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Education Psychology Perspective: Does Excessive Digital Gaming Impair Cognitive Flexibility? Evidence from Neurodivergent Students

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Abstract

Numerous studies have investigated the association between excessive digital gaming and its impact on cognitive flexibility; however, when it comes to neurodivergent individuals, such studies are limited. The present study aimed to investigate the impact of excessive digital gaming on cognitive flexibility, particularly among neurodivergent students diagnosed with autism spectrum disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) in the cultural context of Pakistan. The study adopted a cross-sectional correlational design and employed a purposive sampling technique.The inclusion criteria for the study comprised students diagnosed with ASD, ADHD, or both, with an age range of 12 to 19 years (i.e., adolescents only). The study utilized two questionnaires, namely the Gaming Addiction Scale for Adolescents and the Cognitive Flexibility Inventory. The findings demonstrated a significant negative correlation between excessive digital gaming and cognitive flexibility, indicating that higher levels of problematic gaming were associated with lower levels of cognitive flexibility among neurodivergent students. Furthermore, regression analysis demonstrated that excessive gaming significantly and negatively predicted cognitive flexibility. The study emphasizes the need for educational institutions and mental health professionals to foster balanced digital gaming habits and cognitive skill development among neurodivergent learners.

Key Words

Excessive Digital Gaming, Cognitive Flexibility, Neurodivergent Students, Autism Spectrum Disorder, Attention-Deficit/Hyperactivity Disorder

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Introduction

Rapid technological advancements have transformed various aspects of daily life, including communication, education, business, and entertainment (Adeoye & Otemuyiwa, 2024; Khan et al., 2024; Shahid et al., 2024). In the contemporary online environment, digital gaming has been a recreational activity, particularly for youth, as these games possess specifications that allow multiple players to play at the same time together around the world, for instance, PUBG and Ludo Star Game (Bashir et al., 2024; Griffiths et al., 2016; Shahid & Yaseen, 2025; Shahid et

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al., 2025). Articles on digital gaming reported that moderate gaming is associated with better focus, visuospatial skills, cognitive processing, and problem-solving skills; however, problematic gaming is associated with impaired cognitive functioning and adverse psychological outcomes (Bashir et al., 2024; Ioannidis et al., 2019; Männikkö et al., 2020; Shahid et al., 2024; Von der Heiden et al., 2019).

Cognitive Flexibility refers to the capacity of an individual to adapt thinking, switch between tasks, and change responses according to the environmental demands (Diamond, 2013). It is also considered the core component of executive functioning and plays an important role in acquiring knowledge, decision-making, social adaptation, and emotional regulation (Miyake et al., 2000). Those with high cognitive flexibility often adjust to novel situations, overcome complex obstacles, and manage high-pressure situations. At the same time, those with cognitive deficits possess a rigid thinking pattern and face challenges in the change of environment (Diamond, 2013).

Some studies revealed that a strategy involving playing video games can improve executive functions, including cognitive flexibility, because players often face situations that require adapting strategies and responding to changes in the demands of the game (Bediou et al., 2018). Contrary to this, excessive gaming is also associated with reduced attention span, compulsive behavioral patterns, decline in academic performance, and impaired cognitive abilities (Irfan et al., 2025; Othman et al., 2025; Shahid et al., 2024). Therefore, it is unclear and ambiguous in today's psychological research whether excessive gaming enhances or impairs cognitive function.

The relationship between excessive digital gaming and cognitive flexibility is important, specifically among neurodivergent individuals, such as students diagnosed with Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD). Neurodivergence refers to naturally occurring variations in neurological development and functioning that affect cognition, behavior, and social interaction (Singer, 2017). ASD is characterized by a fixation on routines, repetitive behaviors, lack of social reciprocity, restricted interests, and cognitive inflexibility (Demetriou et al., 2018). Likewise, ADHD is characterized by deficits in executive functioning, inattention, distractibility, impulsivity, difficulties sustaining attention, and cognitive inflexibility (Barkley, 2015).

Researchers suggest that digital gaming offers structured and rewarding experiences that may align with the cognitive characteristics of individuals with ADHD and ASD (Masi et al., 2021; Mazurek & Engelhardt, 2013). Digital gaming may provide opportunities for the development and refinement of cognitive skills, including attentional shifting and rapid decision-making (Bediou et al., 2018). Nevertheless, problematic gaming may contribute to greater impairments in executive functioning when engagement becomes excessive and interferes with everyday responsibilities (Paulus et al., 2018; Turan et al., 2024; Zhao et al., 2025). However, this relationship among children with ADHD and ASD is rarely studied when it comes to the cultural context of Pakistan.

Rationale

Despite increasing international interest in digital gaming and neurodiversity, empirical evidence regarding the relationship between excessive digital gaming and cognitive flexibility remains limited, particularly in developing countries such as Pakistan. Over the past decade, Pakistan has witnessed substantial growth in internet accessibility, smartphone ownership, and participation in digital gaming activities among young individuals. Neurodivergent students diagnosed with Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) may experience unique cognitive and educational challenges, including deficits in executive functioning and cognitive flexibility. Although previous studies have examined the cognitive outcomes of gaming in the general population, research focusing on neurodivergent students remains scarce. Therefore, investigating the association between excessive digital gaming and cognitive flexibility among neurodivergent students is important for enhancing understanding of cognitive functioning in this population and for informing educational and psychological interventions within the Pakistani context.

The present study aims to examine whether excessive digital gaming is associated with cognitive flexibility among neurodivergent students diagnosed with ASD and ADHD in Pakistan. By addressing this gap, the study seeks to contribute to the growing literature on neurodiversity, executive functioning, and digital gaming while providing culturally relevant evidence from an underrepresented population.

Objective

1. To assess the effect of excessive digital gaming on cognitive flexibility among adolescents with ADHD and ASD.

Hypothesis

H1: Excessive digital gaming predicts cognitive flexibility among adolescents with ADHD and ASD.

Methodology

Research Design

The present study utilized a quantitative cross-sectional correlational research design to assess the relationship between excessive digital gaming and cognitive flexibility among neurodivergent students, particularly diagnosed with ADHD and ASD in Pakistan.

Sampling Technique and Inclusion Criteria

A purposive sampling technique was employed to recruit neurodivergent adolescent students diagnosed with Autism Spectrum Disorder (ASD) and/or Attention-Deficit/Hyperactivity Disorder (ADHD) from special education institutions in Lahore and Islamabad, Pakistan. Participants were eligible if they were adolescents aged 12 to 19 years, had a documented diagnosis of ASD and/or ADHD, and had been engaged in digital gaming for at least one year with a minimum gaming duration of one hour per day.

Procedure

The researchers approached special education institutions in Islamabad and Lahore for participant recruitment. A total of 29 institutions participated in the study, including 13 from Lahore and 16 from Islamabad. Permission for data collection was obtained from the heads of the respective institutions. Parents of neurodivergent students diagnosed with ASD and ADHD were invited to the institutions and were briefed about the purpose and procedures of the study, particularly for participants under the age of 18. Written informed consent was obtained from parents for minors, while consent was obtained directly from participants aged 18 and above. The authors assisted participants in completing the questionnaires when required. Of the 250 participants approached, 24 withdrew from the study. The collected data were then entered into IBM SPSS Version 27 for analysis.

Sample Characteristics

The final sample consisted of 226 neurodivergent students with a mean age of 15.46 years (SD = 1.47). Regarding clinical diagnosis, 42.5% (n = 96) had autism, 40.3% (n = 91) had ADHD, and 17.3% (n = 39) had both conditions. The sample included 57.1% (n = 129) males and 42.9% (n = 97) females. In terms of educational level, 63.7% (n = 144) were enrolled in primary education, 17.7% (n = 40) in Montessori, 15.5% (n = 35) in middle school, and 3.1% (n = 7) in matriculation. Regarding residence, 46.9% (n = 106) were from Lahore and 53.1% (n = 120) from Islamabad. Concerning gaming habits, 34.1% (n = 77) reported gaming for 1–4 hours daily, 33.6% (n = 76) for 5–8 hours, 23.5% (n = 53) for 9–12 hours, and 8.8% (n = 20) reported more than 12 hours of daily gaming.

Measures

Gaming Addiction Scale for Adolescents

Excessive digital gaming was measured using the Gaming Addiction Scale for Adolescents (Lemmens et al., 2009). The scale consists of seven items rated on a five-point Likert scale, ranging from 1 (Never) to 5 (Very Often). The Cronbach alpha of the scale is 0.92, which is excellent. In the current study, the internal consistency is 0.72, which is satisfactory.

Cognitive Flexibility Inventory

Cognitive flexibility was measured using the Cognitive Flexibility Inventory (Dennis & Vander Wal, 2010). The instrument comprised 20 items rated on a seven-point Likert scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). The Cronbach alpha of the original scale is 0.91. In the current study, the internal consistency is 0.88, which is satisfactory.

Ethical Consideration

The study followed the American Psychological Association 7th edition, for data collection, participants' parents were asked for permission, particularly for those under 18 years. Participants were informed of the confidentiality of their information. The special education institute's name was kept confidential as the authors were asked to do so. Upon written signature of the consent form by the parents for those with children less than 18 and for those aged 18 and above, written consent was taken from the participants directly. Subsequently, demographics and study instruments were provided to the participants, and they were asked to leave at any juncture of the study if they wanted to leave. The special education institution heads, participants, and their parents were thanked for their valuable time and permission to gather the data.

Results

Pearson Product Correlation

Table 1

Relationship between Study Variables (N = 226)

Variables	1	2	Mean	Standard Deviation
1. Excessive Digital Gaming	-	-.72***	18.76	4.87
2. Cognitive Flexibility		-	102.36	17.80

Note. *** p < .001

The above table revealed a significant negative relationship between excessive digital gaming and cognitive flexibility, $r = -.72$, $p < .001$.

Regression Analysis

Table 2

Predicting Cognitive Flexibility from Excessive Digital Gaming (N =226)

	B	*SE*	**B**	R^2	*F*	*t*	*LLCI*	*ULCI*
				.51	241.69			
Constant	151.77***	3.28				46.23	145.30	158.24
EDG	-2.63***	.16	-.72			-15.54	-2.96	-2.29

Note. *** p < .001, EDG = Excessive Digital Gaming

A simple linear regression showed that excessive digital gaming significantly predicted cognitive flexibility, F(1, 224) = 241.69, p < .001, explaining 51% of the variance ($R^2 = .51$). Excessive digital gaming was a significant negative predictor of cognitive flexibility (B = −2.63, SE = .16, β = −.72, t = −15.54, p < .001), indicating that higher gaming levels were associated with lower cognitive flexibility.

Discussion

The present study explored whether excessive digital gaming enhances or impairs cognitive flexibility among neurodivergent students, particularly those diagnosed with ASD, ADHD, or both, in Pakistan. The findings

contribute to the growing body of literature examining the cognitive consequences of gaming behavior among students diagnosed with ASD and ADHD.

The findings of the study revealed that excessive digital gaming negatively and significantly predicted cognitive flexibility among students diagnosed with ADHD and ASD. The finding is aligned with previous research demonstrating that excessive gaming is associated with deficits in executive functioning, low attentional control, and cognitive fixation (Paulus et al., 2018; Turan et al., 2024). Although some researchers have stated that strategic video games may enhance cognitive skills, such benefits are generally observed among moderate gamers rather than individuals exhibiting problematic gaming patterns (Bediou et al., 2018; Shahid et al., 2025). Excessive gaming may restrict opportunities for real-world cognitive engagement, social interaction, and adaptive problem-solving and decision-making skills, which are key to the development of cognitive flexibility.

The findings may be specifically relevant for adolescents with ASD and ADHD, as these populations already experience hurdles related to executive functioning and cognitive inflexibility (Barkley, 2015; Demetriou et al., 2018). Excessive gaming may further exacerbate repetitive behavioral patterns, attentional difficulties, and rigid thinking patterns, thereby reducing the ability to adapt to changing academic and social demands.

Conclusion

The study aimed to investigate the impact of excessive digital gaming on cognitive flexibility among neurodivergent students diagnosed with ADHD and ASD in Pakistan, with an age range of 12 to 19 years (i.e., adolescents) who were currently enrolled in special education institutions and had been engaged in digital gaming for at least one year prior to participation. The findings revealed a significant negative relationship between excessive digital gaming and cognitive flexibility, indicating that higher levels of gaming were associated with lower cognitive flexibility. Furthermore, excessive digital gaming significantly and negatively predicted cognitive flexibility. Thus, the study addressed an important gap in the existing literature by providing empirical evidence from the Pakistani context.

Implications

The findings have vital implications for educational psychology, i.e., excessive gaming may interfere with cognitive processes required for learning, decision making, and academic success. Educational institutions should develop digital well-being awareness programs and encourage balanced gaming habits among neurodivergent students. Furthermore, parents, counsellors and educators should collaboratively closely monitor gaming behavior to prevent excessive use from affecting daily functioning. Additionally, mental health experts may incorporate digital behavior assessments into intervention plans for neurodivergent students to enhance better cognitive and emotional results.

Limitations and Recommendations

The sample size is very limited, i.e., 226, which cannot be generalized to the whole population of ADHD and ASD students. Future studies are suggested to include a larger sample size. The data was gathered from only Islamabad and Lahore, which further limits the findings; future studies need to include more regions of Pakistan to enhance the generalizability. Thirdly, the study questionnaires were in English; Pakistani studies, particularly those diagnosed with ADHD and ASD, might not understand the content adequately. Furthermore, the data representation of ASD and ADHD and the comorbidity of both are not balanced; therefore, future studies are suggested to utilize a stratified sampling technique to collect the data.

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