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Understanding Brain Functions of Prospective Biology Teachers From An Educational Neuroscience Perspective: A Qualitative Study With A Phenomenological Design

Biyoloji Öğretmen Adaylarının Eğitsel Sinirbilim Perspektifinden Beyin İşlevlerini Anlama: Olgubilim Desenli Nitel Bir Araştırma

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Abstract: In recent years, educational neuroscience, a new field examining the interaction between neuroscience and education, has gained importance. This field stands out as an approach that aims to utilize neuroscience research to understand brain functioning and learning processes. Biology teacher candidates are the cornerstone of biology education and play a crucial role in not only teaching biology topics to students but also guiding them towards learning and using effective learning strategies. Therefore, the knowledge and understanding of educational neuroscience among prospective biology teachers are of critical importance in understanding factors that influence learning processes and developing instructional strategies. The aim of this research is to examine the level of understanding and misconceptions of brain functions from the perspective of educational neuroscience among biology teacher candidates. The study also aims to identify the knowledge and understanding of prospective biology teachers regarding educational neuroscience and enhance awareness in this field. The research utilized a qualitative research method called phenomenology. The study group consisted of 16 prospective biology teachers studying at a state university in Turkey. Semi-structured interview questions were used as the data collection tool, and the obtained data were analyzed through content analysis. The findings were examined under the categories of "Concept of Educational Neuroscience," "Relationship between Educational Neuroscience and Unhealthy Food Preferences," "Educational Neuroscience and Playing Brain Games," and "Technology Use in Preferred Tasks and Reducing Boredom Threshold." The participants' views regarding the concept of educational neuroscience, its relationship with unhealthy food preferences, the relationship between playing brain games and cognitive development, and the use of technology in preferred tasks to reduce the threshold of boredom were revealed. The results of the research highlight the importance of increasing awareness of educational neuroscience among prospective biology teachers and emphasizing educational neuroscience in teacher training programs. Additionally, it is recommended to develop effective strategies to reduce conceptual misconceptions regarding brain functioning among teacher candidates.

Keywords: Biology Teacher Candidates, Neuroscience, Educational Neuroscience, Phenomenology

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Öz: Son yıllarda, nörobilim ve eğitim arasındaki etkileşimi inceleyen yeni bir alan olan eğitim nörobilimi önem kazanmıştır. Bu alan, beyin işleyişini ve öğrenme süreçlerini anlamak için nörobilim araştırmalarından yararlanmayı hedefleyen bir yaklaşım olarak öne çıkmaktadır. Biyoloji öğretmen adayları, biyoloji eğitiminin temel taşıdır ve öğrencilere biyoloji konularını anlatmanın yanı sıra onları öğrenmeye yönlendirmek ve etkili öğrenme stratejilerini kullanmalarını sağlamak gibi önemli bir rol üstlenirler. Bu nedenle, biyoloji öğretmen adaylarının eğitim nörobilimine ilişkin bilgi ve anlayışları, öğrenme süreçlerini etkileyen faktörleri anlamada ve öğretim stratejilerini geliştirmede kritik öneme sahiptir. Bu araştırmanın amacı, biyoloji öğretmen adaylarının eğitim nörobilimi perspektifinden beyin işlevlerini anlama düzeylerini ve yanılgılarını incelemektir. Araştırma ayrıca biyoloji öğretmen adaylarının eğitim nörobilimi hakkındaki bilgi ve anlayışlarını belirlemeyi ve bu alanda farkındalığı artırmayı hedeflemektedir. Bu araştırmada, nitel araştırma yöntemlerinden olgubilim (fenomenoloji) kullanılmıştır. Araştırmanın çalışma grubunu Türkiye'deki bir devlet üniversitesinde öğrenim gören 16 biyoloji öğretmen adayı oluşturmaktadır. Veri toplama aracı olarak yarı yapılandırılmış görüşme soruları kullanılmış ve elde edilen veriler içerik analizi yöntemiyle analiz edilmiştir. Bulgular, "Eğitsel Sinirbilim Kavramı", "Eğitsel Sinirbilim ve Sağlıksız Yiyecek Tercihleri Arasındaki İlişki", "Eğitsel Sinirbilim ve Zeka Oyunları Oynama", "Eğitsel Sinirbilim ve Tercih Edilen Görevlerde Teknoloji Kullanma" başlıkları altında incelenmiştir. Katılımcıların eğitsel sinirbilim kavramını, sağlıksız yiyecek tercihleriyle ilişkisini, zeka oyunları oynama ile zeka gelişimi arasındaki ilişkiyi ve tercih ettikleri görevlerde teknoloji kullanımının sıkılmaya karşı eşik düzeyini azaltma konusundaki görüşleri ortaya çıkmıştır. Araştırma sonuçları, biyoloji öğretmen adaylarının eğitim nörobilimi hakkındaki farkındalığını artırmak ve öğretmen yetiştirme programlarında eğitim nörobilimine daha fazla vurgu yapmanın önemini vurgulamaktadır. Ayrıca, öğretmen adaylarının beyin işleyişine yönelik kavramsal yanılgılarını azaltmak için etkili stratejilerin geliştirilmesi önerilmektedir.

Anahtar Kelimeler: Biyoloji öğretmen adayları, Sinirbilim, Eğitsel Sinirbilim, Olgubilim

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1. INTRODUCTION

Neuroscience is the branch of science that studies the anatomy, physiology, biochemistry, and biology of the human nervous system. However, in recent times, many neuroscientists have focused their research on the relationship between brain development, learning, motivation, emotions, cognitive functions, and behavior. Therefore, this field of study is also referred to as brain science. According to neuroscientists, both learning and teaching are natural cognitive functions of the brain and often occur spontaneously without deliberate instructional practices (Pasquinelli, 2013). Cognitive functions refer to all the processes and activities that occur in the brain, such as attention, memory, reasoning, problem-solving, decision-making, and language, which enable raw information acquired through the senses to be transformed into meaningful knowledge. This interdisciplinary field, known as Cognitive Science, investigates these mental processes and activities by combining different disciplines such as philosophy, psychology, linguistics, and computer science. It is necessary to establish specific neural connections in the brain for learning, teaching, and the expected outcomes resulting from these processes, in other words, for certain cognitive processes to take place (Antonenko, van Gog, & Paas, 2014).

Education as a social science deals with phenomena related to behaviors described with mental terms (e.g., understanding, comprehension, identity), while neuroscience as a biological science deals with physical phenomena described with bodily terms (e.g., white matter, synapses, hemodynamic response) (Varma, McCandliss, & Schwartz, 2008). The structural difference between these two disciplines is emphasized as an obstacle to the development of this new field called educational neuroscience, which emerges as a result of the interaction between neuroscience, psychology, and education (Devonshire & Dommett, 2010). Researchers in the field of educational neuroscience seek answers to questions such as how students learn and how learning changes the brain, and they are interested in translating the findings into meaningful and applicable instructional practices in the classroom (Howard-Jones et al., 2016). In summary, educational neuroscience is a new field that uses brain imaging technologies to inform the design of instructional processes as a way to support learning (De Corte, 2018). As can be seen from the literature, there is a significant group of critics who approach and criticize educational neuroscience with skepticism. The main criticism of educational neuroscience is based on the view that education and neuroscience are two separate worlds that cannot be brought together. The main argument put forward by those who hold this view is that neuroscience research has not yet demonstrated the expected impact on educational practices, in other words, the desired transformation has not been achieved in classroom applications. It is often cited that findings from neuroscience research, such as increased activity in the parietal and prefrontal regions of the brain during numerical operations, may not provide much guidance for a mathematics teacher in planning instructional activities (Sigman, Pena, Goldin, & Riberio, 2014). There is a significant number of educators who hold the view that educational neuroscience will have limited contribution to the field of education (Clement & Lovat, 2012).

Another argument put forth by those who claim that the contribution of neuroscience to the field of education is limited is that studies using brain imaging technologies are conducted in restricted laboratory environments and on isolated tasks. It is argued that the results of such studies may not be instructive for learning and teaching practices in real classroom environments with socio-cultural contexts. Additionally, it is emphasized that the use of brain imaging technologies in educational research has technical and

logistical challenges and requires both expensive equipment and expert support (Stern & Schneider, 2010). On the other hand, there are those who argue for a close collaboration between education and especially cognitive neuroscience, and propose that education adopts a biological-psychological-social perspective (Ceake & Cooper, 2003; De Smedt et al., 2010).

In recent years, with the rapid development of neuroscience research and its increased visibility in society, it has been observed that many misinterpretations, oversimplifications, and irrelevant generalizations are made regarding the findings of these studies in the field of education. These distortions, known as neuromyths, include the following most common ones: (1) we only use 10% of our brain; (2) listening to classical music, especially Mozart's compositions, increases IQ; (3) the first three years of life are crucial for the development of synaptic connections in the brain; (4) individuals learn better when they access information through preferred visual, auditory, or kinesthetic learning channels (styles); (5) individual differences among students are due to some individuals having a dominant right brain hemisphere, while others have a dominant left hemisphere; (6) according to Gardner's theory of multiple intelligences, individuals should be provided with education that is tailored to their specific type of intelligence (Alferink & Farmer-Dougan, 2010; Dekker et al., 2012; Howard-Jones, 2014; Fischer et al., 2010; Geake, 2008; Goswami, 2006; Pasquinelli, 2012, 2013).

1.1. Aim of the study

The aim of this research is to determine the knowledge levels and misconceptions of prospective biology teachers regarding educational neuroscience, with the goal of increasing awareness in this field and emphasizing the importance of emphasizing educational neuroscience in teacher training programs. It is of great importance for teacher candidates to possess accurate and up-to-date knowledge, develop a healthy understanding of brain functioning and learning processes, guide their students with effective teaching strategies, and create an educational environment free from myths.Additionally, this research focuses on examining the opinions of prospective biology teachers studying at a state university in Turkey regarding their understanding of brain functioning in the context of educational neuroscience. The research question is as follows:

1- In which areas do prospective biology teachers focus on their knowledge levels and misconceptions regarding educational neuroscience?

1.2. The importance of the study

The focus of the research is the necessity for prospective biology teachers to convey educational content about learning and the brain and to guide their students towards sustainable learning. A recent study has revealed that prospective biology teachers hold misconceptions about learning and the brain, which are largely characterized by "neuromyths," even though they have completed neuroscientific coursework (Grospietsch & Mayer, 2018). Often, the findings of neuroscientific research (= correct base) turn into scientifically incorrect conclusions due to misunderstandings and exaggerations in teaching and learning. Examples of these include the existence of learning styles (lacking experimental evidence) or the idea that the left and right brain hemispheres generally function independently and need to be better connected (= Brain Gym) (Macdonald et al., 2017). Studies on the adoption of neuromyths by teachers of different subjects have been conducted in various countries such as the Netherlands, the United Kingdom (Dekker et al., 2012; Simmonds, 2014), Portugal (Rato, Abreu & Castro-Caldas, 2013), Greece (Deligiannidi & Howard-Jones, 2015), Switzerland (Tardif, Doudin, Meylan, 2015), Spain (Ferrero, Garaizar, Vadillo, 2016), China (Pei et al., 2015), Turkey (Karakus et al., 2015; Gülsün & Köseoğlu, 2020; Mercan, Tibi, Altun & Köseoğlu, 2022; Mercan, Altun Köseoğlu, 2023), Australia (Bellert & Graham, 2013), Latin America (Bartoszeck & Bartoszeck, 2012), United States (Lethaby & Harries, 2016), and Canada (Macdonald et al., 2017). Howard-Jones et al. (2009), Fuentes & Risso (2015), Dündar & Gündüz (2016), Düvel et al. (2017),

Canbulat & Kiriktas (2017), Kim & Sankey (2017), Papadatou-Pastou et al. (2017), and Grospietsch & Mayer (2018) provide evidence regarding the adoption of neuromyths by prospective teachers. Most studies have found that university students adopt many neuromyths, indicating the need for intervention. However, intervention studies have not yet been conducted. According to Papadatou-Pastou et al. (2017), studies should "evaluate prospective teachers' knowledge about neuroscience and their beliefs in neuromyths after studying neuroscience". As part of university studies, prospective biology teachers who received training in neuroscience content were found to adopt 11 neuromyths: the existence of learning styles, the effectiveness of Brain Gym, the idea of information being stored in specific locations (hard drive), learning differences based on the use of different hemispheres, the optimal learning age being before the age of 3, logic in the left hemisphere/creativity in the right hemisphere, critical periods in childhood, using only 10% of our brain, learning during sleep, blocked learning being superior to spaced learning, and the genetic determination of the number of cells determining learning (Dekker et al., 2012). They also hinder teachers and students from allocating these resources to more effective theories and methods (e.g., teaching learning strategies). Grospietsch and Mayer (2018) did not find any differences in the adoption of neuromyths among first-semester students, advanced students, and postgraduate teacher candidates. Furthermore, the study demonstrates that neuromyths persist as misconceptions despite the presence of better scientific concepts. This indicates that even prospective biology teachers are unable to successfully transform their misconceptions about learning and the brain into scientific concepts during their university teacher education. Therefore, the previous literature on neuromyths has advocated for further integration of neuroscience into teacher education (Howard-Jones, 2014), but this does not appear to be sufficient for rectifying prospective teachers' misconceptions about learning and the brain. As neuroscience knowledge continues to advance, research in the relevant literature has shown that there is a widespread prevalence of misconceptions and myths based on brain functioning in educational practices. These myths can lead to misguidance and misinformation among teacher candidates and educators, resulting in the misuse of resources and neglect of effective teaching strategies.

This research offers a perspective on identifying the misconceptions of teacher candidates regarding educational neuroscience and understanding the reasons and effects behind these misconceptions. The findings can contribute to promoting more knowledge sharing in the education system regarding educational neuroscience, providing accurate information to teacher candidates, and incorporating educational neuroscience into teacher training programs.

2. METHOD

2.1. Research design

In this research, the qualitative research method of phenomenology was used. The phenomenon of this research is the opinions of prospective biology teachers regarding educational neuroscience, with the aim of understanding their understanding of brain functioning. The phenomenology design is described as the activity of giving meaning and explanation to various phenomena based on the essence and core of individuals' experiences (Yıldırım & Şimşek, 2018). The essence and core of experiences refer to the "commonalities in people's experiences" and understanding these commonalities is achieved through the phenomenology design by making conceptual inferences about what a phenomenon exactly means and looks like (Johnson & Christensen, 2004).

At the center of the phenomenology design is the concept of "phenomenon" or "phenomena," which refers to everything experienced within a lived experience. Perception, consciousness, thought, emotion, memory, language, and other topics are all encompassed within the concept of phenomenon. According to Vagle (2014), a phenomenon is related to how we relate ourselves to the world in our everyday experiences. Phenomenological research aims to understand and explain experiences and the firsthand experiences individuals have within these experiences. The fundamental purpose is to understand and interpret

experiences in the deepest and richest way possible. Therefore, in such studies, phenomena are approached not with an explanatory approach but with a descriptive approach. In this research, the phenomenology design was chosen to examine the opinions of prospective biology teachers studying at a state university in Turkey regarding their understanding of brain functioning in the context of educational neuroscience. The data obtained through the phenomenology design in this research serves as an important source for the in-depth analysis of qualitative research questions.

2.2. Participants

In this research, a convenience sampling method called purposive sampling was used to create the study group. Purposive sampling is a sampling technique used in studies where similar cases or groups are examined (Patton, 2002). In purposive sampling, it is expected that participants with common characteristics will be included in the research (Yıldırım and Şimşek, 2018). The common characteristic of the participants constituting the study group in this research is that they are biology teacher candidates. The study group consists of 16 participants determined using purposive sampling from prospective biology teachers studying at a state university in Turkey. The participants in the study group are indicated as P1, P2, P3, ..., P16. The demographic characteristics of the participants are presented in Table 1.

Table 1.
Demographic characteristics of participants

Demographic Characteristics		Frequency (f)
Gender	Male	5
	Female	11
Class	2nd Class	8
	3th Class	8
Participation in Educational Neuroscience Training Attended	Training Attended	1
	Not Training Attended	15
Total		16

According to Table 1, the demographic characteristics of the participants constituting the study group are as follows: 5 are male, and 11 are female. In terms of grade levels, 8 participants are in the second year, and 8 participants are in the third year. In terms of participation in educational neuroscience training, 15 participants indicated that they did not attend, while 1 participant indicated that they attended. The participant coded as K16, who attended educational neuroscience training, stated that they frequently attended Eye Movement Desensitization and Reprocessing (EMDR) symposiums. The reason for selecting participants from second and third-year students is that they are students who have taken fundamental courses related to biology education program and brain functioning.

2.3. Data Collection Instruments

Semi-structured interview questions were used as the data collection instrument in the research to explore the opinions of prospective biology teachers regarding their understanding of brain functioning in the context of educational neuroscience. To prepare the semi-structured interview questions, the literature was reviewed, and a draft interview form was created. The draft questions were presented to domain experts for their opinions. Expert feedback was sought to check the grammatical accuracy and comprehensibility of the questions. Based on the feedback received from experts, the semi-structured interview questions were revised. The interview form prepared includes 3 open-ended questions. In addition, at the beginning of the interview, there is 1 semi-structured probe question to obtain in-depth answers from the participants

within the context of their experiences. The questions included in the semi-structured interview form are provided below:

Probe Question: What does educational neuroscience mean to you?

Semi-Structured Interview Questions: Do you agree or disagree with the statement "Children behave more carelessly after consuming carbonated beverages and/or snacks (chocolate, chips, etc.)"? Explain your reasons.

Do you agree or disagree with the statement "Playing brain games on the computer improves our intelligence"? Explain your reasons. What is the source of your opinion? Where did you acquire this information?

Do you agree or disagree with the statement "Using technology while doing something we love reduces our threshold for boredom"? Explain your reasons. What is the source of your opinion? Where did you acquire this information?

2.4. Data Analysis

Content analysis was used to analyze the data obtained in the research. Content analysis is a type of analysis that organizes similar concepts and themes to interpret the data (Yıldırım & Şimşek, 2018).

Content analysis was performed using the qualitative data analysis program MAXQDA 2018 in conjunction with the analysis stages used by Thomas & Harden (2008). These stages are explained below:

Coding of Findings: In this stage, direct quotations or key concepts extracted from primary studies are coded by reading them line by line. After all the findings are coded, the second stage can be initiated.

Development of Descriptive Themes: In this stage, the obtained codes are compared based on their similarities and differences and grouped to form a hierarchical tree structure. Each group is assigned a theme name. Each theme is created to encompass the definitions and meanings of the grouped codes.

Generation of Analytical Themes: In this stage, while staying close to the findings of the primary studies in the process of developing themes, new interpretive structures and explanations are generated that go beyond the primary studies in the process of generating analytical themes. Going beyond the primary studies requires the use of descriptive themes obtained through inductive analysis to answer the temporarily suspended research questions. For this purpose, the descriptive themes are compared and discussed with other researchers to generate more abstract analytical themes.

Ensuring Credibility and Consistency: The most important factor in considering a qualitative research as a scientific study is credibility and consistency. Therefore, ensuring the credibility and consistency of the research is essential.

Through content analysis, themes were identified, codes were extracted, and a content analysis suitable for qualitative research was attempted, and findings were presented. The obtained data were analyzed by identifying themes and subthemes in line with the objectives of the study.

To ensure the consistency of data analysis in the research, the data were also analyzed by another domain expert apart from the researcher, and efforts were made to reach consensus. Miles and Huberman's (1994) consistency formula was used to calculate consensus. The formula is provided below:

Reliability = [Consensus / (Consensus + Disagreement)] x 100

= [112/ (112+12)] x 100 = [112/124] x 100 = 0.903

As a result of the analysis, a consensus of 90% was reached between the researcher and the domain expert. Miles and Huberman (1994) state that research results with a consistency of 70% or higher are considered to be highly consistent.

In the research, data were collected through individual interviews conducted in the meeting room of the Department of Biology Education at a state university in Turkey. Accordingly, face-to-face interviews were conducted with the participants at a convenient time between October 15, 2022, and November 15, 2022. The duration of individual interviews ranged from 10 to 13 minutes. The resulting data set, obtained by transcribing the interviews, is 32 pages long.

2.5. Ethical approval

The researcher states that they have shown the necessary sensitivity and adhered to scientific ethical principles throughout the entire process, from planning to implementation and reporting of the study.

During the research process, the data obtained with the permission of the participants were utilized, and off-record interviews and assessments were excluded from the scope of the research and not included in any way. The data obtained from the participants were limited to the scope of the subject. Participants were not asked unrelated questions. The process of conducting interviews, analyzing data, and reporting was carried out by the researcher.

Ethical committee= Hacettepe University, Institute of Information Sciences, Research and Publicartion Ethics Committee

Data of ethical approval = 28.03.2023

The number of ethical approvals= E-35853172-000-00002802185

3. FINDINGS

In this section of the study, the findings obtained from individual interviews conducted with prospective biology teachers who constituted the study group were analyzed under categories. These categories can be seen in Table 2.

Table 2.
Categories of Participant Views

	Categories
Categories of Participant Views	Educational Neuroscience Concept
	Relationship Between Educational Neuroscience and Unhealthy Food Choices
	Educational Neuroscience and Playing Brain Games
	Educational Neuroscience and Using Technology in Preferred Tasks

As seen in Table 2, the categories related to participant views have been presented in order. These categories consist of Educational Neuroscience Concept, Educational Neuroscience and Unhealthy Food Choices Relation, Educational Neuroscience and Playing Brain Games, and Educational Neuroscience and Using Technology in Preferred Tasks:

3.1.Educational neuroscience concept

The participants' views on the concept of educational neuroscience are presented in Table 3.

Table 3.
Participants' Views on the Educational Neuroscience Concept

Category	Themes	Frequency (f)
Educational Neuroscience Concept	The Impact of Learned Information on the Brain	2
	Structure and Functioning of Neurons	5
	Structure and Functioning of the Body	1
	Psychological Effects	1
	Nervous System	5
	Structure and Functioning of the Brain	4
	Brain Education	1
	Educational Dimension of the Nervous System	2

As seen in Table 3, the participants' views on the concept of educational neuroscience are categorized as: The Impact of Learned Information on the Brain (2), Structure and Functioning of Neurons (5), Structure and Functioning of the Body (1), Psychological Effects (1), Nervous System (5), Structure and Functioning of the Brain (4), Brain Education (1), and Educational Dimension of the Nervous System (2). Some examples of participant responses related to these themes are provided below:

> *"I haven't researched much, but it could be about the impact of learned information on the brain, the changes it creates in the brain, it could be about the transmission of neurons, how the interactions between neurons occur, what kind of changes happen."* (The Impact of Learned Information on the Brain; Structure and Functioning of Neurons) (P1)

> *"Our body consists of nerves, it might explain the functioning of these nerves, its contribution to us, the functioning of the body, its effects on our body movements and psychologically."* (Structure and Functioning of the Body; Psychological Effects) (P2)

> *"It might include information about the structure and functioning of the nervous system, it could be a broader aspect of the nervous system."* (Nervous System; Structure and Functioning of the Brain) (P3)

> *"I think it could be about brain education. It could be about nerves, their functioning, and their relation to the brain."* (Brain Education; Structure and Functioning of Neurons) (P4)

> *"Neuroscience is a discipline that studies neurons and the nervous system. It also examines nervous system disorders. Educational neuroscience is about teaching neuroscience, the educational aspect of it."* (Educational Dimension of the Nervous System) (P5)

3.2.Educational and unhealthy food choices

The participants' views on the relationship between educational neuroscience and unhealthy food choices are presented in Table 4.

Table 4.

Participants' Views on Educational Neuroscience and Unhealthy Food Choices

Category	Themes		Frequency (f)
Educational Neuroscience and Unhealthy Food Choices	Those Who Believe There Is No Relationship Between Educational Neuroscience and Unhealthy Food Choices	Motivation	1
		Reward	1
		Individual Characteristics	2
		Physiological Effects	1
		Psychological Effects	1
		Individual Behaviors	2
	Source of Opinion	Individuals' Experiences	7
		Experiences of Reference Groups	1
		Visual Media	1
		Lessons	1
	Those Who Believe There Is a Relationship Between Educational Neuroscience and Unhealthy Food Choices	Irregular Lifestyle	1
		Individual Behaviors	8
		Individual Experiences	5
	Source of Opinion	Popular Science Websites	2
		Social Media	3
		Educational Field of Study	1

As seen in Table 4, the participants' views on the relationship between educational neuroscience and unhealthy food preferences have been categorized as follows: those who believe there is no relationship between educational neuroscience and unhealthy food preferences (8) and their sources of opinion (10), and those who believe there is a relationship between educational neuroscience and unhealthy food preferences (9) and their sources of opinion (10).

The category of those who believe there is no relationship between educational neuroscience and unhealthy food preferences (8) has been categorized into Motivation (1), Reward (1), Individual Characteristics (2), Physiological Effects (1), Psychological Effects (1), and Individual Behaviors (2). Here are some examples of participant responses related to these themes:

> *"I personally think that eating junk food motivates me when I do something, because I enjoy it. It becomes a motivating factor for me. When I think about children, I used to be a volleyball coach, and when we told the children that we would get them chocolate after the training, they became more motivated. When I think about it as a reward, I can consider it as a motivating factor. I haven't read any sources on this topic, but if I think about it as a reward, I wouldn't think that they would behave carelessly, so I don't agree with this view."* (Effect of Motivation; Reward) (P1)

> *"I don't think that behaviors are related to drinks or food. I don't think that hyperactivity in children develops based on their nutrition. For example, I wasn't a naughty child, nor was I irregular, but my sibling, who consumed more junk food than me, is not naughty either, he is well-behaved."* (Individual Characteristics) (P3)

> *"I don't think that these types of foods have a direct impact on behaviors. They may have more of a physiological effect; I don't think they directly affect us psychologically. Junk food may have a*

physiological effect on physical appearance, but in terms of behavior, which includes psychology, I don't think that food has an impact." (Physiological Effects; Psychological Effects) (P4)

"Because children don't have consciousness, if they consume too many unhealthy foods carelessly, there is a higher chance of being careless. I believe that our nutrition has an impact on our behavior." (Individual Behaviors) (P5)

The category of Opinion Source (10) has been categorized into Individual Experiences (7), Reference Group Experiences (1), Media (1), and Lessons (1). Here are some examples of participant responses related to these themes:

"I haven't read any sources on this topic, but if I think about it based on my own experiences..." (Individual Experiences) (P1)

"I can't give you a definite source, but in daily life, we come across such information. For example, when we drink milk or eat yogurt and feel sleepy afterward, it can be an example of this. We often encounter this kind of information in daily life, but we don't verify its accuracy. Most of it is hearsay. These kinds of conversations often come up at home while watching TV. We had a discussion about food and obesity in class." (Individual Experiences; Reference Group Experiences; Visual Media; Lessons) (P5)

The category of those who believe there is a relationship between educational neuroscience and unhealthy food preferences (9) has been categorized into Irregular Lifestyle (1) and Individual Behaviors (8). Here are some examples of participant responses related to these themes:

"I have read a lot of things about how if we don't pay attention to children's nutrition and health at an early age, it will be bad for them in later years, and if a healthy eating awareness is not instilled in early ages, their lives will be irregular. But I can't provide a specific source, but I have seen and read many things about it." (Irregular Lifestyle) (P2)

"I think that unhealthy food and nutrition can have an impact on behavior. These types of foods are harmful because they can lead to obesity, and I think they can also have an impact on behavior." (Individual Behaviors) (P6)

"Too much sugar can cause focus problems in children, which can lead to more carelessness." (Individual Behaviors) (P9)

The category of Opinion Source (10) has been categorized into Individual Experiences (5), Popular Science Websites (2), and Social Media (3). Here are some examples of participant responses related to these themes:

"I may have come across such information from various sources in bits and pieces. I may have encountered it on Evrim Ağacı [a popular science website], and I also follow many scientific pages on social media. I have read a few studies on this topic, but I can't remember where or when I read them." (Popular Science Websites; Social Media) (P2)

"I have never read any articles on this topic, but if I think based on my siblings' experiences, my sibling consumes a lot of junk food and is very naughty. My sibling is very active and hyperactive. However, I haven't read anything related to this. I haven't come across any scientific content." (Individual Experiences) (P6)

"I am a biology education student, and during my education, I learned that we should use natural options, but I don't have a specific source. However, based on my education, I came to this conclusion." (Educational Field of Study) (P10)

3.3.Educational neuroscience and playing brain games

The participants' views on playing brain games with educational neuroscience are provided in Table 5.

Table 5.
Participants' Views on Playing Brain Games with Educational Neuroscience

Category	Themes		Frequency (f)
Playing Brain Games with Educational Neuroscience	Relationship between Playing Brain Games with Educational Neuroscience and Development of Intelligence Skills	Development of Cognitive Skills	10
		Improving Brain Functions	4
	Source of opinion	Written Media	1
		Internet Websites	2
		Visual Media	1
		Documentaries	1
		Reference Group Experiences	1
		Social Media	3
		Personal Experiences	5
	Both those who believe there is a relationship and those who don't believe	Mediating Role Effect on Intelligence Development	2
	Source of opinion	Internet Websites	1
		Personal Experiences	1
	Those who believe there is no relationship between Educational Neuroscience and Playing Brain Games: Source of opinion	Individual Characteristics	2
		Experience	1
		Personal Experiences	2

As seen in Table 5, participants' views regarding the playing of educational neuroscience and brain games are categorized as follows: Those who believe there is a relationship between Educational Neuroscience and Playing Brain Games (14), Source of Opinion (10); Those who believe it is both related and unrelated (2), Source of Opinion (2); Those who believe there is no relationship between Educational Neuroscience and Playing Brain Games (3), Source of Opinion (2).

The category of Those who believe there is a relationship between Educational Neuroscience and Playing Brain Games (14) is further categorized as follows: Development of Cognitive Skills (10) and Improving of Brain Functions (4). Below are some examples of participant responses related to these themes:

> *"If there is a high-quality source and it is played, its effect can be observed. I believe that brain games we generally know such as Sudoku and puzzles contribute to cognitive development."* (Development of Cognitive Skills) (P1)

"Playing brain games on the computer allows us to practice rather than improve our intelligence directly. Those practices may indirectly enhance our intelligence over time." (Development of Cognitive Skills) (P2)

"Playing brain games on the computer may help reduce our reaction time when faced with a problem. If we are solving a problem for a longer time, playing brain games might help solve it in a shorter time, but I don't think it can develop intelligence from scratch. We can say it enhances existing intelligence." (Improving of Brain Functions) (P4)

"We cannot say that playing a computer game suddenly increases our ability to solve math problems, but I think there may be different effects." (Improving of Brain Functions) (P7)

The category of Source of Opinion (10) is further categorized as follows: Personal Experiences of Individuals (7), Experiences of Reference Groups (1), Media (1), and Course (1). Below are some examples of participant responses related to these themes:

"I think I read such an article on one of the pages of the newspaper, it must be Habertürk. It mentioned that brain games are played in schools in the UK, but I don't know how true it is because I didn't investigate its accuracy. However, I only read the article stating that brain games are being played. Such information also circulates on the internet, but it depends on the type of game and its source." (Written Media; Internet Websites) (P1)

"When I watch documentaries on channels like National Geographic or TLC on television." (Visual Media; Documentary) (P2)

"I haven't read any scientific content on this topic or come across any, but based on my surroundings, some of my friends play a lot of brain games, and I can say that their intelligence is higher than mine and they are more practical-minded." (Experiences of Reference Groups) (P3)

"I come across these kinds of short articles frequently while doing research on different topics and on social media." (Social Media) (P6)

"This idea is entirely my personal opinion. I haven't come across any scientific content, but in a documentary called 'Mind Games' that I watched, experiments were conducted by playing such games. Maybe I can say that based on that documentary, which was shown on the National Geographic channel. I love documentaries and watch them often. Regardless of the topic, I usually enjoy watching documentaries on biology." (Personal Experiences of Individuals; Documentary) (P7)

The category of Both Related and Unrelated (2) is further categorized as the Role of Mediating Role Effect on Intelligence Development (2). Below are some examples of participant responses related to this theme:

"In the developmental period, which is the period of intense brain plasticity, i.e., childhood, development, adolescence, I think playing brain games that promote neural connections may have a role in cognitive development. However, I still believe that its effect is small and I may not think it has a significant impact. I can say that it might increase it to a considerable extent." (Mediating Role Effect on Intelligence Development) (P11)

The category of Source of Opinion (2) is further categorized as follows: Personal Experiences of Individuals (1) and Internet Websites (1). Below are some examples of participant responses related to these themes:

"I read that playing games that improve intelligence or strengthen memory during the developmental period stimulates neural connections and helps increase memory and think quickly. I read that article about 3-4 years ago, also in a foreign source, but I don't remember. However, it was an article with a source." (Internet Website) (P11)

The category of Those who believe there is no relationship between Educational Neuroscience and Playing Brain Games (3) is further categorized as follows: Individual Characteristics (2) and Experience (1). Below are some examples of participant responses related to these themes:

> *"Nowadays, children grow up in front of screens, their interest in physical objects is much less compared to something on the screen, they show much more interest in screens. However, I don't think that playing a game on the screen would develop their intelligence. Because I think intelligence can develop through interaction, experience, and physical touch."* (Individual Characteristics; Experience) (P13)

The category of Source of Opinion (2) is further categorized as follows: Personal Experiences of Individuals (2). Below are some examples of participant responses related to this theme:

> *"I have no scientific source or study that I can refer to. It's entirely my own interpretation."* (Personal Experiences of Individuals) (P13)

3.4.Educational neuroscience and using technology in preferred tasks

Table 6 presents the views of the participants who constitute the study group regarding the use of technology in the production of preferred jobs with educational neuroscience.

Table 6.
Participants' Views on the Use of Technology in the Production of Preferred Jobs with Educational Neuroscience

Category	Themes		Frequency (f)
Use of Technology in the Production of Preferred Jobs with Educational Neuroscience	Those who believe there is relationship between the Use of Technology in the Production of Preferred Jobs and Educational Neuroscience	Support for Learning	6
		Motivation for Preferred Job	3
		Efficient Time Management	1
	Source of Opinion	Personal Experiences of Individuals	7
		Web 2.0 Tools	1
		Written Text	1
	Those who believe there is no relationship between the Use of Technology in the Production of Preferred Jobs and Educational Neuroscience	Motivation for Preferred Job	5
		Visual Problem-Solving Skills	1
		Intervention Effect on Cognitive Skills	1
	Source of Opinion	Personal Experiences of Individuals	6
		Professional Experience	1

As seen in Table 6, participants' views on the use of technology in the production of preferred jobs with educational neuroscience are categorized as follows: Those who believe there is a relationship between the Use of Technology in the Production of Preferred Jobs and Educational Neuroscience (10), Source of Opinion (9); Those who believe there is no relationship between the Use of Technology in the Production of Preferred Jobs and Educational Neuroscience (7), and Source of Opinion (7).

The category of Those who believe there is a relationship between the Use of Technology in the Production of Preferred Jobs and Educational Neuroscience (10) is further categorized as follows: Support for Learning (6), Motivation for Preferred Job (3), and Efficient Time Management (1). Below are some examples of participant responses related to these themes:

> *"When I read the lecture notes of a course, there can be unfamiliar words or things that I can't visualize. After conducting research on the internet to fill in my missing knowledge, I can continue my work in the same way. Therefore, when a technological device is involved in the work, when we use technology, I can better understand and visualize some information, and then understand it better and continue my work."* (Support for Learning) (P1)

> *"If we are doing a job that we love, no matter what we use, I don't think technology usage will negatively affect our enjoyment. I don't think boredom is related to technology because it is being used at that time, whether we use it or not does not have a positive or negative effect on our boredom."* (Motivation for Preferred Job) (P3)

> *"Playing brain games on the computer may help reduce our reaction time when faced with a problem. If we are solving a problem for a longer time, playing brain games might help solve it in a shorter time, but I don't think it can develop intelligence from scratch. We can say it enhances existing intelligence."* (Enhancement of Brain Functions) (P4)

> *"When doing a job we love, using technology may reduce the time we spend on it and lower our threshold for getting bored."* (Efficient Time Management) (P6)

The category of Source of Opinion (9) is further categorized as follows: Personal Experiences of Individuals (7), Web 2.0 Tools (1), and Written Text (1). Below are some examples of participant responses related to these themes:

> *"I haven't researched much on this topic, but if I were to give an example based on my own experiences and observations"* (Personal Experiences of Individuals) (P1)

> *"I usually follow Khan Academy and YouTube academically. However, I haven't come across a study on this subject."* (Web 2.0 Tools) (P4)

> *"I haven't come across any scientific content on this. However, I might have read it in passing from experiments mentioned in paragraphs."* (Written Text) (P15)

The category of Those who believe there is no relationship between the Use of Technology in the Production of Preferred Jobs and Educational Neuroscience (7) is further categorized as follows: Motivation for Preferred Job (5), Visual Problem-Solving Skills (1), and Intervention Effect on Cognitive Skills (1). Below are some examples of participant responses related to these themes:

> *"If I am already doing a job that I love, whether I use technology or not, it will not affect my boredom. Using technology when doing a job that I don't like may prevent boredom, but I don't think it will have an impact on a job that I love."* (Motivation for Preferred Job) (P2)

> *"I still use a dictionary. Playing chess on the computer or on the table is very different. Technology may work in terms of preventing boredom."* (Motivation for Preferred Job) (P8)

> *"If a person has high visual intelligence and uses the technological device to support their visual intelligence, it may reduce their boredom level. Therefore, it may not lower our threshold but instead increase it."* (Visual Problem-Solving Skills) (P11)

> *"With more visual stimuli, we can gather our attention more easily. In our principles and methods of instruction class, our teacher mentioned that the more monotonous the learning environment is, the more students' concentration level decreases. It was mentioned that the more different stimuli there are, the higher our level of attention will be."* (Intervention Effect on Cognitive Skills) (P16)

The category of Source of Opinion (7) is further categorized as follows: Personal Experiences of Individuals (6) and Professional Experience (1). Below are some examples of participant responses related to these themes:

> *"I have no scientific source or study that I can refer to. It's entirely my own interpretation."* (Personal Experiences of Individuals) (P13)

> *"From my undergraduate teacher."* (Professional Experience) (P16)

4. DISCUSSION and RESULTS

This study aims to examine the views of prospective biology teachers on educational neuroscience. It is important to support the findings with the relevant literature to contribute to previous studies in the field and discuss the results of the research in a more comprehensive framework. Based on the findings of this study, the following are discussed below, taking into account the relevant literature:

Findings under the category of "Concept of Educational Neuroscience" include the participants' views on the concept of educational neuroscience. The participants focused on the impact of acquired knowledge on the structure and functioning of the brain. These findings indicate that educational neuroscience supports brain-based approaches in learning processes. Studies have also examined the impact of educational neuroscience on learning processes. For example, Goswami (2006) emphasized that educational neuroscience can help optimize learning and teaching strategies. Similarly, Carey (2014) stated that educational neuroscience could play a significant role in understanding the brain-based mechanisms in learning processes. These studies highlight the potential contribution of educational neuroscience to learning processes. Regarding the concept of educational neuroscience, participants' views were analyzed under various sub-themes. Participants focused on topics such as the impact of acquired knowledge on the brain, the structure and functioning of neurons, the structure and functioning of the body, the nervous system, and brain structure and functioning. These findings indicate that the concept of educational neuroscience focuses on the neural processes that underlie learning processes. Similarly, a review by Howard-Jones (2014) discusses how educational neuroscience can be used to make learning and teaching strategies more effective. The research highlights the connection between understanding the brain mechanisms underlying learning processes and transferring this knowledge to pedagogical practices.

Findings under the category of "Relationship between Educational Neuroscience and Unhealthy Food Preferences" reflect the participants' views on the relationship between educational neuroscience and unhealthy food preferences. The findings show that there are different views among the participants in this regard. Similarly, studies on this topic have yielded various results. For instance, Burrows et al. (2019) stated that dietary habits can affect cognitive development and unhealthy food consumption can have negative effects on cognitive functions. However, another study by Pasquinelli (2012) revealed that the effects of epigenetic mechanisms on unhealthy food preferences are more complex. These variations indicate that participants consider various factors while discussing the relationship between educational neuroscience and unhealthy food preferences. Another important issue is the relationship between educational neuroscience and unhealthy food preferences. Some participants believe that unhealthy food

preferences are associated with factors such as motivation, reward, and individual characteristics (Pasquinelli, 2012), while others have rejected this relationship (Bowers, 2016). These differences indicate the need for further research on unhealthy food preferences and their behavioral effects in educational neuroscience. A study by Carey (2014) examines the effects of dietary habits on brain functions and, consequently, their potential effects on learning and behavior.

Findings under the category of "Playing Brain Games and Cognitive Skills" reflect the participants' views on the effects of playing brain games with educational neuroscience. Some participants believe that brain games contribute to the development of cognitive skills, while others question this relationship. Research on this topic has shown that brain games can enhance cognitive functions such as attention, memory, and problem-solving. For example, Green and Bavelier (2012) found that video games can improve attention control and increase memory capacity. However, more research is needed to understand the effects of brain games more comprehensively. A review by Bavelier, Green, and Dye (2010) revealed that video games are only effective for specific cognitive skills, and their impact on general intelligence is uncertain. These conflicting findings indicate the need for further research to better understand the relationship between educational neuroscience and brain games. The relationship between educational neuroscience and brain games is also a controversial issue. While some participants believe that brain games contribute to the development of cognitive skills (Galli & Zayas, 2019), others question this relationship (Varma, McCandliss & Schwartz, 2008). Research in this area suggests that brain games can enhance cognitive skills but more studies are needed to explore how this effect can be integrated into general learning and educational processes. For example, a review by Goswami (2006) addresses the relationship between the development of cognitive skills and learning.

Findings under the category of "Technology Use in Preferred Tasks and Educational Neuroscience" reflect the participants' views on the relationship between using technology in preferred tasks and educational neuroscience. The participants mentioned that using technology in preferred tasks supports learning, provides motivation, and facilitates efficient time management. These views align with the literature supporting the role of technology in education. The concepts of "digital natives" and "digital immigrants" introduced by Prensky (2001) emphasize that the new generation of students is more familiar with technology, and technology can be used as an effective tool in education. A meta-analysis by Sitzmann (2011) found that computer-based simulation games can support instructional activities and enhance learning. These studies highlight the need for further research on the potential relationship between educational neuroscience and technology use.

In conclusion, this study examines the views of prospective biology teachers on educational neuroscience and is supported by scientific studies in the literature. The findings indicate that educational neuroscience can support brain-based approaches in learning processes and can be associated with topics such as unhealthy food preferences, playing brain games, and technology use. However, further research is needed in these areas. Future studies will help us better understand how educational neuroscience can be integrated into educational processes, how it can be used to promote healthy eating habits, how the effects of brain games can be optimized, and how technology can support learning experiences. Finally, the relationship between technology use in preferred tasks and educational neuroscience is also a debatable topic. Participants mentioned that using technology in preferred tasks can support learning, provide motivation, and facilitate efficient time management. Research in this area examines the role of educational technologies and discusses how they can be integrated into pedagogical approaches (Howard-Jones, 2014). A study by Bowers (2016) addresses how educational technologies can be integrated and how they can impact student achievement.

Based on the findings of this study and the existing literature, the following recommendations are proposed for further research in the field of educational neuroscience:

Educational neuroscience and education integration: More research should be conducted to better understand the relationship between educational neuroscience and educational processes. Understanding how learning and teaching strategies are related to brain functioning can help create more effective and efficient learning environments. Studies should explore how educational neuroscience can be integrated into educational programs, included in teacher training processes, and reflected in classroom practices.

Healthy eating and educational neuroscience: The findings suggest a potential relationship between unhealthy food preferences and educational neuroscience. Further comprehensive studies are needed to understand the impact of dietary habits on learning and cognitive functions. Additionally, research should focus on how educational neuroscience can be used to promote healthy eating habits and examine the effects of nutrition education on brain health.

Brain games and cognitive skills: More research is needed to better understand the effects of brain games on cognitive skills. While participants had diverse views, some studies have shown that brain games can contribute to the development of attention, memory, and problem-solving skills. Advanced studies should investigate which types of games are more effective for specific populations and in different learning contexts to optimize the impact of brain games.

Technology and educational neuroscience: The role of technology in education is rapidly expanding. More research should be conducted on how educational neuroscience can be integrated with technology use and how it can support learning experiences. Studies should explore the use of interactive simulations, virtual reality, artificial intelligence, and other technology-based tools in learning processes, their impact on learning outcomes, and their effect on student motivation. It is important for teachers to keep their knowledge of educational neuroscience up to date and learn how to integrate this knowledge into classroom practices. Teacher education programs should include foundational knowledge on educational neuroscience and teach teachers how to utilize this knowledge. Additionally, teachers should be encouraged to follow educational neuroscience research and stay informed about the latest developments.

These recommendations aim to advance research in the field of educational neuroscience and enhance learning processes. Further research and implementation can contribute to the integration of educational neuroscience into pedagogical approaches and improve students' learning experiences.

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GENİŞLETİLMİŞ ÖZET

1. GİRİŞ

Son yıllarda, nörobilim ve eğitim arasındaki etkileşimi inceleyen yeni bir alan olan eğitim nörobilimi önem kazanmıştır. Bu alan, beyin işleyişini ve öğrenme süreçlerini anlamak için nörobilim araştırmalarından yararlanmayı hedefleyen bir yaklaşım olarak öne çıkmaktadır. Biyoloji öğretmen adayları, biyoloji eğitiminin temel taşıdır ve öğrencilere biyoloji konularını anlatmanın yanı sıra onları öğrenmeye yönlendirmek ve etkili öğrenme stratejilerini kullanmalarını sağlamak gibi önemli bir rol üstlenirler. Bu nedenle, biyoloji öğretmen adaylarının eğitim nörobilimine ilişkin bilgi ve anlayışları, öğrenme süreçlerini etkileyen faktörleri anlamada ve öğretim stratejilerini geliştirmede kritik öneme sahiptir. Bu bağlamdan yola çıkılarak araştırmanın amacı, biyoloji öğretmen adaylarının eğitim nörobilimi perspektifinden beyin işlevlerini anlama düzeylerini ve yanılgılarını incelemektir. Araştırma biyoloji öğretmen adaylarının eğitim nörobilimi hakkındaki bilgi ve anlayışlarını belirlemeyi ve bu alanda farkındalığı artırmayı hedeflemektedir. Aynı zamanda, araştırma, biyoloji öğretmen adaylarının beyin işleyişi hakkındaki yanılgıları ve bu yanılgıların nedenleri ve etkileri konusunda anlayış sağlamayı amaçlamaktadır.

Bu araştırma, biyoloji öğretmen adaylarının eğitim nörobilimi perspektifinden beyin işlevlerini doğru bir şekilde anlamalarını ve yanılgılarından arınmalarını sağlamayı amaçlamaktadır. Eğitim nörobilimi, öğrenme süreçlerini etkileyen faktörleri anlamada ve etkili öğretim stratejileri geliştirmede büyük bir potansiyele sahiptir. Bu çalışmanın bulguları, biyoloji öğretmen adaylarına doğru ve güncel bilgi sağlama, beyin işleyişini anlama konusunda farkındalığı artırma ve eğitim nörobilimini öğretmen eğitim programlarına daha iyi entegre etme çabalarını destekleyebilir. Ayrıca, bu araştırma, eğitim nörobilimi alanında daha fazla çalışma ve bilgi birikimine katkıda bulunarak, öğretmen adaylarının beyin işleyişlerine yönelik kavram yanılgılarını azaltmaya yönelik etkili stratejilerin geliştirilmesine yardımcı olmayı hedeflemektedir.

2. YÖNTEM

Bu araştırmada, nitel araştırma yöntemlerinden olgubilim (fenomenoloji) kullanılmıştır. Bu araştırmanın olgusu biyoloji öğretmen adaylarının beyin işlevlerini anlamlandırmak amacıyla sahip oldukları eğitsel sinirbilime yönelik görüşleridir. Araştırmada olgubilim deseni, Türkiye'de bir devlet üniversitesinde öğrenim gören biyoloji öğretmen adaylarının beyin işlevlerini anlamlandırmak amacıyla sahip oldukları eğitsel sinirbilime yönelik görüşlerinin ele alınması amacıyla seçilmiştir. Araştırmada olgubilim deseni ile elde edilen veriler, nitel araştırma sorularının derinlemesine analizinde önemli bir kaynaktır.

Araştırmanın çalışma grubu, benzeşik örnekleme ile oluşturulmuştur. Bu araştırmanın çalışma grubunu oluşturan katılımcıların ortak özelliği ise biyoloji öğretmen adayı olmalarıdır. Araştırmanın çalışma grubu Türkiye'de bir devlet üniversitesinde öğrenim gören biyoloji öğretmen adaylarından amaçlı örnekleme yöntemlerinden benzeşik örneklemesi kullanılarak belirlenen 16 katılımcıdan oluşturmaktadır. Araştırmanın çalışma grubunu oluşturan katılımcılar; K1,K2, K3, …, K16 şeklinde belirtilmiştir.

Araştırmada veri toplama aracı olarak biyoloji öğretmen adaylarının beyin işlevlerini anlamlandırmak amacıyla sahip oldukları eğitsel sinirbilime yönelik görüşlerinin ele alındığı yarı yapılandırılmış görüşme soruları kullanılmıştır. Yarı yapılandırılmış görüşme soruları hazırlamak amacıyla alanyazın incelenmiş ve taslak görüşme formu hazırlanmıştır. Taslak sorular alan uzmanlarının görüşüne sunulmuştur. Soruların dil bilgisi açısından doğruluğu ve anlaşılır olma durumunu denetlemek için ise görüş alınmıştır. Uzmanlardan gelen dönütler doğrultusunda yarı yapılandırılmış görüşme soruları düzenlenmiştir. Buna göre hazırlanan görüşme formunda 3 açık uçlu soru yer almıştır. Ayrıca görüşmenin başlangıcında araştırmanın amacına göre katılımcıların deneyimleri bağlamında derinlemesine yanıtlar alabilmek için 1 yarı yapılandırılmış sonda/sondaj sorusu yer almaktadır. Araştırmada elde edilen verilerin analizinde

içerik analizi kullanılmıştır. İçerik analizi yoluyla temalar belirlenmiş, kodlar çıkartılmış, nitel araştırmaya uygun bir içerik çözümlemesi yapılmaya çalışılmış ve bulgular sunulmuştur. Elde edilen veriler, çalışmanın amaçları doğrultusunda temalar ve alt temalar tanımlanarak analiz edilmiştir.

3. BULGULAR, TARTIŞMA ve SONUÇ

Bu çalışmanın sonuçlarına göre, biyoloji öğretmen adaylarıyla yapılan bireysel görüşmelerden elde edilen bulgular, kategorilere göre analiz edilmiştir. Bulgular, "Eğitsel Sinirbilim Kavramı", "Eğitsel Sinirbilim ve Sağlıksız Yiyecek Tercihleri Arasındaki İlişki", "Eğitsel Sinirbilim ve Beyin Oyunları Oynama", "Eğitsel Sinirbilim ve Tercih Edilen Görevlerde Teknoloji Kullanma" kategorileri altında incelenmiştir. Katılımcıların eğitsel sinirbilim kavramı, eğitsel sinirbilim ve sağlıksız yiyecek tercihleri arasındaki ilişki, eğitsel sinirbilim ve beyin oyunları oynama, tercih edilen görevlerde teknoloji kullanma konularındaki görüşleri analiz edilmiştir.

"Eğitsel Sinirbilim Kavramı" kategorisinde, katılımcıların öğrenilen bilginin beyin üzerindeki etkisi, nöronların yapısı ve işleyişi, vücudun yapısı ve işleyişi, psikolojik etkiler, sinir sistemi, beyin yapısı ve işleyişi, beyin eğitimi, sinir sisteminin eğitsel boyutu gibi alt temalar altında görüşleri belirlenmiştir. Katılımcıların bu konudaki görüşleri, eğitsel sinirbilim kavramının öğrenilen bilginin beyindeki etkisi, nöronların yapısı ve işleyişi gibi konuları içerdiğini ifade etmişlerdir.

"Eğitsel Sinirbilim ve Sağlıksız Yiyecek Tercihleri Arasındaki İlişki" kategorisinde, katılımcıların eğitsel sinirbilim ile sağlıksız yiyecek tercihleri arasındaki ilişkiye yönelik görüşleri incelenmiştir. Bu kategori altında, eğitsel sinirbilimin sağlıksız yiyecek tercihleriyle ilişkisi olmadığını düşünenlerin ve bu görüşleri destekleyen kaynaklarının yanı sıra, eğitsel sinirbilimin sağlıksız yiyecek tercihleriyle ilişkisi olduğunu düşünenlerin ve bu görüşleri destekleyen kaynaklarının görüşleri sunulmuştur. Katılımcılar, sağlıksız yiyecek tercihlerinin motivasyon, ödül, bireysel özellikler, fizyolojik etkiler, psikolojik etkiler, bireysel davranışlar gibi alt temalar altında incelendiğini ifade etmişlerdir.

"Eğitsel Sinirbilim ve Zeka Oyunları Oynama" kategorisinde, katılımcıların eğitsel sinirbilimle beyin oyunları oynama konusundaki görüşleri incelenmiştir. Bu kategori altında, beyin oyunlarının bilişsel becerilerin gelişimine katkı sağladığını düşünenlerin görüşleri ve bu konudaki kaynakları ile eğitsel sinirbilimle beyin oyunları oynamanın zeka fonksiyonlarını geliştirdiğini düşünenlerin görüşleri ve kaynakları sunulmuştur. Katılımcılar, bilişsel becerilerin gelişimi, beyin fonksiyonlarının geliştirilmesi gibi alt temalar altında görüşlerini ifade etmişlerdir.

"Eğitsel Sinirbilim ve Tercih Edilen Görevlerde Teknoloji Kullanma" kategorisinde ise katılımcıların tercih ettikleri işlerde teknoloji kullanımıyla eğitsel sinirbilim arasındaki ilişki hakkındaki görüşleri incelenmiştir. Bu kategori altında, tercih edilen işlerde teknoloji kullanımıyla öğrenmeyi destekleme, tercih edilen işe motivasyon sağlama, verimli zaman yönetimi gibi alt temalar altında görüşler belirlenmiştir. Katılımcılar, bu konudaki görüşlerini kişisel deneyimler, web 2.0 araçları, yazılı metinler gibi kaynaklarla desteklemişlerdir.

Sonuç olarak, bu araştırma biyoloji öğretmen adaylarının eğitsel sinirbilim hakkındaki görüşlerini incelemekte ve literatürdeki bilimsel çalışmalarla desteklenmektedir. Bulgular, eğitsel sinirbilimin öğrenme süreçlerinde beyin temelli yaklaşımları destekleyebileceğini ve sağlıksız yiyecek tercihleri, beyin oyunları oynama ve teknoloji kullanımı gibi konularla ilişkilendirilebileceğini göstermektedir. Ancak, bu konularda daha fazla araştırma yapılması gerekmektedir. İleri çalışmalar, eğitsel sinirbilimin eğitim süreçlerinde nasıl entegre edilebileceğini, sağlıklı beslenme alışkanlıklarının teşvik edilmesi için nasıl kullanılabileceğini, beyin oyunlarının etkisinin nasıl optimize edilebileceğini ve teknolojinin öğrenme deneyimlerini nasıl destekleyebileceğini daha iyi anlamamıza yardımcı olacaktır. Son olarak, tercih edilen işlerde teknoloji kullanımıyla eğitsel sinirbilim arasındaki ilişki konusu da tartışmalıdır. Katılımcılar, tercih edilen işlerde teknoloji kullanımının öğrenmeyi destekleme, motivasyon sağlama ve verimli zaman

yönetimi gibi alanlarda etkili olabileceğini belirtmişlerdir. Bu konuda yapılan araştırmalar, teknolojinin öğrenme ve eğitimdeki rolünü incelemekte ve öğretim süreçlerine nasıl entegre edilebileceğini ele almaktadır (Howard-Jones, 2014). Bowers (2016) tarafından yapılan bir çalışma, eğitim teknolojilerinin pedagojik yaklaşımlara nasıl entegre edilebileceğini ve öğrenci başarısını nasıl etkileyebileceğini ele almaktadır.

ETHICAL PERMISSION FOR THE RESEARCH

All rules stated under the "Higher Education Institutions Scientific Research and Publication Ethics Guidelines" have been adhered to in this study. None of the actions specified under the section "Actions Contrary to Scientific Research and Publication Ethics" in the second part of the guidelines have been performed.

Ethics Committee Information

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CONTRIBUTION OF RESEARCHERS

Author 1 (20%): Research design, data collection.

Author 2 (20%): Research design, data collection.

Author 3 (30%): Data analysis, report writing.

Author 4 (30%): Determining the methodology, consultation, validity and reliability studies.

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CONFLICT OF INTEREST

The authors declare that they have no financial or personal conflicts of interest with any individual or institution that could potentially bias the outcome or interpretation of this research.