Educational environments that serve fewer students are more sensitive to student-oriented differences, resulting in more positive academic outcomes (Batool et al., 2022). Thus, brain-based learning can be facilitated in today's conditions that respect learners' differences and allow the creation of learning environments that are sensitive to these differences.

Today's learning environments are more dynamic (Haleem et al., 2022), so today's learners can encounter much more diverse and rich experiences. While traditional learning methods aim for individuals to learn in a similar way, the new methods that emerge today offer individuals options and emphasize that each individual is unique. It is stated that today's learners are very diversified (McMillian-Bohler & Tornwall, 2023). This can be attributed to the rich and dynamic learning environments, making learning unique for every individual. In the past, individuals did not have the necessary conditions for their differences to emerge as they do today. Therefore, today, opportunities that nurture the differences of individuals and support them in every environment make brain-based learning more visible.

## 4. CONCLUSION

Human societies have undergone gradual changes throughout history. In contrast, today, there are societies that change rapidly and interact more with each other. The advent of the digital era has brought about a substantial and irreversible change in everyday life (Ibda et al., 2023; Pyper, 2017;

Radhakrishnan, 2021). Technological advances have significantly impacted the field of education, and the use of emerging technological developments has played a supportive role in brain-based learning. For example, classrooms have become more equipped, schools are more student-oriented, and learners have more possibilities thanks to the digital era. These changes in learning environments facilitate brain-based learning. Thus, today's current conditions can be seen breakthrough for brain-based learning, considering that learning environments are better organized and equipped to support learners' unique needs.

Parents have adopted new mechanisms to raise children in a fast-changing world. For example, helicopter parenting, which is characterized by overprotectiveness, may hinder children's experiences and make them more sensitive to future threats. At this point, new parenting styles are some of the obstacles hindering brain-based learning. On the one hand, the rapidly changing world and new technologies are creating developments that support brain-based learning; on the other hand, new problem situations such as cyberbullying and internet addiction increase the anxiety of parents and cause restrictions on children, making brain-based learning difficult. The changing world may be frightening for parents, so eliminating the sense of threat as a prerequisite for brain-based learning should be one of the main goals in today's world.

Technology has expanded opportunities for all individuals and created a more competitive world (Munasinghe et al., 2022). In this sense, students can get away from brain-based learning while learning with the desire to compete. Furthermore, students who compare themselves with other learners and feel threatened are less likely to experience a healthy learning process. While brain-based learning suggests that learning materials should become increasingly difficult in order to maintain optimal learning; instead today's world makes the learning process difficult with a competitive system. Difficulties controlling the developments in today's world are a big handicap for brain-based learning. The spread of developments such as Chat GPT when society is not ready may undermine the learning process. There are more opportunities today to support the principles of brain-based learning, but at the same time, increasing threats, such as the Covid-19 pandemic, disasters, and AI-driven tools, may undermine brain-based learning. In the digital era, researchers are trying to integrate technological developments in society (Congge et al., 2023; Xia, 2020), and the risk factors for brain-based learning can be eliminated over time. As a result, the principles of brain-based learning have become much more meaningful and have gained great importance in today's world.

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