DETERMINING ENGLISH TEACHERS' NEUROMYTHS ABOUT BRAIN FUNCTIONS

GÜRŞEN ŞİŞMAN

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Assoc.Prof. Dilara DEMİRBULAK

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DETERMINING ENGLISH TEACHERS' NEUROMYTHS ABOUT BRAIN FUNCTIONS

by

Gürşen ŞİŞMAN

Approved by:

Assoc. Prof. Dr. Dilara DEMIRBULAK ……
(Thesis Supervisor)
(Yeditepe University)

Ph D. Ayşe Yılmaz VİRLAN ……
(Marmara University)
(Co-supervisor)

Prof. Dr. Ayşe Münire ERDEN ……
(Yeditepe University)

Assoc. Prof. Dr. Bengisu KOYUNCU ……
(Mimar Sinan Fine Arts University)

DATE OF APPROVAL: 31 /05/2023

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Gürşen ŞİŞMAN

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ABSTRACT

This study aimed at determining the neuromyths of English language teachers at K12 level regarding brain functions and its relation to learning together with the sources of these determined neuromyths. In order to find out whether English language teachers have neuromyths about brain functions that affect learning processes directly or indirectly in the classrooms, the researcher tried to apply a descriptive study design in which a questionnaire was used to get quantitative data from 114 English teachers in Istanbul in Turkey during the 2021-2022 academic year. Based on the results of the study, it was found out that teachers of English have a mean score of 7.33 on the belief in neuromyths and a mean score of 9.35 on general knowledge. Also, the findings showed that the participants possessed 8 of the neuromyth items including the effect of fatty acid supplements on academic success, the right and left dominance of the brain explaining the individual differences, critical periods in childhood, VAK learning styles, stimulus-rich environments which develop preschool children's brains, repetitive exercises improving literacy skills, short coordination exercises which increase both hemispheres' integration and lastly, the effect of consumption of sugary drinks and/or snacks on attention. Moreover, according to the study's findings, there was a positive relationship between English teachers' general knowledge about brain functions and neuroeducation and their neuromyths. Finally, there is no statistically significant association between English teachers' neuromyths and their participation in professional development activities.

Key Words: neuromyths, neuroeducation, English language teachers, foreign language education

ÖZET

Bu çalışma, K12 seviyesindeki İngilizce öğretmenlerinin beyin fonksiyonları ve beynin öğrenme ile ilişkisine dair nöromitlerini ve belirlenen nöromitlerin kaynaklarını belirlemeyi amaçlamaktadır. Araştırmacı, İngilizce öğretmenlerinin sınıflarda öğrenme süreçlerini doğrudan veya dolaylı olarak etkileyen beyin işlevleri hakkındaki bu nöromitlere sahip olup olmadığını öğrenmek amacıyla, 2021-2022 akademik yılında İstanbul'da görevli 114 İngilizce öğretmeni ile bir anket çalışmasının kullanıldığı betimsel bir çalışma yürütmüştür. Araştırmanın sonuçlarına dayanarak, İngilizce öğretmenlerinin ortalama nöromit puanı 7,33 ve ortalama genel bilgi puanı 9,35 puan olarak tespit edilmiştir. Ayrıca katılımcıların 8 nöromit maddesine sahip olduğu bulunmuştur ki bu maddeler arasında yağ asidi takviyelerinin akademik başarıya etkisi, bireysel farklılıkları sağ ve sol beyin farklılıklarıyla açıklanabilmesi, çocukluktaki kritik dönemler, görsel-işitsel-kinestetik öğrenme stilleri, okul öncesi çocukların beyinlerini geliştiren uyaran açısından zengin ortamlar, okuryazarlık becerilerini geliştiren tekrarlı egzersizler, beynin her iki yarımküresinin entegrasyonunu artıran kısa koordinasyon çalışmaları ve son olarak şekerli içecek ve/veya atıştırmalık tüketiminin dikkat üzerindeki etkisi yer almaktadır. Ayrıca, çalışmanın bulgularına göre, İngilizce öğretmenlerinin genel bilgisi ile nöromitleri arasında olumlu bir ilişki tespit edilmiştir. Ancak, İngilizce öğretmenlerin nöromitleri ile mesleki gelişim faaliyetlerine katılımları arasında istatistiksel olarak önemli bir ilişki bulunamamıştır.

Anahtar Sözcükler: nöromitler, eğitimsel sinirbilim, İngilizce öğretmenleri, yabancı dil eğitimi

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LIST OF ABBREVIATIONS

CERI: Centre for Educational Research and Innovation of the OECD

ELT: English language teaching

IMBES: International Mind, Brain, and Education Society

MBE: Mind, Brain, and Education Science

OECD: Organization for Economic Co-operation and Development

VAK: Visual, auditory, and kinaesthetic

CHAPTER I

1. INTRODUCTION

This thesis explores whether English teachers have neuromyths about brain functions that affect learning processes directly or indirectly in the classrooms together with the sources of the determined neuromyths of English teachers. There are three interrelated reasons that inspired the researcher who is an English language teacher at K12 level to conduct this study. Firstly, globalization and migration in recent years affecting education have led students more than ever to be bilingual and/or multilingual and the need to learn English as it has become lingua franca of the world, and the importance of foreign language teaching and learning has increased. Secondly, influence of neuroscience on education have created a new field denominated "neuroeducation" and took attention of teachers worldwide. There need to be more scientific research to be done to prove the results of this field in various situations because teachers' need to understand the data and results of neuroeducation and make use of them in their practices has increased to extreme levels, which is the third reason for carrying out this research. Teachers want to use the scientific facts from this field more and more in their classrooms to enhance their teaching and their students' learning. The pursuit of accurate scientific information and its proper application in educational settings is a significant challenge for them. At this point, the issue of neuromyths, which can result in misguided educational practises, becomes an important concern. Finally, language learning is a pressing and persistent problem in foreign language education in Turkey, so we need to investigate and then solve this problem from different points of view such as

neuroeducation. Therefore, it is imperative to examine the neuromyths of teachers in the realm of foreign language instruction. The persistence of neuromyths in in the context of foreign language education may lead to continuity of ineffective instructional and learning methods in educational settings.

1.1. Problem

Neuroscience is a scientific study of brain and nervous system, which tries to discover what is happening in our brains during our mental processes such as memory, perception, learning, and behaviour. The advent of neuroimaging technologies in recent times has augmented the understanding of brain functions and influenced the overall outlook on the process of learning. Increased chances for in-depth research have been made possible by recent advancements in neuroimaging technology and the results of neuroscience research in terms of behaviour, senses, emotions and especially learning (Koyuncu, 2017). To understand the biological nature of learning has been one of the important purposes in research. In this context, interdisciplinary studies which are carried out together with education and neuroscience becomes particularly important (Koçak, 2020). In addition, it has now become such a significant field for educators and teachers that a new field called “educational neuroscience” or “neuroeducation” has evolved. Neuroeducation brings two fields, education and neuroscience together to explore learning processes in our brains. Thus, the more we find out about the learning processes, the more successful and appropriate methods and skills we will find for teaching.

However, as neuroeducation is a newly blooming field, we come across with the common problem of hearsay information related to this field among teachers, educators, and parents. Even we have a term for the misunderstanding of brain's functions in learning: "neuromyths". Neuromyths are seen by scientists in educational neuroscience as the first problem in the field. (Beauchamp and Beauchamp, 2012, as cited in Karakus, 2013, p.22).

The project of OECD which is named as "Brain and Learning" attracted attention to the concept of "neuromyth" internationally for the first time. According to the Organisation for Economic Co-operation and Development (OECD) in 2002, neuromyths are characterized as a form of misperception that arises from a misinterpretation, misreading, or misquotation of established facts from brain research, which are intended to promote the application of brain research in educational and other settings. Neuromyths refer to false beliefs concerning learning and education that originate from ignorance of how the brain works. These false beliefs generated common neuromyths in subjects such as different learning styles, multiple intelligence, and "categorizing learners according to the dominance of the right and left hemisphere of the brain". (OECD, 2002 as cited in Canbulat & Kiriktas, 2017, p.326-327). Goswami (2006) discovered that due to educators' interest in neuroscience, there is a flood of books, courses, and educational resources urging teachers and school boards to establish "brain-based classrooms" and adopt "brain-based curriculum and instruction." As well, there are a lot of commercial goods being developed that are based on misconceptions about research findings, such as the idea of brain neuroplasticity, in addition to myths. Schools and teachers are frequently

advised to spend a lot of money on pricy software that can "cure" learning issues and enhance academic achievement. Thus, the OECD emphasized the fact that neuromyths waste time, money, and effort in the field of education (Karakus, 2013).

Thus, determining the neuromyths will help teachers to reach true scientific information in this field and improve their teaching skills thereby. They will be able to apply appropriate teaching methods and techniques in their classrooms more efficiently and will adapt to learners' needs and individual differences in their learning adventure. From another perspective, identifying neuromyths will ensure that incorrect applications based on them will be eliminated from classrooms, as they negatively impact the teaching processes in schools, such as the neuromyth which states humans only use 10% of their brain (Dekker et al, 2012, as cited in Dogan, 2018, p. 83). If teachers realize what their neuromyths are and where this false information come from, they will be able to stop the spread of neuromyths and educate their students more effectively in their classes (Dogan, 2018).

1.2. Aim of the Study

The present research aims at determining whether English teachers have neuromyths about brain functions and its relation to learning. In addition, it tries to find out whether there is a relation between these neuromyths and the demographic features of English teachers: gender, level of education (undergraduate, Masters or PHD), reading scientific journals, professional experience, and professional development (attending a neuroscience education course or attending a conference about brain functions and neuroeducation). Thus, it tries to demonstrate the possible sources of neuromyths among

English teachers. It aims to help reduce the number of neuromyths in education, which will lead to a better education, especially in teaching foreign languages. Furthermore, we can discuss whether new curriculums will help us dispel these neuromyths.

1.3. Significance of the Study

Studies about educational neuroscience among teachers are really limited in Turkey. This study will contribute to the field of neuroeducation as it will present data about English teachers' neuromyths and also their views about neuroeducation. As the study will be carried out in a sample of English teachers, it will contribute to the field of foreign language education too. It will provide helpful and significant data in integration of educational neuroscience studies into teaching and learning processes of a foreign language. Moreover, it will shed light on any cultural differences in popularity of neuromyths amongst English teachers in Turkey. Therefore, the implementation of neuroeducation can facilitate educators and education programmers in comprehending and addressing the requirements of learners with greater ease. Hopefully, it will be useful for them while designing new curriculums and developing new educational materials and practices. It will be a reference point to understand the current situation of English teachers in neuromyths and to determine the development areas of teachers in both English teaching and other fields.

1.4. Research Questions

This research aims to determine the neuromyths held by English teachers regarding brain functions and its relation with the process of learning. The study tries to demonstrate the relations among demographic

characteristics of English teachers including gender, educational level, and professional experience, and their identified neuromyths if there is any. Additionally, the study aims to examine the correlations between factors such as reading scientific journals about neuroeducation, professional development activities, and the identified neuromyths.

This research will attempt to provide answers to these questions:

1) What are the neuromyths and general knowledge level of English teachers about brain functions and neuroeducation?

2) Do the neuromyths of English teachers about brain functions and neuroeducation differ by gender?

3) Do the neuromyths of English teachers about brain functions and neuroeducation differ by level of education?

4) Do the neuromyths of English teachers about brain functions and neuroeducation differ by the type of school they work in?

5) Do the neuromyths of English teachers about brain functions and neuroeducation differ by to their school levels?

6) Do the neuromyths of English teachers about brain functions and neuroeducation differ by professional experiences?

7) Do the neuromyths of English teachers about brain functions and neuroeducation differ by to their ages?

8) Is there a meaningful relationship between general knowledge and neuromyths of English teachers about brain functions and neuroeducation?

9) Is there a correlation between professional development activities, (reading scientific journals, taking a course in educational neuroscience, or attending a

seminar /workshop /conference about brain functions and neuroeducation) and neuromyths of English teachers about brain functions and neuroeducation?

1.5. Assumptions

It is assumed that the individuals in the sample represents the universe and English teachers in the sample of this study have answered the questionnaire sincerely.

1.6. Limitations

The sample of the study is restricted to 114 English teachers who were employed during the 2021-2022 academic year. Therefore, findings and conclusions are limited to the answers of the participants. Also, there is a potential risk of self-report bias as all self-report studies. All data was collected anonymously to reduce this.

1.7. Definitions of terms

Neuromyth: "a misconception generated by a misunderstanding, a misreading or a misquoting of facts scientifically established (by brain research) to make case for use of brain research in education and in other contexts" (as defined in OECD, 2002).

Neuroeducation (educational neuroscience): a new area of study, which brings two disciplines, education and neuroscience together to explore learning processes in brain.

Neuroscience: a scientific study of brain and nervous system, which tries to discover what is happening in brain during mental processes such as memory, perception, learning, and behaviour.

ELT teachers: English language teachers who work either in public or private schools at the different levels of education in Istanbul.

Mind, Brain, and Education Science: a new area of study which combines different perspectives from pedagogy, psychology, and neuroscience to gain a better grasp of human learning and how it relates to teaching practices.

CHAPTER II

2. LITERATURE REVIEW

This chapter aims to outline the main background information about neuromyths of English language teaching (ELT) teachers. First, the principles and components of neuroscience and neuroeducation will be provided and discussed. The objective of this research is to discern the neuromyths prevalent among educators of English Language Teaching (ELT), thus, the study will delve into the correlation between the acquisition and instruction of foreign languages and the prevalence of neuromyths. Then, the summary of the findings of studies carried in Turkey and abroad related to the aim of this study will be analyzed and discussed.

2.1. Neuroscience

Neuroscience is a relatively recent field that primarily combines biology, psychology, and neurology. According to Goswami's (2004) definition, neuroscience focuses on the examination of the mechanisms underlying learning and memory in the brain, encompassing molecular and cellular processes as well as neural systems, such as the areas and pathways involved in language comprehension and production. Understanding brain systems such as cell signalling, and synaptic connections is crucial for comprehending learning. The main principle is that a brain cell, namely a neuron connects to another one through a synapse. Electrical signals from brain cells or neurons, which travel between cells through synapses and trigger the release of neurotransmitters (chemical messengers) in the synapses, are used to transmit information between the cells. The brain comprises about 100 billion neurons, each of which is highly connected to the others. Learning, in

general, entails changes in connectivity; consequently, effective teaching has a direct impact on brain functions through altering connectivity (Goswami, 2004).

2.2. Neuroeducation (Educational Neuroscience)

The concept of a "neuroeducator" was first introduced by James Glendening and Jocelyn Fuller in 1985. These authors explored the creation of an interdisciplinary branch of science that would emphasise the value of effective instruction by using the understanding of brain structure and function. After receiving in-depth training in the fields of learning sciences, psychology, and neuroscience, the "neuroeducator" would have a position in classrooms and laboratories (Fuller and Glendening, 1985).

Afterwards, the 1990s through 1999 were called "The Decade of the Brain" in the USA (Sousa, 2010). This allowed for quick progress in research in the fields of brain, mind and educational studies. It can be argued that the progress of educational neuroscience as a subject during the 1990s has made a substantial contribution to the area by taking into account earlier attempts and explanations of learning. The goal of this newly established, multidisciplinary research field known as educational neuroscience is to enrich educational practise by the use of recent advances in the study of the brain. Utilizing neuroimaging technology, researchers have gained the ability to observe the functioning of the human brain, thereby enhancing their knowledge of the intricate systems underlying cognitive processes such as thinking, reasoning, speech, reading, language, and mathematics. Thus, now we have a better grasp of how the brain develops and functions, it is time to think about how we may apply this knowledge to address educational issues (Goswami, 2004).

According to Feilera and Stabio (2018), three key themes—application, interdisciplinary cooperation, and language translation—have dominated educational neuroscience for the past thirty years. They believe that these ideas have supported the field's development and will continue to do so. In a similar manner, they think educational neuroscience aims to assist students and encourage them to recognise their preferred learning styles in order to reduce unfair challenges in the classroom and encourage success throughout their lives (Feilera & Stabio, 2018).

The findings of educational neuroscience research have already provided new insights into topics such as brain plasticity (which is a trait that is maintained throughout one's lifetime), brain development (which occurs from childhood through adulthood), the significance of memory in the educational process, and the working memory's role in the acquisition of new mental abilities (Howard-Jones, 2010 as cited in Karakus, 2013).

However, concerns regarding how risky it can be to attempt to link knowledge of neuroscience with education, particularly after the publication of "Education and the Brain: A Bridge Too Far" (Bruer, 1997), were raised. According to Bruer (1997), it is impossible to combine these two fields, neuroscience and education because they have so little in common. In spite of the efforts to narrow this bridge persisted, and a significant turning point occurred in 1999 when the Centre for Educational Research and Innovation (CERI) of the OECD started the Learning Sciences and Brain Research project, which aimed at understanding first how the brain interprets the information, and then the processes of learning throughout a person's lifetime (OECD, 2007). The Teaching and Learning Research Project (TLRP), one of

the largest and most costly efforts, was started in the UK in 2000 in order to advance research in education on how to increase the results of students and what factors affect teaching. Throughout a ten-year period, hundreds of researchers worked together on 90 projects, especially on one that examined possible classroom applications of neuroscience (Blakemore & Frith, 2005; James & Pollard, 2011).

Other significant improvements in the effort to combine neuroscience and education include the 2002 establishment of the MBE master's programme at the Harvard Graduate School of Education, the 2005 introduction of the MBE course at the University of Arlington in Texas, the 2005 opening of the Cambridge Centre for Neuroscience and Education, and then the 2007 launch of the Journal Mind, Brain, and Education by the IMBES (International Mind, Brain, and Education Society), whose first issue was published in 2008. In order to provide teachers, administrators in schools, as well as decision-makers with the most up-to-date information on how individuals learn and how it applies to classroom practise, MBE aims to integrate contributions from different areas of education and cognitive sciences such as neuroscience and psychology. The aim of this objective is to debunk neuromyths, as they have the potential to adversely affect the academic outcomes of students (Fischer, 2010; Dekker et al., 2012).

However, according to Bruer (2016), neuroscience was recently in headlines because of the claims stated by proponents of early childhood education regarding the applications of neuroscience to parenting and learning. The basis for these claims was an oversimplification and overgeneralisation of previous research on developmental synaptogenesis, enriched environments,

and key periods. These assertions were overstated, according to Bruer (1997) and later the literature began to refer to these assertions as "neuro-myths." (Goswami, 2004; OECD, 2007).

A crucial objective for educational neuroscience is the identification of causal developmental pathways of learning. A thorough understanding of brain information coding and transmission should make it possible to comprehend how sensory systems gradually establish the cognitive mechanisms necessary for education such as memory, language, and attention (Goswami, 2006).

It appears that the application of neuroscience will proceed slowly and remain connected to other ideas and occasions. The emergence of an entirely new discipline of educational neuroscience may be associated with this phenomenon, which is the creation of evaluations and interventions that are more precisely targeted, a greater understanding of the socio-emotional components of education, the potential emergence of new neuromyths, and an increase in the use of in-situ neural testing in the classroom.

Most recently, the number of publications addressing the educational implications of neuroscience has steadily increased: a new journal, Mind, Brain and Education, has been established, as have study groups (such as Cambridge University's Centre for Neuroscience in Education), and there have already been overt calls for the creation of a new sub-discipline of educational neuroscience. Neuroscientists have already made significant progress in figuring out the key skills that underlie many skills. This development is probably going to continue, leading to a more precise understanding of the nature of some academic challenges. This could result in a more accurate

assessment of these difficulties and the use of more specialised repair plans. Education will be affected by developments in cognitive psychology as it develops. As a result, it appears likely that recent research in social and affective neuroscience which has been mostly ignored will become more significant. Subsequently, the augmented emphasis on the social and emotional dimensions of teaching and learning within the educational system may give rise to novel neuromyths.

A new discipline based on such collaboration is currently emerging, though it is still very early for its numerous supporters to have chosen a good name for it; current candidates include "Educational Neuroscience," "Neuroeducation," and "Brain, Mind, and Education." A field focused on how education and neuroscience interact would enrich educational strategies as well as possibly fostering scientific knowledge of how neurological processes relate to the complicated actions seen in the classroom. Over the world, institutes for research, which combine education and neuroscience are emerging and frequently providing postgraduate courses. Although there are differences in personal approaches in these institutions, there is a shared understanding among researchers. The scope of the challenge, the striking distinctions in concepts and language of education and neuroscience, and the necessity of collaboration between neuroscientists and educators when attempting to bridge these two fields are already known to them. Such cooperation will be crucial in the future if we want neuroscience to enrich education rather than lead it astray (Howard-Jones, 2014).

2.3. Neuromyths

2.3.1. What is a neuromyth?

According to Howard-Jones (2014), the word "neuromyth" was introduced by Alan Crockard, a neurosurgeon, during the 1980s to describe erroneous notions about the brain that were widespread in the medical community. Howard-Jones (2010) asserts that due to the growing popularity of this area, inaccurate "brain-based" information (pseudo-science) as well as scientific knowledge were created using neuroscientific results. Due to both public interest and the growing popularity of neuroscience, the utilization of unverified and unsupported "brain-based" information as a marketing strategy by certain individuals has given rise to neuromyths in the field of education (Karakus, 2013).

Later, the OECD's Brain and Learning project, which ran from 1999 to 2006, raised awareness of the negative outcomes of misunderstandings, misconceptions and misuses of empirical data and results from cognitive sciences in the field of education (OECD, 2002: 69; Dekker et al., 2012). In 2002, the organisation redefined "neuromyths" as "a misconception generated by a misunderstanding, a misreading, or a misquoting of facts scientifically established by brain research to make a case for use of brain research in education and in other contexts" in order to support the use of brain research in education and other fields.

Also, as mentioned in Karakus (2013), researchers in the field believe that the emergence of "neuromyths" is the main problem in educational neuroscience, which is supported by Beauchamp and Beauchamp (2012).

Neuromyths, despite frequently having their roots in actual scientific data, are false assumptions about how the brain functions in learning.

According to the OECD's Brain and Learning Project (2002), a lot of educational professionals hold misconceptions about the brain.

Regrettably, due to the popularity of educational neuroscience, inaccurate "brain-based" information (pseudo-science) was created using the results of the field of neuroscience as well as scientific-base information (Howard-Jones, 2010). The growing popularity of neuroscience and the public interest in it have encouraged some people to employ unfounded and unsupported "brain-based" information as a marketing tactic, which has led to the emergence of neuromyths in education. So, according to experts in the subject, the occurrence of "neuromyths" is the primary issue with educational neuroscience (Beauchamp and Beauchamp, 2012).

The implementation of scientific discoveries from neuroscience in teaching environments has sparked great interest among teachers. Unfortunately, the topic of neuroscience is vast and complicated, and it is frequently difficult to transmit study findings accurately to the classroom (Ansari et al., 2011). Many misconceptions about new discoveries in neuroscience have emerged as a result of the distinction between education and neuroscience (Goswami, 2006).

Because mainstream media tries to reach a large number of people, information they provide is frequently oversimplified or over-interpreted. Consequently, popular media has been blamed for spreading misinformation (Beck, 2010). Therefore, insufficient knowledge of neuroscience and exposure to mainstream media can be variables in predicting the existence of neuromyths related to the brain among teachers (Dekker et al, 2012).

As previously indicated, the OECD (2002) has identified several prevalent neuromyths in education, including:

- Only 10% of the human brain is utilized.
- People either have a left brain or a right brain.
- There exist various primary learning styles, namely VAK (visual, auditory, and kinaesthetic), catering to the learner's favoured sensory modality can facilitate the learning process.
- Additionally, there are diverse categories of intelligence, each of which operates from a distinct region with corresponding IQs, as evidenced by studies conducted by Howard-Jones in 2010 and OECD in 2007.

2.3.2. Sources of Neuromyths

According to Ferrero (2016), there are a lot of "neuromyths" out there because of absence of sufficient information, a lack of collaboration between scientists and teachers, and the successful promotion of questionable educational materials.

Because it is difficult to get the counter-evidence and the neuroscientific results on which the false belief was incorrectly founded, the myth is effectively shielded from inspection. This is another circumstance that is probably going to encourage the spread of a myth. The proliferation of myths in neuroscience can go unchecked due to the potential for non-specialists to overlook, misinterpret, or dismiss complex counter-evidence and discoveries that are exclusively published in neuroscience journals (Howard-Jones, 2014).

Obvious simplicity in well-known publications could give readers the false impression that complicated neuroscience is simple to apply in the classroom. People may be more susceptible to neuromyths when they do not have an overall comprehension of the brain and when they do not think critically about what they read.

Moreover, the popularity of alleged 'brain-based learning' programmes has been linked to the growth of neuromyths in many studies (e.g., Geake and Cooper 2003; Howard Jones, 2008, Coch & Ansari, 2009). A big sector has arisen around these commodities, which are vigorously marketed to academic institutions (Rato et al., 2013). For instance, teachers in the UK have been flooded with emails inviting them to take part in training sessions to discover how to utilise these brain-training programmes (Goswami, 2006). Similar instances take place all around the world, and numerous concepts disseminated by these commercially available packages have become established in school pedagogical culture.

2.3.3. Significance of Neuromyths

These so-called "neuromyths" may have negative consequences on educational practise even though they are very loosely based on scientific truths. They have a detrimental effect on education because they cause a waste of resources like money, time and effort that could be applied to the creation of practices that are supported by evidence. Additionally, it can make teachers less optimistic about the potential for a fruitful partnership between the domains of education and neuroscience (Pasquinelli, 2012).

Teachers who employ incorrect brain-based notions in educational practise generate major problems in student education. According to Fischer et

al. (2010), teaching is an important and serious activity in terms of the growth and preservation of humans' welfare as well as the alteration of brain structure. Teachers are referred to as "brain changers" by Sousa (2011), which may help to clarify the importance of brain knowledge to the teaching-learning process.

Some of these false beliefs have unfortunately served as the foundation for common programmes for education like Brain Gym and the VAK approach (categorising students based on their VAK learning preferences). In addition, there is no scientific proof to support these programmes' claims that they are "brain-based," despite their claims. These applications have been widely available in classrooms all around the world as a result of a quick commercialization.

Teachers must be educated on accurate and practical neuroscientific findings, especially since a good teaching-learning environment depends greatly on the calibre of the teachers (Goswami, 2006). Also, there is a need to look into and comprehend the origins of these neuromyths in order to better prevent their proliferation, particularly because neuromyths hinder the progress of educational neuroscience (OECD, 2002). Furthermore, the prevalence of these neuromyths generally is one of the reasons why some scientists are hesitant to apply neuroscientific results to the field of education (Varma et al., 2008).

2.3.4. Neuromyths in Foreign Language Education

There exists a close relation between neural networks and language learning ability proper to mankind. Learning has an impact on the brain's

structure and functions, and the systematic functioning of the brain influences learning processes as well.

In fact, according to Herculano-Houzel (2002), the learning procedure occurs through the alteration of neural connections within the brain where memory storing, encoding and retrieval have a significant impact on ensuring the cognitive function of learning.

However, foreign language teachers should be alert to teaching methods based on loosely supported facts, namely "neuromyths". There are three most prevalent neuromyths in the education field, which are presented with reference to the work of Masson and Sarrasin (2015).

1. The first common misconception concerns the usefulness of tailoring instruction to individual students' preferred modes of learning. It is argued that students differ on which style they prefer to receive information since there are different information transmission methods (Buckley et al, 2016). The myth suggests that teachers ought to adapt their teaching strategies to students' preferred learning styles for better learning results. Studies, however, found little evidence to sustain this pedagogical thread (Masson & Sarrasin, 2015).

2. Recent research described a second widely received neuromyth in teaching. The neuromyth concerns the effect of hemispheric dominance on students' output (Masson & Sarrasin, 2015). Research finds that there are actual differences between the two hemispheres (Olfaz, 2011) but to explain individual differences among learners on the basis of differences in hemispheric dominance is not strongly supported in the literature (Masson & Sarrasin, 2015). This misconception could have far reached negative implications.

3. The third most popular question is about the effects of coordination activities on the integration of the left and right hemispheres. Coordination exercises are claimed to be as efficient as to improve cognitive functioning in the learning tasks. One example of these exercises is for instance using your right hand to touch your left ankle (Masson & Sarrasin, 2015). One of the most known programs offering trainings based on coordination exercises and receiving attention at an international level is the popular Brain Gym program. Despite the wide popularity of this program, no credible empirical studies are reported to support neither its theoretical basis nor its claimed beneficial effect (Hyatt, 2007).

Furthermore, a comprehensive study conducted in September 2019 regarding neuromyths and evidence-based practices in higher education revealed that the most commonly believed neuromyths among participants from various nations were as following:

- listening to classical music has been associated with an increase in reasoning ability,
- dyslexia is often characterized by the perception of letters in reverse order,
- individuals tend to learn more effectively when information is presented in their preferred learning style,
- hemispheric dominance may contribute to differences in learning between individuals who are left-brained or right-brained,
- it has been suggested that humans only utilize 10% of their brain capacity (Betts et al, 2019).

2.4. Studies about Neuromyths

All previous studies are briefly summarized here under two categories, the ones conducted abroad, and the ones conducted in Turkey.

2.4.1. Studies Abroad

This part aims to summarize the main studies all around the world about the related area, namely neuromyths and its implications in education in a chronological order.

Suzana Herculano- Houzel (2002) conducted a survey in 1999 with the potential visitors of the Museum of Life in Rio de Janeiro. The survey in question holds significant importance within the realm of neuromyth research since it is the first one and sets a good example for the future studies. She wanted to find out what the general population knew and did not know about the brain because there was a group of activities, which intended to inform museum visitors about brain research. Although certain basic truths about the brain were known to the general public and that brain research was crucial to improving life quality, they did not connect learning to changes in the brain, particularly in the synapses, and they did not accept the existence of several types of memory. They bought into the flawed comparison of the human brain to a machine and the notion that we only make use of about ten percent of our mental capacity.

This survey also succeeded in identifying main factors that contributed to the enhancement of the public's neuroscience literacy such as education, reading newspapers, and popular science magazines. Due to the fact that this literature offered a way to access specialised information that was usually not addressed in school or university programmes, benefits related with reading

science magazines were considerable but often smaller than what one might have expected. Curiously, topics like learning and memory and contemporary imaging techniques were frequently covered in the media those days and seem to be those about which the public seemed worst informed. The findings demonstrated the importance of communicating scientific discoveries to a general audience and suggested areas of emphasis for future communication initiatives intended to heighten the public's understanding of the brain.

In 2012, Dekker and colleagues conducted a study to examine the occurrence and determinants of neuromyths in a sample of approximately 250 elementary and high school educators from the United Kingdom and the Netherlands. They conducted an online survey containing 32 assertions, 15 of which were neuromyths, about the brain and how it affects learning with the participants. They discovered that teachers who were excited about the potential applications of recent advances in neuroscience to the classroom found it challenging to differentiate between pseudoscience and scientific truths. Despite possessing a certain level of general knowledge about the brain, teachers were still susceptible to embracing neuromyths. The acquisition of broader knowledge has been found to be positively correlated with an augmented acceptance of neuromyths.

In 2013, Rato et al. conducted another study with nearly 600 Portuguese teachers aged between 25 and 61 years and teaching at from preschool to high school levels. The study investigated three aspects, namely the employment of brain-based techniques by Portuguese educators in their instructional practices, their level of familiarity with educationally significant brain-related information, and the sources from which they obtained such

information. Their primary research question was whether teachers could discriminate between scientific facts and neuromyths. The study brought attention to how challenging it is to discriminate between myths and facts, which supported worries raised by the OECD (2002) about the development of neuromyths in the educational community. The most prevalent neuromyths were the myths ‘multiple intelligences’, ‘preferred learning style (VAK model)’ and ‘left-brain versus right-brain’. Only less than 20% of the participants could identify these myths. The multi-sensory learning approach was another myth that was still prevalent in the school community, according to the teachers' replies. Nearly 40% of the teachers were not sure whether learning depended on synaptic plasticity. Their comments indicated a lack of understanding of brain-based approaches, which indicates they did not employ them.

A study conducted by Deligiannidi et al. (2015) explored the perceptions of Greek educators regarding the brain and its impact on the learning process. A survey, previously utilized in a study of UK trainee teachers, was administered to a cohort of over 200 primary and secondary school teachers who served as participants in the present investigation. The study revealed that Greek participants exhibited comparable neuromyths and misconceptions regarding the brain to those observed in other European regions. A significant proportion of educators concurred that tailoring instruction to suit the learning styles of students is efficacious. Furthermore, almost 75% of teachers posited that variances in hemisphere dominance, i.e., left-brain versus right-brain, can account for the distinctive dissimilarities observed among learners. Upon comparing this study with other global

studies, notable distinctions emerge that reflect the influence of cultural factors on teachers' perceptions and ideas regarding the functioning of the brain. The perception of the relationship between the mind and the brain among educators in Greece diverged from that observed in the United Kingdom and the Netherlands. A significant proportion of Greek teachers subscribed to the notion that the soul serves as a mediator in this interaction. Furthermore, a correlation was established between the conviction that academic success is constrained by biology and the ascription of scholastic achievements to genetic factors.

Pei et al. (2015) conducted a survey to gather the perceptions of approximately 240 primary, secondary, and high school teachers in East China regarding the brain. The findings of this study were subsequently reported. The objective of the research is to ascertain the frequency of "neuromyths" as a potential source of disruption to classroom instruction. As per the research findings, a multitude of neuromyths and misconceptions pertaining to the brain, which have been previously documented in various regions of Europe, were also observed among teachers in East China. The effectiveness of teaching according to learners' learning styles is believed by a significant majority (97%) of teachers, with similar percentages of 93% and 96% reported in the UK and Netherlands, respectively. Furthermore, a substantial proportion of teachers (71%) hold the view that variations in hemispheric dominance, specifically left-brain versus right-brain, can provide insight into the individual differences observed among learners. In contrast to the majority of teachers in Greece (65%) and trainee teachers in the UK (63%), a smaller proportion of teachers in East China (40%) exhibited enthusiasm towards the

prospect of rigorous physical exercise as a means of enhancing cognitive abilities. It can be seen through a comparison of their findings with global data that cultural factors affect teachers' perceptions of the brain.

The year of 2015 continued with a third study in the area. Gleichgerrcht et al. (2015) examined regional and country-specific trends in the level of neuroscientific literacy and belief in neuromyths among Latin American teachers, especially from Peru, Chile, and Argentina. They questioned about 3,500 Latin American teachers in total using a Spanish translation of the survey that Dekker et al. (2012) first presented. They discovered that teachers in Latin America have similar neuromyths with participants in previous studies in other regions. Nine of the twelve neuromyths were not recognised by more than 50% of the teachers. The present study's results align with those of Dekker et al. (2012) in their investigation of British and Dutch educators. Their research revealed that teachers subscribed to over 50% of the misconceptions and demonstrated a 70% level of accuracy in their understanding of general brain knowledge. Furthermore, these results align with the discoveries regarding the response tendencies of educators from Greece, Turkey, and China, as reported by Howard-Jones (2014). The study's findings indicate that educators possessing a greater understanding of the brain were also more prone to harbouring misconceptions regarding the practical implementation of neuroscientific research. The fact that this link was replicated when examining each country separately is significant, but the fact that the impact sizes were so tiny suggests that there may not be a strong correlation between these two factors. Yet, this conclusion is consistent with earlier research (Dekker et al, 2012). The Latin

American sample scored a little worse than the European samples, probably because there was less Spanish-language content available.

Ferrero and colleagues (2016) extended the scope of their applied research by procuring data from a novel cohort of Spanish educators and performing a meta-analysis of antecedent investigations. A survey developed by Dekker et al. (2012) was utilized to investigate educational neuromyths and general statements about the brain among approximately 290 teachers in Spain. The participants consisted of kindergarten, primary, and secondary school teachers, as well as vocational education teachers from public, private, and state institutions. The survey included a list of neuromyths as described by OECD (2002). The findings of the study indicate that a significant number of Spanish educators also subscribed to various neuromyths. A majority of the educators held erroneous beliefs in five out of the twelve neuromyths. Furthermore, it was found that women held a higher number of neuromyths in comparison to men, as per the average. Educators who demonstrated a greater familiarity with the workings of the brain exhibited a higher frequency of errors in identifying neuromyths. The research results also underscored the correlation between the quality of information and educators' perceptions of the brain. It has been observed that the educational resources that are perceived to enhance overall knowledge are the least utilized among educators. In contrast to the results reported by Gleichgerrcht et al. (2015) pertaining to Latin America, a negligible proportion of educators engage with primary scientific journals. The present outcome exhibits a moderate improvement compared to the results obtained in Latin America and Turkey and bears a striking resemblance to the trends observed among British and

Dutch instructors. Conversely, the educators from Spain obtained an average score exceeding 60% on inquiries related to the fundamental understanding of the brain. The comparatively lower outcome in this regard, as compared to the UK, Netherlands, and Latin America, may be ascribed to the restricted accessibility of content in the Spanish language.

In order to identify the frequency and risk factors for neuromyths in the United States, Macdonald et al. (2017) carried out the first study with a large sample but different from other research in the area, they made a comparison between three groups of participants: educators, the members of general public, and people with high neuroscience exposure. The study revealed that individuals with significant neuroscience exposure and educators exhibited superior performance in neuromyth comprehension compared to the general population. Moreover, individuals with high levels of neuroscience exposure outperformed educators in this regard. In contrast to the lay population, educators exhibited superior proficiency in identifying neuromyths, albeit they frequently concurred with the same fallacious beliefs. The aforementioned results are consistent with the outcomes of a correlated investigation conducted by Dekker et al (2012). For the neuromyths concerning learning styles, sugar and attention, and 10% human brain use, their sample demonstrated marginally better performance. Even though performance was slightly better in the American sample, the level of constancy in the occurrence of these neuromyths was particularly striking. Dyslexia and learning styles were the two neuromyths that were most frequently affirmed across all groups. A younger age, having a doctorate degree, having taken

neuroscience classes, being exposed to peer-reviewed science all predicted better performance on the neuromyths.

There is again one more study conducted in Greece about the frequency of neuromyths and the level of neuroscience in 2017. However, this time, Papadatou-Pastou et al. (2017) conducted their survey among prospective teachers in Greece and it identified predictors of neuromyths. They also looked into whether future teachers would be interested in studying the brain during their education and whether they would favour having neuroscience classes offered as part of the training programme. All participants completed a questionnaire that contained 70 statements. The current writers created seven items that were relevant to special education, while 22 statements (taken from Lilienfeld et al., 2011; Dekker et al., 2012) were educational neuromyths. Results revealed that while prospective teachers' neuroscience literacy was generally strong, neuromyths were worryingly pervasive among potential teachers. Further research revealed that the best defence against believing in neuromyths was general understanding of how the brain functions. Prospective teachers thought it was crucial to learn about neuroscience and that education departments should include courses on brain functioning in their curricula. The findings also demonstrated the value of academic teaching in neuroscience for prospective special education teachers.

Kim and Sankey (2018) undertook a three-year study with almost 1200 first-year pre-service student teachers at the University of Sydney in Australia in an effort to investigate the causes of these neuromyths and why they received so much attention. Their findings show that the five neuromyths—VAK learning styles, left/right brain learners, Brain Gym, fatty acid

supplements, and super-enriched environments in early years—are believed at alarmingly high levels. They also attempted to demonstrate the participants' levels of confidence in their acceptance of neuromyths. The strongest beliefs are those in VAK learning styles and fatty acid supplements, and then the belief in environments that are extraordinarily enriched in the early years before the belief of the existence of students who use their left or right brain when learning. The least firmly held belief is in Brain Gym. They identified some sources of neuromyths such as some commercial TV advertisements as the primary source of the myth that fatty acid supplements improve academic achievement, schoolteachers as the source of the myths of VAK learning styles and Left/Right Brain learners, a university course, a feeling of intuition that the myth made sense, and finally their parents. Finally, it was asserted that, in light of their findings, having a general understanding of the brain does not guarantee being able to recognize neuromyths.

Betts et al. (2019) carried out a global study (88% of participants were from the United States while 12% of them were from other countries), which first looked at instructors, instructional designers, and administrators' recognition of neuromyths and general knowledge regarding the brain in higher education. The same group of participants were also questioned regarding their familiarity with scientific approaches from the learning sciences and MBE Science. In addition, they made an effort to provide indicators of knowledge about, first, neuromyths and general understanding pertaining to the brain, and second, scientific techniques in higher education. According to their results, most of the participants indicated a desire to find out more about the brain and how it affects learning. Also, they said it was

helpful for their professional development, course design, and teaching style. As predicted, instructional designers had a higher level of brain knowledge, understanding of neuromyths, and scientific practises than teachers and school administrators did. Additionally, they discovered that reading publications in the fields of MBE science, psychology, and neuroscience, raised readers' understanding of neuromyths, basic comprehension of the brain, and scientific methods. A person's professional progress is an important predictor of scientific methods, general brain knowledge, and awareness of neuromyths. They found out that the common neuromyths among the participants were VAK learning styles, left/right brain learners, 10% human brain use as well as the neuromyths that classical music listening improves critical thinking and seeing letters backwards is a key sign of dyslexia (Betts et al, 2019).

In the year 2020, Idrissi and his colleagues conducted a study to evaluate the level of understanding of the brain among Moroccan educators, as well as the prevalence of neuromyths and the roots of these misconceptions. They employed a survey that was taken from Dekker's work (Dekker et al.,2012), in which they used a questionnaire with 32 questions about how the brain functions and how this information is applied in teaching, 12 of which were neuromyths. Their findings showed that Moroccan teachers had a poor understanding of the brain and there was a significant distribution of neuromyths among them. The research has additionally revealed a robust association between the frequency of neuromyths and the extent of cerebral knowledge. Notably, a substantial prevalence of neuromyths is linked to possessing a considerable degree of brain knowledge. They discovered that gender and taught subjects were further neuromyth predictors, but none of the

other sociodemographic factors contributed. Nonetheless, age and length of teaching were predictive of general brain knowledge.

When we compare the results of this study in Morocco with the similar studies in other parts of the world, we can see that, on average, Moroccan teachers had a higher level of brain knowledge than Spanish educators (Ferrero et al., 2016) and a lower level than teachers from the UK, the Netherlands (Dekker et al., 2012), Greece (Deligiannidi et al., 2015; Papadatou-Pastou et al., 2017), and teachers from Latin America (Gleichgerrcht et al., 2015). Furthermore, compared to European nations, the state of the USA, East China, and Latin American nations, they recorded the largest percentage of incorrect responses for four neuromyths (Dekker et al, 2012; Deligiannidi et al, 2015; Ferrero et al, 2016; Gleichgerrcht, 2015; Karakus, 2013 – Macdonald et al, 2017; Papadatou-Pastou, 2017; Pei, X., 2015). These neuromyths were about the rich environment during early years and learning styles, exercises for coordination in brief intervals and impact of rehearsal of coordination exercises on literacy skills. Women were more prone to believe in neuromyths in this study, as was the case in other investigations (Ferrero et al, 2016; Macdonald et al, 2017).

Ching et al. (2020) looked into preservice teachers' understanding of neuroscience in education and their level of neuroscience literacy in Hong Kong that same year. Similar to their international counterparts, the prospective teachers in Hong Kong knew little about the brain and believed a lot of popular neuromyths. The high prevalence of neuromyths was in line with earlier research on educators. In particular, there was widespread consensus regarding the neuromyths of VAK learning styles and the

relationship between left-brain and right-brain dominance and the process of learning. This brought to light the fact that so-called "brain-based" instructional strategies are still commonly utilized within educator preparation programs, despite the fact that such strategies have been discredited by scientific research. Knowledge about the brain appears to be a predictor of beliefs in neuromyths, according to a number of studies (Dekker et al, 2012; Papadatou-Pastou et al, 2017). However, in this study neuromyths were less common among the prospective teachers who were better knowledgeable about the brain. They also concurred that additional neuroscience education for preservice teachers was necessary for the effective integration of neuroscience into the classroom.

Finally, in 2021 Bissessar and Youssef conducted a study among primary and secondary school teachers in Trinidad & Tobago, which is a small island developing state in the Caribbean, during the COVID-19 pandemic. They tried to evaluate their level of acceptance of neuromyths and how those neuromyths affected their instruction. Similar to prior studies, they employed a questionnaire based on self-report, which contained 30 statements which was used by Dekker et al in 2012 and customised for the regional setting (Bissessar & Youssef, 2021). The key finding of this research was the high prevalence of neuromyth belief among the teachers. This result was not unexpected, but it was superior to studies from many other countries, such as the UK and the Netherlands (Dekker et al.,2012), Peru, Chile, and other Latin American nations (Gleichgerrcht et al, 2015), Spain (Ferrero et al.,2016), and Morocco (Idrissi et al.,2020), The use of Brain Gym and other neuroscience-related items did not appear to be employed in Trinidad and Tobago or the wider

Caribbean, which restricted the spread of numerous neuromyths (Bissessar & Youssef, 2021).

On the other hand, certain neuromyths, particularly those that pertain to learning styles and anatomical notions of the brain, such as the myth that humans only use 10% of their brain and the myth that the right and left brains are each in charge of distinct higher cognitive functions, seemed to be extremely popular and appeared to predominate. Higher general brain knowledge scores were the strongest predictor of believing in neuromyths, according to multiple other studies (Dekker et al., 2012; Ferrero et al., 2016). These findings were found in two separate investigations. In contrast, the earlier study came to the opposite conclusion, concluding that brain knowledge was the sole factor that could accurately predict an individual's capacity to recognize neuromyths (Ching et al., 2020).

Table 2.1 summarizes the studies conducted about neuromyths abroad from 2002 to 2021. It contains information about the researchers of these studies, the participants included in these studies, years and countries in which they were carried out as well as the methods used in them. Thus, the historical background of neuromyth studies can be easily observed.

Table 2. 1. *Studies conducted abroad about neuromyths.*

Researchers	Year	Participants	Country	Methods Used
Herculano-Houzel	2002	35 neuroscientists and 2158 members of the public	Brazil	Conducting surveys
Dekker et al.	2012	242 primary and secondary school teachers	the UK and the Netherlands	Conducting surveys

Rato et al.	2013	583 teachers in preschool to high school levels	Portugal	Conducting surveys
Pei et al.	2015	238 primary, secondary and high school teachers	East China	Conducting surveys
Deligiannidi & Howard-Jones	2015	217 primary and secondary school teachers	Greece	Conducting surveys
Gleichgerrcht et al.	2015	3451 teachers	Latin America	Conducting surveys
Ferrero et al.	2016	284 kindergarten, primary and secondary school and vocational education teachers	Spain	Conducting surveys
Papadatou-Pastou et al.	2017	prospective teachers in Education Departments in two universities	Greece	Conducting surveys
Kim & Sankey	2018	1144 pre-service student teachers over a period of three years	Australia	Conducting surveys
Betts et al.	2019	929 participants including instructors, instructional designers, and administrators	88% from the USA while 12% international	Conducting surveys
Idrissi et al.	2020	teachers in elementary education	Morocco	Conducting surveys
Ching et al.	2020	986 preservice teachers in the Bachelor of Education programme	Hong Kong	Conducting surveys
Bissessar & Youssef	2021	338 teachers	The island of Trinidad & Tobago in the Caribbean	Conducting surveys

To sum up, Table 2.1 presents a comprehensive summary of research conducted internationally regarding the prevalence of neuromyths among educators. Research has been carried out in multiple nations including Brazil, the United Kingdom, Portugal, Greece, Spain, Australia, Morocco, Hong Kong, Latin America, and Trinidad & Tobago. All investigations employed survey methodologies to collect information from educators, aspiring

educators, and other professionals in the field of education. The studies' sample size exhibited variability, ranging from 35 to 3451 participants, while the participants' educational attainment spanned from primary school to university education. The findings of these investigations indicate that the occurrence of neuromyths is not restricted to particular geographical areas or societies, but rather a common occurrence among educators across the globe. The results of these investigations emphasize the necessity for increased opportunities for teacher professional development aimed at enhancing their comprehension of neuroscience and enabling them to differentiate between neuromyths and practices that are supported by empirical evidence. Consequently, it is imperative to increase educators' knowledge of neuromyths and furnish them with precise data derived from scientific research to enhance the quality of instruction.

2.4.2. Studies in Turkey

This part aims to summarize the studies in Turkey about neuromyths and its implications in education in a chronological order.

It is observed that the first study in Turkey on neuromyths among teachers, and the sources of these neuromyths was conducted by Karakus in 2013. Her research first looked at the general knowledge and neuromyths that elementary and secondary school teachers had about the brain, then it looked at where these misconceptions came from, and lastly, it looked into how Turkish teachers felt about educational applications of neuroscience. The study's findings indicated that most teachers had little knowledge of the brain and that more than half of them generally believed in neuromyths. Additionally, teachers did not trust their comprehension of how the brain

works and how it affects learning, and they believed more than half of the neuromyths. She compared these results with those of the study by Dekker et al. (2012). Comparisons revealed that while teachers' overall knowledge of the brain and its functioning is stronger in the UK and the Netherlands than in Turkey, neuromyths are largely the same in all three countries (the UK, the Netherlands, and Turkey) (Karakus, 2013). Moreover, the percentages of those who believe in neuromyths did not change much, which is an accurate reflection of the worries about the common acceptance of neuromyths over the world (OECD, 2002). The results of the interviews with the teachers in the study showed that their personal experiences had a greater impact on their knowledge of and misconceptions about the brain than any other factor. Lastly, the majority of participants thought that neuroscience was essential in education, and they also emphasised the necessity for instructors to have training in the field of neuroscience.

Subsequently, in 2016, Dundar and Gunduz conducted a study with university students preparing to become classroom, math, and science teachers in order to try and discover prevalent neuromyths among these aspiring teachers. By dispelling the neuromyths and demonstrating how neuroscience may influence theories in educational sciences and practises, they hoped to assist the aspiring teachers. Their results firstly supported the idea that neuromyths are common among them. Similar to other nations, Turkey was plagued by widespread neuromyths in the educational sector, including those about left and right brain learners, VAK learning styles, and the development of mental capacity through the use of fatty acid supplements and water consumption. The study's findings, which were consistent with past research

from other sources, revealed that humans mostly only use 10% of their brains, which was another common neuromyth (Dekker et al., 2012; Karakus et al., 2015; Pasquinelli, 2012). Several neuromyths are prevalent, including those related to Brain Gym and language acquisition. One such myth suggests that mastering one's native language is a prerequisite for learning a second language. Additionally, it is believed that there are specific developmental windows in childhood that dictate the acquisition of certain skills.

This study also detailed how these neuromyths vary depending on the department, participants' grade levels and gender, as well as the informational sources used, such as newspapers, popular science magazines or books. The study's findings revealed that neuromyth scores varied by department and were typically more common among aspiring science teachers. Also, it was discovered that aspiring teachers at the first and fourth grades believed more neuromyths. Neuromyth scores varied with newspaper and journal reading levels but not with book reading levels. Reading newspapers, popular science magazines or books, according to Herculano-Houzel (2002), were neuromyth-minimizing variables, which is consistent with the outcomes of Dundar and Gunduz' study (2016). However, according to Dekker et al. (2012), reading popular scientific magazines was not an efficient means of learning about neuroscience. Males displayed more educational neuromyths than females in terms of gender differences. Contrary to these results, Dekker et al. (2012) and Karakus et al. (2013) discovered no relationship between gender and neuromyths.

Canbulat and Kiriktas (2017) conducted a study in Izmir to determine the level of neuromyths among Class Teachers and Science Teachers, as well

as their respective candidates, and to investigate whether there exists a statistically significant difference with respect to certain variables such as gender and class. They carried out the research with 241 teachers and 511 preservice teachers. Based on the findings, it appears that both teachers and teacher candidates have incorrectly answered 50% of the survey questions. A statistically significant difference (p=.000) was observed in favour of the teachers when comparing the scores of teachers and teacher candidates. Again, compared to teacher candidates, the teachers have much more knowledge about the brain and learning. In addition, it was found that prospective teachers and current teachers who had participated in a workshop or a class on the subject of the brain and learning had a greater degree of educational awareness than those who had not participated in such activities. The researchers also tried to investigate the differences between preservice teachers with respect to their point average and grades. Preservice teachers with academic point averages between 2.01-3.00 and 3.01-4.00 exhibit a higher level of awareness regarding educational neuromyths compared to teacher candidates with academic point averages between 0.00-2.00. The level of educational neuromyths awareness among teacher candidates in the third grade is comparatively higher than those in the second grade. These findings are generally comparable with the study that was conducted on English and Dutch teachers by Dekker et al. (2012).

When we come to the year of 2018, we come across with the research done by Dogan with biology teachers in Ankara. She attempted to expose the accurate knowledge biology teachers had regarding the structure and operations of the brain, and also to reveal neuromyths of biology teachers and

the relationship between the identified neuromyths and certain demographic variables. The results of the study were in agreement with those of Karakus (2013), indicating that the current understanding of the structure and functioning of the brain among biology teachers was either deficient or erroneous. Several studies have identified nine prevalent neuromyths among biology teachers. These studies have revealed that teachers from various countries, such as the UK, the Netherlands, Turkey, Greece, and China, share comparable misconceptions (Dekker et al., 2012; Karakus, 2013; Howard Jones, 2014; Deligiannidi & Howard Jones, 2015; Pei et al., 2015). Likewise, there was no significant relationship between neuromyths and gender of biology teachers except one, which says that individual differences among students can be explained by a right-left brain hemispheric dominance pattern. The rate of female teachers having this neuromyth was higher than male teachers. It was concluded that any lecture or workshop on educational neuroscience did not provide any content related to these neuromyths or was insufficient. The nine neuromyths did not differ significantly according to gender, professional experience, or graduation level.

The table below summarises all of the neuromyth studies that have been conducted in Turkey.

Table 2. 2. *Studies conducted in Turkey about neuromyths among teachers.*

Researchers	Year	Participants	Cities	Methods Used
Karakus	2013	278 elementary and secondary school teachers answered a questionnaire and 6 of them were interviewed	Istanbul and Mersin	survey and interview

Dundar & Gunduz	2016	2932 preservice teachers from six state universities	in different cities	survey
Canbulat & Kiriktas	2017	241 teachers and 511 teacher candidates	Izmir	survey
Dogan	2018	100 biology teachers	Ankara	survey

To summarize, the table provides an overview of research conducted in Turkey with respect to the frequency of neuromyths among educators. The research was carried out by multiple investigators across diverse urban locations, utilizing a range of techniques, including questionnaires and in-person discussions. The related literature study indicates a significant prevalence of neuromyths among educators in Turkey, potentially leading to adverse effects on pedagogical approaches and the academic achievements of their pupils. The aforementioned discoveries emphasize the significance of increasing cognizance regarding neuromyths and advocating for evidence-based methodologies in the realm of education.

CHAPTER III

3. METHODOLOGY

This chapter will provide an in-depth explanation of the research design, participants, data collection instruments, data collection procedure and statistical analysis of data as well as the research methods used in this study.

3.1. Design of the Study

The purpose of this study is to identify the neuromyths that are prevalent among English teachers who work at various educational levels in various types of institutions in the sample of Istanbul. The researcher employed a descriptive research methodology to portray the neuromyths prevalent among English teachers. According to Fraenkel, Wallen & Hyun (2012), the descriptive survey model is an approach that aims to reveal the existing situation (participants' views, interests, skills, abilities, etc.) regardless of the relationships between the variables. Descriptive studies aim to provide a comprehensive and precise depiction of a particular situation and the survey method is widely utilised in the field of education as a descriptive research technique. This is due to its ability to effectively summarise the characteristics of individuals, groups, or physical environments under investigation by researchers (Buyukozturk et al., 2022).

In order to achieve this objective, the researcher endeavoured to provide quantitative data from participants via a questionnaire. It had been utilized in prior research endeavours pertaining to educators' perspectives and comprehension of educational neuroscience, both domestically and internationally. Thus, it will be possible to make comparisons between these

previous studies and the current study and to show the predominance of neuromyths among teachers through years. In addition, by observing the limitations and outcomes of the earlier research and comparing those results, the researcher was able to gain a more comprehensive understanding of the situation involving neuromyths among English teachers.

3.2. Participants

Research participants consisted of 114 English teachers in Istanbul in Turkey during the 2021-2022 academic year.

The first rationale for selecting English teachers as the study's sample population was the notable observation that there have been only a few studies about opinions of English teachers regarding neuromyths, after reviewing the literature in the related area. Secondly, English teachers can reach sources of information with greater ease due to their proficiency in English, which serves as the global lingua franca. In this context, it is evident that English teachers can readily access both scientific facts and neuromyths with equal ease and expediency. This makes them an appropriate group for investigating prevalent neuromyths. Thirdly, the effective instruction and acquisition of English language skills has consistently been a significant challenge within the realm of education in Turkey. Thus, determining neuromyths will obviously be beneficial in foreign language education in Turkey since there can be many incorrect implications and applications in English language classrooms because of the prevalence of neuromyths among English teachers.

The sampling method used here was the convenience sampling technique, which is categorised as one of the non-random sampling methods.

The convenience sampling approach involves the construction of a sample by initially selecting the most readily available participants and subsequently expanding the group until the desired sample size is achieved. Convenience sampling involves the collection of data from a sample that is readily accessible to the researcher (Buyukozturk et al., 2022). The fact that the time during which the study was conducted coincided with the Covid 19 pandemic period is the biggest reason for choosing this sampling method.

3.2.1. Descriptive Statistics about Participants

Demographic information of 114 participants who took part in the study are presented in Table 3.1.

Table 3. 1. *Demographic information of the participants*

		f	%
Gender	Female	93	81,6%
	Male	21	18,4%
Institution Level	Kindergarten	0	0
	Elementary School	13	11,4%
	Secondary School	61	53,5%
	High School	40	35,1%
Institution Type	Public School	94	82,5%
	Private School	20	17,5%
Year of Seniority (English Language Teaching)	5 years and under	5	4,4%
	Between 6 and 10 years	20	17,5%
	Between 11 and 15 years	21	18,4%
	Between 16 and 20 years	42	36,8%
	21 years and above	26	22,8%
Age	40 years and under	49	43%
	41 years and above	65	57%
Level of Education	Undergraduate	84	73,7%
	Master's degree	28	24,6%
	PhD	2	1,8%

According to the findings of the study, the participants were

English teachers working in Istanbul at different levels of education institutions. Only 21 participants were male while the rest of 114 participants was female participants.

More than half of the participants (61%) were working at the level of secondary school and the other half consisted of English teachers at the levels of elementary school (11,4%) and high school (35,1%). Unfortunately, there were no English teacher working in kindergarten level. Most of the participants (82,5%) were working in public schools and the rest of them (17,5%) were working in private schools at different levels of education.

Exactly half of the participants were between the ages of 41 and 50, followed by the group of the participants aged between 31 and 40 (n=40). According to the results, more than half of the participants (59,6%) were experienced English teachers for more than 15 years. The rest of the teachers (40,3%) had an experience of less than 15 years. As for the level of teachers' education, a big majority of them (n=84) had an undergraduate degree while only 24,6% of the participants (n=28) had a master's degree and only two teachers had a PhD degree.

Shortly, the participants of the study are mostly female middle-aged English teachers who were experienced mostly more than 15 years as seen in Table 3.1.

3.3. Setting

The study was carried out with English teachers working at different levels of education ranging from elementary school to high school and different institutions such as public or private schools in the city of Istanbul.

Istanbul was chosen as the sample of study as Istanbul can represent a good example with a large number of nearly 161 thousand teachers and nearly 3 million students according to the statistical information retrieved from Istanbul Provincial Directorate of National Education's web site (https://istanbul.meb.gov.tr/). Another important factor is the practicability of implementing the research in a particular urban area.

3.4. Data Collection Instruments

The present research required the administration of a survey aimed at gathering information on the prevalence of neuromyths among English teachers. The survey consisted of three crucial parts.

The main part consisted of a questionnaire, which had been previously utilized in various studies (e.g., Dekker et al., 2012; Herculano-Houzel, 2002; Karakus, 2013 Gleichgerrcht, et al., 2015; Ferrero et al., 2016). The questionnaire consisted of 32 statements that pertained to the brain and its impact on the learning process (see Appendix D). The OECD (2002) has identified and acknowledged 15 statements as educational neuromyths. The remaining 17 statements comprised of general scientific knowledge related to the brain. By selecting "true," "false," or "don't know," the participants could respond to these assertions. Karakus (2013) translated the questionnaire herself and revised it after performing a pilot study with 38 teachers. She used Turkish translation of the questionnaire in her study (2013). While reviewing the literature about the related area in Turkey, it is seen that there were other studies which used or were inspired by the same questions (e.g., Dogan, 2018). Thus, it was decided to use the same questionnaire here to collect data from participants after taking permission from Karakus (see Appendix B). In addition, the results of the current study will be easily compared with the results of previous

studies abroad and in Turkey, and the significance of the study can be more obviously seen among other studies in the area.

In addition, two important sections were added before the questionnaire items were introduced. The first section was included to gather data about the demographic features of English teachers such as age, gender, institution level, institution type, years of seniority in English language teaching and level of education (see Appendix F).

Then, another section was added about the independent variables of the study following the section about the demographic questions. In this part, there were seven additional questions, which were utilized to obtain necessary background information to describe how these variables could be effective on the assertions that would be made by the participants. Participants were asked to indicate whether they read scientific magazines regularly; take any courses or attended any workshops/ seminars/ conferences, so as to be able to determine the sources of neuromyths (see Appendix F). Furthermore, they indicated how sure they were about the information they had related to brain, whether they want to learn scientific facts about the brain and how it affects learning, whether they thought neuroscience in education was important, and whether they thought they needed an in-service training course on the subject.

To summarize, a survey which consisted of three important parts was used to collect data about neuromyths of English teachers in this study. The first part was to collect data about demographic features of participants, the second part was to gather necessary background information of participants and the third part was the scientific questionnaire which consists of 32 assertions.

3.4.1. Reliability

"The consistency of scores or answers from one administration of a data collection instrument to another" is referred to as reliability (Fraenkel et al., 2012). The quality of the data collection instruments is crucial because the inferred conclusions in the research depend on these results according to Fraenkel et al. (2012). Thus, research need to ensure that the data collection instruments are reliable and valid so are their inferences from them. The Cronbach Alpha value was used for reliability analysis. The questionnaire's Cronbach's Alpha value was determined to be .842, indicating a high level of reliability since a Cronbach Alpha value of 0.70 and above proves that the data collection tool is a reliable one according to Buyukozturk (2021).

3.5. Data Collection Procedure

The present study was carried out during the 2021-2022 academic year, involving a sample of 114 English teachers located in Istanbul, Turkey. The researcher created a digital form of the questionnaire adapted from Karakus' study (2013) on the Google Forms and delivered its URL link to the teachers through e-mails and various communication platforms on social media in the 2021-2022 academic year. The explanation section at the beginning of the questionnaire clearly stated all relevant information that should have been provided to the participants. First, the purpose and content of the study were described, followed by a brief explanation of the questionnaire's structure. In addition, their participation rights were highlighted, including their right to withdrawal. The data gathered from the participants was also confirmed to be kept anonymous and private as well. The research was based on the principle of volunteering.

Moreover, the Humanities and Social Research Ethics Committee at Yeditepe University approved the study design and procedures of this study with the decision made at the meeting numbered 26/2021 and dated January 27, 2021 and all the necessary legal permissions required for data collection from English teachers working in both state and private schools in Istanbul, which were officially affiliated to the Ministry of National Education, was obtained from Istanbul Provincial Directorate of National Education.

3.6. Data Analysis

The data obtained from English teachers was analysed with the SPSS program (IBM SPSS Statistics 22.0) by using descriptive statistical analysis including frequencies and percentages. The obtained data were also analysed using inferential statistics including t-tests and ANOVA tests. After testing the normality, inferential analyses related to the research questions of the study were conducted. Also, correlation analysis was used to answer the last two research questions.

3.6.1. Normality Distribution

The initial step in the statistical analysis involved the verification of the normal distribution of the data in this research, and in order to check this, the researcher checked the answers of each participant according to the answer key and, 1 point is given for each assertion which the participant marked correctly according to the answer key (see Figure 1). Then these points were added and a total for each participant, which was called “QTotal” by the researcher, was obtained. As for the “I don’t know” answers, another total which was called “QDontknow” was obtained. These totals were used to determine whether the data in this study were normally distributed.

	Participants' answers			
	C	I	C	I
Answer Key	C	I	I	C
Given Numerical Value	1	1	0	0

Figure 1. Given points for the participants' answers.

As the application of many statistical analyses requires a normal distribution of data, a statistical test should be performed to show that the data are normally distributed. The Lilliefors Test can be used when the number of participants is 29 or more. The Lilliefors Test is based on a modified version of the Kolmogorov-Smirnov test and should be used when the mean and variance estimated from the data is unknown (Akgul, 2022).

Table 3. 2. *Test of normality results*

Tests of Normality

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Total	,082	112	,063

a. Lilliefors Significance Correction

If a p >.05 value is obtained in the single-sample Kolmogorov Smirnov test, the distribution is normal, if a p <.05 value is obtained, the distribution is not normal. According to these values, the results in the single-sample Kolmogorov-Smirnov test show normal distribution. In other words, as our value exceeds the 0.05 level of significance, we can infer that the data are fairly normally distributed.

CHAPTER IV

4. FINDINGS

This chapter will present the findings of this study about the prevalent neuromyths of English teachers in the context of Istanbul. The collected data will be analysed in accordance with the research questions.

The aim of this section is to find out the prevalent neuromyths and whether there are differences in the neuromyths of English teachers according to demographic variables such as gender, level of education, professional experience, and professional development activities. In addition, the possible relationship between the general knowledge of English teachers in the field of neuroeducation and their beliefs in neuromyths and the potential correlation between various professional development activities and the neuromyths of English teachers about brain functions and neuroeducation will be explored.

4.1. The neuromyth and general knowledge levels of English teachers about brain functions and neuroeducation

The descriptive values pertaining to English teachers' neuromyths regarding brain functions and neuroeducation, as well as their levels of general knowledge, are presented in Table 4.1.

Table 4. 1. *The Neuromyth and General Knowledge Levels of English Teachers*

	N	M	sd
Neuromyths	114	7,33	2,268
General knowledge		9,35	2,787

After analysing the data presented in Table 4.1, it becomes evident that English teachers exhibit an average score of 7.33 (with a standard deviation of 2.268) in terms of their beliefs regarding neuromyths pertaining to brain functions and neuroeducation. Furthermore, it has been determined that the

mean level of general knowledge among the individuals in question is 9.35, with a standard deviation of 2.787.

In summary, the data analysed indicates that the participants possess a mean level of misconceptions, despite certain variations observed within the "Neuromyths" category. In contrast, the participants as a whole demonstrate a higher mean level of accuracy and a wider range of variability in the "General Information" category. In other words, the participants, on average, perform well and have a relatively high level of accuracy, while there is also a notable variability in their individual performance levels, suggesting that some participants may perform exceptionally well while others may perform less effectively.

4.2. The prevalent neuromyths of English teachers about brain functions and neuroeducation

The 15 statements in Table 4.2 can be used to comprehend the prevalent neuromyths of English teachers (see Appendix E for the neuromyth items). Teachers' replies are also shown by frequencies and percentages under the headings C = Correct, I = Incorrect, and D.K. = Do Not Know in the table below.

Table 4. 2. *15 Neuromyth Assertions and Teachers' Replies.*

Neuromyths in the Questionnaire	Teachers' Replies					
	C		I		D.K.	
	f	%	f	%	f	%
Neuromyth item 1	29	25,4	74	64,9	11	9,6
Neuromyth item 2	22	19,3	46	40,4	46	40,4
Neuromyth item 3	88	77,2	0	0	26	22,8
Neuromyth item 4	38	33,3	43	37,7	33	28,9
Neuromyth item 5	95	83,3	5	4,4	14	12,3
Neuromyth item 6	65	57,0	33	28,9	16	14,0
Neuromyth item 7	104	91,2	4	3,5	6	5,3
Neuromyth item 8	103	90,4	4	3,5	7	6,1

Neuromyth item 9	78	68,4	9	7,9	27	23,7
Neuromyth item 10	46	40,4	29	25,4	39	34,2
Neuromyth item 11	70	61,4	7	6,1	37	32,5
Neuromyth item 12	62	54,4	10	8,8	42	36,8
Neuromyth item 13	105	92,1	1	0,9	8	7
Neuromyth item 14	16	14	63	55,0	35	30,7
Neuromyth item 15	83	72,8	1	0,9	30	26,3

As can be seen from Table 4.2, the given data presents the responses of teachers on the questionnaire regarding their beliefs about neuromyths. The frequencies and percentages are shown for each of the 15 statements. It can be observed that some neuromyths are more prevalent among teachers than others. Eight assertions received more than 50% agreement from the participants, which are the most prevalent neuromyths among English teachers. The outcomes of these eight assertions are referred to as "neuromyths", and they are widely held and used by English teachers today.

Because of these disparities, it seems likely that there are variations in the level of understanding regarding neuromyths among the various categories of educators. Figure 2 presents these prevalent neuromyths in a percentage format, with the highest percentage appearing first and the lowest percentage appearing last.

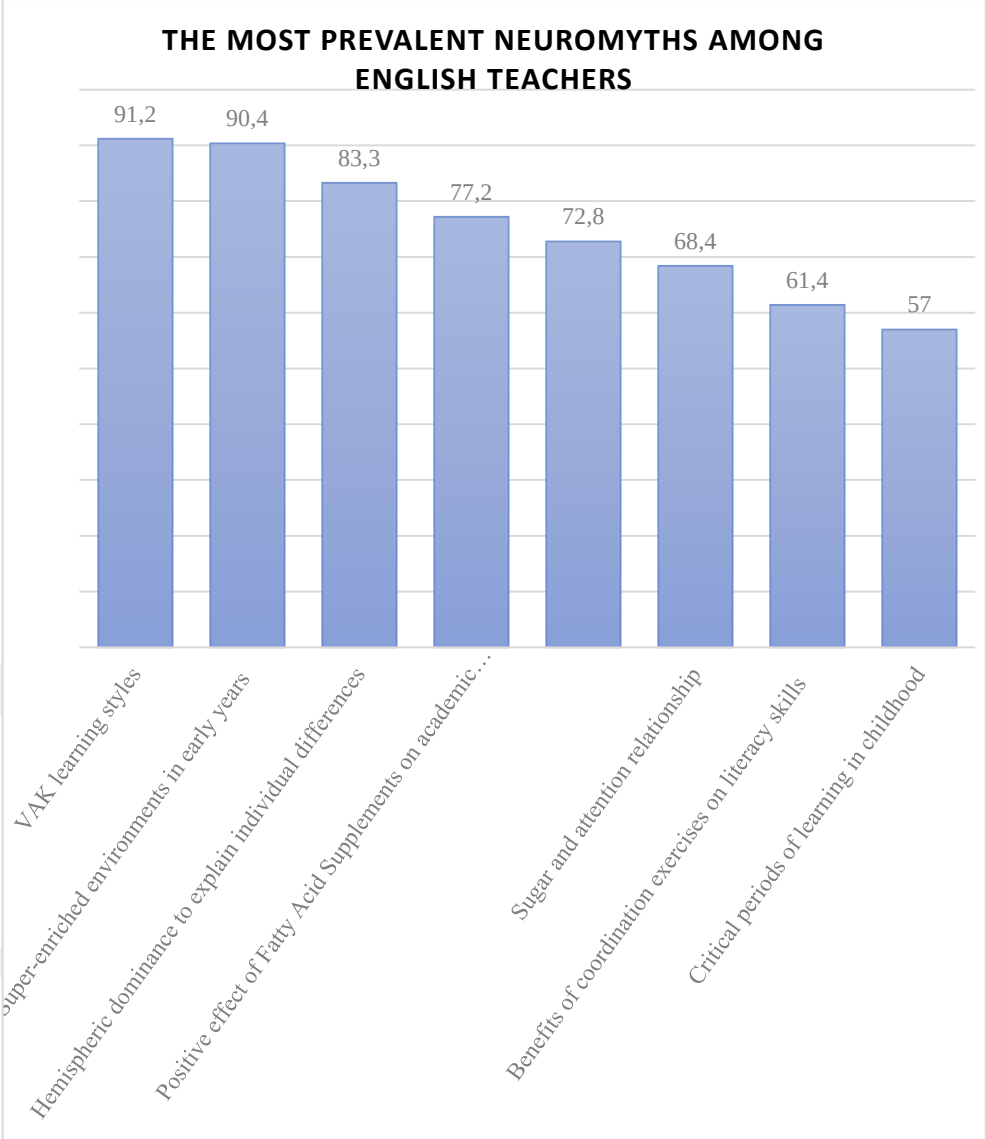

Figure 2. The most prevalent neuromyths among English teachers.

Figure 2 shows us that the myths “preferred learning style (VAK model)”, “super-enriched environments in early years”, and “left-brain versus right-brain” are the top three misconceptions, which have a degree of agreement of more than 80% among English teachers. Additionally, more than 70% of English teachers believe the myths about "fatty acid supplements" and "an integration of the left and right hemispheres by means of exercises”. The misconceptions about “sugar and attention relationship” and “the benefits of coordination exercises on the integration of left and right hemispheres”

received an agreement of over 60% as well. The least common neuromyth is about "critical periods of learning in childhood," with a percentage of 57%.

4.3. Differences between genders in the neuromyths of English teachers about brain functions and neuroeducation

An independent groups t-test was conducted to determine the difference in the degree of belief in neuromyths about brain functioning and neuroeducation between female and male participants, and the results are displayed in Table 4.3.

Table 4. 3. *Independent Samples t-Test Results of English Teachers' Neuromyths by Genders*

	Groups	N	M	sd	t	df	p
Neuromyths	Female	93	7,39	2,368	,531	112	,597
	Male	21	7,10	1,786			

There were no significant differences (t [112] =.531, p >.05) between the two genders. It is seen that the level of belief in neuromyths does not differ according to gender.

4.4. Differences according to the institution level in the neuromyths of English teachers about brain functions and neuroeducation

In order to assess any possible differences in the degree of belief in neuromyths about brain functioning and neuroeducation among participants based on the institution level at which they teach, a statistical analysis was performed using an independent samples t-test. The findings are displayed in Table 4.4, provided below.

It is important to note that the participants in this study chose the institutional level by accurately indicating their school level, namely kindergarten, elementary school, secondary school or high school, in the

questionnaire form. The sample used in this study was limited in terms of participant diversity with regard to the institution level of English teachers. There were no English teachers working at the level of kindergarten among the participants. Also, the inability to establish face-to-face connections with participants, coupled with the general fatigue experienced by individuals in online environments due to the constraints imposed by the pandemic, necessitated the consolidation of elementary and secondary school groups under the label "Primary education", and the high school group was named as “Secondary education”. This decision was made in order to ensure the attainment of meaningful and reliable results.

Table 4. 4. *Independent Samples t-Test Results of English Teachers' Neuromyths by the Institution Levels*

	Groups	N	M	sd	t	df	p
Belief in Neuromyths	Primary education	74	7,24	2,232	-,575	112	,566
	Secondary education	40	7,50	2,353			

The neuromyth level of English teachers does not substantially differ according to the institution level at which they teach (t [112] = -.575; p >.05). In other words, teachers who work at the primary education (including elementary and middle schools) and secondary education (only high schools) levels have equal degrees of neuromyths.

4.5. Differences according to the institution types in the neuromyths of English teachers about brain functions and neuroeducation

Participants in this study either work in a public school or a private school, and to see whether there is a difference between these two groups of English teachers in the degree of belief in neuromyths about brain functioning

and neuroeducation, an independent samples t-test was conducted. The findings from the independent groups t-test are displayed in Table 4.5.

Table 4. 5. *Independent Samples t-Test Results of English Teachers' Neuromyths by the Institution Types*

	Groups	N	M	sd	t	df	p
Belief in Neuromyths	Public school	94	7,48	2,252	1,492	112	,139
	Private school	20	6,65	2,277			

English teachers' neuromyths (t [112] = -1.492; p >.05) do not differ significantly according to the type of institution they work for. To put it differently, the level of neuromyth beliefs among teachers in public and private schools is similar.

4.6. Differences according to professional experience in the neuromyths of English teachers about brain functions and neuroeducation

An ANOVA test was conducted to compare the neuromyth levels of English teachers about brain functions and neuroeducation according to their professional experience in teaching English as a second language, and the findings are presented in Table 4.6.

The participants in this study provided information about their professional experience by selecting from a range of options, including 5 years and under, between 6 and 10 years, between 11 and 15 years, between 16 and 20 years, and 21 years and above, in the questionnaire. To ensure the validity and reliability of the results, the participants were subsequently grouped into three main categories based on their years of professional experience: 10 years and under, between 11 and 20 years, and 21 years and above.

Table 4. 6. *ANOVA Results of English Teachers' Neuromyths by Teachers' Professional Experience.*

	Experience	N	M	sd	Source of Variance	Sum of Squares	df	Mean Square	F	p
Neuromyths	10 years and under	25	6,56	2,329	Between Groups	21,834	2	10,917	2,166	,119
	Between 11-20 years	21	7,24	2,022	Within Groups	559,499	111	5,041		
	21 years and above	68	7,65	2,277	Total	581,333	113			
	Total	114	7,33	2,268						

Based on the analysis of professional experience levels, there is no significant difference observed in the neuromyth scores of English teachers (F [2-111] = 2.166; p >.05). Put simply, English teachers with different levels of professional experience exhibit similar levels of neuromyths.

4.7. Differences according to age in the neuromyths of English teachers about brain functions and neuroeducation

The results of the independent groups t-test, as displayed in Table 4.7, demonstrate the examination of the differences in neuromyths about brain functions and neuroeducation among English teachers based on their age.

Table 4. 7. *Independent Samples t-Test Results of English Teachers' Neuromyths by Age*

	Groups	N	M	Sd	t	df	p
Belief in Neuromyths	40 years and under	49	7,14	2,151	-,777	112	,439
	41 years and above	65	7,48	2,359			

There is no statistically significant difference in the neuromyth beliefs (t [112] = -.777; p >.05) among English teachers when considering their age. In other words, there is a similarity in the neuromythical beliefs held by teachers across different age groups.

4.8. Differences according to the level of education in the neuromyths of English teachers about brain functions and neuroeducation

The results of the independent groups t-test analysis are presented in Table 4.8. This statistical test was performed to examine the differences in the degree of belief in neuromyths about brain functioning and neuroeducation among English teachers based on their educational background.

It is noteworthy to acknowledge that the participants in this study chose their educational level by accurately indicating their academic degree, namely undergraduate, master's, or PhD, in the questionnaire form. Due to the constraints imposed by the pandemic, the sample used in this study was limited in terms of participant diversity. The inability to establish face-to-face connections with participants, coupled with the general fatigue experienced by individuals in online environments during the pandemic, necessitated the consolidation of the last two groups under the label "Graduate." This decision was made in order to ensure the attainment of meaningful and reliable results.

Table 4. 8. *Independent Samples t-Test Results of English Teachers' Neuromyths by the Level of Education*

	Groups	N	M	sd	t	df	p
Belief in Neuromyths	Undergraduate	84	7,07	2,379	-2,094	112	**,039**
	Graduate	30	8,07	1,760			

The neuromyths of English teachers differ significantly according to their education levels (t [112] = -2.094 p <.05). In other words, English teachers holding a graduate degree (M = 8.07; sd = 1.760) exhibit a greater prevalence of neuromyths compared to English teachers with an undergraduate degree (M = 7.07; sd = 2.379).

4.9. Relationship between general knowledge and neuromyths of English teachers about brain functions and neuroeducation

To investigate the potential relationship between the general knowledge and the prevalence of neuromyths among English teachers about brain functions and neuroeducation, a correlation analysis was performed, as presented in Table 4.9.

Table 4. 9. *The Relationship Between English Teachers' Neuromyths and General Knowledge about Brain Functions and Neuroeducation*

		Neuromyths	General Knowledge
Neuromyths	Pearson Correlation	1	,467**
	Sig. (2-tailed)		,000
	N	114	114
General Knowledge	Pearson Correlation	,467**	1
	Sig. (2-tailed)	,000	
	N	114	114

**. Correlation is significant at the 0.01 level (2-tailed).

It was determined that there was a positive and moderately significant relationship between English teachers' general knowledge and neuromyths about brain functions and neuroeducation ($r = .467$; $p < .01$). In other words, as the neuromyths of English teachers increase, their general knowledge also increases, or vice versa: as their general knowledge increases, their neuromyths also increase.

4.10. Correlation between professional development activities and neuromyths of English teachers about brain functions and neuroeducation

The presented findings in Table 4.10 depict the results of a correlation analysis that aimed to establish the relationship between English teachers' beliefs in neuromyths, their general knowledge about brain functions and neuroeducation, and their engagement in professional development activities

related to this topic. These activities include reading popular scientific journals, taking any classes, participating in any workshops, seminars or conferences, having a keen interest in scientific knowledge about the brain and its influence on learning, valuing scientific knowledge with regard to the brain and its influence on learning, as well as receiving in-service training about the same subject.

Table 4. 10. *The Relationship between Neuromyth and General Knowledge Levels of English Teachers and Independent Variables*

		Neuromyths
Reading popular science magazines	Pearson Correlation	-,132
	Sig. (2-tailed)	,163
	N	114
Taking any classes on brain and its influence on learning	Pearson Correlation	-,014
	Sig. (2-tailed)	,886
	N	114
Attending any workshops /seminars /conferences on brain and its influence on learning	Pearson Correlation	-,051
	Sig. (2-tailed)	,587
	N	114
Any interest in having scientific knowledge about brain and its functioning in the learning process	Pearson Correlation	-,106
	Sig. (2-tailed)	,262
	N	114
Valuing scientific knowledge about brain and its influence on learning for teaching practices	Pearson Correlation	-,149
	Sig. (2-tailed)	,113
	N	114
Being confident about your knowledge on brain	Pearson Correlation	**,334****
	Sig. (2-tailed)	,000
	N	114
Any need for an in-service training course to understand about brain and its effect on learning	Pearson Correlation	-,019
	Sig. (2-tailed)	,843
	N	114

indicated that there was no statistically significant relationship between English teachers' beliefs in neuromyths about brain functions and neuroeducation and professional development activities related to this topic. Specifically, there was no significant correlation found between reading popular scientific journals (r = -.132, p >.05), taking any classes on the brain and its influence on learning (r = -.014, p >.05), attending workshops,

seminars or conferences on the topic ($r = -.132$, $p > .05$), wanting to have more scientific knowledge ($r = -.106$, $p > .05$), valuing scientific knowledge with regard to the brain and its influence on learning ($r = -.149$, $p > .05$), and the perceived need for in-service training courses ($r = -.019$, $p > .05$). These findings suggest that English teachers' beliefs in neuromyths do not appear to influence their engagement in professional development activities. However, a statistically significant and moderately positive correlation was observed between the prevalence of neuromyths among English teachers and their tendency to rely on their knowledge of the brain ($r = .334$; $p < .05$).

CHAPTER V

4. DISCUSSION

The goal of this research is to determine the level of accurate knowledge English teachers have regarding brain functions and neuroeducation and also whether they have any neuromyths, and the relationship between their identified neuromyths and various demographic factors, including gender, age, institution level and type at which they work, their professional experience, their level of education as well as their professional development activities such as reading scientific journals, and attending a course or attending a workshop, a seminar or a conference about brain and its influence on learning.

As for the first research question, the findings indicate that English teachers exhibit a mean belief score of 7.33 in relation to neuromyths, alongside an average general knowledge level of 9.35. English teachers typically possess a certain level of accurate general knowledge about brain functions and neuroeducation. However, the findings of this study indicate that the teachers' level of accurate general knowledge is comparatively lower than that reported in previous international studies, though it is over 50%. The participants in the latter studies achieved a higher level of success, as indicated by mean correct answer rates exceeding 60% (Dekker et al., 2012; Gleichgerrcht et al., 2015; Ferrero et al., 2016; Papadatou-Pastou et al., 2017; Kim and Sankey, 2018; Idrissi et al., 2020; Bissessar and Youssef, 2021). In terms of neuromyth scores, English teachers in Turkey demonstrate a slightly higher level of success compared to their counterparts in other countries. When comparing the neuromyth scores obtained in the current study with

those reported in previous international studies, it becomes evident that certain studies have found that teachers were unable to correctly identify an average rate of approximately 50% or more of neuromyths (Dekker et al., 2012; Gleichgerrcht et al., 2015; Ferrero et al., 2016; Papadatou-Pastou et al., 2017, Idrissi et al., 2020).

It will be a healthier approach and avoid including two studies when comparing the current study with the neuromyth studies conducted in Turkey because of the limited data provided in these two studies, which poses a challenge in conducting a comprehensive comparison. The first one is the research in which Canbulat and Kiriktas (2017) presented comprehensive information on the overall average scores attained by both experienced teachers and teacher candidates. In addition, the second one was conducted by Dundar and Gunduz (2016) to examine the neuromyths held by preservice teachers across various academic disciplines, as well as the influence of different factors on the emergence of these neuromyths. After conducting a thorough analysis of the current study and two other similar studies conducted in Turkey, it is seen that the average level of general knowledge in the present study is comparatively lower than that observed in both Karakus' study (2013) and Dogan's study (2018).

Regarding the second research inquiry of the investigation, a scale comprising 15 items was utilized to assess neuromyths. The findings indicated that the participants possessed 8 of the neuromyth items. The following items are arranged in descending order of prevalence, with the most common item listed first and the least common item listed last:

- When individuals absorb information in the manner most conducive to their preferred mode of learning (for example, auditory, visual, or kinaesthetic), they are able to learn more effectively.
- The brains of preschool children benefit from being exposed to environments that are full of stimuli.
- Disparities in hemisphere dominance (left brain vs. right brain) can be one factor that contributes to individual disparities among students.
- Empirical evidence supports the notion that the consumption of fatty acid supplements, specifically omega-3 and omega-6, has a beneficial impact on academic performance.
- Brief sessions of coordination exercises have the potential to enhance the integration of left and right hemispheric brain function.
- Consuming sugary beverages and/or snacks causes children to have decreased attention spans.
- Literacy skills can be enhanced by drills that practise motor-perception coordination.
- There are crucial developmental stages in childhood after which some skills can no longer be mastered.

The present study compares its findings on the prevalence of neuromyths among English teachers in Turkey, based on the items included in the scale utilised, with the results of previous research conducted abroad, as depicted in Figure 3 (see Appendix E for the neuromyth items).

Neuromyths	Herculano-Houzel (2002)	Dekker et al. (2012)	Rato et al. (2013)	Pei et al. (2015)	Dobrynina & Howard-Jones (2015)	Gleichgerrcht et al. (2015)	Ferrero et al. (2016)	Papadatou-Pastou et al. (2017)	Kim & Sankey (2018)	Betts et al. (2019)	Idrizi et al. (2020)	Ching et al. (2020)	Hosseini & Youssif (2021)	The Present Study (2023)
Neuromyth item 1								✓					✓	
Neuromyth item 2			✓											
Neuromyth item 3			✓		✓	✓		✓	✓		✓			✓
Neuromyth item 4	✓		✓			✓				✓	✓	✓	✓	
Neuromyth item 5		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Neuromyth item 6						✓								✓
Neuromyth item 7		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Neuromyth item 8				✓	✓	✓	✓	✓	✓		✓	✓		✓
Neuromyth item 9				✓	✓	✓					✓		✓	✓
Neuromyth item 10														
Neuromyth item 11				✓	✓	✓	✓	✓			✓			✓
Neuromyth item 12														
Neuromyth item 13														
Neuromyth item 14				✓										
Neuromyth item 15		✓		✓	✓	✓	✓		✓		✓	✓		✓

Figure 3. The comparison chart of neuromyth studies abroad with the present study.

Upon close examination of the comparative chart of neuromyths studies depicted in Figure 3, it becomes apparent that two prominent neuromyths exhibit consistent prevalence across all studies, including the present one. These neuromyths pertaining to the right and left dominance of the brain to explain individual differences among learners, as well as the concept of visual-auditory-kinaesthetic (VAK) learning styles, ranks highest among the most widespread neuromyths globally. Also, the other two neuromyths regarding the stimulus-rich environments developing preschool children's brains and short coordination exercises improving left-right brain integration are ranked second in terms of their prevalence.

In addition, the misconception about fatty acid supplements having a positive effect on academic performance is seen in in six additional studies, as well as the current study. The present study, along with six other studies conducted abroad, has observed the neuromyth which suggests that repetitive exercises of motor-perception skills can enhance literacy skills. The chart

depicted in Figure 3 indicates that the neuromyth about the negative influence of the consumption of sugary drinks and/or snacks on attentiveness in children has been observed in six studies, including the current one.

Another important neuromyth that we use only 10% of our brains, which is seen in seven studies is not observed as a common neuromyth in the present study. Interestingly enough, this particular neuromyth does not appear to be present in the research conducted in European countries such as the UK and the Netherlands, Greece, and Spain, based on the sources accessed and analysed in this investigation (refer to Figure 3). Furthermore, the neuromyth that there exist critical periods during childhood beyond which certain skills or knowledge cannot be acquired, has been documented solely in the investigation conducted in Latin America by Gleichgerrcht et al. (2015) and this study.

The present study compares its findings on the prevalence of neuromyths among English teachers in Turkey, based on the items included in the scale utilised, with the results of previous research conducted by Karakus (2013), Dundar and Gunduz (2016), and Dogan (2018), as depicted in Figure 4 (see Appendix E for the neuromyth items). However, the study conducted by Canbulat and Kiriktas (2017) was ignored in Figure 4 as it focused on the level of neuromyths among teachers and candidate teachers and it emphasized the differences in the level of neuromyths among participants based on factors such as gender, attendance at seminars, professional experiences, and specialisation rather than determining the presence of specific educational neuromyths of participants in the study.

The purpose of this comparison is to determine whether or not there have been any noteworthy shifts or similarities in the prevalence of neuromyths among educators across time in Turkey. It is crucial to have an awareness of the prevalence of neuromyths among teachers since this information may assist policymakers and educators in the development of more efficient measures to enhance teachers' knowledge and comprehension of the role that neuroscience plays in education. Therefore, the comparison of the findings from the current investigation with those of prior research endeavours could provide useful insights into the contemporary prevalence of misconceptions regarding neuroscience among educators.

Neuromyths	*Karakus (2013)*	*Dundar and Gunduz (2016)*	*Dogan (2018)*	*The Present study (2023)*
Neuromyth item 1	✓			
Neuromyth item 2				
Neuromyth item 3	✓	✓	✓	✓
Neuromyth item 4	✓	✓		
Neuromyth item 5	✓	✓	✓	✓
Neuromyth item 6	✓		✓	✓
Neuromyth item 7	✓	✓	✓	✓
Neuromyth item 8	✓		✓	✓
Neuromyth item 9				✓
Neuromyth item 10				
Neuromyth item 11	✓	✓	✓	✓
Neuromyth item 12				
Neuromyth item 13				
Neuromyth item 14				
Neuromyth item 15	✓	✓	✓	✓

Figure 4. The comparison chart of three significant neuromyth studies in Turkey.

In 2013, Karakus conducted the initial investigation on neuromyths in Turkey (based on the sources accessed and analysed in this research). The

findings revealed that primary and secondary school teachers possess 9 out of the 15 identified neuromyths. These nine neuromyths were about learning better through preferred learning styles (VAK learning styles), the positive effect of stimulating environments on pre-school children, positive effect of fatty acid supplements on academic achievement, hemispheric dominance to explain individual differences between students, short coordination exercises to improve right-left brain integration, critical periods in childhood, native language acquisition before a second language, the effect of motor-perception skills coordination on literacy skills, and 10% use of our brain.

Although the two neuromyths items about the prioritisation of children's acquiring their native language prior to a second language and 10% usage of our brain, were discovered to be widespread among educators according to previous research (Karakus, 2013; Dundar and Gunduz, 2016), the present study's findings do not indicate the presence of these two neuromyths. Furthermore, the current study has identified a newly prevalent neuromyth which suggests that the consumption of sugary drinks and/or snacks leads to decreased attention in children.

The research conducted by Dundar and Gunduz does not support the neuromyth items pertaining to stimulus-rich environments which develop pre-school children's brain, as well as the notion of critical periods during childhood after which certain skills cannot be acquired, which is particularly a significant observation as this diverges from other research conducted in Turkey.

Dogan's study (2018) involving biology teachers, which is another significant study on Turkish neuromyths, discovered that the participants

shared similar neuromyths items with those identified in the present study. Also, it is seen that two specific neuromyths (namely the belief about the 10% usage of human brain and the importance of children's acquisition of their native language before learning a second language) were not commonly held among her participants. These findings are consistent with the results of the current study. In addition to these, there were two additional neuromyth assertions regarding the relation between attention and face-to-face communication with smartphones (Dogan, 2018).

These significant studies in Turkey, one of which is the current one, all involved educators and include the following sharing statements as neuromyths:

- Fatty acid supplements have a positive effect on academic performance.
- Right and left dominance of the brain explains the individual differences.
- Individuals learn better when they receive the information in the manner most conducive to their preferred mode of learning (for example, auditory, visual, or kinaesthetic).
- Repetitive exercises improve literacy skills.
- Short coordination exercises increase both hemispheres integration.

Unlike the previous research conducted in Turkey, the neuromyth item relating to the "sugar-attention relationship" was found to be a prevalent neuromyth in the present research. According to the OECD report, it can be posited that despite the increase of information sources, there is a growing prevalence of neuromyths since people including educators have difficulty to differentiate between scientific and non-scientific information sources. Here, the increased public interest and media coverage surrounding the significance

of maintaining a healthy and balanced diet has resulted in the emergence of a brand new neuromyth. In other words, it can be noted that the list now includes a new neuromyth.

Moreover, the neuromyth related to “VAK learning styles” still maintains its validity as the most common neuromyth assertion. It can be said that only the percentage rate has decreased partially. While the neuromyth related to "critical periods in childhood" was prevalent among the participants with a rate of 83% in Dogan's study, it was found to be the least common neuromyth with a rate of 57% in this study.

The researcher examined whether there were any changes in the neuromyths of English teachers according to demographic factors such as gender, institution level, institution type, professional experience, age, and level of education, from the third research question to the ninth question. In summary, the level of neuromyths among English teachers does not substantially differ according to these factors including gender, institution level, institution type, professional experience, and age, with the exception of their educational attainment. The association between teachers' educational attainment and the prevalence of neuromyths has not been encountered in any previous studies. It is noteworthy that English teachers with a graduate degree exhibit a higher incidence of neuromyths in comparison to their counterparts with an undergraduate degree. Betts et al (2019) had a different result that the participants who had obtained doctoral degrees demonstrated a higher level of knowledge about neuromyths and general information about the brain when compared to individuals with master's, associate's, or bachelor's degrees.

When reviewing prior studies which examined similar demographic factors, it is observed that a majority of these studies yield similar findings (Dekker et al., 2012; Karakus, 2013; Gleichgerrcht et al., 2015; Betts et al., 2019; Bissessar and Youssef, 2021). However, there is another important observation that women were more likely to hold stronger beliefs in neuromyths than males in the studies conducted by Ferrero et al. (2016), Dundar and Gunduz (2016), and Idrissi et al. (2020). Canbulat and Kiriktas (2017) discovered in their study that female teacher candidates exhibit a higher level of awareness regarding educational neuromyths compared to their male counterparts although no significant difference was observed between male and female teachers. Moreover, in a study conducted by Dogan (2018), it was observed that there was a variation between genders in the prevalence of a single neuromyth which is about the belief that discrepancies in hemispheric dominance (left or right brain) can account for individual differences among learners. However, no statistically significant association was observed between the remaining eight neuromyths and gender in the study.

Regarding the ninth research question of the study, which pertains to the possible relationship between the general knowledge and neuromyths held by English teachers about brain functions and neuroeducation, it was seen that there was a positive correlation between the prevalence of neuromyths among English teachers and their level of general knowledge. In other words, as the neuromyths of English teachers increase, their general knowledge also increases, or vice versa.

Previous research has yielded similar results (Dekker et al., 2012; Karakus, 2013; Gleichgerrcht et al., 2015; Ferrero et al., 2016; Ching et al.,

2020; Idrissi et al., 2020; Bissessar and Youssef, 2021). According to these studies, teachers with higher knowledge ratings were more inclined to believe in myths. Kim and Sankey (2018) and Papadatou-Pastou et al. (2017) discovered that, contrary to initial expectations, a modest negative correlation was observed between participants' performance in general statements about the brain and their ability to identify neuromyths. This finding implies that possessing general knowledge about the brain does not necessarily correspond to the capacity to recognise and identify neuromyths.

As for the final research question regarding the possible correlation between professional development activities (reading popular scientific journals, taking any classes or attending any workshops, seminars or conferences about the brain and its influence on learning, wanting to have more scientific knowledge and valuing scientific knowledge with regard to the brain and its influence on learning, as well as receiving in-service training about the same subject) and beliefs of English teachers in neuromyths about brain functions and neuroeducation, the results revealed that there was not a statistically significant correlation between English teachers' adherence to neuromyths and their participation in professional development activities. However, a notable and slightly positive correlation was identified between the prevalence of neuromyths among English teachers and their tendency to rely on their knowledge of the brain.

In contrast to the present study, Betts et al (2019) asserted that professional development was a significant predictor of both awareness of neuromyths and general knowledge about the brain in their study. Furthermore, the study conducted by Canbulat and Kiriktas (2017) revealed

that the status of attending seminars or courses is a significant factor in enhancing the awareness of educational neuromyths among teachers and teacher candidates.

Reading popular science journals has been a key factor in a lot of studies in the past. In some studies (Dundar and Gunduz, 2016; Dogan, 2018; Betts et al., 2019; Ching et al., 2020), it was seen as a factor that indicated belief in neuromyths. In other studies (Dekker et al., 2012; Karakus, 2013; Papadatou-Pastou et al., 2017), it was seen as an ineffective factor, which aligns with the findings of the present study.

Moreover, the study conducted by Bissessar and Youssef (2021) revealed that both teacher training and in-service educational neuroscience training emerged as significant predictors of individuals' belief in neuromyths. This finding suggests that individuals who received teacher training exhibited an elevated inclination towards endorsing neuromyths. Conversely, those who received specific in-service training on educational neuroscience topics demonstrated a decrease in their endorsement of neuromyths.

CHAPTER VI

5. CONCLUSION

5.1. Conclusion

According to the literature review, the spread of neuromyths is the first issue that researchers in the area of educational neuroscience have come with since they impede the discipline's ability to advance. The OECD also brought attention to the fact that neuromyths in the realm of education waste time, effort, and resources. The results of this study showed that neuromyths are also common among English teachers likewise.

The research's main finding is that there hasn't been much progress in reducing the prevalence of neuromyths among teachers. Even though several neuromyths lost their validity, there are still a significant number of them being circulated among teachers and teachers still believe more than half of neuromyths. In addition, teachers think that they need an in-service training program to understand the brain better and how it works in the learning process.

By avoiding these myths:

- Learners will be able to concentrate on learning strategies that have been demonstrated to be successful, which enables them to make use of their time and resources more efficiently.
- Learners can get a more accurate grasp of how their brain processes information, which can help them learn English more efficiently.
- Students can develop a more positive attitude towards their education and gain more self-confidence in their talents.

- Educators can more easily implement teaching strategies that are supported by research and are more likely to promote student learning and academic success.
- When it comes to learning English, avoiding neuromyths can help both students and teachers make the most of their available time, resources, and efforts, which can ultimately lead to improved outcomes for everyone involved.

5.2. Recommendations for Future Research

This research can contribute to future studies in the field by helping teachers, administrators and curriculum programmers in becoming more aware of the significance of neuromyths and how they affect their interactions with students as well as their attitudes toward them.

1. First of all, as this study shows us the prevalence of neuromyths among teachers, further steps to determine the sources of these neuromyths should be taken.

2. In the future, research might concentrate on developing and testing intervention programs for the purpose of debunking neuromyths held by teachers and students involved in the instruction of a foreign language.

3. In future studies, researchers might also investigate the origins of neuromyths that are prevalent in the teaching of foreign languages, as well as the variables that lead to the spread of these beliefs among instructors and students. National Ministry of Education and other authorities can take some steps to organize in-service training programs especially about neuromyths and its possible negative effects on learning and teaching.

4. Curriculum developers can design new programs for in-training courses to increase awareness of teachers regarding neuromyths and its implications in the classroom.

5. Teachers can be trained upon how to reach scientific information in the appropriate way, and they can be warned about how safe it is to implement scientific information in the classroom without necessary background. Academicians should help teachers on this and guide them through this hard path. Thus, more interactive meetings where teachers express and discuss their opinions with academicians should be organized.

5.3. Pedagogical Implications

The outcomes of this research imply that preservice teachers could benefit from receiving training on neuromyths since it would improve their knowledge of brain functions, enhance their capacity to discern legitimate neuroscience discoveries from neuromyths, and promote evidence-based teaching practices. Preservice teachers can provide more effective and interesting educational opportunities for the students they will one day teach by avoiding the implementation of neuromyths and instead relying on methods supported by scientific evidence.

Despite the fact that technological improvements have made it significantly easier and more expedient to gain access to various information resources than it was in the past, it is abundantly obvious that educators continue to struggle to acquire trustworthy scientific data, and they are required to gain access to scientific information in the correct manner. As a result, there is a pressing requirement to bring together neuroscientists and educators, either in the setting of conferences or in the form of in-service training courses.

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APPENDICES

Appendix A. Approval from the Humanities and Social Research Ethics Committee at Yeditepe University

T.C.
YEDİTEPE ÜNİVERSİTESİ REKTÖRLÜĞÜ

16.02.2022

Sayı : E.50532705-302.14.01-1147
Konu : Gürşen Şişman Kurul Onayı

İLGİLİ MAKAMA

Üniversitemiz Eğitim Bilimleri Enstitüsü Eğitim Programları ve Öğretim Yüksek Lisans Öğrencilerinden Gürşen Şişman'ın, Doç. Dr. Dilara Demirbulak danışmanlığında gerçekleştireceği "Determining English Teachers's Neuromyths About Brain Functions - İngilizce Öğretmenlerinin, Beynin İşlevlerine İlişkin Doğru Bilinen Yanlışlarının (Nöromitlerinin) Belirlenmesi" başlıklı araştırmasının Beşeri Bilimler etik standartlarına uygunluğuna ilişkin Yeditepe Üniversitesi Beşeri ve Sosyal Araştırmalar Etik Kurulu Onayı ekte sunulmuştur.

Gerekli iznin verilmesi hususunu bilgilerinize arz ve rica ederim.

İmza
Prof. Dr. Fatma Yeşim EKİNCİ
Rektör a.
Rektör Yardımcısı

Ek: Etik Kurul Onayı.pdf

Appendix B. Declaration of Consent for the Use of Scale

Appendix C. Approval from The Directorate of National Education in Istanbul for the Research

Appendix D. Assertions in the questionnaire with the answer key.

Statements	Answers
1. We use our brains 24 hours a day.	Correct
2. Children must acquire their native language before a second language is learned. If they do not do so neither language will be fully acquired.	Incorrect
3. Boys have bigger brains than girls.	Correct
4. If pupils do not drink sufficient amount of water (6–8 glasses a day) their brains shrink.	Incorrect
5. It has been scientifically proven that fatty acid supplements (omega-3 and omega-6) have a positive effect on academic achievement.	Incorrect
6. When a brain region is damaged, other parts of the brain can take up its function.	Correct
7. We only use 10% of our brain.	Incorrect
8. The left and right hemispheres of the brain always work together.	Correct
9. Differences in hemispheric dominance (left brain, right brain) can help to explain individual differences amongst learners.	Incorrect
10. The brains of boys and girls develop at the same rate.	Incorrect
11. Brain development has finished by the time children reach secondary school.	Incorrect
12. There are critical periods in childhood after which certain things can no longer be learned.	Incorrect
13. Information is stored in the brain in a network of cells distributed throughout the brain.	Correct
14. Learning is not due to the addition of new cells to the brain.	Correct
15. Individuals learn better when they receive information in their preferred learning style (e.g., auditory, visual, kinaesthetic).	Incorrect
16. Learning occurs through modification of the brains' neural connections.	Correct
17. Academic achievement can be affected by skipping breakfast.	Correct
18. Normal development of the human brain involves the birth and death of brain cells.	Correct
19. Mental capacity is hereditary and cannot be changed by the environment or experience.	Incorrect
20. Vigorous exercise can improve mental function.	Correct
21. Environments that are rich in stimulus improve the brains of pre-school children.	Incorrect
22. Children are less attentive after consuming sugary drinks and/or snacks.	Incorrect
23. Circadian rhythms ("body-clock") shift during adolescence, causing pupils to be tired during the first lessons of the school day.	Correct

24.	Regular drinking of caffeinated drinks reduces alertness.	Correct
25.	Exercises that rehearse co-ordination of motor-perception skills can improve literacy skills.	Incorrect
26.	Extended rehearsal of some mental processes can change the shape and structure of some parts of the brain.	Correct
27.	Individual learners show preferences for the mode in which they receive information (e.g., visual, auditory, kinesthetic).	Correct
28.	Learning problems associated with developmental differences in brain function cannot be remediated by education.	Incorrect
29.	Production of new connections in the brain can continue into old age.	Correct
30.	Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function.	Incorrect
31.	There are sensitive periods in childhood when it's easier to learn things.	Correct
32.	When we sleep, the brain shuts down.	Incorrect

Appendix E. Neuromyth items in the questionnaire.

Neuromyths in the Questionnaire	Teachers' Replies					
	C		I		D.K.	
	f	%	f	%	f	%
1) Children must acquire their native language before a second language is learned. If they do not do so neither language will be fully acquired. ***(Incorrect)***	29	25,4	74	64,9	11	9,6
2) If pupils do not drink sufficient amount of water (6–8 glasses a day) their brains shrink. ***(Incorrect)***	22	19,3	46	40,4	46	40,4
3) It has been scientifically proven that fatty acid supplements (omega-3 and omega-6) have a positive effect on academic achievement. ***(Incorrect)***	88	77,2	0	0	26	22,8
4) We only use 10% of our brain. ***(Incorrect)***	38	33,3	43	37,7	33	28,9
5) Differences in hemispheric dominance (left brain, right brain) can help to explain individual differences amongst learners. ***(Incorrect)***	95	83,3	5	4,4	14	12,3
6) There are critical periods in childhood after which certain things can no longer be learned. ***(Incorrect)***	65	57,0	33	28,9	16	14,0
7) Individuals learn better when they receive information in their preferred learning style (e.g., auditory, visual, kinesthetic). ***(Incorrect)***	104	91,2	4	3,5	6	5,3
8) Environments that are rich in stimulus improve the brains of pre-school children. ***(Incorrect)***	103	90,4	4	3,5	7	6,1
9) Children are less attentive after consuming sugary drinks and/or snacks. ***(Incorrect)***	78	68,4	9	7,9	27	23,7
10) Regular drinking of caffeinated drinks reduces alertness. ***(Correct)***	46	40,4	29	25,4	39	34,2
11) Exercises that rehearse co-ordination of motor-perception skills can improve literacy skills**.** ***(Incorrect)***	70	61,4	7	6,1	37	32,5
12) Extended rehearsal of some mental processes can change the shape and structure of some parts of the brain. ***(Correct)***	62	54,4	10	8,8	42	36,8
13) Individual learners show preferences for the mode in which they receive information (e.g., visual, auditory, kinesthetic). ***(Correct)***	105	92,1	1	0,9	8	7
14) Learning problems associated with developmental differences in brain function cannot be remediated by education. ***(Incorrect)***	16	14	63	55,0	35	30,7
15) Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function. ***(Incorrect)***	83	72,8	1	0,9	30	26,3

Appendix F. Questions identifying demographics of the participants.

Demographics	**Answers**
Gender	Female Male
Institution Level	Kindergarten Elementary School Secondary School High School
Institution Type	Public School Private School
Year of Seniority (English Language Teaching)	5 years and under Between 6 and 10 years Between 11 and 15 years Between 16 and 20 years 21 years and above
Age	40 years and under 41 years and above
Level of Education	Undergraduate Master's degree PhD

Appendix F. Breakdown of the independent variables

Questions	**Answers**
Do you read popular science magazines?	Yes. No.
Have you ever taken any classes on brain and its influence on learning?	Yes. No.
Have you ever attended any workshops /seminars /conferences on brain and its influence on learning?	Yes. No.
Do you want to have scientific knowledge about brain and its functioning in the learning process?	Yes. No.
Do you think it is valuable to have scientific knowledge on brain, and its influence on learning for your teaching practice?	Yes. No.
How confident you are about your knowledge on brain?	1 – Do not trust 2 3 4 5 – Very confident.
Do you think that you need an in-service training course to understand about brain and its effect on learning?	Yes. No.