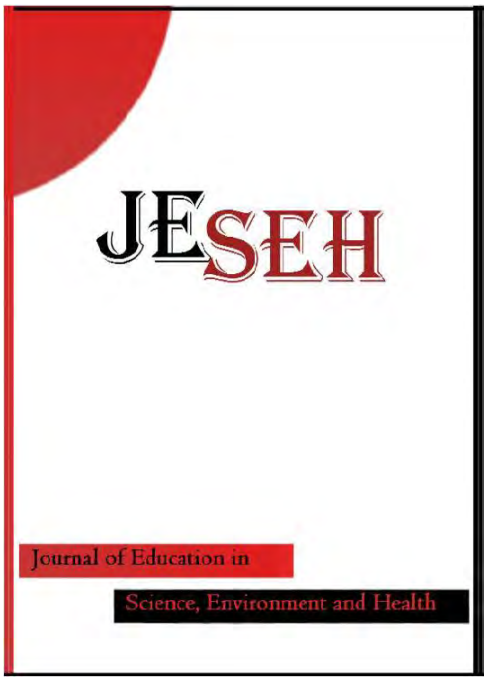

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Abstract

Technology may lead to many new problems, especially for students at high school level. The ease of using and accessing technology increases the risk of the younger pupils' addiction to technology. Problematic uses of technology, especially among high school students, include internet use, instant messaging, online gaming, social networking and computer use. Given the large young population in Turkey, it is important to evaluate the internet-based technologies' potentially positive effects as well as their undesirable effects. For this reason, the technology addiction levels of high school students before and after the pandemic and the change in technology addiction based on demographic characteristics (owning a computer, socio-economic level, time spent on social networks, grade level) were investigated. The cross-sectional survey method, one of the descriptive research designs, was used in the research. Participants consisted of 304 high school students selected via random sampling method. "Technology Addiction Scale" was used in the research. The data of the study was compared with the data of another study conducted with the same measurement tool and a similar sample before the pandemic. As a result of the research, when the addiction levels of adolescents before and after the pandemic are compared, it is seen that the students in the low-risk group move towards the risky and the addicted groups. In addition, it was determined that the percentage of highly-addicted students increased. It was observed that the students' highest addiction levels were in instant messaging, website use, social network use and online gaming, respectively. While the addiction levels of the participants varied based on the time spent on social networks and online gaming, the interaction effect between owning a computer and the family socioeconomic level also caused significant differences.

Introduction

Technology has become a part of life and contemporary society (Derbyshire, et al., 2013). The use of technology in daily life is growing very rapidly (Perrin & Duggan, 2015; Kartal & Çınar, 2022). With the emergence of smartphones and easy access to the internet via smartphones, activities such as social media usage, messaging, playing games (online and offline games), recreation, listening to music on the internet, and watching movies have become vital daily action (Kim et al., 2014; Jamir et al., 2019). Similarly, people use computers to study, search for information on the internet, play games, and communicate with others (Kim et al., 2014; Dere, 2022; Salehan & Negahban, 2013). Some use it only for communication, while others use it for entertainment (watching movies, listening to music, playing online games), shopping, browsing educational materials, etc. (Agarwal & Kar, 2015). New technologies have great benefits for students in terms of their education, socialization, communication, and academic performance (Simsek & Sali, 2014; Kartal, 2019). However, the type and extent of technology use can sometimes potentially harm physical and mental health, leading to serious social problems not only for individuals but also for their families and communities (Do & Lee, 2018; Amudhan et al., 2022). Research is concerned about adolescents' uncontrollably access to technological devices and loss of control over using them (Park & Hyun, 2014; Vilca & Vallejos, 2015; Sigerson et al., 2017; Sabbah et al., 2019; Chen et al., 2021; Dere, 2022).

While technology makes life easier and contributes positively to social development and modernization, it causes new behavioral problems such as technology addiction, which is characterized by excessive use and neglect of responsibilities (Huang et al., 2007; Muslu & Bolışık, 2009; Dong & Potenza, 2014). The use of technology is essential to make life easier; however, abnormal, excessive, and unnecessary use can lead to addiction (Sim et al., 2012). According to the American Psychiatric Association (APA), addiction is defined as

"continuing to make incompatible choices even in the face of a clearly expressed desire to make a different choice" (APA, 2013). Addiction not only causes the behavior to be repeated frequently, but also causes loss of control and important problems in daily life. Within the framework of these definitions, the concept of addiction can be associated with a person's obsession with a particular activity that disrupts his daily activities. Addiction reduces time spent on other activities such as eating, sleeping, studying, or chatting with other family members (Kim et al., 2014; Davis, 2001; Kim et al., 2010; Çelik, Odacı, & Bayraktar, 2015). The increase in the time spent on technologies such as computers and mobile phones not only causes problems with the eyes but is also associated with the risk of many health problems (Grøntved et al., 2014). Nowadays, there is a dependency on new and rapidly developing technologies such as smartphones, the Internet, computers, etc. One of the best examples of behavioral addiction is technology addiction (Young, 2007; Block, 2008; Amudhan et al., 2022).

Technological addictions are considered behavior-based addictions (Young & Abreu, 2011; Davis, 2001; Chóliz, 2010), and in such addictions, individuals can become passively dependent on watching television (Bachleda & Darhiri, 2018) as well as digital games (Kesici & Tunç, 2018; Söylemez, 2021), the Internet (Anand et al., 2018; Vadher et al., 2019), smartphones (APA, 2013; Davey & Davey, 2014; Grøntved et al., 2014), and computers (Kesici & Tunç, 2018; Wang, Sigerson, & Cheng, 2019) may also make individuals active technology addicts.

Technology addiction causes many problems such as sleep disorders (Männikkö, Billieux, & Kääriäinen, 2015), decreased academic performance (Thomée, Härenstam, & Hagberg, 2011; Wentworth & Middleton, 2014), reduced social relationships (Whang, Lee, & Chang, 2003; Meena, Mittal, & Solanki, 2012; Muusses et al., 2014; Bayar & Budak, 2021), weight gain (Porter & Kakabadse, 2006), malnutrition (Davis, 2001; Lepp ve diğ., 2013; Çelik et al., 2015) and cardiovascular disease (Grøntved et al., 2014). Depression and irritability (Lemmens, Valkenburg, & Peter, 2009; Matar Boumosleh & Jaalouk, 2017), insomnia (Nalwa & Anand, 2003; Lam, 2014), frustration (Young, 1998; Suler, 2005), anxiety (Nalwa & Anand, 2003; Tassin, Reynaert, Jacques, & Zdanowicz, 2014; Männikkö et al., 2015), difficulty in concentrating (Mok et al., 2014), restlessness (APA, 2013), withdrawal (Turel, Serenko, & Giles, 2011b; APA, 2013) symptoms may occur during adolescence because of technology addiction.

Technology addiction can damage the user's social life, disrupt emotional functioning, affect school, family, and work, and negatively affect others in the user's milieu (Block 2008). Adolescents with technology addiction experience a lack of social skills and opposition, which have harmful implications on their relationships with their families (Davis, 2001; Samaha & Hawi, 2016), social (Frangos, Frangos, & Sotiropoulos, 2011), academic or work environments (Young & Rogers, 1998; Young, 2007; Amudhan et al., 2022). Among adolescents, pathological uses of technology include internet use, instant messaging, online gaming, social networking, and computer use (Choi & Kim, 2004; Wang et al., 2009; Charlton & Danforth, 2010; APA, 2013; Kaess et al., 2014). Adolescents are less able to control their enthusiasm, which keeps their interest in these technologies alive (Wang et al., 2009). The American Psychiatric Association (2013) determined computer and Internet addiction as a subcategory of behavioral addiction in the new edition of the International Classification of Diseases.

Griffiths (1998) argues that internet addiction can be viewed as a technological addiction and a subset of a type of behavioral addiction. Young (1998) stated that internet addiction is a new clinical disease and phenomenon of postmodern society. The features of this phenomenon are (a) internet use to control mood, (b) increased time spent on the internet to achieve the same level of satisfaction, (c) repeated efforts to reduce internet use, (d) irritability, depression, or frustration in the absence of an internet connection, (e) internet connection takes longer than the user perceives, (f) a user lies to his/her environment about the time spent in cyberspace, (g) a user prefers the Internet to other activities and (h) strong devotion to the internet. Internet addiction is diagnosed when at least five of these eight criteria are experienced by an individual (Young, 1998). According to Akbulut et al. (2016), cyberloafing, as a subdimension of technology addiction, includes activities such as browsing websites, communicating in chat rooms or social networks, other activities in social networks, online shopping, downloading or playing games for private non-work-related purposes.

The American Psychiatric Association (2013) recently added "Internet Gaming Disorder" to Chapter III of the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders. This addition to the DSM-5 has addressed not only Internet gaming disorder but also a field that has expanded to include all kinds of digital addictions (Choi & Kim, 2004; Block, 2008; Kaess et al., 2014). Many researchers (Young, 1998; Moon, Koo, & Park, 2005; Charlton & Danforth, 2010; Griffiths, 2008, 2010; Chou et al., 2016) have addressed internet addiction and video game addiction. Online games are becoming increasingly popular among children, adolescents, and young adults and are often used for stress relief (Lemmens et al., 2009; Snodgrass et al., 2014).

It has been suggested that online games may help young people socialize by talking about the same topic in their spare time (Söylemez, 2021), relieve stress, stimulate their imagination (Kesici & Tunç, 2018), and improve their cognitive skills (Subrahmanyam et al., 2000). However, as the time adolescents spend with internet games increases, it has been stated that playing games may become addictive for some people and may harm the individual's social, professional, family, school, and psychological functioning (Charlton & Danforth, 2010; Kuss, 2013; Söylemez, 2021). According to a review by Kuss and Griffiths (2012), estimates of the prevalence of internet gaming disorder range from 30 to 50 percent depending on gender, age, and types of games played.

Social networks are a set of web applications where people exchange information, share their status, and entertain themselves (Boyd & Ellison, 2007; Clemons, 2009; Park et al., 2013). The development of online social networks has increased the time spent on social sites (Sigerson, & Cheng, 2018). It enables people to use social networks as a source of entertainment and to stay in touch with friends and family wherever they are (Amichai-Hamburger & Ben-Artzi, 2003; Salehan & Negahban, 2013) as well as to create or maintain new relationships as well as create connections that would not otherwise be made (Boyd & Ellison, 2007; Ganesh et al., 2017). Social networks come to the fore among new communication technologies and adolescents are the most intensive users, and this is a constantly growing trend (Meena et al., 2012). Social network relationships can allow adolescents to express themselves not as they are, but as they want to be (Kandell, 1998; Simsek, & Sali, 2014). The transition from normal use to problematic social media use is seen as an important mechanism for the individual to alleviate feelings of stress, loneliness, or depression (Kandell, 1998; Costa et al., 2016). Social network addiction has been associated with excessive use of social networks and has negative effects on the user's behavior (Esmaeili Rad & Ahmadi, 2017). When the literature is examined, it is seen that addiction to social networks causes loss of control (Andreassen et al., 2012), forgetfulness (Xanidis & Brignell, 2016), distraction (Moqbel & Kock, 2018), decreased academic performance (Turel, Serenko, & Bontis, 2011; Karpinski et al., 2013; Attree et al., 2014; Vilca & Vallejos, 2015; Xanidis & Brignell, 2016), withdrawal syndrome (Esmaeili Rad & Ahmadi, 2017), mood change (Griffiths, 2005), and interest loss in other activities (Young, 1998), and these can cause strong negative emotions such as stress, anxiety, depression and dissatisfaction with life (Hong et al., 2014; Samaha & Hawi, 2016).

The development of technology creates many new problems for adolescent students, especially at the high school level. The ease of use and access to technology causes young people to become one of the groups at higher risk of experiencing addiction (Pratiwi, Suranata, & Dwiarwati, 2021). The reason for the possibility of addiction in adolescents may be that psychological and developmental factors specific to their developmental period make them more vulnerable to this type of addiction. Additionally, establishing close relationships can put adolescents in a problematic and stressful situation (Vilca & Vallejos, 2015). The existence of dependency on various information technologies has been demonstrated (Griffiths, 2001; Porter & Kakabadse, 2006; Jamir et al., 2019; Bayar & Budak, 2021; Pratiwi et al., 2021; Amudhan et al., 2022). Considering the large young population in Turkey, the massively increased use of internet-based technologies during and after the pandemic indicates that more studies are needed to assess their potentially positive effects as well as their undesirable effects. For this reason, this study aims to examine the technology addiction levels of student adolescents before and after the pandemic, to provide a comprehensive assessment of the roles of demographic characteristics (owning a personal computer, socioeconomic level, time spent on social networks, grade level) on technology addiction of adolescents, and develop appropriate interventions for technology addiction among adolescents. It can be said that the results of this research will contribute to the field, especially in terms of showing how the technology addiction levels of adolescents change before and after the pandemic.

Method

The research is a descriptive survey design. The main purpose of survey research is to describe the characteristics of a sample group that can represent a population (Fraenkel, Wallen, & Hyun, 2011). Within the scope of this study, the post-pandemic technology addiction of adolescents was considered as a phenomenon and this phenomenon was tried to be described cross-sectionally. In addition, the research phenomenon was examined in the context of independent variables that are thought to be influencing factors on students' technology addiction (whether having a computer, family socioeconomic status, time spent on social networks, time playing online games, and grade level). In addition, the current research data was compared with the data of a study conducted by Aydın (2017) on a similar group, before the pandemic, in which students' technology addictions were examined. This comparison enabled the technology addictions of adolescents to be revealed and the change to be seen longitudinally, especially before and after the pandemic. In this context, we also sought an answer to the question "How has the pandemic process affected the technology addictions of adolescents?".

Participants

The accessible population of the research is 9th, 10th, and 11th-grade high school students studying in a city center in Central Anatolia in the 2021-2022 academic year. According to the National Education Statistics (2021), approximately 5440 high school students are studying in different public schools. The sample of the study consisted of 304 students selected from the accessible universe employing the random sampling method. Power analysis was performed to determine the sample size of the study. Technology addiction levels of high school students were evaluated as primary outcome parameters and the effect size value obtained from the literature (Griffiths, 2005; Aydın, 2017; Young, 1996) was calculated. In this context, the optimal sample size was calculated as 280 with effect size (0.26), Alpha (0.05), and Power (0.95) values for a five-way independent variable in the one-way analysis of variance test (Faul et al., 2007). Therefore, it can be said that the study sample of 304 high school students is enough to generalize results to the accessible universe. The demographic characteristics of the adolescents in the study group are given in Table 1.

Table 1. Demographics of participants

		f	%
Having a computer	No	186	61,2
	Yes	118	38,8
Socioeconomic status	Low	35	11,51
	Medium	243	79,93
	High	26	8,55
Time Spent on Social Networks	Less than 1 hour	100	32,89
	1-2 hour	72	23,68
	3-4 hour	67	22,04
	5-6 hour	29	9,54
	7 hours and above	36	11,84
Time spent on online games	Less than 1 hour	92	30,26
	1-2 hour	94	30,92
	3-4 hour	63	21,05
	5-6 hour	22	7,27
	7 hours and above	32	10,53
Grade Level	9	92	30,26
	10	134	44,08
	11	78	25,66
	Total	304	100

Table 1 shows that 61.2% of the students do not have a personal computer, and the socioeconomic levels of their families are generally at a medium level (f=243; 79.93%). In addition, the time students spend on social networks is mostly less than 1 hour (f=100; 32.8%), and the time spent playing games mostly varies between 1-2 hours (f=94; 30.92%).

Data Collection Tools

In the research, the "Personal Information Form" was used to reveal data regarding the demographic characteristics of the students, and the "Technology Addiction Scale" was used to determine technology addiction.

(i) Personal Information Form. It was used to determine the independent variables that are thought to be a factor in the post-pandemic technology addiction of adolescents, which was considered a phenomenon in the research process. The personal information form developed by the researchers includes questions at five classification levels (e.g., having a computer, family socioeconomic status, time spent in social networks, online gaming time, and grade level). In the development of the personal information form, studies on technology addiction were examined and independent variables thought to affect technology addiction were determined based on these studies (Griffiths, 2005; Aydın, 2017; Young, 1996).

(ii) Technology Addiction Scale. The measurement tool was developed by Aydın (2017) to determine the technology addiction levels of adolescents. 'Technology Addiction Scale' consists of four sub-dimensions and a total of 24 items. The scale was used as a five-point Likert (1: strongly disagree; 5: strongly agree) as it was in the original form. The number of items, reliability coefficients calculated in this study and expressed in the original form, and the minimum and maximum scores for each factor are given in Table 2.

Table 2. Reliability coefficients and number of items for each factor

Sub-dimensions	Number of Items	Cronbach Alpha	Cronbach Alpha in the original form (Aydın, 2017)	Min-Max scores
Instant Messaging	6	0.781	0.806	6-30
Social Network Use	6	0.742	0.786	6-30
Web Site Use	6	0.844	0.861	6-30
Online Gaming	6	0.827	0.897	6-30

The calculated internal consistency coefficients of the sub-dimensions of the technology addiction scale ranged between 0.742 and 0.844. Cronbach Alpha internal consistency coefficients calculated by Aydın (2017) varied between 0.789 and 0.897. These values show that each sub-dimension of the scale has an acceptable level of internal consistency (Kalaycı, 2010).

Data Collection Process and Analysis

It was aimed to increase the reliability of the data by briefly explaining the purpose of the study in simple terms to the students, along with the instructions regarding filling out the survey, that the answers would be kept strictly confidential, and that they had the right to withdraw at any time. All surveys were distributed to participants at a predetermined time and in a classroom environment. In addition, a flexible time frame was provided to enable the participants to easily answer the items in the measurement tool. The surveys did not ask for names or any information that could provide a clue about the participants. To avoid any prejudice, influence, or hesitation on the participants, the researchers were not present in the classrooms during the data collection. Data were collected using a paper-and-pencil test.

Before proceeding with the data analysis, the data were examined and the data of the participants who were thought to be not appropriate regarding the measurement tool (left blank, standard scoring, missing data, etc.) were removed from the data set. In the descriptive analysis of the data, frequency (f), percent (%), arithmetic mean ($\bar{x}$), and standard deviation (SD) were calculated. Before proceeding with the relational analyses, the normality assumptions of the data were examined, and the results are given in Table 3.

Table 3. Normality of data

Dependent variables	N	$\bar{x}$	Sd	Mode	Median	Skewness	Kurtosis	Kolmogorov-Smirnov	
								statistics	p
Technology addiction	304	2,90	,791	3,00	2,95	-,187	-,387	,048	,092

Normality assumptions were examined for the overall Technology Addiction scale. It is seen that the mean, mode, and median ($\bar{x}$=2.90; Mode=3.00; Median=2.95) are almost equal. Skewness (-.187) and kurtosis (-.387) vary between -1 and +1 (Tabachnick & Fidell 2019). Kolmogorov Smirnov test is not significant (p>.05). All these values can be interpreted as the data set showing a normal distribution. In this context, the following steps were performed to analyze data:

- A one-sample t-test was used to compare the observed and expected scores of adolescents on the technology addiction scale. In the one-sample t-test, data from the study conducted by Aydın (2017) before the pandemic were taken as the expected score. It can be said that, especially in line with the purpose of the study, comparing the technology addictions of students in a similar sample before and after the pandemic will reveal important findings to reveal the effects of the pandemic on technology use. In this respect, it is worth noting that the data analysis process is discussed in a longitudinal context. In Aydın's (2017) study; the total average for the technology addiction scale was calculated as 50.32. The average scores for subscales are 12.91 for social network addiction; 13.70 for instant messaging addiction; 10.10 for online gaming addiction; and 13.59 for website addiction.
- In the context of independent variables (grade level, computer ownership, family socioeconomic status, time spent in social networks, and time spent in online gaming), a multi-factorial ANOVA test was used to examine adolescents' technology addictions. Scheffe test was performed to determine the source of the difference. In addition, the Eta square (η^2) was calculated for the effect size of the significant differences. The calculated eta-square values were interpreted as .01=small, .06=moderate, and .14=large effect based on the references suggested by Cohen (1988).
- In addition, high school students' addiction levels were grouped by considering similar studies in the literature (Young, 1998; Hazar & Hazar, 2017). For example, the Internet Addiction Scale, which was first

developed by Young (1998), is a 20-item, five-point Likert-type scale. Total scores are obtained from the sum of 20 items ranging from 20 to 100. The higher the score, the higher the level of addiction. According to Young's criteria, total internet addiction scores between 0-30 points mean *normal users*, 31-49 points mean *average internet users* who have control over their internet use, and 50-79 points mean occasional/frequent users who have problems. Scores between 80 and 100 indicate internet addicts who have severe problems due to internet use. In another study, the cut-off value was taken as 51 to categorize participants' internet use as *problematic* or *non-problematic* (Stavropoulos, Alexandraki, & Motti-Stefanidi, 2013). In this study, the ranges determined for technology addiction levels are as follows: "1-24: Normal group, 25-48: Low-risk group, 49-72: Risky group, 73-96: Addicted group, 97-120: Highly addicted group".

Results

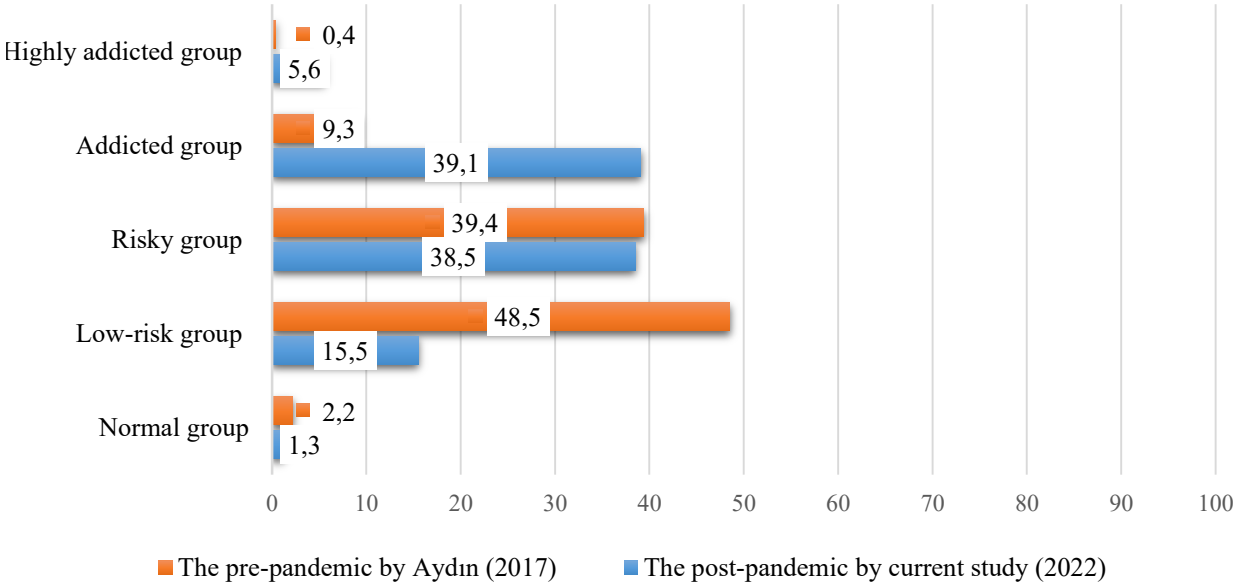

Figure 1. Percentage distribution of adolescents' technology addiction levels before/after the pandemic

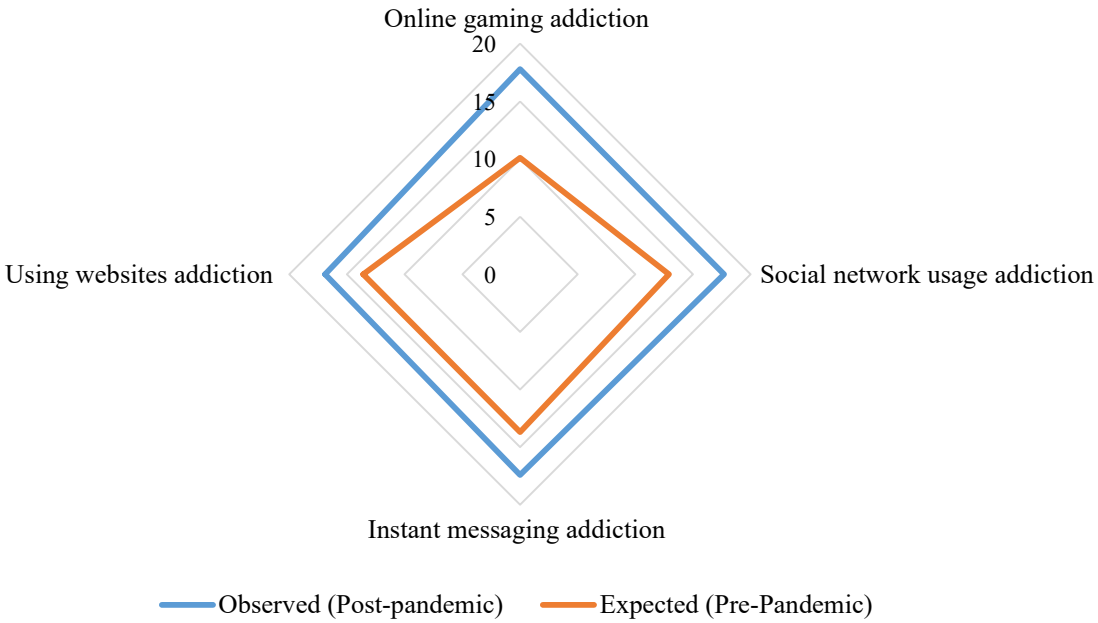

Figure 2. Findings regarding the observed and expected averages regarding technology addiction sub-factors.

When the post-pandemic technology addiction levels of the students in the study group were examined, the highest percentages were in the addicted group (n=119; 39.1%), the risky group (n=117; 38.5%), and the low-risk group (n=47; 15.5%), respectively. In addition, while 17 students are in the highly addicted group (5.6%), only 4 students are in the normal group (1.3%). In the study conducted by Aydın (2017) before the pandemic, it was determined that 48.5% of the students in the study group were in the low-risk group and 39.4% were in the risk group. In addition, only 9.3% of the students in the study group are in the addicted group, while 0.4% are in the highly addicted group. When the addiction levels of adolescents before and after the pandemic are compared, it is seen that the students in the low-risk group move towards the risky group and the addicted group. In addition, it was determined that the percentage of highly addicted students increased. These findings generally show that the COVID-19 pandemic has increased students' addiction to technology. This increase has especially manifested itself in the level of addiction.

The minimum score that participants can get from each sub-dimension of the scale is 6, while the maximum is 30. When the findings regarding technology addictions of high school students before the pandemic are examined, the highest addiction levels were in instant messaging addiction ($\bar{x}$=13.7) and using websites ($\bar{x}$=13.59), respectively, while the lowest averages were in online gaming addiction ($\bar{x}$=10.10) and social network usage ($\bar{x}$=12.91). After the pandemic, the averages for each addiction level generally increased. In particular, the highest averages have turned into an addiction to online gaming ($\bar{x}$=17.78) and social network use ($\bar{x}$=17.70), unlike before the pandemic. Addiction to using websites remained at the lowest level. All these findings show that the technology addiction levels of adolescents have increased, especially with the pandemic. In addition, it has been determined that addiction types have changed significantly before and after the pandemic.

Table 4. One sample t-test results regarding technology addiction sub-factors

Addiction Sub-factors	N	Observed Mean	Sd	Expected Mean (Aydın, 2017)	Mean difference	t	p
Technology Addiction (General)	304	69,79	18,978	50,32	19,47	17,896	,000
Social Network	304	17,70	5,136	12,91	4,79	16,260	,000
Instant Messaging	304	17,41	5,660	13,70	3,71	11,452	,000
Online Gaming	304	17,78	6,136	10,10	7,68	21,849	,000
Using Websites	304	16,89	6,361	13,59	3,30	9,049	,000

According to Table 4, students have the highest mean scores, respectively, in online gaming addiction ($\bar{x}$=17.78), social network addiction ($\bar{x}$=17.70), and instant messaging addiction ($\bar{x}$=17.41). The lowest average occurred in website addiction ($\bar{x}$=16.89). There was a significant difference between the technology addiction scale averages of the students (observed means) and the expected average for the overall scale (t_{304}=17,896; p<0.00). When examined in terms of sub-dimensions, it was determined that the highest level of significant difference occurred in online gaming (t_{304}=21,849; p<.00) and social network addictions (t_{304}=16.260; p<.00). In addition, there is a difference in favor of the observed means in instant messaging (t_{304}=11.452; p<.00) and Website (t_{304}=9.049; p<.00) addictions. These findings show that students' technology addiction levels have increased significantly, especially after the pandemic. This increase is especially higher in online gaming and social network addiction.

Table 5. Multiple ANOVA test results for the overall technology addiction scale

Source	Type III Sum of Squares	df	Mean Square	F	p	η^2	Source of difference*
Corrected Model	97,205	144	,675	1,163	,176	,513	
Intercept	615,375	1	615,375	1060,513	,000	,870	
Computer ownership	,450	1	,450	,776	,380	,005	
Family socioeconomic level	,782	2	,391	,674	,511	,008	
Time spent on social network	7,931	4	1,983	3,417	,010	,079	5>1,2,3
Time spent on online gaming	2,692	4	,673	1,160	,331	,028	
Grade Level	,728	2	,364	,627	,535	,008	
Computer ownership* Family socioeconomic level	4,244	2	2,122	3,657	,028	,044	
Error	92,262	159	,580				
Total	2760,773	304					
Corrected Total	189,467	303					

*[1]Less than 1 hour, [2]1-2 hours, [3]3-4 hours, [4]5-6 hours, [5]7 hours and above

In addition, it has been determined that students' addiction to instant messaging and using websites has increased. Findings regarding whether the technology addiction levels of high school students differ based on their demographic characteristics are given between Tables 5 and Table 9. While it was observed that the mean scores of the students for the overall technology addiction scale did not differ significantly based on computer ownership, family socioeconomic level, and time spent on online gaming, it was determined that it differed significantly based on the time spent on social networks ($F=3.417$; $p < 0.05$). This significant difference has a medium effect size ($\eta^2=.044$). The Scheffe test for the source of the significant difference showed that the difference was in favor of students who spent 7 hours or more a day on social networks. It has been observed that students who spend 5-6 hours and 7 or more hours on social networks are significantly more addicted to technology than other students.

The interaction effect between having a computer and the family socioeconomic level is statistically significant ($F=3.657$; $p<.05$). When the averages between groups are examined, the highest average among students who do not have a computer was found in those from families with high-income level ($\bar{x}=2.97$). However, among students with computers, the highest average was found in students from families with low ($\bar{x}=3.01$) and middle-income levels ($\bar{x}=3.02$). These findings show that decreasing income levels and owning a personal computer increase adolescents' technology addiction.

Table 6. Multiple ANOVA test results for social network addiction sub-dimension

Source	Type III Sum of Squares	df	Mean Square	F	p	η^2
Corrected Model	107,859	144	,749	1,042	,398	,486
Intercept	646,737	1	646,737	900,091	,000	,850
Computer ownership	1,552	1	1,552	2,161	,144	,013
Family socioeconomic level	1,669	2	,835	1,162	,316	,014
Time spent on social network	5,949	4	1,487	2,070	,087	,049
Time spent on online gaming	2,109	4	,527	,734	,570	,018
Grade level	,251	2	,125	,175	,840	,002
Error	114,245	159	,719			
Total	2867,861	304				
Corrected Total	222,104	303				

Social network addiction does not differ significantly based on high school students' computer ownership, family socioeconomic level, time spent on social networks and online gaming, and grade levels. In addition, the interaction effects between independent variables are not statistically significant. These findings show that demographic characteristics have a similar effect on social network addiction.

Table 7. Multiple ANOVA test results for instant messaging addiction sub-dimension

Source	Type III Sum of Squares	df	Mean Square	F	p*	η^2
Corrected Model	130,868	144	,909	1,041	,401	,485
Intercept	614,291	1	614,291	703,703	,000	,816
Computer ownership	,318	1	,318	,365	,547	,002
Family socioeconomic level	,555	2	,277	,318	,728	,004
Time spent on social network	8,214	4	2,054	2,353	,056	,056
Time spent on online gaming	8,501	4	2,125	2,435	,050	,058
Grade Level	,816	2	,408	,467	,628	,006
Computer ownership * Time spent on social network	9,266	4	2,316	2,654	,035	,063
Error	138,798	159	,873			
Total	2831,528	304				
Corrected Total	269,665	303				

*[1]Less than 1 hour, [2]1-2 hours, [3]3-4 hours, [4]5-6 hours, [5]7 hours and above

Given the instant messaging addiction, it is seen that the mean scores between the groups do not differ significantly based on computer ownership, family socioeconomic level, and grade levels. However, the instant messaging addiction level is statistically different at the benchmark level based on the time spent on online gaming ($F=2,435$; $p=,05$). This shows that the instant messaging addiction levels of high school students are similar in terms of having a computer, family socioeconomic level, and class levels. However, instant messaging addiction varies, albeit at a borderline level, based on online gaming time.

In terms of the effect of the interaction between two variables, adolescents' instant messaging addiction levels vary significantly based on the interaction between computer ownership and time spent on social networks (F=2.654; p<.035). This difference has a medium-level effect (η^2=.063). When the mean scores between groups are examined, the highest addicted students who do not have a computer are those who spent 3-4 hours ($\bar{x}$=3.20), 5-6 hours ($\bar{x}$=3.07), and 7-plus hours ($\bar{x}$=3.06) on social networks. Similarly, among students who own computers, the highest addicted students are those who spent 5-6 hours ($\bar{x}$=2.94) and 7 or more hours ($\bar{x}$=3.27) on social networks. In addition, the lowest instant messaging addiction level belongs to students who have a computer and spend less than 1 hour ($\bar{x}$=2.5) on social networks. These findings generally show that students who do not own computers spend more time on social networks and that instant messaging addiction increases as time spent on social networks increases.

Table 8. Multiple ANOVA test results for online gaming addiction sub-dimension

Source	Type III Sum of Squares	df	Mean Square	F	p	η^2	Source of difference*
Corrected Model	158,460	144	1,100	1,104	,270	,500	
Intercept	643,737	1	643,737	645,997	,000	,802	
Computer ownership	,429	1	,429	,431	,512	,003	
Family socioeconomic level	2,603	2	1,301	1,306	,274	,016	
Time spent on social network	6,793	4	1,698	1,704	,152	,041	
Time spent on online gaming	10,726	4	2,681	2,691	,033	,063	5>1,2 2,3,4>1
Grade Level	,565	2	,282	,283	,754	,004	
Computer ownership * Family socioeconomic level	6,546	2	3,273	3,285	,040	,040	
Error	158,444	159	,997				
Total	2989,278	304					
Corrected Total	316,904	303					

*[1]Less than 1 hour, [2]1-2 hours, [3]3-4 hours, [4]5-6 hours, [5]7 hours and above

When adolescents' online gaming addictions are examined in terms of demographic characteristics, it is determined that they do not differ significantly based on computer ownership, family socioeconomic level, time spent on social networks, and grade levels. However, students' addiction to online gaming varies based on the time spent on online gaming (F=2.691; p<.05). This significant difference has a medium effect size (η^2=.063). When the posthoc test (Scheffe) results were examined to determine the source of the significant difference; it has been seen that the mean scores differ significantly in favor of the second group between those whose game playing time is less than 1 hour and those whose game playing time is between 1-2 hours, 3-4 hours, 5-6 hours and 7 hours and more. Similarly, there was a difference in favor of the second group between those who played for less than 1 hour and 1-2 hours and those who played for 7 hours or more. These findings show that students' addiction to online gaming increases, especially as the playing time increases. In addition, the online gaming addiction levels of students who play games for less than 1 hour and 1-2 hours a day are similar.

Table 9. Multiple ANOVA test results for website addiction sub-dimension

Source	Type III Sum of Squares	df	Mean Square	F	p	η^2	Source of difference*
Corrected Model	177,569	144	1,233	1,203	,128	,521	
Intercept	558,809	1	558,809	545,008	,000	,774	
Computer ownership	,048	1	,048	,047	,829	,000	
Family socioeconomic level	,704	2	,352	,343	,710	,004	
Time spent on social network	16,282	4	4,071	3,970	,004	,091	5>1,2,3,4
Time spent on online gaming	2,781	4	,695	,678	,608	,017	
Grade Level	3,848	2	1,924	1,876	,157	,023	
Error	163,026	159	1,025				
Total	2749,972	304					
Corrected Total	340,595	303					

*[1]Less than 1 hour, [2]1-2 hours, [3]3-4 hours, [4]5-6 hours, [5]7 hours and above

The effect of the interaction between computer ownership and family socioeconomic level is statistically significant (F=3.285; p<.05). This difference has a low effect size (η^2=.040). The addiction levels were close to each other in terms of family socioeconomic level among students who did not own a computer ($\bar{x}_{low}$=2.85;

$\bar{x}_{medium}$=2.99; $\bar{x}_{high}$=2.98). This situation is different for adolescents who have a computer. While online game addiction is highest in children from low-income families who own computers ($\bar{x}$=3.21), the lowest online game addiction is in students from high-income families who own computers ($\bar{x}$=2.53). These findings show that computer ownership and family socioeconomic level have an interaction effect on students' online game addiction. Especially children from low-income families who own computers have higher levels of online game addiction.

Table 9 demonstrates that website addictions do not change statistically in terms of students' computer ownership, family socioeconomic level, time spent on online gaming, and grade levels. The difference in mean scores between groups in terms of time spent on social networks is significant (F=3.970; p<.05). This significant difference has a medium effect size (η^2=.091). Scheffe test results regarding this difference show that there is a difference between the students who spend 7 hours or more on social networks and the other groups (4 hours and below) in favor of the first group. These findings show that the addiction level of adolescents, who spend 7 hours or more on social networks, to use websites also increases significantly. In addition, the interaction effects in terms of independent variables are not statistically significant.

Conclusion and Discussion

This study aimed to evaluate the technology addiction levels of high school students before and after the pandemic by comparing them in terms of multiple variables. 9th, 10th, and 11th grade Industrial Vocational High School (IVHS) students were included in the study. IVHS students gain professional competence in the relevant field by receiving vocational training in many different fields (e.g. information technologies, machine technologies, furniture, interior design, etc.) at different grade levels (9th, 10th,11th, and 12th grades). Almost all of the students studying in high schools are male students. In this context, all of the participants of this study (N=304) consisted of male students. The students participating in this study are mainly from rural areas. Sánchez-Martínez and Otero (2009) stated that students from rural areas are more likely to develop technology addiction.

The low socioeconomic levels of the students and their families studying at these schools and the high rate of mobile phone and cigarette use are seen as important limitations and threats (Strategic Plan, 2019-2023). According to Gökbulut (2019), the reason why Vocational High School students' technology addiction levels are higher than other schools is that it is the school with the lowest score on national entrance exams. Another reason may be that vocational high school students have low university admission rates, they lack university goals, and they perceive themselves as intermediate staff in the labor market because they do not focus on academic success.

It is seen that 38.8% (f = 118) of the participants own a personal computer and approximately 80% (f = 243) have a moderate socioeconomic status. In addition, 67% of the students (f=204) spend at least 1-2 hours a day on social networks. Within this group, 21% (f=65) spend at least 5-6 hours a day on social networks. In the study conducted by Erol and Çırak (2019), participants who used social media very frequently were significantly more internet addicted than participants who used social media occasionally. Similarly, participants who spent more than three hours on a computer each day were significantly more internet addicted than participants who spent less than an hour and between one and three hours. In addition, as the time spent by adolescents on social networks increases, the time spent on school and other activities decreases, which may harm students' school success.

When the online gaming time of the participants was examined, it was seen that approximately 70% (f=212) spent at least 1-2 hours a day. Approximately 18% (f=54) spend at least 5-6 hours a day on online games. Considering that all the participants in the research were male students, this result can be considered a natural result since it is addressed that men have a stronger motivation to play games (Chou & Tsai, 2007). Horzum (2011), on the other hand, reported that male students develop more positive thoughts by playing computer games, and therefore computers are accepted as "boys' toys". Increasing the time adolescents spend on technology makes them spend less time with their environment and family, and this will negatively affect parental relationships. Additionally, this may cause problems in connecting to school. Therefore, adolescents' relationships with their parents and social environment need to be strengthened. Furrer and Skinner (2003) confirmed that a high-quality parent-adolescent relationship is an important motivational source that has an impact on adolescents' school engagement. Similarly, Zhu et al. (2015) argue that a low level of parent-adolescent relationship will place a limitation on the development of school engagement and ultimately lead to basic psychological needs not being met, a deficiency that the adolescent may tend to compensate for through

the internet games. Teens who are addicted to online games will have difficulty establishing social relationships with peers or other communities. This is because young people spend too much time playing online games, thus reducing their opportunities for social interaction.

The measurement tool used in the research is a five-point Likert scale consisting of four factors (Social network addiction, instant messaging addiction, online game addiction, and website addiction) and has 24 items. The minimum and maximum score range that students can get from this scale varies between 24-120. Participants are grouped into five categories based on their scores: normal group (1-24 points), low-risk group (25-48 points), risky group (49-72 points), addicted group (73-96 points), and highly-addicted group (97-120 points).

The highest distribution of participants is in the addicted group (n=119; 39.1%), the risky group (n=117; 38.5%), and the low-risk group (n=47; 15.5%), respectively. Additionally, 17 students (5.6%) are in the highly addicted group. In a study conducted by Aydın (2017) in a similar study group before the pandemic, 48.5% of the students were in the low-risk group and 39.4% in the risky group. When the distribution of students before and after the pandemic is compared, it is possible to say that the students who were in the low-risk group before the pandemic passed into the risky and addicted group after the pandemic. It is also seen that the prevalence of the highly addicted group has increased significantly after the pandemic. Social isolation, which started with the pandemic, has also revealed many limitations. During the pandemic, all face-to-face activities turned into online services that increased internet use. The Internet strengthens behavior by offering numerous options, personalized recommendations, autoplay, and socialization, especially increasing technological addiction (Shim & Kim, 2018). It also negatively affected the communication between students and teachers. The use of information technologies to reduce stress and ensure interpersonal communication due to the pandemic has increased significantly and has become an important part of our lives (Király et al., 2020). The pandemic may be effective in the increase in technology addiction found in this study. Studies show that people tend to watch videos (Xiang, Zhang, & Kuwahara, 2020), use social media (Gao et al., 2020; Majeed et al., 2020), surf the internet (Király et al., 2020) or gaming (Sun et al., 2020) to reduce their anxiety about changing living conditions during the pandemic period.

When the general technology addiction levels of students before and after the pandemic are compared, there is a difference of 19.47 points in favor of post-pandemic between pre-pandemic ($\bar{x}$=50.32) and post-pandemic ($\bar{x}$=69.79). This difference is statistically significant in favor of post-pandemic data. This result shows that students' technology addiction increased after the pandemic. When the sub-dimensions were examined, the statistically highest increase was in online gaming addiction. Similarly, there was a difference in favor of post-pandemic use of social networks, instant messaging, and using websites. It is possible to note that online education with many online tools during the pandemic period also might have an impact on addiction since many homework and activities given by the teachers have emerged as a necessity to be done over the Internet. However, considering the developmental stages of the students, many students may have preferred to focus on operating their devices to navigate the virtual world rather than paying attention to the material given by the teacher. Wentworth and Middleton (2014) found that students who spend more time using technology spend less time studying. Changing and developing technologies are an important part of the learning process, but an effective guidance service may be needed to ensure that students use technology in a purposeful and controlled manner. Koovakkai and Muhammed (2010) reported that rural students had higher unethical internet use than other students due to the lack of guidance.

When students' technology addiction levels after the pandemic were examined based on the demographic variables, it was seen that the students' technology addiction mean scores did not change based on computer ownership, family socioeconomic level, and online gaming. However, it has been observed that students' technology addiction levels vary depending on the time spent on social networks. The results demonstrated that students who spend 7 hours or more on social networks are more technology addicted than others. Alavi et al. (2012) stated that technology-addicted adolescents generally stay on devices for more than 6 hours a day and present unhealthy lifestyle symptoms. Similarly, Mohamed Ibrahim et al. (2018) revealed that there is a significant positive relationship between technology addiction and time spent on technology. The current study shows that social network use is significantly associated with technology addiction as previously reported (Salehan & Negahban, 2013; Lopez-Fernandez et al., 2014; Esmaeili Rad & Ahmadi, 2017). This finding implies that the purpose of using technology is one of the important determinants of addiction. Accordingly, parents can restrict internet use for non-educational purposes. The use of additional gadgets can also be a risk factor for technology addiction. Therefore, parents can control the number of gadgets that children can access.

When the interaction effect between computer ownership and family socioeconomic level is examined, there is a significant change in the technology addiction levels of the students. It was seen that the highest technology

addiction level among the students who did not have a personal computer was among the children of families with high-income levels. This result may be because students have easy access to technological opportunities other than computers in families with high incomes. Rosen et al. (2013) stated that students with higher economic incomes use social media more frequently. Toker and Baturay (2016) stated that socio-economic status, online gaming, computer game playing, and mother's working status increase the levels of game addiction. On the other hand, in this study, among the students who had a personal computer, the students with the highest technology addiction were those with low and middle-income levels. In other words, even if the socioeconomic levels of families are low, it can be said that students' possession of personal computers may support their technology addiction.

Adolescents' social network addiction does not differ significantly based on independent variables (owning a personal computer, family socioeconomic level, time spent on social networks, and online gaming time). In other words, it can be said that the social network addictions of the participants are similar. When students' instant messaging addiction levels are examined based on the independent variables, it is seen that online gaming time has a significant effect at the borderline level. Instant messaging addiction level does not differ significantly in terms of other independent variables (grade level, time spent on social networks, family socioeconomic level, and owning a personal computer). In terms of these variables, it is possible to imply that students' instant messaging addiction levels are similar. The interaction effect between owning a personal computer and the time spent on social networks on students' instant messaging levels demonstrates a significant effect on the instant messaging addiction level. Among the students who do not have a computer, the most addiction to instant messaging belongs to those who spend 3 hours or more on social networks. In the student group that owns a computer, the highest instant messaging addiction is in favor of the student groups that spend 5 hours or more on social networks. Regardless of whether students have a personal computer or not, it can be said that as the time students spend on social networks increases, instant messaging addiction also increases. Similarly, in many studies (Leung, 2006; Sharma et al., 2016; Vadher et al., 2019), internet usage time was found to be a significant predictor of technology addiction. In the study conducted by Serdar and Demirel (2021), it was determined that the highest average in the sub-dimensions of the technology addiction scale was in the "Instant Messaging" sub-dimension, and the lowest average was in the "Online Game Addiction" sub-dimension. Twenge (2017) reported that high school students spend an average of 2-2.5 hours a day on messaging, approximately 2 hours on online activities, 1.5 hours on electronic games, and half an hour on chatting. These results mean that young students spend an average of 6 hours a day on technology. This period corresponds to an adult's average sleep duration on a normal day. This amount of time adolescents spend on texting may cause them to have problems in their academic and daily work; Therefore, it is important to pay attention to the internet addiction of adolescents and to design interventions to alleviate the undesired outcomes of the addiction. In another study conducted by Vadher et al. (2019), they found that problematic internet users have used the internet for a long time and spent more time per day than problem-free internet users. They also found a significant relationship between total monthly expenditure and monthly cost of internet services between problematic internet users and non-problematic internet users.

Adolescents' online gaming addiction levels vary significantly based on the online gaming time. When the source of the significant difference is examined, it is between those who play games for 7 hours or more and those who play for 4 hours or less, and in favor of those who play games for 7 hours or more. Similarly, there is a significant difference in online gaming addiction between those who play games for less than 1 hour a day and those who play for more than 1 hour, and in favor of those who play games for more than 1 hour. It can be said that as the time adolescents play games increases, their online game addiction increases. When the combined effect of owning a computer and family socioeconomic level on online gaming addiction is examined, it is seen that this effect is significant. It can be said that the online gaming addiction levels of students who do not own a computer are close and like each other regardless of their income levels. This result may imply that game-addicted students can play digital games for a long time even if they do not have a personal computer. However, among adolescents who own a computer, it is seen that the group with the highest score on online gaming addiction is the low-income group. As the income level increases in this group, online gaming addiction scores decrease. Unwanted negative or poor relationships of adolescents with their families may also have had an impact on this result. An unwanted parent-adolescent relationship may frustrate basic expectations (Turel et al., 2011a), and adolescents may seek to meet these needs through internet games (Kwon, Chung, & Lee, 2011). For example, Kwon and colleagues (2011) documented that adolescents tend to increase the time spent on online games when they perceive a poor relationship with their parents, who are unaware of their activities, oppress them, and act hostile towards them. Horzum (2011) found that game addiction had a significant difference based on gender, socioeconomic level, and grade level. There was no significant difference between having a computer to play games and game addiction.

When the website addiction was examined in terms of independent variables, it was seen that only the time spent on social networks led to a significant difference. When the source of the difference is examined, students who spend 7 hours or more a day on social networks are more addicted to using websites than others. As the time students spend on social networks increases, it causes a decrease in the time spent on other social and basic needs (eating, resting, sleeping, etc.). According to Pratiwi et al. (2021), most students prefer to spend their time playing on social media instead of interacting with their classmates. In some cases, it has also been seen that students are late for class just because they stay up all night to play online games.

Recommendations

A cross-sectional survey model was used in the research. A five-point Likert questionnaire was used to obtain the data. The data were obtained under teacher control within the scope of a course. The participants filled out the survey in the classroom environment, which is considered the students' natural environment, together with their friends but independently of each other. When students are directed to participate in a survey by a teacher, the possibility of feeling even slightly pressured to answer the survey may limit the process. Moreover, although the survey was completed anonymously by the participants, the possibility of social influence in the process of students filling out the survey cannot be excluded. In this context, considering the nature of the process, the answers given by the students are limited to their honesty and self-evaluation. There was no analysis examining the relationship between technology addiction and mobile phone use. However, it may be necessary to evaluate students' smartphone usage because the study conducted by Jamir et al. (2019) shows that technology addiction is higher among students who have access to smartphones.

Although playing online games may be considered a way to escape from problems, avoiding problems instead of solving them will cause the problem to continue. Additionally, a lack of knowledge and understanding of the dangers of online gaming will promote students' addiction. Therefore, it is crucial to highlight efforts to improve students' understanding and awareness of the dangers of online gaming addiction. Preventing teenage technology addiction can mean finding balance in teens' lives, and adults can help teens develop a healthy relationship with technology. To prevent technology use from becoming addictive, unplugging for 30 minutes can be effective to take some time for yourself, focus on the people around you, and establish a healthy balance. Additionally, parents need to control the content of children's games (Griffiths, 2009). Parents can help their children choose educational games over violent games. Apart from this, children can play computer games in groups instead of alone. Additionally, parents can limit their children's play time.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

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