



Awareness in the Age of Screens: A Comparative Analytical Study of Mindfulness and Digital Gaming Patterns Among Adolescents

Yahya M. Khatatbeh^{*a} & Bandar S. Alalam^a

* Corresponding author:

Email: ymkatatbh@imamu.edu.sa

a. Department of Psychology, College of Social Sciences, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia.

Article Info

Received: April 19, 2026

Accepted: August 17, 2026

Published: September 29, 2026



10.46303/jcve.2026.46

How to cite

Khatatbeh, Y. H., & Alalam, B. S. (2026). Awareness in the Age of Screens: A Comparative Analytical Study of Mindfulness and Digital Gaming Patterns Among Adolescents. *Journal of Culture and Values in Education*, 9(3), 203-221. <https://doi.org/10.46303/jcve.2026.46>

Copyright license

This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International license.

ABSTRACT

The increasing prevalence of digital gaming among adolescents has raised concerns regarding its potential impact on attentional regulation and mindfulness. However, existing research remains inconsistent and theoretically fragmented, particularly in integrating demographic characteristics with behavioral gaming patterns. This study examines how gaming intensity and play-style, alongside demographic factors, relate to mindfulness among adolescents. A cross-sectional design was employed with a sample of 373 adolescents. Mindfulness was assessed using the Clinical Assessment of Mindfulness in Children and Adolescents (CAMM). Multiple linear regression was conducted to identify significant predictors of mindfulness, while two-way factorial ANOVAs examined the effects of gaming intensity (daily hours, weekly frequency) and play-style (device type, game type). The regression model was significant ($F(6, 366) = 3.135, p = .005; R^2 = .045$). Gender ($p = .044$), perceived socioeconomic status ($p < .001$), and game type ($p = .037$) were significant predictors. Lower mindfulness scores were observed among participants who engaged in ≥ 5 hours of gaming per day. Weekly gaming frequency was not significant independently but showed a significant interaction with daily gaming duration. Device type was not a significant factor. These findings indicate that gaming-related variables exert modest effects on mindfulness, suggesting that adolescent attentional regulation is more strongly influenced by broader psychosocial factors.

KEYWORDS

Mindfulness; adolescents; digital gaming intensity; game type; gaming behavior; ANOVA analysis.

INTRODUCTION

Particularly in more socially interactive and competitive forms, digital gaming has grown to become an integral part of teenagers' everyday lives. Between one percent and nine percent of young people worldwide suffer from Internet Gaming Disorder (IGD), according to recent worldwide estimates (Alfaifi et al., 2022; Stevens et al., 2021). The participation in esports and the fast growth of online multiplayer environments are indicators of larger changes in the ways people socialize online (Overå et al., 2024). There is ongoing concern about the cognitive and attentional consequences of gaming during adolescence, a developmental stage characterized by the ongoing maturation of the executive system (Steinberg, 2010), despite the fact that gaming does provide opportunities for skill development, social connection, and achievement.

According to many studies (Hammad & Al-Shahrani, 2024; Paulus et al., 2018), pathological or addiction-based models have been used to describe excessive gaming, with an emphasis on impulsivity, aggression, and impaired behavioral control. In addition, some researchers have suggested that these kinds of approaches can miss larger patterns of variation in how much time adolescents spend engaging with games and how digital communication affects the way adolescents regulate their focus and cognition. The studies cited by Greco et al. (2011) and Kabat-Zinn (2003) indicate that adolescents who are mindful, defined as being aware without judgment in the present moment are generally able to manage their emotions and tend to be less impulsive than those who are not. Mindfulness has been conceptualized as a multidimensional cognitive regulatory process by developmental psychologists and educators as it relates to attentional awareness (Greco et al., 2011) emotional regulation and adaptive self-awareness (Tang et al., 2015) for adolescent populations. There are mixed results but research on screen time suggests the more an individual spends time viewing a digital screen, the less stable their focus will be (Kim et al., 2024; Temizarabacı et al., 2025).

Digital games have a theoretically high level of engagement based on Self-Determination Theory (SDT) (Przybylski et al., 2010; Ryan et al., 2006). According to the theory, digital games can meet the three primary psychological needs of autonomy, competence and relatedness. In addition, since many digital games provide competitive or multi-player experiences, these factors contribute to encouraging extended periods of participation. While this study is not an operationalization of SDT constructs it does provide a theoretical basis for continued participation in digital game environments and potentially how those influences focus participants' attention and increase participant's immersion into behavior. At the same time, high levels of arousal appear to cause people's focus of attention and habitual responses to be narrowed. This is especially true for adolescents whose regulatory systems have yet to mature (Steinberg, 2010; Tang et al., 2015). The above-described interpretations of attention also correlate with aspects of Attention Restoration Theory (ART), which explains how extended time spent in environments that require intense cognitive processing will affect both attention restoration and self-regulation processes. The Theory of Planned Behavior (TPB) proposed by Ajzen (1991) supports these findings and suggests that adolescents' beliefs about what others

think and believe they can control their behavior leads to repeating behaviors they have identified as harmful (King & Delfabbro, 2014). Since this study did not assess or measure the TPB variables directly, it uses the TPB to provide a broader context and conceptualization of why adolescents engage repeatedly in digital media use within their social/behavioral environment. In addition, while the TPB was employed as an additional interpretive lens to understand repeated digital use behaviors among adolescents, the authors do not propose using the TPB as a direct testable theoretical model.

Research into adolescent health and gaming is abundant. However, the majority of this research also has three major issues. First, awareness and other aspects of attentional regulation (i.e. those associated with being aware of what you are doing) have been understudied in favor of studying pathologies such as Internet Gaming Disorder (IGD). Second, there is a tendency to define gaming intensity narrowly. For example, while studies often examine the frequency and duration of gaming per week, few studies examine the interaction effect of both factors. Finally, few studies utilize a single comparative framework when examining the relationship between demographic variables (such as gender) and style of play (for example, type of game or gaming console) and intensity of gaming. As a result, current understanding of the relationship between contextual gaming environments and cognitive awareness remains limited because of this lack of analytical integration. Scholars have increasingly questioned whether prolonged immersion in high-arousal digital contexts affects attentional regulation and present-moment awareness during a neurocognitive sensitive developmental stage (Alfaifi et al., 2022; Steinberg, 2010; Tang et al., 2015; Temizarabacı et al., 2025).

Gender differences in engagement persist across cultures (Overå et al., 2024), while socioeconomic factors affect gaming risk in different contexts (Sensua et al., 2025). Moreover, prior studies have rarely integrated demographic characteristics, gaming intensity patterns, and play-style variables within a single comparative analytical framework. Few studies combine demographics, gaming intensity (daily hours $\times$ weekly frequency), and play-style (game type $\times$ device) into a single model for predicting mindfulness. The rationale for examining interaction effects is based on the assumption that gaming behaviors may operate configurationally rather than independently. For example, if adolescents engage in gaming for extended periods every day, then also engage in gaming over the weekend, they may experience a different relationship to their attentional awareness compared to engaging in gaming only during one time frame. Therefore, this study will examine both the main and interaction effects of each variable to assess which variables (gaming duration, style of play, demographic) are related to adolescents' attentional awareness.

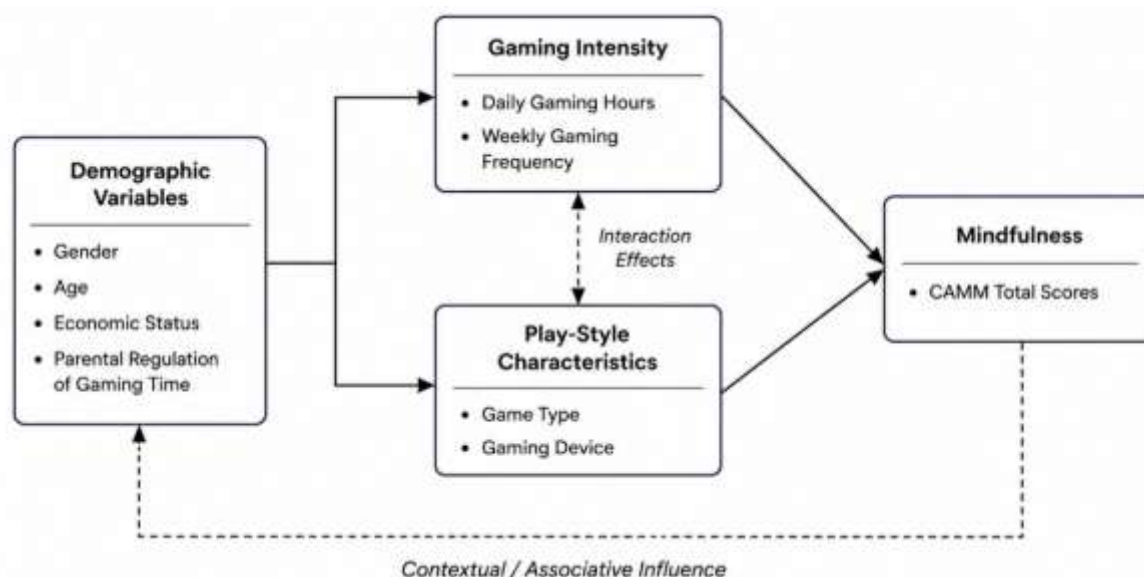
Figure 1 illustrates the conceptual framework used as a guide to explain how demographic variables, gaming behavior/characteristics, and mindfulness outcome variables were connected.

To fill these gaps, this study investigates whether there are any differences in mindfulness among secondary school adolescents when broken down by demographics, gaming

intensity (hours played per day and frequency of play), and play-style characteristics (game type and gaming device). To better understand mindfulness in digitally immersive adolescent settings, this study seeks to move beyond disorder-based models and toward attentional functioning, while also testing main and interaction effects.

Figure 1.

Conceptual Framework of the Relationship Between Demographic Characteristics, Gaming Patterns, and Adolescent Mindfulness



Note. This conceptual framework demonstrates the suggested associative connections between demographics, gaming involvement, style of play, and mindfulness among adolescents explored in this research.

Hypotheses

The following hypotheses were developed based on the theoretical framework and the identified gaps in the empirical literature:

H1: There will be substantial variation in mindfulness levels across demographic variables such as age, gender, perceived economic status, and parental regulation of gaming time.

H2: Adolescents who engage in longer daily gaming sessions will report lower levels of mindfulness.

H3: Adolescents who engage in more frequent weekly gaming activities will experience lower mindfulness levels.

H4: There will be a significant interaction between daily gaming time and weekly gaming frequency regarding mindfulness levels.

H5: Mindfulness levels will differ based on the type of video game and gaming platform used.

H6: The type of video game and gaming platform will show a significant interaction effect on mindfulness levels.

METHODS

Study design

This quantitative cross-sectional study of secondary school students aimed to identify variations in mindfulness as a function of demographic variables, gaming intensity, and play-style traits. The analytical framework that was chosen was a predictive-comparative one. Multiple linear regression was employed to examine the extent to which demographic and gaming-related variables predicted mindfulness levels. Moreover, to investigate the primary and secondary impacts of gaming intensity (daily hours $\times$ weekly frequency) and play-style traits (game type $\times$ gaming device), two-way factorial analyses of variance (ANOVA) were performed. Because of the cross-sectional nature of the design, the study was intended to identify associations rather than establish causal relationships between gaming-related variables and mindfulness outcomes.

Participants

The primary recruiting phase occurred at the beginning of the first academic semester of 1447H. To limit sector-specific sampling error and to increase geographic diversity among participants, participants were recruited from public secondary schools located in the four major sectors of the city; i.e., north, south, west and east. This multi-site recruitment process enhanced external validity while maintaining an equal distribution of educational levels among participants. Principals of each school provided the necessary administrative approvals to recruit eligible students. Students were eligible for participation if they demonstrated two characteristics: (1) active and continuous involvement in online gaming during the first six months of 1447H, and (2) enrollment in a secondary school during the study period.

The sampling approach can be characterized as a non-probability multi-site purposive convenience sample, as participants were recruited from geographically distributed public schools while participation remained voluntary and contingent upon eligibility criteria related to gaming engagement.

Consistent rather than sporadic or casual engagement in digital gaming activities was used as the operational definition of gaming engagement in the present study. Data collection utilized a Google Forms-based web-based self-report instrument administered on-line. An email containing a link to access the on-line survey instrument was distributed via an official school channel under direct supervision of school administrators. The on-line format allowed for standardizing the administration of the survey instrument, decreasing potential errors due to manual input of data, and ensuring secure storage of data.

Participants were under no obligation to complete a survey. The participants received an explanation about what they would learn from the research; that their answers would remain confidential; that they could withdraw from participating in this study at any time without penalty. Before accessing the survey, each participant electronically signed off on the informed consent agreement. No identifiable data was collected for the surveys because all answers were anonymous. All steps were taken in accordance with well-established rules of research ethics

that are in line with the standards set by the world's academic publishers. A total of 10 questionnaires were excluded following data screening procedures because of either incomplete responses exceeding 20% of survey items, duplicate submissions, or response patterns indicating statistical inconsistency (e.g., uniform response selection across all items). Table 1 presents the demographic and gaming-related characteristics of the final analytical sample ($N = 373$). Data collection combined geographically stratified recruitment with standardized online administration conducted within school settings.

Table 1.

Demographic and Gaming Characteristics of the Sample ($N = 373$)

Variable	Category	n	%
Gender	Female	189	50.7
	Male	184	49.3
Age	11–14 years	14	3.8
	15–18 years	269	72.1
	Above 18 years	90	24.1
Daily Gaming Hours	Less than 1 hour	117	31.4
	3 to <5 hours	61	16.4
	5 hours or more	195	52.3
Weekly Gaming Days	Two days or less	243	65.1
	5–6 days	130	34.9
Main Game Type	Esports (Competitive Games)	148	39.7
	Single-player Games	40	10.7
	Online Multiplayer Games	185	49.6
Perceived Economic Status	Low	283	75.9
	Medium	90	24.1
Gaming Device	Smartphone	183	49.1
	Console (PlayStation/Xbox)	190	50.9
Parental Regulation of Gaming Time	No	153	41.0
	Yes	220	59.0

As shown in Table 1, high daily gaming intensity (≥ 5 hours) was reported by more than half of the participants, and multiplayer formats were the most prevalent. The observed variability across demographic and gaming indicators supported the subsequent inferential analyses. Although the range of ages included is quite large, the same categories for adolescent development stages that are representative of different levels of education during adolescence in the sampled secondary school student population were maintained to include this variety. Because all students over 18 years old continued to attend classes at a secondary school level, and therefore reflect the institutional age distribution of the sampled schools, those students

also remained in the sample. The very low number of students in the 11-14 year-old group may need to be taken into account when making comparisons on a developmental basis among the various age groups.

Measurement

Incorporating a set of demographic and gaming-related variables into the analytical framework allowed the present study to achieve its objectives. Gender and age group (11–14, 15–18, and over 18) were the demographic variables. The variables pertaining to gaming were able to capture the level of digital engagement as well as its contextual aspects. Weekly gaming frequency (two days or less, 5–6 days) and daily gaming hours (less than 1 hour, 3 to <5 hours, 5 hours or more) were used to operationalize gaming intensity. The weekly gaming frequencies that comprised the categories of this study paralleled the distributions noted in the initial review of the data. Given the low number of responses located at the middle level (3–4 days per week, and given that these responses appeared to be irregularly dispersed among the different levels of gaming intensity, it was decided to limit further comparison by focusing on two extremes (≤ 2 days) as a representation of lower gaming frequency, and (5–6 days) as a representation of higher gaming frequency. In future research, the use of a balanced set of gaming frequency per week should be used to improve accuracy and increase comparison among the gamers. Contextual factors related to gaming involved device type (cell phone, console), economic perception (poor, average), and parent control on game hours. These variables were subsequently used as independent and grouping variables in the factorial ANOVA and regression analyses.

Child and Adolescent Mindfulness Measure (CAMM)

The Child and Adolescent Mindfulness (CAMM) Measure, created by Greco et al. (2011) was used to evaluate mindfulness. Kids and teens can gauge their level of mindfulness with the help of the CAMM, a 10-item self-report tool that emphasizes being in the here-and-now and accepting one's inner experiences without judgment. The items are evaluated using a 5-point Likert scale, where 0 represents never true and 4 represents always true. The total score can be anything from 0 to 40, with higher scores suggesting a higher level of mindfulness. Core components of mindfulness, such as accepting one's thoughts and feelings without judgment, acting with awareness, and observing one's internal experiences, are captured by the scale. There was sufficient evidence of construct validity and a unidimensional factor structure in the initial validation study, which also indicated satisfactory internal consistency (Cronbach's $\alpha = .80$). Its good psychometric properties in teenage populations have been validated by subsequent cross-cultural studies. The validated CAMM was used to examine associations between mindfulness, demographic characteristics, and gaming-related behaviors.

To make sure it was age-appropriate and clear in language, the current study used the validated version that Dion et al. (2018) adapted. At the time of the research, no standard Arabic norms were available to test the CAMM with adolescent Saudis. Therefore, it was subject to the same process as all other non-English versions in this study (i.e., bilingual language review,

contextualization, and piloting) so that its words had both high levels of semantic clarity and cultural relevance to the adolescent populations. Two bilingual educational specialists independently evaluated the culturally adapted wording to ensure conceptual equivalence and age-appropriate clarity. Within the adolescent sample, the instrument has shown satisfactory internal consistency and a stable unidimensional structure. The internal consistency in the present sample was satisfactory (Cronbach's $\alpha = .86$), indicating that it is appropriate for use in this particular population.

Validity and reliability

A pilot sample ($n = 42$) that was similar in age and education level to the target population was used to re-evaluate the CAMM's psychometric properties. Educational psychologists and psychometricians checked the content validity to make sure it was age-and stage-appropriate and easy to understand. Factor loadings varied from .42 to .71, and exploratory factor analysis confirmed a unidimensional structure that was in line with the initial scale, accounting for 32.4% of the total variance. Although the proportion of explained variance was modest, it remained acceptable for an exploratory validation process involving a brief psychological screening instrument administered within a culturally specific adolescent sample. With a Cronbach's α value of .86, the internal consistency reliability was deemed satisfactory. Accurate item-total correlations ranging from .48 to .69 and a composite reliability (CR) of .88 suggest sufficient internal homogeneity. The results show that the CAMM was reliable and had acceptable validity in this study.

Statistical analysis

All statistical analyses were conducted using IBM SPSS (Version 26). First, demographic and gaming-related characteristics were summarized using descriptive statistics, including frequencies and percentages. The assumptions of linear regression and ANOVA, which include normality, homogeneity of variance, Durbin-Watson independence of errors, and multicollinearity (VIF values), were checked and found to be acceptable before inferential testing could be conducted. To address the first research question, multiple linear regression analysis was conducted to see if there was a correlation between mindfulness levels and demographic variables like age, gender, perceived economic status, parental regulation, and gaming characteristics. Use of F statistics, standardized beta coefficients (β), and explained variance (R^2) allowed for the evaluation of model significance. An a priori statistical power estimation based on medium-to-small effect assumptions indicated that the achieved sample size ($N = 373$) was adequate for detecting interaction effects and conducting factorial ANOVA procedures with acceptable statistical power at $\alpha = .05$. A two-way factorial ANOVA was carried out to determine if mindfulness varied in relation to the intensity of gaming (daily hours $\times$ weekly frequency). The effects were measured using omega squared (ω^2), and both main and interaction effects were examined. The LSD post hoc comparisons were used when significant main effects were observed. Because the study emphasized exploratory comparisons between gaming systems, the LSD test was chosen due to its high sensitivity even though it increased the

probability of Type I errors. Likewise, extra two-way ANOVAs were carried out to evaluate variations in mindfulness based on play-style attributes (game type $\times$ gaming device), with effect sizes being reported using eta squared (η^2). A significance level of $p < .05$ was used for all two-tailed statistical tests.

RESULTS

Differences in levels of mindfulness according to demographic variables

To find out if demographic and gaming-related factors predicted mindfulness levels, a multiple linear regression analysis was conducted. Overall, the model was statistically significant in predicting mindfulness levels; it accounted for approximately 4.5 % of the variance in mindfulness scores with an R^2 of .045. A statistically significant relationship was identified ($F(6, 366) = 3.135, p = .005$), but the model demonstrated limited predictive ability and therefore would expect most of the variance in mindfulness levels to be due to other factors including psychosocial, developmental, and/or contextual factors that are beyond the scope of this study.

Table 2.

Multiple Linear Regression Predicting Mindfulness from Demographic and Gaming Variables

Predictor	B	SE	β	t	p	VIF
Gender	-0.154	0.076	-0.125	-2.023	.044	1.619
Age	0.021	0.068	0.017	0.311	.756	1.251
Economic Status	-0.230	0.072	-0.159	-3.215	.001	1.031
Gaming (Hours/Pattern)	0.116	0.075	0.094	1.558	.120	1.545
Parental Regulation	-0.057	0.064	-0.045	-0.889	.374	1.078
Main Game Type	-0.068	0.033	-0.104	-2.098	.037	1.038

Significant predictors included gender ($\beta = -.125, p = .044$), perceived economic status ($\beta = -.159, p = .001$), and main game type ($\beta = -.104, p = .037$). No statistically significant relationships were found between age ($p = .756$), gaming intensity ($p = .120$), and parental regulation of gaming time ($p = .374$). Since the beta coefficients are negative, a score that is closer to the reference category for both gender and economic status was found to be negatively correlated with low levels of mindfulness. This suggests that there were directional differences between these groups. There was no indication of multicollinearity among predictors, as the variance inflation factor (VIF) values were within acceptable limits.

Main and Interaction Effects of Daily Gaming Hours and Weekly Frequency on Mindfulness

To determine how much time spent gaming each day and how often gaming each week affected participants' levels of mindfulness, a two-way factorial ANOVA was conducted. The analysis revealed a statistically significant main effect for daily gaming hours, $F(2, 370) = 5.31, p = .005, \omega^2 = .020$, indicating a small effect size. In contrast, the main effect of weekly gaming frequency was not statistically significant, $F(1, 370) = 0.0003, p = .986, \omega^2 = .000$. A statistically significant interaction effect was also observed between the number of hours played each day and the

frequency of gaming each week, with an F-value of 8.40, a p-value less than .001, and a ω^2 value of .034. Although statistically significant, the interaction effect size remained small, suggesting modest practical significance.

Adolescents who played for five hours or more every day reported substantially lower mindfulness compared to those who played for one hour or less ($p = .025$) and those who played for three to less than five hours ($p = .014$), according to post hoc comparisons using the LSD test. The three-to-less-than-five-hours group and the less-than-one-hour group did not differ significantly ($p = .805$).

Table 3.

Two-Way ANOVA for Daily Gaming Hours and Weekly Frequency on Mindfulness

Source	SS	df	MS	F	p	ω^2
Daily Gaming Hours	3.862	2	1.931	5.314	.005	.020
Weekly Gaming Days	0.0001	1	0.0001	0.0003	.986	.000
Daily $\times$ Weekly	6.104	2	3.052	8.398	< .001	.034
Residuals	146.460	370	0.363	—	—	—

Post hoc comparisons were conducted using the LSD test to determine the specific group differences. The results are presented in Table 4.

Table 4.

LSD Post Hoc Comparisons for Daily Gaming Hours

Comparison	Mean Difference	SE	t	p
Less than 1 hour vs 3–<5 hours	-0.057	0.091	-0.627	.805
Less than 1 hour vs 5 hours or more	0.192	0.074	2.611	.025
3–<5 hours vs 5 hours or more	0.249	0.089	2.808	.014

Main and Interaction Effects of Game Type and Gaming Device on Mindfulness

To examine whether mindfulness levels differ according to gaming pattern characteristics (game type and gaming device), a two-way analysis of variance (ANOVA) was conducted. The results are presented in Table 5

The main effect of gaming device was not statistically significant, $F(1, 370) = 0.806$, $p = .370$, $\eta^2 = .002$. The main effect of game type, however, was statistically significant $F(2, 370) = 3.03$, $p = .049$, $\eta^2 = .015$. Furthermore, it was found that there was a significant interaction effect between the type of game and the gaming device, $F(2, 370) = 3.60$, $p = .028$, $\eta^2 = .017$. Nevertheless, all observed effect sizes remained small, indicating limited practical impact despite statistical significance.

While the comparison between single-player and online multiplayer games came close to significance ($p = .086$), post hoc comparisons did not show any statistically significant pairwise differences between particular game type categories. This implies that the omnibus ANOVA

might capture the general variation between groups rather than strong contrasts between the gaming groups. It is important to note that no significant post hoc tests imply that the game type influence should be carefully evaluated.

In light of the statistically significant main effect of game type, pairwise differences between game categories were examined through post hoc comparisons using the LSD procedure (refer to Table 6). None of the pairwise comparisons achieved statistical significance, as shown in Table 6. While the difference between online multiplayer and single-player games was close to significance ($p = .086$), it fell short of the traditional cutoff point ($p < .05$).

Table 5.

Two-Way ANOVA for Gaming Device and Game Type on Mindfulness

Source	SS	df	MS	F	p	η^2
Gaming Device	0.298	1	0.298	0.806	.370	.002
Game Type	2.246	2	1.123	3.034	.049	.015
Device $\times$ Game Type	2.662	2	1.331	3.596	.028	.017
Residuals	149.165	370	0.370	—	—	—

Table 6.

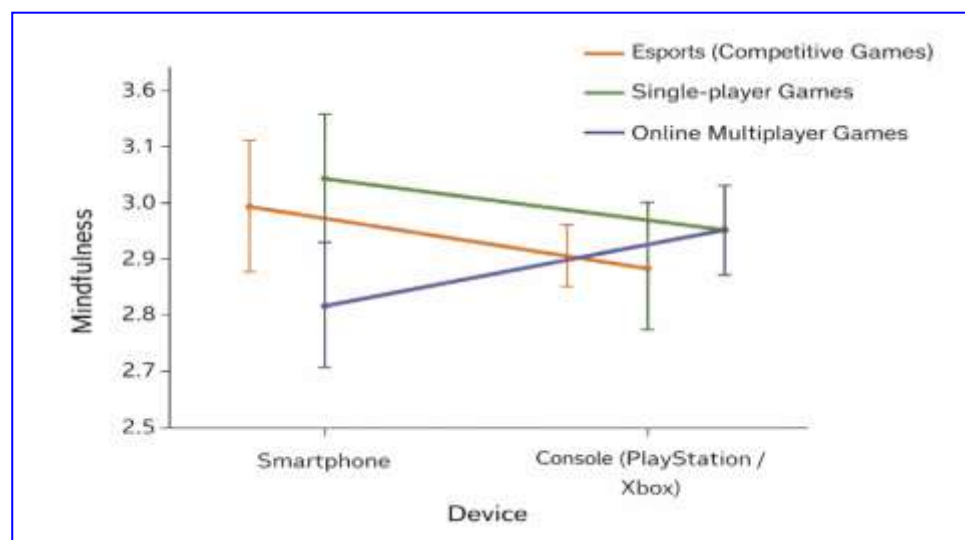
LSD Post Hoc Comparisons for Game Type

Comparison	Mean Difference	SE	t	p
Esports vs Single-player	-0.106	0.107	-0.996	.580
Esports vs Online Multiplayer	0.114	0.065	1.761	.184
Single-player vs Online Multiplayer	0.221	0.104	2.126	.086

Figure 2 shows how the gaming device interacts with the type of game as it relates to mindfulness. Figure 2 illustrates variation in mindfulness levels across different game types and gaming devices.

Figure 2.

Interaction Between Gaming Device and Game Type on Mindfulness Levels



The scores for both esports and online multiplayer games appear to be similar regardless of which gaming device is used. However, scores for single player games were slightly higher when using a smartphone compared to console use. The relationship between gaming type and mindfulness is slightly different depending on what technology was used while playing, but the actual difference based on the technology (or how much of a difference) is relatively small. The visual representation shows the statistically significant interaction between gaming device and game type, as shown in table 5.

Effects of Daily Gaming Intensity and Game Type on Mindfulness

A two-way factorial ANOVA was conducted to examine whether mindfulness levels differed according to daily gaming intensity and game type. The main effect of daily gaming intensity was not statistically significant, $F(2, 367) = 2.48$, $p = .085$, $\eta^2 = .012$. In contrast, a statistically significant main effect of game type was observed, $F(2, 367) = 4.04$, $p = .018$, $\eta^2 = .020$. The interaction between daily gaming intensity and game type was not statistically significant, $F(4, 367) = 1.60$, $p = .175$, $\eta^2 = .016$. As with the previous analyses, the effect sizes were small, indicating that the observed associations should be interpreted cautiously in terms of practical significance. The interaction pattern is illustrated in Figure 3.

Table 7.

Two-Way ANOVA for Daily Gaming Intensity and Game Type on Mindfulness

Source	df	F	p	η^2
Daily Gaming	2	2.48	.085	.012
Game Type	2	4.04	.018	.020
Daily $\times$ Game Type	4	1.60	.175	.016
Residuals	367			

Figure 3.

Interaction Between Daily Gaming Intensity and Game Type on Mindfulness

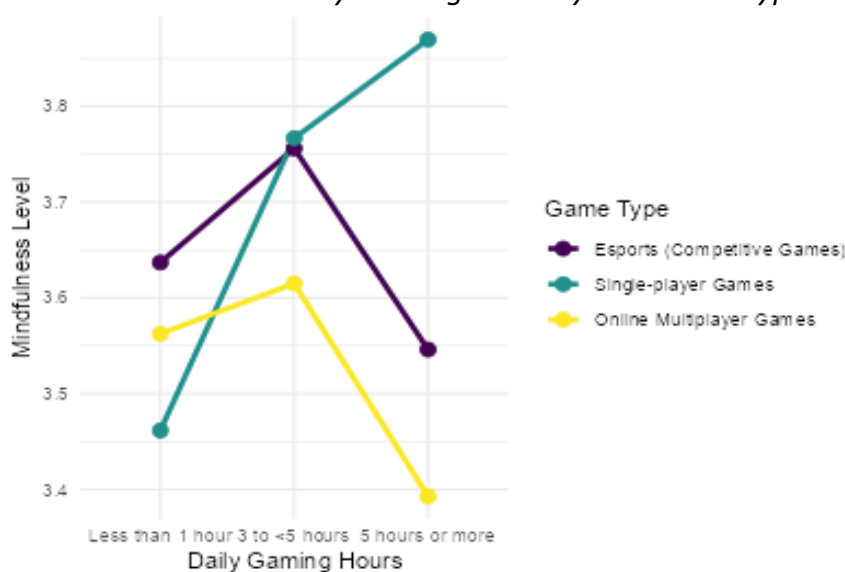


Figure 3 shows how the interaction pattern works. As shown, the levels of mindfulness changed depending on the type of game and how much time was spent playing each day. Even though visual discrepancies occurred at higher frequencies of video games played in a day, interaction effect did not turn out to be statistically significant, implying that differences due to combinations of playing frequency and video games should not be considered as differential effects.

DISCUSSION

The findings demonstrated that adolescents' digital gaming activities relate to their state of mindfulness. However, the observed associations were generally small in magnitude and therefore cannot be taken as indicative of large-scale predictive or causal relationships. Additionally, the results do not demonstrate a clear (i.e., deterministic) correlation between digital gaming and mindful states. Rather, the level of attentional awareness appears to be influenced by both how engaged in gaming adolescents are and their patterns of gaming engagement. Therefore, these findings suggest a multifaceted and interactive view of adolescents' digital engagement that is very different from a simplistic "screen harm" framework.

Interpreting the results from the theoretical viewpoint, it appears that the mindfulness level of teenagers is not influenced solely by their experience with games but is also determined through the process of cognitive engagement regulation during development and situational contexts. These findings correspond to previous studies indicating that attention regulation does not depend on specific behaviors and should be explained through general development factors (Steinberg, 2010; Tang et al., 2015). Digital games can still be considered highly motivating because they provide opportunities for satisfying basic needs described in Self-Determination Theory (Przybylski et al., 2010; Ryan & Deci, 2000). However, since the current research does not contain measurements of concepts like autonomy, competence, or relatedness in the context of SDT, the theory can only be used as a theoretical framework and not as an explanation tested in practice.

The findings may theoretically support the idea that an adolescent brain experiencing increased susceptibility to long-term exposure to highly stimulating virtual environments due to less developed executive functioning skills; however, the statistical effects measured were relatively small and thus do not demonstrate a strong relationship between digital environment and adolescents' ability to maintain their attention over time (Steinberg, 2010). Thus, the results may be seen as suggesting mild correlations between gaming-induced patterns and attention awareness rather than implying major cognitive interference.

Further regression analysis showed that a relatively small proportion of the variation in mindfulness could be accounted for by demographic and gaming factors. The findings support the developing consensus that adolescent attentional awareness has multiple determinants and cannot be adequately described using one behavioral indicator alone (i.e., adolescents' level of

video game play/exposure). Rather than focusing on a singular factor (e.g., time spent gaming), prior research emphasizes the combined influence of self-regulation, executive functioning, emotional regulation, and metacognitive capacity on attentional outcomes (Kim et al., 2024; Tang et al., 2015). The low explanatory power of the regression model therefore reinforces the interpretation that mindfulness is shaped by a broader psychosocial and developmental ecology extending beyond gaming-related variables alone.

The findings also support growing concerns regarding overly simplified screen-time paradigms that imply either a direct or deterministic relationship between screen exposure and behavioral outcomes (Przybylski & Weinstein, 2017). Current studies have revealed that the effects of screen exposure are relatively minor, contextual, and mediated by both personal and environmental influences (Schuengel, 2022; Tang et al., 2015). The neurodevelopmental literature provides additional support to the claim that attention-control mechanisms undergo continued development during adolescence within the brain areas dedicated to executive and emotional functioning. Thus, gaming frequency must be regarded as one element of the wider ecological framework of cognitive growth.

One of the most interesting results of this research is that longer periods of time spent playing games on a given day seemed to have a greater relationship to mindfulness than did how many times you played during an entire week. This suggests that prolonged gaming exposure may demonstrate stronger associations with attentional awareness than gaming frequency alone. This pattern may be theoretically explained by the possibility that high cognitive workload and lack of attention restoration opportunity can result from continuous exposure rather than intermittent exposure (Orben & Przybylski, 2019; Park & Hwang, 2009). Indeed, earlier studies demonstrated that daily play time was more related to attention fluctuations than frequency indices (Messena & Everri, 2023; Paulus et al., 2018).

From a neurodevelopmental point of view, lengthy exposure to intense game play can exert temporary stress on regulatory control mechanisms that are still developing during adolescence, specifically those related to the inhibitory functions and decision-making processes of the prefrontal cortex (Crone & Dahl, 2012). Nevertheless, the small and consistent effect sizes indicate that these effects are minor and depend on other external factors. However, because the research design was cross-sectional, the results cannot be causally interpreted, and it is impossible to determine whether gaming frequency affects mindfulness or whether adolescents with varying attentional predispositions play video games differently.

Additionally, these interactive findings provide further evidence for an interpretation of digital engagement as pattern-based. It also suggests that the two dimensions of gaming intensity and the various contextual attributes of playing are operating together to form configurations of use that should be interpreted in combination, and not as separate individual factors. The latter is supported by a growing body of literature which indicates that a set of patterns of digital engagement can be better predictors of a wide range of psychological

outcomes than simply how frequently people engage with technology (Odgers & Jensen, 2020; Valkenburg et al., 2022).

Whereas the type of device used had no significant effect, variations in game type suggest that the structure and experience provided by games might be more important than the technology used to play them. These results agree with the findings that cognitive effects are more dependent on game structure, social engagement, and reward systems rather than hardware medium (Bediou et al., 2018; King & Delfabbro, 2018). However, as recently shown by meta-analytic studies, such impacts remain insignificant and highly context-dependent (Johannes et al., 2021; Stevens et al., 2021). In addition, considering the nonsignificant results of the pairwise post hoc comparison test, it is imperative to approach any differences between gaming genres with caution even though ANOVA produced a significant result.

Overall, the results suggest a broader theoretical understanding of digital engagement than just "harm," and include motivation, cognition, and environment. Research on this topic has demonstrated some positive aspects to video game play in adolescent populations; however, these benefits appear to be contingent upon a variety of both internal and external factors (Ryan et al., 2006). Therefore, it would seem important for educators as well as counselors in schools to realize that limiting students' access to digital media is insufficient; instead, educators need to provide educationally relevant training in digital literacy and self-regulation skills that describe the possible advantages or disadvantages associated with a given type of environment. School districts and counselors would also benefit from providing students with skills to regulate their own digital behaviors using mindful awareness techniques.

To conclude, this research emphasizes the need to move beyond singular measures of digital exposure (gaming engagement) in order to develop comprehensive models which include both social/behavioral and structural aspects of gaming, along with demographic factors. A multidimensional model may allow for a broader understanding of adolescents' digital engagement and its association with cognitive-regulatory constructs, including mindfulness. Such an approach is especially appropriate for educators, school counselors, and decision-makers trying to create a digital well-being intervention program in schools.

CONCLUSION

The purpose of this research was to determine whether and to what degree digital gaming, combined with demographic variables, accounts for the variance in mindfulness among adolescents. The results allow for an appropriately careful yet scientifically founded conclusion that game-playing frequency and mode are linked to mindfulness, despite the fact that the effects found were small in magnitude and not enough to suggest a strong role in attention regulation among adolescents. In contrast to reductionist claims regarding the adverse effect of digital gaming exposure on mindfulness, the complexity of their connection is stressed here.

Holistically considered, the findings suggest that frequent play over a long period strongly associated with lower mindfulness compared to frequency of game use alone; and the

interaction terms also demonstrate that games can't be fully interpreted in isolation from their environment. The results therefore support the shift away from the simple exposure-based models towards a configuration model where digital usage has a psychological outcome arising from an interaction of degree, context, and personality. In addition, the findings are consistent with cognitive regulatory perspectives on mindfulness as a multi-factorial construct.

The greatest amount of value added to this research was creating an analytical model that compares gaming intensity patterns; play style variables; and demographic characteristics in a single comparison. This study will advance methodology for researching gaming behaviors with respect to other disciplines, by using a multi-dimensional approach, and through applying the principles of behavioral ecology to understand gaming behavior beyond simply understanding it as a risk factor.

The scholarly implications of this research are to emphasize that we should use longitudinal and multi-dimensional research methods to measure the developmental trajectory and causal relationship of gaming-related problems. Because the present study used a self-report approach; therefore, no causal relationships can be drawn from these findings. Consequently, the results can only be interpreted as being associated with each other. The practical and policy implications of this research study involve the necessity of devising specific intervention programs for combating the issues related to gaming. It might not always prove effective to generalize about the negative consequences of gaming, and efforts should be made to tackle specific problems faced by each gamer individually. In terms of education, the findings indicate the efficacy of devising school programs that would promote digital literacy and self-regulatory skills among young gamers.

Limitations

There are also several important limitations. First, given that this research utilized a cross-sectional research methodology, it cannot be determined what direction (i.e., which variable affects the other) the causal relationship is between gaming habits and mindfulness. Second, all variables studied were measured by self-report methods; therefore, it can be assumed there will be some form of response bias. Third, since this study was limited to adolescents attending public school within one Saudi city, generalizability beyond this population remains limited. Fourth, although the CAMM had acceptable psychometric properties concerning the target population, unfortunately no standardized normative data exist in Arabic for Saudi Arabia. Fifth, as indicated previously, the amount of variance accounted for by each regression model is relatively small and could indicate that there are many additional important factors influencing adolescent mindfulness. Future research with longitudinal and cross-cultural designs could offer greater insights into the relationship between digital game playing and attention function during adolescence. Future research designs that combine longitudinal study designs with behavioral assessments of attention and culturally valid measures of mindfulness could also help improve interpretability in this area.

Data availability statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical approval

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments. Ethical approval was obtained from the relevant institutional ethics committee prior to data collection. Informed consent was obtained electronically from all participants and, where applicable, from their legal guardians. Participation was voluntary, and participants were informed of their right to withdraw at any stage without consequences. All data were anonymized prior to analysis to ensure confidentiality and compliance with ethical standards.

Funding

This research received no external funding.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Acknowledgments

The authors would like to express their gratitude to the schools, school administration, and students for making this research possible by participating in the study. The authors would also like to thank the members of faculty and researchers who gave valuable comments on this research study.

REFERENCES

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Alfaifi, A. J., Mahmoud, S. S., Elmahdy, M. H., & Gosadi, I. M. (2022). Prevalence and factors associated with Internet gaming disorder among adolescents in Saudi Arabia: A cross-sectional study. *Medicine*, 101(26), e29789. <https://doi.org/10.1097/MD.00000000000029789>
- Bediou, B., Adams, D. M., Mayer, R. E., Tipton, E., Green, C. S., & Bavelier, D. (2018). Meta-analysis of action video game impact on perceptual, attentional, and cognitive skills. *Psychological Bulletin*, 144(1), 77–110. <https://doi.org/10.1037/bul0000130>
- Crone, E. A., & Dahl, R. E. (2012). Understanding adolescence as a period of social-affective engagement and goal flexibility. *Nature Reviews Neuroscience*, 13(9), 636–650. <https://doi.org/10.1038/nrn3313>
- Dion, J., Paquette, L., Daigneault, I., Godbout, N., & Hébert, M. (2018). Validation of the French version of the Child and Adolescent Mindfulness Measure (CAMM) among samples of French and indigenous youth. *Mindfulness*, 9(2), 645–653. <https://doi.org/10.1007/s12671-017-0807-x>

- Greco, L. A., Baer, R. A., & Smith, G. T. (2011). Assessing mindfulness in children and adolescents: Development and validation of the Child and Adolescent Mindfulness Measure (CAMM). *Psychological Assessment*, 23(3), 606–614.
<https://doi.org/10.1037/a0022819>
- Hammad, M. A., & Al-Shahrani, H. F. (2024). Impulsivity and aggression as risk factors for internet gaming disorder among university students. *Scientific Reports*, 14(1), 3712.
<https://doi.org/10.1038/s41598-024-53807-5>
- Johannes, N., Vuorre, M., & Przybylski, A. K. (2021). Video game play is positively correlated with well-being. *Royal Society Open Science*, 8(2), 202049.
<https://doi.org/10.1098/rsos.202049>
- Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, 10(2), 144–156.
<https://doi.org/10.1093/clipsy.bpg016>
- Kim, S., Munten, S., Kolla, N. J., & Konkolý Thege, B. (2024). Conduct problems, hyperactivity, and screen time among community youth: Can mindfulness help? An exploratory study. *Frontiers in Psychiatry*, 15, 1248963. <https://doi.org/10.3389/fpsy.2024.1248963>
- King, D. L., & Delfabbro, P. H. (2014). The cognitive psychology of Internet gaming disorder. *Clinical Psychology Review*, 34(4), 298–308. <https://doi.org/10.1016/j.cpr.2014.03.006>
- King, D. L., & Delfabbro, P. H. (2018). The concept of “harm” in Internet gaming disorder. *Journal of Behavioral Addictions*, 7(3), 562–564.
<https://doi.org/10.1556/2006.7.2018.24>
- Messena, M., & Everri, M. (2023). Unpacking the relation between children’s use of digital technologies and children’s well-being: A scoping review. *Clinical Child Psychology and Psychiatry*, 28(1), 161–198. <https://doi.org/10.1177/13591045221127886>
- Odgers, C. L., & Jensen, M. R. (2020). Annual research review: Adolescent mental health in the digital age: Facts, fears, and future directions. *Journal of Child Psychology and Psychiatry*, 61(3), 336–348. <https://doi.org/10.1111/jcpp.13190>
- Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, 3(2), 173–182.
<https://doi.org/10.1038/s41562-018-0506-1>
- Overå, S., Bakken, A., & Hyggen, C. (2024). Prevalence and characteristics of female and male esports players among Norwegian youth: A general population study. *International Journal of Environmental Research and Public Health*, 21(9), 1136.
<https://doi.org/10.3390/ijerph21091136>
- Park, S., & Hwang, H. S. (2009). Understanding online game addiction: Connection between presence and flow. In J. A. Jacko (Ed.), *Human-computer interaction: Interacting in various application domains* (Lecture Notes in Computer Science, Vol. 5613, pp. 378–386). Springer. https://doi.org/10.1007/978-3-642-02583-9_42

- Paulus, F. W., Ohmann, S., von Gontard, A., & Popow, C. (2018). Internet gaming disorder in children and adolescents: A systematic review. *Developmental Medicine & Child Neurology*, 60(7), 645–659. <https://doi.org/10.1111/dmcn.13754>
- Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). A motivational model of video game engagement. *Review of General Psychology*, 14(2), 154–166. <https://doi.org/10.1037/a0019440>
- Przybylski, A. K., & Weinstein, N. (2017). A large-scale test of the Goldilocks hypothesis: Quantifying the relations between digital-screen use and the mental well-being of adolescents. *Psychological Science*, 28(2), 204–215. <https://doi.org/10.1177/0956797616678438>
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78. <https://doi.org/10.1037//0003-066x.55.1.68>
- Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, 30(4), 344–360. <https://doi.org/10.1007/s11031-006-9051-8>
- Schuengel, C. (2022). Learning to love the null. *Journal of Child Psychology and Psychiatry*, 63(3), 249–251. <https://doi.org/10.1111/jcpp.13577>
- Sensua, B., Baruah, A., & Mukherjee, D. (2025). Prevalence and predictors of internet gaming disorder among adolescents in Northeast India: A cross-sectional study. *Industrial Psychiatry Journal*, 34(3), 470–477. https://doi.org/10.4103/ipj.ipj_61_25
- Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Developmental Psychobiology*, 52(3), 216–224. <https://doi.org/10.1002/dev.20445>
- Stevens, M. W., Dorstyn, D., Delfabbro, P. H., & King, D. L. (2021). Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry*, 55(6), 553–568. <https://doi.org/10.1177/0004867420962851>
- Tang, Y.-Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience*, 16(4), 213–225. <https://doi.org/10.1038/nrn3916>
- Temizarabacı, İ., Köse, G., Baş, M., & Nehring, I. (2025). Associations between screen time and mindfulness and eating behaviors among Turkish school-aged children: A cross-sectional study. *Children*, 12(6), 696. <https://doi.org/10.3390/children12060696>
- Valkenburg, P. M., Meier, A., & Beyens, I. (2022). Social media use and its impact on adolescent mental health: An umbrella review of the evidence. *Current Opinion in Psychology*, 44, 58–68. <https://doi.org/10.1016/j.copsyc.2021.08.017>