

The Association between Addiction to Online Games and Students' Academic Engagement: Determining the Mediating Role of Executive Function

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Abstract

Background: Online gaming addiction can negatively affect academic performance. Thus, it is important to understand the factors that influence it. This study aimed to investigate the correlation between online gaming addiction and academic engagement with the mediating role of executive functions among secondary school students.

Methods: The present cross-sectional study included all secondary high school students in Tehran, Iran in the academic year of 2023-2024. A total number of 384 students were selected using the random cluster sampling method, and they were asked to fill out the Internet Gaming Disorder Test (IGD-20), Student Engagement Questionnaire, Adult Executive Functioning Inventory (ADEXI), and Nejati Cognitive Abilities Questionnaire. Data were analyzed using Pearson correlation analysis and structural equation modeling (SEM) with SPSS version 26 and AMOS version 24.

Results: The results showed that online game addiction is negatively correlated with students' academic engagement ($r=-0.336$) as well as all dimensions of executive function, including planning ($r=-0.425$), cognitive flexibility ($r=-0.455$), working memory ($r=-0.420$), and inhibition ($r=-0.350$). Furthermore, path analysis revealed that online game addiction does not directly predict academic engagement ($\beta=-0.12$, $P=0.37$). However, it can indirectly predict academic engagement through the mediation of working memory ($\beta=-0.013$, $P=0.025$) and inhibition functions ($\beta=-0.013$, $P=0.016$). Overall, addiction to online games and the dimensions of executive function collectively account for nearly 44% of students' academic engagement.

Conclusions: These results suggested that excessive online gaming is destructive to cognitive abilities and motivation toward learning and schooling among adolescent students. Consequently, parents, teachers, and school psychologists should develop suitable educational, training, and therapeutic strategies to mitigate these harmful effects.

Keywords: Internet gaming disorder, Executive function, Engage, Students

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1. Introduction

In recent years, the Internet has become the most significant scientific and entertainment tool for teenagers and adults around the world. The Internet is among the events with high prevalence rate in the world (1). Prolonged and continuous use of the Internet has led to a condition known as *Internet addiction*, which has garnered the attention of numerous specialists and social pathologists over the past decade (2). It is estimated that the prevalence of Internet use is between 4 and 22.8 (3); however, it can reach the point where it affects the private life of students and even becomes a disorder. Due to the wide spread of online games, Internet gaming disorder mainly affects teenagers and young people and engages this age group (4).

Online smart games have become widespread due to the increased familiarity of people, especially the young, with the Internet; the increased Internet speed; and the access to smart phones and tablets. This disorder manifests in three main ways. First, the use of mobile phones during educational activities tends to have a negative impact on academic performance and progress. Second, for students to achieve academic success, it is essential to master basic skills and cognitive abilities, which are adversely affected by excessive mobile phone use and addiction (5). Third, addiction to online gaming negatively influences students' motivation to learn (6). Although online gaming fulfills different needs of individuals, it can lead to negative effects on individuals, particularly adolescents. As soon as the behavior becomes addictive, it impairs

their mental health. Online game addiction among teenagers causes mental health disorder, increased depression, anxiety and psychosis, disruption of family relationships and academic problems (7).

Another problem that may be caused by this disorder is related to academic engagement (8). Academic engagement can be considered as a sense of belonging and the person's tendency to participate in class activities or extracurricular activities such as sports, music, theater, and collective work organized by the school (9). Student academic engagement has three dimensions including behavioral, cognitive, and emotional and each dimension has some indicators (10). In this regard, previous studies (11, 12) discovered a reverse association between time spent on Internet and social networks and academic engagement.

On the other hand, various factors may affect the relationship between online gaming addiction and students' engagement, one of which can be executive functions. *Executive function* refers to a set of cognitive processes that are essential for goal-directed behaviors, thoughts, and emotions. These processes are particularly crucial in new or challenging situations where quick and flexible adjustments in behavior are needed to adapt to changing environmental demands (13). The development of executive function depends not only on the maturation of related areas of the brain but also on the social experiences a child encounters, particularly within the home and school environments. In recent years, the term "executive function" has gained significance in education, as both researchers and educators highlight the importance of skills such as goal setting, planning, and organization for academic success (13). In this regard, Bouzaboul and colleagues (14) stated in their own study that executive functions affect the level of education. Likewise, Amani (15) came to the conclusion that desirable executive functions affect performance and high academic achievement. However, addiction to online games and the Internet, in general, can be related to executive functions (16). Studies showed that the inability in executive function of the response inhibition type is considered as the main core of addictions (17). In a study, Gravand and Sabzian (18) concluded that Internet addiction directly reduces academic engagement. Soares and co-workers (16) identified a link between Internet gaming disorder and executive functions, which include response

inhibition, working memory, delay aversion, and emotion regulation. Previous research (11, 19, 20) also reached similar results in their own study.

Therefore, according to the issues discussed, it is clear that online gaming addiction may decrease the learning and academic progress of students. Academic performance is a very important aspect of an individual's life; thus, if individuals have some problems in their education, they can be prone to other problems as well. Therefore, it is vital to know more about the effect of addictive use of online games on the components needed for academic progress.

After the establishment of virtual classrooms during the spread of Corona virus and the availability of the Internet and smartphones for young students, the issue of students' addiction to the Internet became more important than before and gained special sensitivity so that, at present, paying attention to education at this stage and level of study is one of the necessities of the national education system. The prevalence of this disorder in both Western and Eastern centuries has been reported as 12.90-15.65% (1). This difference is likely due to variable levels of Internet access, multiple definitions of Internet addiction, and different diagnostic tools in different countries (21). On the other hand, the prevalence of disorder related to Internet games has also been reported as 5.3%, which makes it necessary to pay attention to this issue (22). In a study, Griffiths (23) concluded that online gaming addiction has a negative impact on individuals' lives. According to Sun and co-workers (6), online gaming addiction negatively impacts the behavioral, emotional, and cognitive aspects of learning interactions. Consequently, when students lack participation in these areas, their motivation for academic progress diminishes. As adolescent gaming addiction emerges as a significant behavioral addiction with various harmful consequences, the findings of this study can enhance our understanding of the multiple dimensions of this issue. Also, several studies investigated the role of Internet addiction in two cognitive and motivational constructs of executive functions (16, 20) and academic engagement (6, 8), separately, but so far, the consequences of web-based game addiction have not been simultaneously studied on these two constructs, especially in Iran. Therefore, this study aimed to explore the association between online gaming addiction and

academic engagement, focusing on the mediating role of executive functions—specifically inhibition, working memory, cognitive flexibility, and planning—among secondary school students.

2. Methods

2.1. Design and Participants

The present cross-sectional study focused on high school students in Tehran, Iran during the academic year of 2023-2024. We selected 384 students using a staged random cluster sampling method. Initially, high schools from District 8 of Tehran, Iran were selected from 20 districts. From these schools, three boys' schools and three girls' schools were selected. However, the primary criterion for entry into the study—daily involvement in online games—was only met by 66 female students at the girls' schools. Consequently, the majority of the sample was drawn from the three boys' schools. The other criteria for entering the study were: not being diagnosed with a psychiatric disorder (according to participants' self-report) and having a parent's consent letter. The exclusion criteria were incomplete questionnaire responses.

2.2. Measures

2.2.1. Internet Gaming Disorder Test of Pontes (IGD-20): IGD-20 is a reliable and valid questionnaire created in 2014 to diagnose Internet Gaming Disorder. It is based on the nine criteria outlined in DSM-5 (24). This test evaluates both online and offline gaming behaviors over the past 12 months. Comprising 20 questions, it covers six dimensions: salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse. These dimensions align with the components of the addiction model. Responses are assessed using a five-point Likert scale, ranging from "completely disagree" to "completely agree," with a minimum score of 1 and a maximum score of 5. The content validity of this tool has mainly been investigated using qualitative methods. Vahidi and colleagues (25) examined the validity and reliability of IGD-20 in Iran. They assessed the qualitative content validity of this test by analyzing the opinions of ten experts regarding the relevance of IGD-20 items to the Iranian population and culture. All translated items of the IGD-20 Test were deemed appropriate, with the exception of one item. The criterion validity of the IGD-20 test was determined by a strong and

significant correlation between its total score and the scores from the Holmes-Rahe Stress Inventory as well as hours of Internet use. Additionally, the test exhibited an internal consistency, measured by Cronbach's alpha coefficient of 0.91, and a test-retest reliability of 0.95. With the aid of eight specialists, we established its validity (CVI=0.84, CVR=0.81). Furthermore, the alpha coefficient in our sample was determined to be 0.90.

2.2.2. Student Engagement Questionnaire (SEQ): This questionnaire consisting of 17 questions was developed by Reeve in 2013. Respondents rate their answers on a 7-point Likert scale (strongly disagree to strongly agree). This questionnaire includes four subscales: agentic, behavioral, cognitive, and emotional engagement. Reeve's study (26) involved a sample of 271 students from six different courses within an engineering faculty in a city in South Korea. To establish the reliability and validity of the questionnaire, Reeve (26) employed Cronbach's alpha and conducted both exploratory and confirmatory factor analyses. In the exploratory factor analysis, four factors emerged based on principal components with oblique rotation and an eigenvalue more than one. In addition, the reliabilities of agentic, behavioral, emotional, and cognitive subscales were obtained as 0.86, 0.86, 0.90, and 0.84, respectively, indicating good internal consistency. In Iran, Ramazani and Khamesan (27) examined this questionnaire on 224 students and concluded that it has a good reliability of 0.92. In assessing the content validity of this tool, the values obtained from calculating the Content Validity Ratio (CVR=0.98) and Content Validity Index (CVI=0.99) were found to be satisfactory. The results of confirmatory factor analysis showed that the structure of the questionnaire had an acceptable fit with the data, and all the goodness of fit indicators were confirmed for the four-factor model underlying the questionnaire. In this study, the overall Cronbach's alpha for all items was 0.91, while the alpha values for the subscales of agency, cognitive, behavioral, and emotional engagement were 0.81, 0.77, 0.87, and 0.82, respectively.

It should be noted that two separate questionnaires were used to examine executive functions, which are mentioned below:

2.2.3. Adult executive functioning inventory (ADEXI): Holst and Thorell (28) developed ADEXI in 2018, based on the Child Executive Functioning

Inventory (CHEXI). This questionnaire contains 14 questions, focusing primarily on measuring working memory (questions no. 1, 2, 5, 7, 8, 9, 11, 12, 13) and inhibition (questions no. 3, 4, 6, 10, 14). The questionnaire is scored on a 5-point Likert scale (from completely wrong to completely right) in which a high score means better performance. ADEXI has been validated in both clinical (ADHD) and non-clinical samples, demonstrating correlations with other behavioral rating inventories and performance-based measures (29). López and co-workers (29) obtained the validity and reliability of this questionnaire. The Cronbach's alpha of the questionnaire in this study was 0.75. In Iran, the questionnaire was validated by Parhoon and colleagues (30). Several experts confirmed its content validity. The researcher evaluated the Persian version of ADEXI in a sample of 250 typically developing adults and found that it demonstrated good reliability, with internal consistency scores ranging from 0.82 to 0.85 and test-retest reliability scores between 0.89 and 0.90. Additionally, appropriate convergent validity was established through correlations with the behavioral rating scale of executive functions for adults, which ranged from 0.63 to 0.68. In our study, eight specialists established CVI values of 0.86 and CVR values of 0.81 for this tool. Then, the internal consistency coefficient was calculated using the alpha coefficient, resulting in values of 0.81 for working memory and 0.69 for inhibition.

2.2.4. Cognitive Abilities Questionnaire (CAQ): This questionnaire, created by Nejati, is designed to evaluate key cognitive abilities essential for everyday life, with a particular focus on executive functions (31). It consists of 30 questions that assess seven subscales: memory, inhibitory control and selective attention, decision-making, planning, sustained attention, social cognition, and cognitive flexibility. The scoring uses a 5-point Likert scale, where 1 corresponds to "almost never" and 5 corresponds to "almost always." After developing the questionnaire items and verifying their face and content validity, Nejati (31) conducted a three-stage validation study. First, the construct validity of the seven subscales was assessed through exploratory factor analysis involving a sample of 1095 adults aged 17 to 58. The questionnaire demonstrated strong internal consistency, with a Cronbach's alpha of 0.834. Next, to evaluate the test-retest reliability, Pearson's correlation was calculated with a three-week interval between

administrations, resulting in a strong reliability ($r=0.865$). Finally, to evaluate concurrent validity, correlation coefficients were calculated between the GPAs of 395 undergraduate students and their scores on the questionnaire. The results indicated a positive and significant correlation across all subscales, with the exception of the social cognition subscale. In this study, by analyzing the opinions of eight experts on the items of this questionnaire, a CVI of 0.93 and a CVR of 0.92 were obtained for the entire questionnaire, indicating its favorable validity. Also, the Cronbach's alpha value was found to be 0.89, indicating that the questionnaire has desirable reliability.

2.3. Implementation Procedure

In order to proceed with the next phases of our study and collect the required data, we initially sought permission from the Education Department of District 8 in Tehran, Iran and also from the selected high schools.

Then two trained interviewers (one male and one female) outlined the objectives and process of the study for both teachers and parents, using a consistent set of instructions. We then randomly selected students who reported using online games based on their statements. Before the students completed the questionnaires, we assured them that their information would remain confidential and that participation in the study was completely voluntary. After that, we provided them with paper-and-pencil questionnaires, and the students completed the questionnaires within the allotted time.

2.4. Statistical Analysis

After collecting the data, descriptive statistics including frequency, percentage, mean, and standard deviation were used to clarify the status of the variables. The Pearson correlation test was employed to calculate the bivariate correlation between the observed variables. Finally, the research model presented in Figure 1 was analyzed using structural equation modeling (SEM). To assess the fitness of the final model, several goodness-of-fit indices were evaluated, including the Chi-Square/Degrees of Freedom Ratio (CMIN/Df), Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), and Root Mean Square Error of Approximation (RMSEA). These analyses were conducted using SPSS version 26 and AMOS version 24.

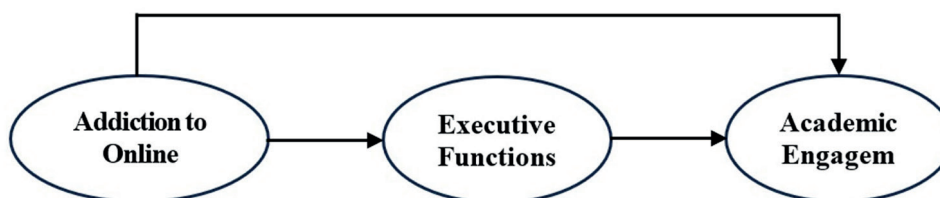


Figure 1: The figure shows the conceptual model of the research.

3. Results

A total number of 384 students participated in the present study, from among whom 318 students (82.8%) were boys and 66 students (17.2%) were girls. Totally, 242 students were in the 10th grade, and 119 and 23 students were in the 11th and 12th grades, respectively. The results of the descriptive statistics, including mean (M) and standard deviation (SD) for each variable, are presented in Table 1. Additionally, Table 1 includes a correlation matrix that reports the Pearson correlation coefficients and the significance levels between the variables, which helps to examine the relationships among them.

According to Table 1, the results of Pearson correlation test indicate a negative and significant correlation between addiction to online games and academic engagement ($r=-0.336$) and executive function dimensions, including planning ($r=-0.425$), cognitive flexibility ($r=-0.455$), working memory ($r=-0.420$), and inhibition ($r=-0.350$). There are positive correlations between academic engagement and planning ($r=0.471$), cognitive flexibility ($r=0.380$) and working memory ($r=0.293$) and inhibition ($r=0.246$).

After conducting these analyses, structural equation modeling was used to test the model examining the impact of online gaming addiction on academic engagement, with executive functions

acting as a mediator. The results are illustrated in Figure 2.

The fit indices of the structural equation model (CMIN/DF=2.85, GFI=0.834, CFI=0.814, NFI=0.856, RMSEA=0.070) indicated that the final model demonstrates an acceptable fit to the data.

Then, the significance of the direct path between online game addiction, academic engagement, and executive functions (planning, cognitive flexibility, working memory, and inhibition) was investigated, with the results shown in Table 2.

The findings shown in Table 2 reveal significant direct links between online gaming addiction and students' executive functions. Specifically, online game addiction negatively predicts planning ($\beta=-0.65$), cognitive flexibility ($\beta=-0.68$), working memory ($\beta=-0.53$), and inhibition ($\beta=-0.58$) functions. Moreover, the direct path coefficient of online game addiction to academic engagement was not significant. Among the executive functions, only planning ($\beta=0.62$) and cognitive flexibility ($\beta=0.20$) were found to significantly predict students' academic engagement.

Subsequently, we analyzed the indirect path coefficients between online gaming addiction and academic engagement using the bootstrap technique. Table 3 presents the estimated parameters for this analysis.

Table 1: Descriptive indicators and correlation matrix of the variables

Variables	Mean (SD)	1	2	3	4	5
1. Online game addiction	50.09 (15.26)	1				
2. Academic engagement	73.04 (19.29)	$r=-0.336$ $P<0.0001$	1			
3. Planning	7.48 (3.80)	$r=-0.425$ $P<0.0001$	$r=0.471$ $P<0.0001$	1		
4. Cognitive flexibility	10.52 (3.44)	$r=-0.455$ $P<0.0001$	$r=0.38$ $P<0.0001$	$r=0.582$ $P<0.0001$	1	
5. Working memory	23.99 (6.40)	$r=-0.420$ $P<0.0001$	$r=0.293$ $P<0.0001$	$r=0.435$ $P<0.0001$	$r=0.499$ $P<0.0001$	1
6. Inhibition	11.60 (3.18)	$r=-0.350$ $P<0.0001$	$r=0.246$ $P<0.0001$	$r=0.307$ $P<0.0001$	$r=0.340$ $P<0.0001$	$r=0.457$ $P<0.0001$

SD: Standard Deviation

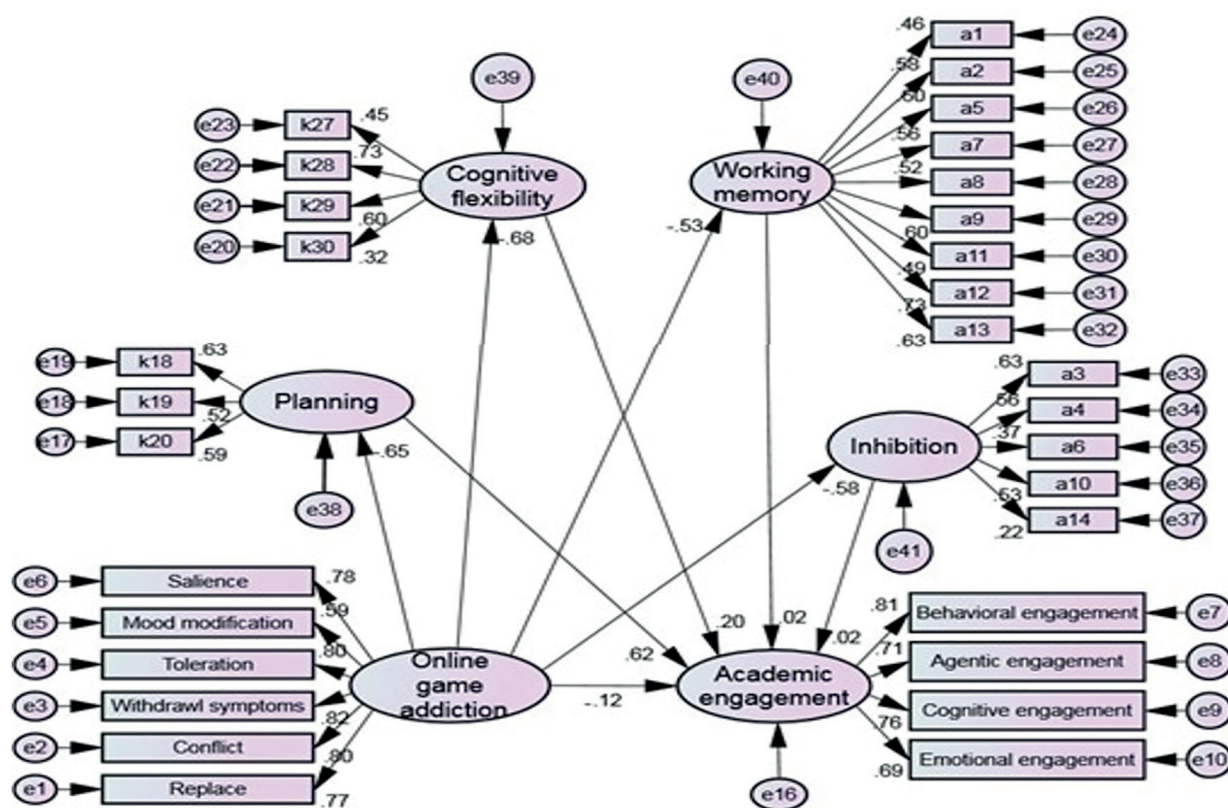


Figure 2: The figure shows the standardized estimates of parameters for the ultimate model.

Table 2: Estimation of non-standard and standard regression parameters of direct effects in the model

Direct paths	B*	Beta*	SE*	CR*	P value
Online game addiction → Planning	-0.22	-0.65	0.03	-7.68	0.001
Online game addiction → Cognitive flexibility	-0.13	-0.68	0.02	-5.11	0.001
Online game addiction → Working memory	-0.11	-0.53	0.17	-6.64	0.001
Online game addiction → Inhibition	-0.17	-0.58	0.02	-7.54	0.001
Online game addiction → Academic engagement	-0.22	-0.12	0.25	-0.90	0.37
Planning → Academic engagement	3.44	0.62	0.68	5.02	0.001
Cognitive flexibility → Academic engagement	1.99	0.20	1.01	1.99	0.046
Working memory → Academic engagement	0.22	0.02	0.57	0.38	0.706
Inhibition → Academic engagement	0.15	0.02	0.52	0.28	0.778

*B: Unstandardized Regression Coefficient; Beta: Standardized Regression Coefficient; SE: Standard Error; CR: Critical Ratio

Table 3: Estimation of non-standard and standard regression parameters of indirect effects in the model

Indirect effects of online gaming addiction on academic engagement through the mediating role of:	B	Beta	Lower limit	Upper limit	P value
Planning	-0.740	-0.401	-0.580	-0.264	0.002
Cognitive flexibility	-0.250	-0.132	-0.515	-0.127	0.001
Working memory	-0.023	-0.013	-0.201	0.025	0.069
Inhibition	-0.024	-0.013	0.232	-0.016	0.064

Upon examining the indirect paths of online gaming addiction to academic engagement (Table 3), it was discovered that only two indirect paths were statistically significant. Specifically, the dimensions of planning ($\beta=-0.401$) and cognitive flexibility ($\beta=-0.132$) in executive functions acts

as a significant negative mediator between online gaming addiction and academic engagement, indicating complete mediation. In essence, online gaming addiction reduces students' engagement by impairing their executive planning and cognitive flexibility.

4. Discussion

The study aimed to explore the link between online game addiction and academic engagement, considering how executive functions (inhibition, working memory, cognitive flexibility, and planning) mediate this relationship among secondary school students. One of the results obtained was that online game addiction cannot directly predict academic engagement. This result was inconsistent with previous studies (5, 6, 8, 11, 12) and consistent with the results reported by Tas (32). These different results can be explained from several perspectives. First, it stems from methodological and statistical factors, particularly the use of structural equation modeling. The bivariate correlation results aligned with existing evidence, showing that executive functions serve as a fully mediating variable in this relationship. In contrast, some previous studies (6, 8) examined only the direct role of online gaming addiction in predicting academic engagement. Second, the evidence collected in the aforementioned studies (6, 8) is based on different instruments or overlapped similar constructs, but is distinct. For example, researchers examined various variables, including Internet addiction (8, 11), social media addiction or excessive use of the Internet and social media (12), and smartphone use (5). These variables or constructs differ from online gaming addiction. Researchers also used constructs such as learning, academic achievement, and motivation (5, 6) or school engagement (32) instead of academic engagement. Different instruments than those used in this study were used to measure online gaming addiction (6) and academic engagement (8, 11, 12). These differences might affect the results. Some studies (8, 32) revealed a negative correlation between engagement and Internet addiction, but not between engagement and online gaming addiction. Therefore, these reasons, along with SEM statistical controls, explain this differing result.

Contrary to the present result, Sunday and co-workers (5) believed that the disorder of online game addiction is revealed in several ways. First, excessive use of mobile phones during teacher instruction can harm academic performance and progress. Second, cognitive ability is required for academic success among students; however, it may be negatively affected by online gaming disorder. In fact, this disorder can be explained in terms of behavior (excessive use of smartphone),

cognition (worry about the lack of smartphone), and emotion (emotional reactions), which may affect academic engagement negatively. In this regard, previous studies (11, 12) showed that there is a negative correlation between the time spent using the Internet and social networks and academic engagement. On the other hand, online game addiction has symptoms that cause it to have a destructive effect on students' engagement. Several studies (5, 9, 11) found a significant link between Internet addiction levels and poor academic performance. The results indicated that these students are more likely to be addicted to the Internet and online games as compared with their peers. As a result, they prioritize the Internet over their academic responsibilities, leading to delays in their own school work.

Another result obtained was that there is a significant, negative role of online game addiction in predicting inhibition, cognitive flexibility, and working memory. This finding was consistent with the results of previous research (16, 20, 33). The neuro-cognitive hypothesis posits that computer gaming addiction resembles drug addiction at both cognitive and neural levels (34). In this regard, evidence obtained from fMRI showed that online game addiction causes executive dysfunction through frontal lobe damage (33) and that excessive online gaming is associated to changes in the structure of the prefrontal cortex and impaired decision-making. Individuals with Internet gaming disorder have smaller gray matter volumes in brain areas associated with executive functions (35). These individuals also have difficulty with impulse control and behavioral inhibition, and show more risky behaviors and prefer immediate rewards (36). It can be concluded that addiction to online games can harm executive function, which is crucial for individuals' psychological health and performance through impulse control and self-control. In this regard, Amani (15) stated that desirable executive functions affect performance and high academic achievement. On the other hand, Internet and online gaming addiction, in general, may be related to executive functions (16). In other words, Internet addiction causes individual's attention to suffer. Also, based on the I-PACE (interaction of person-affect-cognition-execution) model, there is a complex interaction between the person's characteristics (such as personality, social cognitions, or psychological trauma) and emotional

and cognitive responses (such as the tendency to regulate mood) that make the person decide to use a specific program in a specific situation, so strengthening the correlation between Internet addiction and attention biases. Recent evidence has indicated that lower cognitive efficiency and cognitive control are associated with attention problems in Internet addicts (37). As a result, if we consider the online game addiction similar to other addictions in terms of the brain system (34), it is expected that this type of addiction will have an adverse effect on the executive function.

Another result obtained was that planning and cognitive flexibility, among other executive functions, could predict academic engagement. This finding aligned with the results reported previously (14, 15, 18). This finding aligned with research indicating that executive functions, such as planning and cognitive flexibility, are essential for academic success (38). The ability to plan is a function through which students can engage in the necessary preparations for academic engagement, including goal setting and self-regulation (39). It is also better to plan so that the individuals can achieve greater success, and these successes can engage students emotionally, cognitively, and behaviorally in their academic affairs (40). Having cognitive flexibility is a necessary context for participation, exchange of ideas, and cooperation, which are obvious manifestations of behavioral and cognitive engagement (26). Additionally, in examining the indirect paths of online gaming addiction to academic engagement, it was also found that only these two executive functions can have a mediating role for these two variables. In a way, addiction to online games can lead to a decrease in students' academic engagement by reducing their planning ability and executive function. This result was consistent with evidence that has shown that people addicted to online games differ from normal people only in warm executive functions such as planning and do not differ from them in cold functions such as working memory (34). Therefore, the significant mediating role of planning and cognitive flexibility shows that online game addiction disrupts warm executive functions, such as planning and cognitive flexibility, in the process of affecting important academic-motivational factors like academic engagement.

4.1. Limitations

Given that addiction to online games differs

from addiction to the Internet and to other new technologies, both in nature and in terms of adolescents' attention and involvement, determining its role in cognitions and motivations related to learning can have important implications for our education system. The sample in this study was limited to secondary school students in Tehran, Iran resulting in reduced generalizability of the results. Thus, it is suggested that future studies focus on universities students and compare the results with those of the present study because universities students are also at risk. Researchers are suggested to consider various intervening factors, such as personality traits and educational influences that may impact the relationship between online game addiction and academic engagement. Based on the findings, it is recommended that a comprehensive screening be conducted to assess the prevalence of online game addiction in each school and students with such problems are identified and subjected to psychological intervention. It is also suggested to inform students, parents, and teachers about online game addiction by holding classes and familiarizing them with their negative consequences. It is suggested that students with low executive function (inhibition, working memory, cognitive flexibility, and planning) are identified and subjected to interventions to prevent their academic failure. Also, parents of students should be given training to learn more about online game addiction so that they can better apply this training in the principles of their education.

5. Conclusions

The results indicated that planning and cognitive flexibility have an indirect effect on the relationship between online game addiction and academic engagement. Specifically, this means that only planning and cognitive flexibility serve as mediating factors in the connection between online game addiction and academic engagement, whereas working memory and inhibition do not have a mediating role. Notably, one characteristic of online game addiction is a loss of self-control in behavior. On the other hand, executive functions enable people to restrain their desires and limit the behaviors related to happiness and pleasure under adverse conditions. However, when a student gets addicted to online games, he/she may lose his/her self-control. On the other hand, the lack of inhibition in these individuals can be caused by obsessive behavior that involves a person in a vicious cycle of

this addictive behavior. Deficiency in this cognitive function makes it more difficult to free a person from this faulty cycle and makes a person spend many hours of his/her waking hours in web surfing, social networks, and online games, thereby making it difficult for him/her to stop these activities. As a result, there may be no time left to do homework and study, and the student may face problems in his/her courses and academic engagement. These results suggested that excessive use of online games plays a destructive role in cognitive abilities and motivation of adolescent students toward learning and schooling. Consequently, parents, teachers, and school psychologists should develop suitable educational, training, and therapeutic strategies to mitigate these harmful effects.

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Authors' Contribution

Masoud Soltani Nazarlou: Substantial contributions to the concept and design of the study, data gathering, interpretation of data, and drafting the manuscript. Mohammadagha Delavarpour: Substantial contributions to the conception and design of the study, analysis and interpretation of the data, critically reviewed the manuscript for important intellectual content. Seyed Musa Tabatabai: Made substantial contributions to the conception and design of the study and critically reviewed the manuscript for important intellectual content. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work, such as the questions related to the accuracy or integrity of any part of the work.

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Ethical Approval

The Ethics Review Board of Ethics Committee of Semnan University of Medical Sciences, Semnan, Iran approved the present study with

the code of IR.SEMUMS.REC.1403.045. Also, written informed consent was obtained from the participants.

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