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Investigation of the Relationship Between Children's Digital Game Addictions and Spatial Reasoning Skills

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Çocukların Dijital Oyun Bağımlılıkları ve Uzamsal Akıl Yürütme Becerileri Arasındaki İlişkinin İncelenmesi

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Abstract

This study aims to examine children's digital game addiction and spatial reasoning skills in terms of various variables and to determine the relationship between them. The participants of this descriptive and correlational study consist of 318 students from 4th and 5th grades attending primary and secondary schools in the central districts of Diyarbakır province, selected through a simple random sampling method. Data were collected using the "Digital Game Addiction Scale for Children" and the "Spatial Reasoning Test." In the analysis of the data, an independent samples t-test, one-way ANOVA, and Pearson correlation coefficient were used. The study found that male students had significantly higher levels of digital game addiction and spatial orientation compared to female students, 5th-grade students had significantly higher levels of digital game addiction than 4th-grade students, and students attending private schools had significantly higher spatial reasoning skills compared to those in public schools. Furthermore, it was revealed that children of parents with higher education levels had lower digital game addiction and significantly higher spatial reasoning skills compared to children of parents with lower education levels. Additionally, it was found that students with generally lower mathematics grades had higher digital game addiction and lower spatial reasoning skills compared to students with higher grades. On the other hand, a low, negative, and significant relationship was found between students' digital game addiction and spatial reasoning skills.

Article Info

Keywords: Spatial reasoning skill, digital game addiction, mental rotation, spatial orientation, spatial visualization

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Çocukların Dijital Oyun Bağımlılıkları ve Uzamsal Akıl Yürütme Becerileri Arasındaki İlişkinin İncelenmesi

Öz

Bu araştırmada, çocukların dijital oyun bağımlılıklarının ve uzamsal akıl yürütme becerilerinin çeşitli değişkenler açısından incelenmesi ve aralarındaki ilişkinin belirlenmesi amaçlanmıştır. Betimsel ve korelasyonel araştırma modelinde tasarlanan bu çalışmanın katılımcılarını, Diyarbakır ili merkez ilçelerinde basit tesadüfi örnekleme yöntemiyle seçilen ilkokul ve ortaokullarda 4. ve 5. sınıflarda öğrenim gören 318 öğrenci oluşturmaktadır. Veriler "Çocuklar için Dijital Oyun Bağımlılığı Ölçeği" ve "Uzamsal Akıl Yürütme Testi" aracılığıyla toplanmıştır. Verilerin analizinde bağımsız örneklemler için t-testi, tek yönlü varyans analizi ve Pearson korelâsyon katsayısı kullanılmıştır. Araştırmada erkek öğrencilerin dijital oyun bağımlılıklarının ve uzamsal yönelimlerinin kız öğrencilere göre, 5. sınıf öğrencilerinin dijital oyun bağımlılıklarının 4. sınıf öğrencilerine göre ve özel okulda öğrenim gören öğrencilerin uzamsal akıl yürütme becerilerinin devlet okulunda öğrenim gören öğrencilere göre anlamlı düzeyde daha yüksek olduğu tespit edilmiştir. Ayrıca eğitim düzeyi yüksek olan ebeveynlerin çocuklarının, eğitim düzeyi daha düşük olan ebeveynlerin çocuklarına göre dijital oyun bağımlılıklarının düşük olduğu, uzamsal akıl yürütme becerilerinin ise anlamlı düzeyde daha yüksek olduğu ortaya çıkmıştır. Genellikle matematik not ortalamaları düşük olan öğrencilerin, ortalamaları yüksek olanlara göre dijital oyun bağımlılıklarının yüksek olduğu, uzamsal akıl yürütme becerilerinin düşük olduğu belirlenmiştir. Öte yandan öğrencilerin dijital oyun bağımlılıkları ile uzamsal akıl yürütme becerileri arasında düşük düzeyde, negatif ve anlamlı bir ilişki olduğu tespit edilmiştir.

Makale Bilgisi

Anahtar Kelimeler: Uzamsal akıl yürütme becerisi, dijital oyun bağımlılığı, zihinsel döndürme, uzamsal yönelim, uzamsal görselleştirme

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Geniş Özet

Giriş

Dijital oyunların, uzamsal akıl yürütme becerisi üzerinde olumlu etkileri olmasına rağmen dijital oyunların kontrolsüz ve aşırı kullanımı sonucu oluşan dijital oyun bağımlılığı gibi olumsuz etkileri de mevcuttur. Kendi kendine kontrolün az olduğu çocukluk dönemi bu anlamda kritik bir öneme sahiptir. Bu nedenle bu araştırma ile 4 ve 5. sınıf öğrencilerinin dijital oyun bağımlılıklarını ve uzamsal akıl yürütme becerilerini çeşitli değişkenler açısından incelemek ve aralarında nasıl bir ilişki olduğunu belirlemek amaçlanmıştır.

Yöntem

Araştırmada öğrencilerinin dijital oyun bağımlılıkları ve uzamsal akıl yürütme becerilerini çeşitli değişkenler açısından incelemek amacıyla "betimsel araştırma", dijital oyun bağımlılıkları ve uzamsal akıl yürütme becerileri arasında nasıl bir ilişki olduğunu belirlemek amacıyla "korelasyonel araştırma" tercih edilmiştir.

Araştırmanın katılımcılarını, 2023-2024 eğitim-öğretim yılı bahar döneminde Diyarbakır ilinde bulunan ilkokul ve ortaokullarda basit tesadüfi örnekleme yöntemiyle seçilmiş 4 ve 5. sınıflarda öğrenim gören toplam 318 öğrenci oluşturmaktadır. Araştırmaya katılan öğrencilerin 155'i kız, 163'ü erkek öğrenci, 151'i dördüncü sınıf, 167'si beşinci sınıf öğrencisidir. Ayrıca öğrencilerin 137'si özel okul, 181'i devlet okulunda öğrenim görmektedir.

Araştırmada veri toplama araçları olarak "Çocuklar için Dijital Oyun Bağımlılığı Ölçeği (DOBÖ)" ve "Uzamsal Akıl Yürütme Testi (UAYT)" kullanılmıştır. DOBÖ, Şahin, Keskin ve Yurdugül (2019) tarafından geliştirilmiş olup, tek faktör ve altı maddeden oluşmaktadır. Ramful ve diğerleri (2017) tarafından 11-13 yaş aralığındaki öğrenciler için geliştirilen, her biri için 10 maddenin bulunduğu üç faktörden (zihinsel döndürme, uzamsal yönelim, uzamsal görselleştirme) oluşan UAYT, Çilingir-Altıner (2018) tarafından Türkçe'ye uyarlanmıştır.

Araştırmada elde edilen verilerin çözümlenmesinde SPSS paket programı kullanılmış ve yapılan tüm analizlerde anlamlılık düzeyi .05 kabul edilmiştir. Elde edilen verilere uygun analiz türünü belirlemek için her bir bağımsız değişkenin alt gruplarına ait verilerin basıklık ve çarpıklık değerleri incelenerek verilerin normal dağılım sergileyip sergilemediğine karar verilmiştir. Westfall ve Henning (2013) ve Gunzler, Perzynski ve Carle'ye (2021) göre her bir bağımsız değişkenin alt gruplarına ait verilerin basıklık ve çarpıklık değerleri [-2,+2] sınırları içerisinde kaldığı için normallik varsayımı karşılanmıştır. Bu nedenle, öğrencilerin dijital oyun bağımlılıkları ve uzamsal akıl yürütme becerilerini "cinsiyet", "sınıf", "okul türü" değişkeni açısından incelemek için bağımsız örneklemler için *t*-testi; anne-baba eğitim düzeyi ve matematik başarı notu değişkenleri açısından incelemek için bağımsız örneklemler için tek yönlü varyans analizi (ANOVA) kullanılmıştır. Gruplar arasında gözlenen anlamlı farkın kaynağını belirlemek için Scheffe testi ile ikili karşılaştırmalar yapılmıştır. Öğrencilerin dijital oyun bağımlılıkları ile uzamsal akıl yürütme becerileri arasındaki ilişkinin belirlenmesi amacıyla Pearson Korelâsyon Katsayısı kullanılmıştır.

Tartışma ve Sonuç

Araştırmada erkek öğrencilerin dijital oyun bağımlılıkları kız öğrencilere göre anlamlı düzeyde daha yüksek olduğu tespit edilmiştir. Yapılan araştırmalarda da (Gökçearslan ve Durakoğlu, 2014; Güllü, Arslan, Dündar ve Murathan, 2012; Horzum, 2011; Kaman ve Bulut, 2024; Şahin ve Tuğrul, 2012) erkek öğrencilerin bilgisayar oyun bağımlılık düzeylerinin, kız öğrencilere göre daha yüksek olduğu gözlenmektedir. Bu araştırma sonuçlarından hareketle, genellikle erkek çocukların dijital oyun bağımlılıklarının, kız çocuklarına göre daha yüksek olduğu söylenebilir. Bunun nedenlerinden biri bireysel farklılıklara göre değişmekle birlikte toplumda erkek çocuklarına genellikle daha rekabetçi ve mücadeleci olmaları gerektiğinin öğretilmesi olabilir. Çünkü dijital oyunlar, özellikle ödül kazanma ve başarı hissi yaratmada başarılıdır. Oyunlar, erkek çocukları tarafından sosyal bağ kurma aracı olarak da kullanılabilir. Bu durumlar erkek çocuklarda bağımlılık riskini artırabilir.

Araştırmada beşinci sınıf öğrencilerinin dijital oyun bağımlılıkları, dördüncü sınıf öğrencilerine ve matematik not ortalaması düşük olan öğrencilerin dijital oyun bağımlılıkları, not ortalaması yüksek olanlara göre anlamlı düzeyde daha yüksek olduğu tespit edilmiştir. Benzer şekilde Şimşek ve Karakuş Yılmaz (2020) yapmış olduğu sistematik inceleme çalışmasında, incelediği araştırmalarda dijital oyun bağımlılığının üst sınıflarda arttığını ve akademik başarı arttıkça bağımlılık puanlarının düştüğünü ortaya koymuştur. Genel olarak, dijital oyun bağımlılığı ile akademik başarı arasında negatif bir ilişki olduğu söylenebilir.

Araştırmada, üniversite-lisansüstü eğitim düzeyine sahip anne ve babaların çocuklarında diğer eğitim kademelerine göre dijital oyun bağımlılığının düştüğü görülmektedir. Yine araştırmada, genellikle anne ve baba eğitim düzeyi üniversite-lisansüstü olan öğrencilerin zihinsel döndürme, uzamsal yönelim ve uzamsal görselleştirme becerileri

diğer öğrencilerinkinden anlamlı düzeyde daha yüksek olduğu ortaya çıkmıştır. Çünkü daha yüksek eğitim düzeyine sahip ebeveynler, eğitime daha fazla önem verme eğiliminde olabilirler. Ayrıca çocuklarına uzamsal becerileri geliştirici daha çeşitli eğitim materyalleri, kitaplar ve yapboz, lego, blok gibi oyuncaklar sunabilirler.

Araştırmada, erkek öğrencilerin uzamsal yönelim becerileri kız öğrencilere göre anlamlı düzeyde daha yüksek olduğu tespit edilmiştir. Bunun nedeni erkek çocuklarının küçük yaşlarda araba, motosiklet gibi bilgisayar oyunları ile oynama, bisiklet sürme gibi aktivitelere daha fazla zaman ayırmalarından kaynaklanabilir. Çünkü bu aktiviteler uzamsal yönelim becerisinin gelişimine katkıda bulunabilir. Bununla birlikte dördüncü sınıf öğrencilerinin uzamsal yönelim ve uzamsal görselleştirme puan ortalamalarının beşinci sınıf öğrencilerine; özel okulda öğrenim gören öğrencilerin zihinsel döndürme, uzamsal yönelim ve uzamsal görselleştirme puan ortalamaları devlet okulunda öğrenim gören öğrencilere göre anlamlı düzeyde daha yüksek olduğu tespit edilmiştir. Dahası genellikle matematik not ortalamaları yüksek olan öğrencilerin zihinsel döndürme, uzamsal yönelim ve uzamsal görselleştirme becerilerinin matematik not ortalamaları düşük olanlara göre anlamlı düzeyde yüksek çıkmıştır. Literatürde bu bulguyu destekleyen araştırmalar (Dokumacı Sütçü, 2021; Gürbüz, Erdem ve Gülburnu, 2018; Tam, Wong ve Chan, 2018) mevcuttur. Bishop'a (1980) göre bu bulguların nedeni uzamsal yeteneğin, öğrencilerin matematik problemlerinin çözümünde problemi zihinsel resimlerle organize etmelerine; problemin bileşenleri arasındaki bilgileri organize etmek ve ilişkileri göstermek için ağaç diyagramları, venn şemaları, grafikler ve diğer şekillerin sıkça kullanılmasına yardımı olduğundan kaynaklanabilir.

Öğrencilerin dijital oyun bağımlılıkları ile uzamsal yönelim ve uzamsal akıl yürütme becerileri (toplam puan) arasında negatif ve anlamlı bir ilişki olduğu görülmektedir. Bu bulguya göre, öğrencilerin dijital oyun bağımlılıkları arttıkça uzamsal becerilerinin olumsuz etkileneceğini söylenebilir. Benzer şekilde Yılmaz ve Bozyiğit (2023) tarafından yapılan araştırmada, video oyunları oynamanın çocukların görsel uzaysal becerilerini ve çalışma belleği performanslarını artırabildiği, ancak bağımlılık arttıkça bu becerilerin bozulabileceği tespit etmiştir.

Öneriler

Araştırmanın alana önemli bir katkısı dijital oyunların uzun süreli ve yanlış kullanımının önlenmesine yönelik tedbirlerin alınması gerektiğidir. Çocuklarda aşırı ve kontrolsüz bir şekilde dijital oyunları oynamaya bağlı olarak uzamsal becerilerin olumsuz etkilenebileceği dikkate alındığında ebeveynlere önemli görevler düşmektedir. Çocuklarının günlük oyun oynama sürelerini sınırlandırarak, belirlenen süreyi aşmamalarına dikkat etmeli; fiziksel aktiviteler, hobiler, sosyal etkinlikler gibi çeşitli faaliyetlere zaman ayırmaları konusunda onları teşvik etmelidirler.

Introduction

It is an undeniable fact that advancing technology has provided many conveniences to human life, shaping many fundamental areas of life such as education, health, transportation, communication, and entertainment (Hazar & Hazar, 2017). Alongside the rapid progress of technology, games, like many technological products that make life easier, have undergone significant changes and transformations. In the past, digital games were played with simple commands and joysticks, but nowadays, they are equipped with tools such as touchscreens, motion sensors, and voice commands. This situation has drawn the attention of children, shifting them from traditional games to digital ones.

One of the innovations that technology has brought into children's lives, and that affects people of all ages today, is the concept of "digital game." Digital games, which have emerged alongside the development of computer technology, represent a massive market in which millions of people worldwide participate (Erboy, 2010). While in our country the term digital games often brings to mind computer games, this concept also includes games played on devices like game consoles, mobile phones, and tablets. The hardware and software features of digital media tools are improving every day, which increases the frequency of people playing games on these devices. Many people spend time playing digital games while walking, traveling, waiting in line, at work, or at home. Driven by instincts like the desire to win, to finish, to challenge, or to escape stress or reality, individuals are dedicating more and more time to these games (Talan & Kalınkara, 2020). Digital games, which are preferred especially for purposes such as entertainment and leisure time, and whose popularity is increasing day by day, have both positive and negative effects on the development of children and young people.

Proponents of digital games argue that they can provide a friendly introduction to computers for children, improving their hand-eye coordination and attention to detail (Cesarone, 1994). Digital games are interactive tools within multimedia education systems and have the potential to make learning more effective and engaging, especially for children (Altawalbeh, 2023). They are also highlighted for their benefits in promoting critical thinking, visual memory development, and creating lasting learning environments (Erboy, 2010). Additionally, digital games can be used to reduce stress and anxiety and alleviate depressive moods (Király et al., 2020). For these reasons, the use of digital game-based learning has been increasing in early childhood education in recent years (Behnamnia et al., 2023). However, excessive use of digital games at an early age can lead to delays in language development. It may reduce children's communication with parents and friends, leading to social isolation and a lack of interest in daily activities and hobbies. Individuals may struggle to differentiate between the real world and the virtual one. Failure to make time for physical activities and disturbances in sleep patterns can result in health problems. Playing violent games can lead to depression, anxiety, violent tendencies, and aggressive feelings and actions (Göldağ, 2019). The root of the negative effects caused by playing games is seen to be digital game addiction, which results from excessive and uncontrolled use, accompanied by an increase in satisfaction (Horzum, Ayas & Çakır, 2008).

Digital Game Addiction

Digital game addiction refers to the excessive and uncontrolled playing of digital games in a way that negatively affects a person's daily activities, responsibilities, and social relationships. According to Weinstein (2010), digital game addiction is the excessive or compulsive use of computer and video games to the extent that it impacts daily life. Users may isolate themselves from other forms of social interaction, playing compulsively, and focusing more on in-game achievements than broader life events. According to Griffiths (2008), the following conditions can be observed in cases of digital game addiction:

- Salience: This is when playing digital games becomes the most important activity in a person’s life, dominating their thoughts, emotions, and behaviors. An example is when a person constantly thinks about the next time they will play, even when they are not playing.
- Mood modification: This occurs when a person views playing digital games as a way to cope with various negative emotions.
- Tolerance: The player gradually increases the amount of time spent online to achieve the mood-altering effects of digital games.
- Withdrawal symptoms: Unpleasant emotional or physical effects, such as shaking, irritability, and frustration, occur when the game is stopped or playing time is reduced.
- Conflict: This involves interpersonal conflict between the player and others, or internal conflict related to losing control, as it affects work, school, social life, hobbies, and interests.
- Relapse: The tendency to repeatedly return to gaming after having controlled or reduced the gaming behavior.

These conditions observed in digital game addiction negatively impact the development of children and young people, leading to a decline in academic performance, health problems, and isolation as they withdraw from social interactions and relationships. To prevent digital game addiction, parents should first set an example for their children regarding the use of digital devices. They should regularly communicate with their children and support their emotional needs. Parents should also limit the daily gaming time of their children, ensuring they do not exceed the set limits, and encourage them to engage in various activities such as physical exercise, hobbies, and social events.

Spatial Reasoning

Spatial reasoning refers to the cognitive functions that allow people to effectively handle spatial relationships, visual-spatial tasks, and the orientation of objects in space (Sjölinder, 1998). In spatial cognition, it is a mental process that facilitates the interaction between information and operation (Hauptman, 2010). Spatial reasoning consists of a series of cognitive processes in which mental representations of spatial objects, relationships, and transformations are constructed and manipulated (Clements & Batista, 1992). Different researchers have defined spatial reasoning skills in various ways depending on their perspectives. This diversity in definition is also reflected in the examination of different components of this skill, as well as in the use of different names for the same components. Lohman (1979) mentions the existence of three major spatial factors: spatial relations, spatial visualization, and spatial orientation. Linn and Petersen (1985), in their meta-analysis study, divided it into three components: spatial perception, mental rotation, and spatial visualization. Clements (1998) divided it into two main components: spatial visualization and spatial orientation. Studies by Lowrie, Logan, and Ramful (2016; 2017), Lowrie, Logan, and Hegarty (2019), and Ramful, Lowrie, and Logan (2017) approached it in three dimensions: mental rotation, spatial orientation, and spatial visualization. In this research, spatial reasoning skills are examined in three dimensions, based on these studies. One of these dimensions, mental rotation, is a cognitive process in which a person imagines how two- or three-dimensional objects would appear after being rotated at a certain angle around a point. Spatial orientation is the ability to imagine how an object or scene looks from different perspectives of the observers (Çilingir-Altıner, 2018). Spatial visualization is the ability to form a mental image of objects and spatial forms (Contero, Naya, Company, Saorin & Conesa, 2005).

Spatial reasoning skills play an important role in performing many everyday tasks, such as driving a car, finding directions using a map, or assembling furniture. They are also positively associated with many disciplines, especially mathematics and geometry (Dokumacı-Sütçü, 2017). Clements (1998) stated that spatial reasoning skills are related to mathematical success, and therefore, they are important for learning many topics in mathematics and geometry. Jirout and Newcombe (2015) emphasized that spatial learning is crucial for children's success in science, technology, engineering, and mathematics (STEM) fields. Hartman and Bertoline (2005) stated that subjects such as architecture, astronomy, biochemistry, biology, cartography, chemistry, engineering, geology, mathematics, music, and physics involve spatial skills. As highlighted by these studies, spatial reasoning skills are important in many fields, and success in these areas is limited without spatial skills. Therefore, there is a need to develop spatial abilities. In this regard, the research results presented below, which examine the effects of digital games on the development of spatial reasoning skills, show that when played in a controlled manner, such games can be effective in enhancing spatial skills.

Related Research

Despite the misrepresentation of digital games in the popular media, an increasing number of scientists have begun to explore the positive aspects of digital games. As a result, digital games are being used more frequently in new fields, particularly in the world of learning and education (Corradini, 2011). Various studies (Corradini, 2011; David, 2012; Lin & Chen, 2016; Martin-Dorta et al., 2013; Moreau, 2013; Olkun, 2003; Yang & Chen, 2010; You, Chuang, & Chen, 2008) have revealed the positive effects of controlled use of digital games on spatial reasoning skills. This highlights the potential of digital games as educational tools and supports their integration into learning processes. However, the digital gaming industry, driven by rapid technological advancements and creative innovations in game design, is increasingly capturing attention and becoming a significant part of daily life. This rapid growth has led to the widespread use of digital games, particularly among children and adolescents. Nonetheless, this proliferation has also brought about various problems. Digital game addiction causes individuals to spend much of their time in front of computers or on mobile devices in virtual worlds, leading to negative outcomes in areas such as social relationships and academic achievement. For instance, excessive gaming can result in reduced physical activity, decreased focus and attention span, disrupted sleep patterns, and emotional instability. Therefore, in cases of uncontrolled and excessive use, the positive effects of digital games on spatial reasoning skills may be overshadowed, adversely affecting the quality of life. Childhood, in particular, is a critical period during which self-regulation skills are not yet fully developed. Consequently, examining the relationship between digital game addiction and spatial reasoning skills in this age group is of great importance. A better understanding of children's gaming habits and cognitive development will contribute to maximizing the positive impacts of digital games while minimizing the risks of addiction. For this reason, this study

aims to investigate the digital game addiction and spatial reasoning skills of 4th and 5th-grade students in relation to various variables. Additionally, the study aims to examine the relationship between students' digital game addiction and their spatial reasoning skills. Accordingly, the following questions are explored:

- Do students' digital game addiction and spatial reasoning skills show significant differences based on variables such as gender, grade level, type of school, parental education level, and math achievement grade?
- What is the relationship between students' spatial reasoning skills and their digital game addiction?

Method

Research Design

This study, which examines children's digital game addiction and spatial reasoning skills, is descriptive and correlational in nature. Descriptive (survey) research involves collecting data to determine certain aspects or characteristics (such as abilities, opinions, attitudes, beliefs, knowledge) of the members of a population (or a sample). Correlational research, on the other hand, is used to determine relationships between two or more variables (Fraenkel, Wallen & Hyun, 2012).

Participants

The participants of the study consist of 318 students from 4th and 5th grades studying in primary and middle schools in Diyarbakır, selected through simple random sampling, during the spring semester of the 2023-2024 academic year. The characteristics of the participants are summarized in Figure 1.

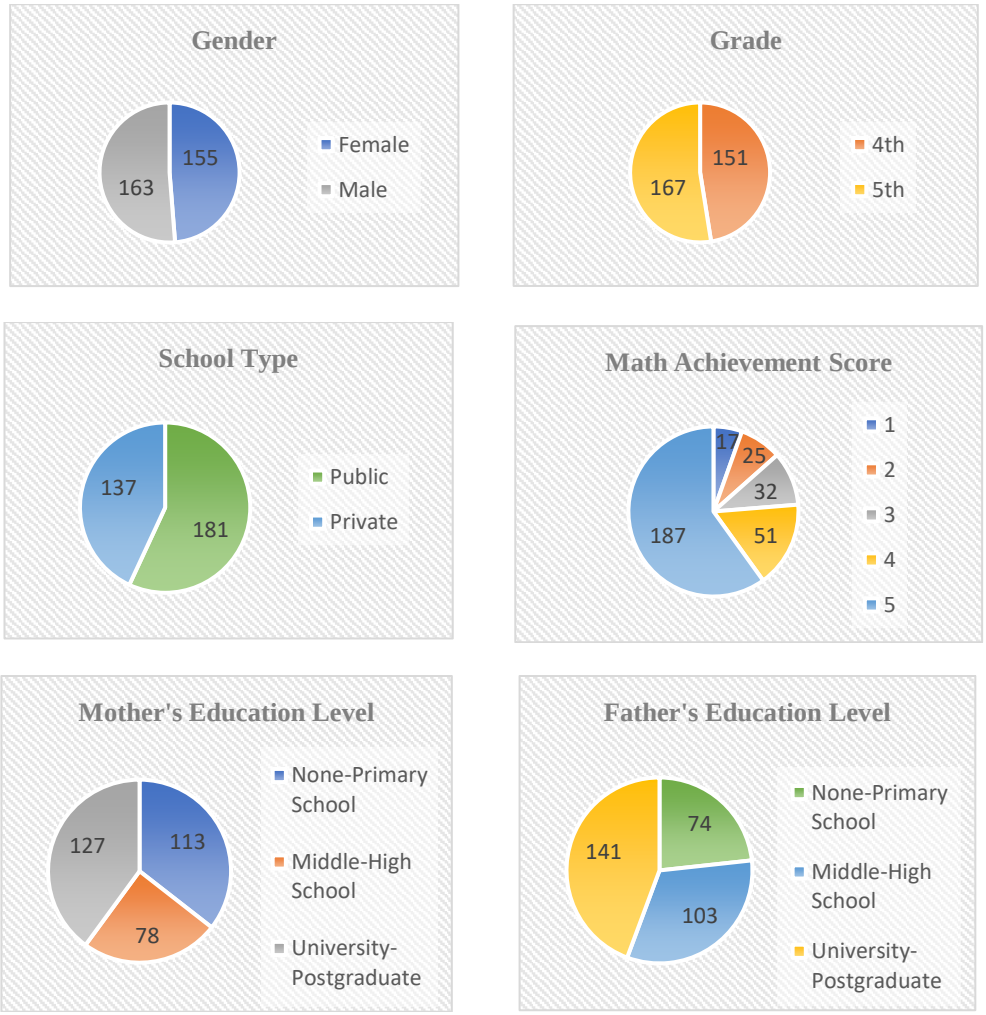


Figure 1. Characteristics of the Participants

Data Collection Tools

In the study, the data collection tools used were the Digital Game Addiction Scale for Children (DGASC) and the Spatial Reasoning Test (SRT).

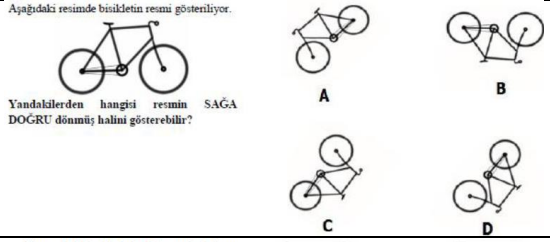
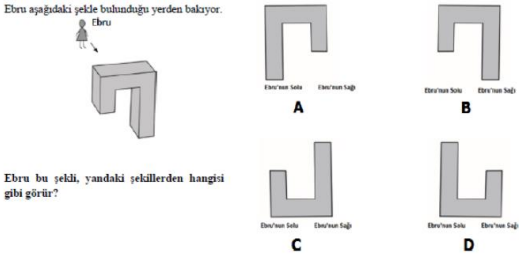
DGASC, developed by Şahin, Keskin, and Yurdugül (2019), consists of a single factor and six items. The scale is rated on a 5-point Likert scale ranging from "Not at all applicable to me" to "Completely applicable to me." During the development phase of the scale, an item pool was initially structured, and item statements were revised based on expert opinions. During the application phase, the psychometric properties of the measurement tool were tested for construct validity and construct reliability using the collected data. The factorial validity of the measurement tool was tested using confirmatory factor analysis. According to the results of the confirmatory factor analysis performed for the factorial validity of the psychological construct the scale aims to measure, the parameter estimates (standardized item factor loadings) for all items were found to be greater than .30, and all items were statistically significant according to the t-test. Additionally, the data-model fit for the estimated confirmatory factor analysis model was examined, and the fit indices were found to be within acceptable ranges. The average explained variance was found to be .57, and the structural reliability (McDonald omega) coefficient was .89. The Cronbach's alpha coefficient for the scale was .78. Sample items from the scale are provided in Table 1.

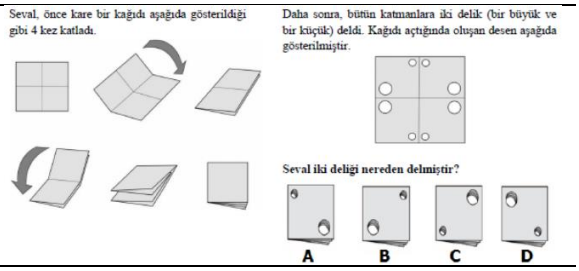
Table 1. Example Items for the DGASC

Item Number	Example Item
2	Sometimes I start playing digital games with a "very little" amount of time in mind, but I end up not being able to stop.
5	My family says that I become disconnected from the real world while playing digital games.

SRT, developed by Ramful et al. (2017) for students aged 11-13, consists of three factors (mental rotation, spatial orientation, spatial visualization), each with 10 items. Çilingir-Altıner (2018) adapted the test into Turkish. Following the first pilot application by Çilingir-Altıner (2018), item analysis and reliability testing were conducted. The KR-20 value of the test was found to be .71. Difficult items were removed after reviewing item indices, and a Lawshe analysis was performed, resulting in a 20-item test. The factors of mental rotation and spatial orientation were organized with seven items each, and spatial visualization was organized with six items. The second pilot application of the test with 20 items yielded a KR-20 value of .75. To ensure construct validity, confirmatory factor analysis was conducted. The confirmatory factor analysis results showed that the test's fit indices ($\chi^2(232) = 204.847$, $p < .001$; GFI = .93; AGFI = .90; CFI = .86; SRMR = .058; RMSEA = .03) were within good and acceptable fit ranges. The characteristics of each factor's questions and example questions of the SRT are provided in Table 2.

Table 2. Example Items for Each Factor of the SRT

Factor	Characteristics of Questions	Example Questions
Mental Rotation	* Determining the outcomes of rotations of two- or three-dimensional shapes * Distinguishing between reflection and rotation	
Spatial Orientation	* Reading maps from different perspectives * Determining the position degree of a point when north is not vertical on a compass * Describing the appearances resulting from transformations of an object	

Spatial Visualization	* Visualizing the results of folding/unfolding a specific structure * Creating solid objects from a specific structure or vice versa * Matching pieces * Finding symmetry in objects * Reflecting an object	

Data Analysis

The SPSS software was used for analyzing the data obtained in the study, with a significance level set at .05 for all analyses. To determine the appropriate analysis type for the obtained data, the skewness and kurtosis values of the subgroups for each independent variable were examined to decide whether the data followed a normal distribution. According to Westfall and Henning (2013), distributions are considered close to normal if the skewness value falls between -2 and +2, and the kurtosis value is 3 or less. Gunzler, Perzynski, and Carle (2021) indicate that distributions are close to normal if the absolute value of skewness does not exceed 2 and kurtosis does not exceed 4. In this study, the skewness and kurtosis values of the subgroups for each independent variable remained within the [-2, +2] range, satisfying the normality assumption. Therefore, to examine students' spatial reasoning skills and digital game addiction in terms of "gender," "grade," and "type of school," independent samples t-tests were used. For examining variables related to parental education level and math achievement grades, one-way ANOVA was employed. To determine the source of significant differences observed between groups, pairwise comparisons were conducted using the Scheffe test.

To determine the relationship between students' digital game addiction and spatial reasoning skills, the normal distribution properties of the dependent variables were examined. Since the skewness-kurtosis values of the variables were within the [-2, +2] range, the normality assumption was satisfied. Therefore, Pearson Correlation Coefficient was used.

Ethical Note: Research and publication ethics were followed.

Findings

This section presents the findings obtained from the analyses related to the sub-problems identified in the research.

The results of t-tests for the mean scores of students on the DGASC and SRT for each dimension, according to the variable of "gender" are shown in Table 3.

Table 3. T-test Results for Mean Scores of Students on DGASC and SRT for Each Dimension by "Gender" Variable

	Gender	**n**	**M**	**SD**	***t* (316)**	***p***
Digital Game Addiction	Female	155	11.90	4.94	-4.299	.000
	Male	163	14.48	5.72		
Mental Rotation	Female	155	2.43	1.43	-.338	.736
	Male	163	2.48	1.36		
Spatial Orientation	Female	155	3.92	1.83	-2.256	.025
	Male	163	4.38	1.79		
Spatial Visualization	Female	155	2.42	1.24	-.158	.875
	Male	163	2.44	1.29		

According to Table 3, there is a statistically significant difference in the mean scores of students on digital game addiction based on gender [t(316)=-4.299, p<.05]. Male students have significantly higher mean scores on digital game addiction compared to female students. However, there is no statistically significant difference in the mean scores for mental rotation [t(316)=-.338, p>.05] and spatial visualization [t(316)=-.158, p>.05] based on gender. On the other hand, there is a statistically significant difference in the mean scores for spatial orientation [t(316)=-2.256, p<.05], with male students having significantly higher scores compared to female students.

The results of t-tests for the mean scores of students on DGASC and SRT for each dimension, according to the variable of "grade" are presented in Table 4.

Table 4. T-test Results for Mean Scores of Students on DGASC and SRT for Each Dimension by "Grade" Variable

	Grade	n	M	SD	*t*(316)	*p*
Digital Game Addiction	4th	151	12.34	5.41	-2.728	.007
	5th	167	14.01	5.47		
Mental Rotation	4th	151	2.56	1.41	1.263	.208
	5th	167	2.36	1.37		
Spatial Orientation	4th	151	4.56	1.81	3.796	.000
	5th	167	3.80	1.76		
Spatial Visualization	4th	151	2.70	1.30	3.720	.000
	5th	167	2.19	1.18		

Table 4 shows that there is a statistically significant difference in the mean scores of students on digital game addiction based on grade level [t(316)=-2.728, p<.05]. Fifth-grade students have significantly higher mean scores in digital game addiction compared to fourth-grade students. However, there is no statistically significant difference in the mean scores for mental rotation [t(316)=1.263, p>.05]. On the other hand, there is a statistically significant difference in the mean scores for spatial orientation [t(316)=3.796, p<.05] and spatial visualization [t(316)=3.720, p<.05], with fourth-grade students having significantly higher scores compared to fifth-grade students.

The results of t-tests for the mean scores of students on DGASC and SRT for each dimension, according to the variable of "school type" are shown in Table 5.

Table 5. T-test Results for Mean Scores of Students on DGASC and SRT for Each Dimension by "School Type" Variable

	School Type	n	M	SD	*t*(316)	*p*
Digital Game Addiction	Public	181	13.34	5.65	.456	.649
	Private	137	13.06	5.31		
Mental Rotation	Public	181	2.28	1.36	-2.544	.011
	Private	137	2.68	1.40		
Spatial Orientation	Public	181	3.73	1.75	-4.929	.000
	Private	137	4.72	1.76		
Spatial Visualization	Public	181	2.22	1.31	-3.565	.000
	Private	137	2.72	1.14		

Table 5 shows that there is no statistically significant difference in the mean scores of students on digital game addiction based on school type [t(316)=0.456, p>.05]. However, there are statistically significant differences in the mean scores for mental rotation [t(316)=-2.544, p<.05], spatial orientation [t(316)=-4.929, p<.05], and spatial visualization [t(316)=-3.565, p<.05] based on school type. Students in private schools have significantly higher mean scores in mental rotation, spatial orientation, and spatial visualization compared to students in public schools.

The results of ANOVA for the mean scores of students on DGASC and SRT for each dimension, according to the variable of "mother's education level" are shown in Table 6.

Table 6. ANOVA Results for Mean Scores of Students on DGASC and SRT for Each Dimension by "Mother's Education Level" Variable

	Mother's Education Level	n	M	SD	*F*(2,315)	*p*	Significant Difference
Digital Game Addiction	None-Primary School[a]	113	13.41	5.57	1.880	.154	
	Middle-High School[b]	78	14.04	5.27			
	University-Postgraduate[c]	127	12.55	5.53			
Mental Rotation	None-Primary School[a]	113	2.33	1.33	8.292	.000	a-c b-c
	Middle-High School[b]	78	2.05	1.39			
	University-Postgraduate[c]	127	2.81	1.37			
Spatial Orientation	None-Primary School[a]	113	3.75	1.69	8.721	.000	a-c b-c
	Middle-High School[b]	78	3.92	1.86			
	University-Postgraduate[c]	127	4.66	1.80			
Spatial Visualization	None-Primary School[a]	113	2.25	1.20	3.904	.021	a-c
	Middle-High School[b]	78	2.31	1.21			
	University-Postgraduate[c]	127	2.67	1.32			

When examining Table 6, it is observed that the average scores for digital game addiction of students do not show a statistically significant difference based on mother's education level [F(2,315)=1.880, p>.05]. However, according to Table 6, there are statistically significant differences in the average scores for mental rotation [F(2,315)=8.292, p<.05], spatial orientation [F(2,315)=8.721, p<.05], and spatial visualization [F(2,315)=3.904, p<.05] based on mother's education level. When examining the binary comparisons, it can be said that students whose mothers have a university or postgraduate education have significantly higher average scores in mental rotation and spatial orientation compared to other students. Additionally, students whose mothers have a university or postgraduate education have significantly higher average scores in spatial visualization compared to students whose mothers have no formal education or only primary education.

The results of ANOVA for the mean scores of students on DGASC and SRT for each dimension, according to the variable of "father's education level" are shown in Table 7.

Table 7. ANOVA Results for Mean Scores of Students on DGASC and SRT for Each Dimension by "Father's Education Level" Variable

	Father's Education Level	**n**	**M**	**SD**	***F*(2,315)**	***p***	**Significant Difference**
Digital Game Addiction	None-Primary School[a]	74	13.28	5.32	2.091	.125	
	Middle-High School[b]	103	14.04	5.39			
	University-Postgraduate[c]	141	12.59	5.63			
Mental Rotation	None-Primary School[a]	74	2.42	1.53	7.525	.001	b-c
	Middle-High School[b]	103	2.07	1.23			
	University-Postgraduate[c]	141	2.75	1.36			
Spatial Orientation	None-Primary School[a]	74	3.81	1.53	7.404	.001	a-c b-c
	Middle-High School[b]	103	3.82	1.85			
	University-Postgraduate[c]	141	4.59	1.86			
Spatial Visualization	None-Primary School[a]	74	2.15	1.40	9.026	.000	a-c b-c
	Middle-High School[b]	103	2.18	1.04			
	University-Postgraduate[c]	141	2.76	1.26			

When examining Table 7, it is noted that the mean scores of students for digital game addiction do not show a statistically significant difference based on their fathers' education levels [F(2,315)=2.091, p>.05]. On the other hand, there are statistically significant differences in the mean scores for mental rotation [F(2,315)=7.525, p<.05], spatial orientation [F(2,315)=7.404, p<.05], and spatial visualization [F(2,315)=9.026, p<.05] based on fathers' education levels. When examining the binary comparisons, it can be said that students whose fathers have university or postgraduate education have significantly higher mean scores in mental rotation compared to those whose fathers have middle or high school education. Additionally, students whose fathers have university or postgraduate education have significantly higher mean scores in spatial orientation and spatial visualization compared to other students.

The ANOVA results for the mean scores of students on the DGASC and SRT for each dimension, according to the variable of "mathematics achievement grade" are presented in Table 8.

Table 8. ANOVA Results for Mean Scores of Students on DGASC and SRT for Each Dimension by "Mathematics Achievement Grade" Variable

	Math Grade	**n**	**Mean**	**SD**	***F* (4,307)**	***p***	**Significant Difference**
Digital Game Addiction	1	17	16.65	6.07	3.900	.004	1-5
	2	25	13.72	4.48			
	3	32	14.69	4.90			
	4	51	14.08	5.47			
	5	187	12.34	5.52			
Mental Rotation	1	17	1.47	1.12	9.407	.000	1-5 4-5
	2	25	1.96	1.24			

	3	32	2.06	1.37			
	4	51	1.94	1.35			
	5	187	2.82	1.33			
Spatial Orientation	1	17	2.41	1.62	19.993	.000	1-5 2-5 3-5 4-5
	2	25	2.92	1.53			
	3	32	3.31	1.55			
	4	51	3.41	1.60			
	5	187	4.77	1.65			
Spatial Visualization	1	17	2.00	.87	7.067	.000	2-5 3-5
	2	25	1.80	1.12			
	3	32	1.84	1.14			
	4	51	2.25	1.34			
	5	187	2.73	1.27			

As seen in Table 8, there are statistically significant differences in the mean scores of students on digital game addiction [F(4,307)=3.900, p<.05], mental rotation [F(4,307)=9.407, p<.05], spatial orientation [F(4,307)=19.993, p<.05], and spatial visualization [F(4,307)=7.067, p<.05] according to mathematics achievement grade. Pairwise comparisons show that students with a math grade of 1 have significantly higher mean scores for digital game addiction compared to students with a math grade of 5. Students with a math grade of 5 have significantly higher mean scores in mental rotation compared to students with math grades of 1 and 4. Furthermore, students with a math grade of 5 have significantly higher mean scores in spatial orientation compared to students with other math grades. Additionally, students with a math grade of 5 have significantly higher mean scores in spatial visualization compared to students with math grades of 2 and 3.

The Pearson correlation results for the mean scores of students on each dimension of DGASC and SRT are presented in Table 9.

Table 9. Pearson Correlation Results for Mean Scores of Students on DGASC and SRT for Each Dimension

	n	**M**	**SD**		**a**	**b**	**c**	**d**	**e**
Digital Game Addiction[a]	318	13.22	5.50	Correlation	1				
				Sig.					
Mental Rotation[b]	318	2.45	1.39	Correlation	-.068	1			
				Sig.	.230				
Spatial Orientation[c]	318	4.16	1.82	Correlation	-.159**	.413**	1		
				Sig.	.005	.000			
Spatial Visualization[d]	318	2.43	1.26	Correlation	-.029	.297**	.281**	1	
				Sig.	.610	.000	.000		
Spatial Reasoning[e]	318	9.04	3.36	Correlation	-.125*	.750**	.819**	.651**	1
				Sig.	.026	.000	.000	.000	

*$p < .05$ **$p < .01$

As shown in Table 9, there is a low-level, negative, and statistically significant relationship between students' digital game addiction and spatial orientation scores (p<.01). Additionally, there is a low-level, negative, and statistically significant relationship between digital game addiction and spatial reasoning scores (p<.05). However, there are no significant relationships between digital game addiction and mental rotation or spatial visualization scores.

Discussion, Conclusion, and Recommendations

Although digital games can have positive effects on spatial reasoning skills, there are also negative impacts, such as digital game addiction, which results from uncontrolled and excessive use. The childhood period, characterized by limited self-control, is critically important in this context. This study aims to examine children's digital game addiction and spatial reasoning skills in terms of various variables and to determine the relationship between them.

The study found that male students have significantly higher levels of digital game addiction compared to female students. Research studies (Gökçearslan & Durakoğlu, 2014; Güllü, Arslan, Dündar & Murathan, 2012; Horzum, 2011; Kaman & Bulut, 2024; Şahin & Tuğrul, 2012) observe that male students have higher levels of computer game addiction compared to female students. Korkmaz & Korkmaz (2019) found that more male students play digital games compared

to female students. However, Aydoğdu (2018) did not find significant differences in digital game addiction levels based on children's gender. Based on these research results, it can be said that male children generally have higher levels of digital game addiction compared to female children. One reason for this, though varying by individual differences, could be that society often teaches boys to be more competitive and combative. Digital games are particularly successful in creating a sense of reward and achievement and can be used by boys as a social bonding tool. This can increase the risk of addiction in boys. Additionally, the different interests and social activities pursued by girls compared to boys may be cited as a reason. According to Lopez-Fernandez, Williams, Griffiths, and Kuss (2019), this may be due to women being less encouraged to play video games because of societal gender expectations and the experiences they have while gaming. Similarly, the study by Griffiths, Davies, and Chappell (2004) explores demographic trends in online gaming and indicates that males tend to have a higher engagement with online games compared to females. This pattern may contribute to higher rates of gaming addiction among males. The findings suggest that male players are generally more involved in competitive and immersive gaming environments, which are often linked to increased gaming behaviors and a higher likelihood of addiction. This distinction aligns with social and cultural norms that emphasize competitive traits more frequently in males, potentially influencing their gaming habits. Furthermore, the study found that fifth-grade students have significantly higher levels of digital game addiction compared to fourth-grade students, and students with lower math grades have higher levels of digital game addiction compared to those with higher math grades. Horzum (2011) found that fifth-grade students had higher computer game addiction scores compared to fourth-grade students. Similarly, Şimşek & Karakuş Yılmaz (2020) found in their systematic review that digital game addiction increases in higher grades and that addiction scores decrease as academic success increases. Generally, there is a negative relationship between digital game addiction and academic success. This can be attributed to students who spend excessive time on games neglecting their studies and other responsibilities. Factors such as lack of sleep and distraction can also reduce academic performance. The study observed that digital game addiction is lower in children whose parents have university or postgraduate education levels compared to those with other educational levels. However, this observed difference was not found to be significant. Gökçearslan & Durakoğlu (2014) found that the level of computer game addiction significantly differed based on parents' education level, with higher education levels correlating with higher addiction levels in children. Some studies (Çakıcı, 2018; Şahin & Tuğrul, 2012) found no significant effect of fathers' education levels on digital game addiction. Based on these findings, it is unclear how parents' education levels affect their children's digital game addiction. Parental education levels can influence children's susceptibility to digital game addiction in various ways and should be evaluated alongside other factors such as family structure, cultural factors, individual characteristics of the child, and socioeconomic status.

The study found that male students have significantly higher spatial orientation skills compared to female students. According to a study by Bonanno and Kommers (2005), males have an advantage over females in visuospatial reasoning, particularly excelling in tasks such as disembedding and internal spatial transformations. In contrast, Sevgi Harput and Bayazıt (2021) did not observe significant differences between the spatial relationships, spatial orientation, and spatial visualization skills of male and female students in their research. Although it is difficult to draw a definitive conclusion based on these studies, the higher spatial orientation skills of male students might be due to their greater engagement in activities such as playing computer games with cars or motorcycles and riding bicycles at a young age. These activities could contribute to the development of spatial orientation skills. It was also found that fourth-grade students have significantly higher average scores in spatial orientation and spatial visualization compared to fifth-grade students, and students attending private schools have significantly higher average scores in mental rotation, spatial orientation, and spatial visualization compared to students attending public schools. The study revealed that students whose parents have a university or postgraduate education level have significantly higher mental rotation, spatial orientation, and spatial visualization skills compared to other students. In a study by İrioğlu and Ertekin (2012), it was found that children of mothers with university or high school education have significantly higher mental rotation skills compared to children of mothers with primary school education. Similarly, children of fathers with university education had significantly higher mental rotation skills compared to children of fathers with high school or primary school education. This suggests that higher parental education levels may positively impact children's spatial skills, as more educated parents might be more inclined to prioritize education and provide a wider range of educational materials, books, and toys like puzzles, Legos, and blocks that enhance spatial skills. Furthermore, students with generally higher math grades have been found to have significantly better mental rotation, spatial orientation, and spatial visualization skills compared to those with lower math grades. This finding is supported by existing literature. For example, Dokumacı Sütçü (2021) found a moderate, positive, and significant relationship between middle school students' spatial visualization skills and their success in mathematics. Gürbüz, Erdem, and Gülburnu (2018) revealed a significant positive relationship between eighth-grade students' spatial abilities and mathematical reasoning. Tam, Wong, and Chan (2018) identified a positive relationship between second-grade students' spatial skills and their mathematical skills.

Clements (1998) stated that spatial reasoning skills are related to math success and are crucial for learning many topics in mathematics and geometry. According to Bishop (1980), these findings may be due to spatial ability aiding students in organizing mathematical problems using mental images and frequently employing tools such as tree diagrams, Venn diagrams, graphs, and other shapes to organize and illustrate information and relationships between problem components.

There is a negative and significant relationship between students' digital game addiction and their spatial orientation and spatial reasoning skills (total score). This finding means that as digital game addiction increases, students' spatial reasoning skills may be negatively affected. In other words, individuals with higher levels of addiction might have lower spatial reasoning abilities. Additionally, the significance of the obtained finding indicates that the relationship between digital game addiction and spatial reasoning skills is not statistically accidental, but rather reflects a real connection between the two variables. In a study by Dokumacı Sütçü (2021), it was found that students who play computer games have significantly higher spatial skills compared to those who do not. Yang and Chen (2010) observed a significant improvement in fifth-grade students' spatial skills, including spatial perception, mental rotation, and spatial visualization, after playing a digital Pentomino game. David (2012) found that students with three different levels of spatial ability showed improved spatial performance following computer game training. However, this study shows that spatial reasoning skills can be negatively affected by conditions such as digital game addiction caused by prolonged and improper use of digital games. Similarly, in the study conducted by Yılmaz and Bozyiğit (2023), it was found that playing video games could enhance children's visual-spatial skills and working memory performance, but as addiction increases, these skills may deteriorate. Griffiths et al. (2004) indicated that individuals with higher levels of digital game addiction experience declines in cognitive and academic performance. Additionally, Prensky (2001) argued that while digital games can have positive effects on children's cognitive development, this impact can only be achieved through measured and purposeful use. Based on these research findings, it can be concluded that digital games can improve spatial reasoning skills when used properly, but the sustainability of this effect in the long term depends on maintaining control over usage and ensuring a balanced approach.

Considering the negative and significant relationship between digital game addiction and spatial reasoning skills, the research contributes significantly to the field by emphasizing the need for measures to prevent the prolonged and improper use of digital games. Otherwise, prolonged and uncontrolled use can lead to negative consequences for children's cognitive development. Parents have crucial responsibilities in preventing excessive and uncontrolled digital game play among children. They should limit their children’s daily gaming time and ensure they do not exceed the set duration, while also encouraging participation in various activities such as physical exercises, hobbies, and social events. The research is critically important as it was conducted with students in the childhood period, where self-control is limited. Similar studies with different age groups could contribute to the literature. Additionally, this research examined the performance of children playing digital games on spatial reasoning tests. Using different tests could reveal how test results vary depending on these games.

Contributions of the Researchers

All authors contributed to the manuscript equally.

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Conflict of Interest

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References

Altawalbeh, K. (2023). Game-based learning: The impact of Kahoot on a higher education online classroom. *Journal of Educational Technology and Instruction*, *2*(1), 30-49.

Aydoğdu, F. (2018). Dijital oyun oynayan çocukların dijital oyun bağımlılıklarının çeşitli değişkenler açısından incelenmesi. *Ulakbilge Sosyal Bilimler Dergisi*, *6*(31), 1-18. https://doi.org/10.7816/ulakbilge-06-31-01

Behnamnia, N., Kamsin, A., Ismail, M. A. B., & Hayati, S. A. (2023). A review of using digital game-based learning for preschoolers. *Journal of Computers in Education*, *10*(4), 603-636.

Bishop, A. J. (1980). Spatial abilities and mathematics education-A review. *Educational Studies in Mathematics*, *11*(3), 257-269. https://doi.org/10.1007/978-0-387-09673-5_5

Bonanno, P., & Kommers, P. A. (2005). Gender differences and styles in the use of digital games. *Educational Psychology*, *25*(1), 13-41. https://doi.org/10.1080/0144341042000294877

Cesarone, B. (1994). Video games and children. ERIC Digest. 1-6. ED365477.

Clements, D. H. (1998). Geometric and spatial thinking in young children. ERIC Document Reproduction Service No. ED 436232.

Clements, D. H., & Battista, M. T. (1992). Geometry and spatial reasoning. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 420-464). New York: Macmillan.

Contero, M., Naya, F., Company, P., Saorin, J. L., & Conesa, J. (2005). Improving visualization skills in engineering education. *IEEE Computer Graphics and Applications*, *25*(5), 24-31.

Corradini, A. (2011). A study on whether digital games can effect spatial reasoning skills. In *Handbook of research on improving learning and motivation through educational games: Multidisciplinary approaches* (pp. 1086-1110). IGI Global.

Çakıcı, G. (2018). *Ergenlerde dijital oyun bağımlılığı ve öfkeyi ifade etme biçimleri arasındaki ilişkinin incelenmesi* (Doktora tezi).Haliç Üniversitesi, İstanbul.

Çilingir-Altıner E.(2018). *İlkokul dördüncü sınıf öğrencilerinin matematiksel düşünme profillerine göre görsel tahmin ile uzamsal akıl yürütme becerilerinin ve problem çözme performanslarının incelenmesi* (Doktora tezi). Marmara Üniversitesi, İstanbul

David, L. T. (2012). Training effects on mental rotation, spatial orientation and spatial visualisation depending on the initial level of spatial abilities. *Procedia-Social and Behavioral Sciences*, *33*, 328-332. https://doi.org/10.1016/j.sbspro.2012.01.137

Dokumacı Sütçü, N. (2017). *Zekâ oyunlarının ortaokul 7. sınıf öğrencilerinin uzamsal yeteneklerine ve uzamsal yetenek öz-değerlendirmelerine etkisi*. (Doktora Tezi). Dicle Üniversitesi, Diyarbakır

Dokumacı Sütçü, N. (2021). Examining the two and three dimensional spatial visualization skills of secondary school students. *Milli Eğitim Dergisi*, *50*(231), 427-448. https://doi.org/10.37669/milliegitim.737639

Erboy, E. (2010). *İlköğretim 4. ve 5. sınıf öğrencilerinin bilgisayar oyun bağımlılığına etki eden faktörler* (Yüksek lisans tezi). Adnan Menderes Üniversitesi, Aydın.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8. Edition). McGraw-Hill.

Gökçearslan, Ş., & Durakoğlu, A. (2014). Ortaokul öğrencilerinin bilgisayar oyunu bağımlılık düzeylerinin çeşitli değişkenlere göre incelenmesi. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, (23), 419-435.

Göldağ, B. (2019). Dijital oyunlar: Olumlu ve olumsuz etkileri. III. Uluslararası Battalgazi Bilimsel Çalışmalar Kongresi (21-23 Eylül), Malatya.

Griffiths, M. D. (2008). Diagnosis and management of video game addiction. *New Directions in Addiction Treatment and Prevention*, (12), 27-41.

Griffiths, M. D., Davies, M. N. O., & Chappell, D. (2004). *Demographic factors and playing variables in online computer gaming*. CyberPsychology & Behavior, 7(4), 479-487. https://doi.org/10.1089/cpb.2004.7.479

Gunzler, D. D., Perzynski, A. T., & Carle, A. C. (2021). *Structural equation modeling for health and medicine*. Chapman and Hall/CRC.

Güllü, M., Arslan, C., Dündar, A., & Murathan, F. (2012). İlköğretim öğrencilerinin bilgisayar oyun bağımlılıklarının incelenmesi. *Adıyaman Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *5*(9), 89-100. https://doi.org/10.14520/adyusbd.301

Gürbüz, R., Erdem, M., ve Gülburnu M. (2018). Sekizinci sınıf öğrencilerinin matematiksel muhakemeleri ile uzamsal yetenekleri arasındaki ilişki. Kastamonu Eğitim Dergisi, 26(1), 255-260. https://doi.org/10.24106/ kefdergi.378580

Hartman, N. W., & Bertoline, G. R. (2005, July). Spatial abilities and virtual technologies: Examining the computer graphics learning environment. In Information Visualisation, Proceedings. Ninth International Conference on (pp. 992-997). IEEE.

Hauptman, H. (2010). Enhancement of spatial thinking with Virtual Spaces 1.0. *Computer & Education, 54*, 125–135. https://doi.org/10.1016/j.compedu.2009.07.013

Hazar, Z., & Hazar, M. (2017). Digital game addiction scale for children çocuklar için dijital oyun bağımlılığı ölçeği. *Journal of Human Sciences*, *14*(1), 203-216. https://doi.org/10.14687/jhs.v14i1.4387

Horzum, M. B., Ayas, T., & Çakır, Ö. B. (2008). Çocuklar için bilgisayar oyun bağımlılığı ölçeği. *Türk Psikolojik Danışma ve Rehberlik Dergisi*. *3*(30), 76-88.

Horzum, M.B. (2011). İlköğretim öğrencilerinin bilgisayar oyunu bağımlılık düzeylerinin çeşitli değişkenlere göre incelenmesi. Eğitim ve Bilim, *36*(159), 56-68.

İrioğlu, Z., & Ertekin, E. (2012). İlköğretim ikinci kademe öğrencilerinin zihinsel döndürme becerilerinin bazı değişkenler açısından incelenmesi. *Journal of Educational and Instructional Studies in the World*, 75-81.

Jirout, J. J., & Newcombe, N. S. (2015). Building blocks for developing spatial skills: Evidence from a large, representative US sample. *Psychological science*, *26*(3), 302-310. https://doi.org/10.1177/0956797614563338

Kaman, Ş., & Bulut, A. (2024). The relationship between students' digital game addiction and their attitudes and habits towards reading. *Kastamonu Education Journal*. 32(3), 498-505. https://doi.org/10.24106/kefdergi.1525396

Király, O., Potenza, M. N., Stein, D. J., King, D. L., Hodgins, D. C., Saunders, J. B., ... & Demetrovics, Z. (2020). Preventing problematic internet use during the COVID-19 pandemic: Consensus guidance. *Comprehensive psychiatry*, *100*,152-180. https://doi.org/10.1016/j.comppsych.2020.152180

Korkmaz, Ö., Korkmaz, Ö. (2019). Ortaokul öğrencilerinin oyun bağımlılık düzeyleri, oyun alışkanlıkları ve tercihleri. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, *20*(3), 798-812. https://doi.org/10.17679/inuefd.505200

Lin, C. H., & Chen, C. M. (2016). Developing spatial visualization and mental rotation with a digital puzzle game at primary school level. *Computers in Human Behavior*, *57*, 23-30. https://doi.org/10.1016/j.chb.2015.12.026

Linn, M. C., & Petersen, A. C. (1985). Emergence and characterization of gender differences in spatial abilities: A meta-analysis. *Child Development*, *56*, 1479-1498. https://doi.org/10.2307/1130467

Lohman, D. F. (1979). Spatial ability: A review and reanalysis of the correlational literature. Tecnical Report No.8, Aptitude Research Project, School of Education, Stanford University.

Lopez-Fernandez, O., Williams, A. J., Griffiths, M. D., & Kuss, D. J. (2019). Female gaming, gaming addiction, and the role of women within gaming culture: A narrative literature review. *Frontiers in psychiatry*, *10*, 454. https://doi.org/10.3389/fpsyt.2019.00454

Lowrie, T., Logan, T., & Hegarty, M. (2019). The influence of spatial visualization training on students' spatial reasoning and mathematics performance. *Journal of Cognition and Development*, *20*(5), 729-751. https://doi.org/10.1080/15248372.2019.1653298

Lowrie, T., Logan, T., & Ramful, A. (2016). Spatial Reasoning Influences Students' Performance on Mathematics Tasks. In White, B., Chinnappan, M. & Trenholm, S. (Eds.). *Opening up mathematics education research* (Proceedings181of the 39th annual conference of the Mathematics Education Research Group of Australasia), pp. 407–414. Adelaide: Merga.

Lowrie, T., Logan, T., & Ramful, A. (2017). Visuospatial training improves elementary students' mathematics performance. *British Journal of Educational Psychology*, *87(2),* 170–186. https://doi.org/10.1111/bjep.12142

Martin-Dorta, N., Sanchez-Berriel, I., Bravo, M., Hernandez, J., Saorin, J. L., & Contero, M. (2014). Virtual blocks: A serious game for spatial ability improvement on mobile devices. *Multimedia Tools and Applications*, *73*(3), 1575-1595. https://doi.org/10.1007/s11042-013-1652-0

Moreau, D. (2013). Differentiating two-from three-dimensional mental rotation training effects. *The Quarterly Journal of Experimental Psychology*, *66*(7), 1399-1413. https://doi.org/10.1080/17470218.2012.744

Olkun, S. (2003). Comparing computer versus concrete manipulatives in learning 2D geometry. *Journal of Computers in Mathematics and Science Teaching*, *22*(1), 43-46. https://doi.org/10.1501/0000984

Prensky, M. (2001). *Digital Game-Based Learning*. McGraw-Hill.

Ramful, A., Lowrie, T., & Logan, T. (2017). Measurement of spatial ability: Construction and validation of the spatial reasoning instrument for middle school students. *Journal of Psychoeducational Assessment, 35*(7), 709-727. https://doi.org/10.1177/0734282916659207

Sevgi, S., Harput, D., & Bayazıt, İ. (2021). Ortaokul öğrencilerinin uzamsal zekâ becerilerinin cinsiyet, sınıf ve okul açısından incelenmesi. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, *18*(2), 558-581. https://doi.org/10.33711/yyuefd.1029079

Sjölinder, M. (1998). Spatial cognition and environmental descriptions. In N. Dahlbäck (Ed.), *Exploring navigation: Towards a framework for design and evaluation of navigation in electronic* spaces (pp. 46-58).

Şahin, C., & Tuğrul, V. M. (2012). İlköğretim öğrencilerinin bilgisayar oyunu bağımlılık düzeylerinin incelenmesi. *Zeitschrift für die Welt der Türken/Journal of World of Turks*, *4*(3), 115-130.

Şahin, M., Keskin, S., & Yurdugül, H. (2019). Impact of family support and perception of loneliness on game addiction analysis of a mediation and moderation. *International Journal of Game-Based Learning (IJGBL)*, *9*(4), 15-30. https://doi.org/10.4018/IJGBL.2019100102

Şimşek, E., & Karakuş Yılmaz, T. (2020). Türkiye'de yürütülen dijital oyun bağımlılığı çalışmalarındaki yöntem ve sonuçların sistematik incelemesi. *Kastamonu Education Journal*, *28*(4), 1851-1866. https://doi.org/10.24106/kefdergi.3920

Talan, T., & Kalınkara, Y. (2020). Ortaokul öğrencilerinin dijital oyun oynama eğilimlerinin ve bilgisayar oyun bağımlılık düzeylerinin incelenmesi: Malatya ili örneği. *Journal of Instructional Technologies and Teacher Education*, *9*(1), 1-13.

Tam, Y. P., Wong, T. T. Y., & Chan, W. W. L. (2018). The relation between spatial skills and mathematical abilities: The mediating role of mental number line representation. *Contemporary Educational Psychology*. https://doi.org/10.1016/j.cedpsych.2018.10.007

Weinstein, A. M. (2010). Computer and video game addiction-a comparison between game users and non-game users. *The American journal of drug and alcohol abuse*, *36*(5), 268-276. https://doi.org/10.3109/00952990.2010.491879

Westfall, P. H., & Henning, K. S. (2013). *Understanding advanced statistical methods* (Vol. 543). Boca Raton, FL: CRC Press.

Yang, J. C., & Chen, S. Y. (2010). Effects of gender differences and spatial abilities within a digital pentominoes game. *Computers & Education*, *55*(3),1220-1233. https://doi.org/10.1016/j.compedu.2010.05.019

Yılmaz, S., & Bozyiğit, T. (2023). Farklı dijital oyun bağımlılığı düzeyine sahip çocuklarda görsel uzaysal bilişsel beceriler ve çalışma belleği kapasitesinin karşılaştırılması. *Bağımlılık Dergisi*, *24*(3), 371-380. https://doi.org/10.51982/bagimli.1207764

You, J. H., Chuang, T. Y., & Chen, W. F. (2008). Enhancing students' spatial ability by implementing a digital game, Proceedings of the 16th International Conference on Computers in Education, Taipei, Taiwan.