JESEH

VOLUME
9
ISSUE
4

YEAR
2023

Journal of Education in Science, Environment and Health

e-ISSN 2149-214X

Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023 e-ISSN:2149-214X

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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
e-ISSN:2149-214X

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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
https://doi.org/10.55549/jeseh.1381065

The Mediating Effect of Social Emotional Learning Between Relationship on Basic Psychological Needs and Technology Addiction

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Article Info

Article History

Published:
01 October 2023

Received:
17 March 2023

Accepted:
01 July 2023

Keywords

Social emotional learning
Technology addiction
Basic psychological needs

Abstract

This study was aimed at testing the hypothetical model, which included technology addiction, basic psychological needs, and social emotional learning skills (SEL). The study also examined whether there is a mediating effect of SEL in the relationship between basic psychological needs and technology addiction. For this purpose, data were collected from a sample of 592 participants [424 (71.6%) females and 168 (28.1%) males] aged between 18 and 27 years. Demographic Information Form, Basic Psychological Needs Satisfaction and Inhibition Scale, Social Emotional Learning Scale-Young Adult Form (SELS-YF), and Technology Addiction Scale (TAS) were used to collect the data. Equation Modeling (SEM) was used to analyze the data, and the results supported the hypothetical model. There was a negative correlation between technology addiction and the satisfaction of basic psychological needs and SEL. There was a positive correlation between the satisfaction of basic psychological needs and SEL. Another finding was that SEL indirectly effected the relationship between satisfaction of basic psychological needs and technology addiction. In addition, the model explained about 14% of the total variance in technology addiction.

Introduction

The rapidly developing and widespread internet and mobile technologies have become an integral part of our lives. An intense impact of technology has been observed in almost all our daily activities (Patrikakou, 2016). With the widespread use of smartphones, using social media, playing online games, sending instant messages, and browsing websites have become our daily routines. This has also led to an increase in the use of digital technologies.

According to the results of the TURKSTAT Household Information Technologies Usage Survey, it was observed that 94.1% of households had access to the Internet from home in 2022 (this rate was 92.0% last year). While the rate of internet usage among individuals aged 16–74 was 82.6% in 2021, it became 85.0% in 2022 (TURKSTAT, 2022). These trends are also observable on a global scale. By the end of March 2022, the number of people actively using the internet had reached 5.4 billion (approximately 67.8% of the total population) (Internet World Stats, 2023). An important factor in the emergence of this situation was the COVID-19 pandemic.

Social distance and quarantine have become the new norms worldwide during the COVID-19 pandemic. This has caused people to spend more time at home and on the Internet (Sun et al., 2020). Many employees conducted their business by working from home. People have turned to activities such as playing online games, using social media and shopping online to reduce their anxiety and stress levels. All these activities led to the increased use of information and communication technologies during this period (Kiraly et al., 2020). According to International Telecommunication Union (ITU) data, there was a 13.3% increase in internet use in 2020, the first year of the pandemic (ITU, 2021). Steam, the largest digital gaming platform, announced that it has reached the highest number of users in its history, with the number of users exceeding 20 million in COVID-19 (Perez, 2020).

During the pandemic, the rate of online gaming increased by 75% in the USA (Javed, 2020). It was also reported that during the pandemic, there was an increase of approximately 50% in internet shopping (McKinsey & Company, 2020) and an increase of approximately 60% in internet traffic (OECD, 2020). However, the excessive use of the internet during the COVID-19 pandemic brought along another problem. Researchers have reported an increased risk of technology addiction during the pandemic (Kiraly et al., 2020).

Technology Addiction

Technology addiction is a type of behavioral addiction associated with excessive and uncontrolled use of technology. In this type of addiction, users show a desire to be constantly busy with technological devices, a feeling of relaxation during use, tension, irritability, and depressive symptoms when they are away (Chen, 2018; Turel et al., 2011). The scope of technology addiction is quite wide and includes various types of addiction such as internet addiction, social network addiction, instant messaging addiction, online gaming addiction, and smartphone addiction.

Technology addiction can have many physiological, mental, social, emotional, and behavioral negative effects (Ağırkan, 2022). These effects can be in the environmental dimension (family relations, friendship relations, relations with others) as well as in the individual dimension. In the literature, these negative effects are listed as low academic achievement (Adiele & Olatokun, 2014; Kim et al., 2010), depression and anxiety (Cho et al., 2013; Zheng et al., 2015), loneliness (Simcharoen et al., 2018), sleep problems (Cheung & Wong, 2011; Zhang et al., 2017), obesity (Sanders et al., 2016), and negative relationships with the environment (Tsitsika et al., 2014; Volpi, 2012).

Some researchers have defined technology addiction as the epidemic of the twenty-first century (Serenko & Turel, 2020). At this point, it is important to determine the risk factors related to technology addiction and plan preventive interventions. The risk factors contain personality-related factors (excitement seeking, low self-esteem), social factors (low parental support, peer norms), and digital factors (inappropriate online applications, online sites) (Anderson et al., 2017). Considering these factors, it is very important that the basic psychological needs of individuals are adequately satisfied.

Technology Addiction and Basic Psychological Needs

Basic psychological needs are based on self-determination theory. According to this theory, there are three basic psychological needs: autonomy, competence, and relatedness (Ryan & Deci, 2000). Autonomy is the ability to take initiative for actions and to have self-regulation skills. Competence is confidence in one's abilities and belief in being able to face challenges. Relatedness is establishing reliable and satisfying relationships with others in a social environment (Deci & Ryan, 2000).

Self-determination theory assumes that people are naturally prone to psychological growth, learning, and connecting with others (Ryan & Deci, 2020). However, individuals need to receive support for their basic psychological needs to ensure their healthy development (Ryan et al., 2019). When individuals have opportunities to satisfy these three basic psychological needs in a social environment, their motivation, performance, and development are maximized (Deci et al., 1996). When psychological needs are not adequately satisfied, individuals try to satisfy them in different ways (Vansteenkiste et al., 2004).

Many internet applications are designed to provide opportunities and incentives to satisfy users' motivations (Nadkarni & Hofmann, 2012; Sheldon et al., 2011). Basic psychological needs that are not adequately satisfied are the main source of individual motivation in the internet environment. Individuals tend to become more active on the internet to compensate for their needs when their needs are not adequately satisfied (Allen & Anderson, 2018; Kardefelt-Winther, 2014). These compensatory behaviors prepare a suitable ground for the development of technology addiction.

According to studies, dysfunctional coping (Kuss et al., 2017), loneliness and low social support (Subrahmanyam & Lin, 2007), getting away from real-life stressors (Leiner et al., 2014), a need for socialization (Griffiths et al., 2004), and a behavioral response to stressful life events (Jun & Choi, 2015) are among the causes of technology addiction. Therefore, not satisfying basic psychological needs is an important factor that causes technology addiction. Many studies have reported a negative relationship between satisfaction with basic psychological needs and technology addiction (Allen & Anderson, 2018; Gugliandolo et al., 2019; Lin et al., 2014; Yu et al., 2015).

The Role of SEL in the Relationship Between Technology Addiction and Basic Psychological Needs

SEL consists of five basic skills: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making (CASEL, 2020). Self-awareness is the ability to recognize one's feelings, thoughts,

and behaviors and to know one's strengths and weaknesses. Self-management is the ability to regulate one's thoughts, feelings, and behaviors. Social awareness is the ability to consider and empathize with the perspectives of others. Relationship skills are the ability to listen effectively, communicate clearly, and maintain. Responsible decision-making is one's ability to make constructive choices regarding different environments and social interactions (CASEL, 2013). Both self-determination theory and SEL emphasize the importance of social environments that support social development and personal well-being and assume that people have natural growth tendencies (Durlak et al., 2011; Ryan & Deci, 2000). Therefore, basic psychological needs are compatible with SEL skills. It is important to consider the satisfaction of basic psychological needs when understanding SEL skills. Satisfying the need for autonomy, which is the freedom to make one's own decisions, fosters the development of self-management and responsible decision-making. Satisfying the need for competence, the belief in confidence in one's abilities, and the ability to face challenges enable the development of self-awareness. The satisfaction of the need for relatedness, which is the experience of feeling appreciated and being able to take care of others, provides the basis for the development of social awareness and relationship skills. In summary, the satisfaction of basic psychological needs also supports the development of SEL skills.

A large body of literature emphasizes that the development of SEL skills contributes to people developing positive relationships with their environment, engaging in prosocial behaviors, increasing their level of well-being, and reducing behavioral disorders (CASEL, 2020). Therefore, the development of SEL skills is likely to have a positive effect on technology addiction, which is a kind of behavioral disorder. Research results in the literature support this idea. Studies show that SEL skills are negatively related to internet addiction (Chen et al., 2021; Yu & Zhou, 2021); online game addiction (Fox, 2021); and social media addiction (Affouneh, 2021; Aftab et al., 2015; Atın, 2022).

Aim of Study

Based on the literature, SEL skills may be an important variable in the relationship between satisfaction of basic needs and technology addiction. Basic psychological needs that are not adequately satisfied may also prevent the development of SEL skills. Insufficient development of SEL skills may cause problems in people's relationships with themselves and their environment. As a way to make up for this deficiency, people can isolate themselves from their social environment and turn to virtual environments. The tempting possibilities of virtual environments may lead to more technology use and cause technology addiction. Based on these assumptions, this study aimed to seek answers to the following research question:

RQ_1: Does the hypothetical model that includes basic psychological needs and SEL skills predict technology addiction?
RQ_2: Does social emotional learning have a mediating effect on the relationship between technology addiction and basic psychological needs?

Method

Participants and Procedure

According to the power analysis, it was sufficient to reach a minimum of 400 people for .80 statistical power at the 95% confidence interval and a .05 significance level for the hypothetical model (Soper, 2023). Nevertheless, data were collected from one and a half times the minimum number of participants, as there may be a lack of data. The study sample consisted of 592 participants, including 424 females (71.6%) and 168 males (28.4%). The ages of the participants ranged from 18 to 27 years (M = 20.7, SD = 1.51). Ethics committee approval was obtained from the Erzincan Binali Yıldırım University Human Research Educational Sciences Ethics Committee for the study. In addition, informed consent was obtained from all participants before the study.

Instruments

Demographic Information Form

Demographic Information Form was developed by the researcher to determine the sociodemographic characteristics (gender and age) of the participants.

Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS)

Basic Psychological Need Satisfaction and Frustration Scale was developed to determine the satisfaction and frustration levels of three basic psychological needs (autonomy, competence, and relatedness) as defined in Self-Determination Theory (Chen et al., 2015) and was adapted to Turkish culture by Selvi & Bozo (2020). The scale consists of six sub-dimensions (autonomy satisfaction, competence satisfaction, relatedness satisfaction, autonomy frustration, competence frustration, and relatedness frustration) and 24 questions. Each sub-dimension consists of four items, and the items are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In this study, the sub-dimensions of autonomy satisfaction, competence satisfaction, and relatedness satisfaction of the scale were discussed. The Cronbach's alpha coefficients for the scale were calculated as .88 for the total scale and 0.80, 0.83, and 0.72 for the sub-dimensions, respectively.

Social Emotional Learning Scale-Young Adult Form (SELS-YF)

Social Emotional Learning Scale-Young Adult Form was developed by Karacan-Özdemir & Büyükçolpan (2021) to measure the SEL skills of young adults. The scale consists of 20 items and five sub-dimensions (self-awareness, self-regulation, social awareness, responsible decision-making, and relationship skills). The dimensions of self-awareness consist of six items; relationship skills consist of four items; responsible decision-making consists of four items; self-regulation consists of three items; and social awareness consists of three items. Items are rated on a 5-point Likert-type scale ranging from 1 (never) to 5 (always). In this study, the Cronbach Alpha coefficients were calculated as .87 for the total scale, .86 (self-awareness), .78 (self-regulation), .77 (social awareness), .75 (responsible decision-making), and.72 (relationship skills) for the sub-dimensions.

Technology Addiction Scale (TAS)

Technology Addiction Scale (TAS) was developed by Aydın (2017) to measure technology addiction levels. The scale consists of 24 items and four sub-dimensions (social network addiction, instant messaging addiction, online gaming addiction, and website addiction). Each sub-dimension consists of six items, and items are rated on a 5-point Likert-type scale ranging from 1 (never) to 5 (always). In this study, the Cronbach Alpha coefficients were calculated as .79 for the sum of the scale, .73 for social network addiction, .76 for instant messaging addiction, .90 for online gaming addiction, and .89 for website addiction sub-dimensions.

Data Analysis

SPSS v25.0 (IBM Corporation, Armonk, NY, USA) and Mplus v8.7 (Muthén & Muthén, Los Angeles, CA, USA) were used for data analysis. Before the analyses, assumptions that missing data, univariate and multivariate outliers, normality, linearity, homogeneity, and multicollinearity (Tabachnick & Fidell, 2013) were examined. No missing data were found in the data set. For the univariate normality criterion, the scores obtained from the measurements were converted into standard z scores, and z scores that were not within ±3 (n=26) were excluded from the data set. The Mahalonobis distance value was used for the multivariate normality criterion, and the data that did not meet the criterion (n=2) were removed from the data set. Afterward, the skewness and kurtosis values of the variables were examined, and it was seen that all values were within acceptable ranges (±1.5) (Tabachnick & Fidell, 2013).

The Durbin-Watson method was used to test for multicollinearity between the variables, and it was found that the value of 2.05 was within the acceptable reference interval. In addition, the condition index (CI) value (19.501), variance inflation factor (VIF) value (1.72), and tolerance value (.58) were examined, and all values were found to be within the accepted reference ranges (Field, 2013). Before the analyses, a data set of 592 observations that met the assumptions was created.

The hypothetical model that includes basic psychological needs, SEL skills, and technology was analyzed by structural equation modeling (SEM). Before SEM analysis, confirmatory factor analysis (CFA) was performed to analyze the factor structures of the variables. The chi-square values ($\chi 2$), the root mean square error of approximation (RMSEA; <.08), the standardized root mean square residual (SRMR; <.08), the comparative fit index (CFI; >.90), and the Tucker-Lewis fit index (TLI; >.90) were used as criteria for evaluating the model fit (Brown, 2015). The method developed by Hayes (2018) was used to test the indirect effect of the model. Indirect effects and standard errors were calculated using 2000 bootstrapping with 95% confidence intervals.

Results

Descriptive Statistics

The means, standard deviations, Cronbach's alphas, and Pearson product-moment correlation coefficients between scale scores are presented in Table 1.

Table 1. Means, standard deviations, internal reliability, and Pearson product-moment correlation coefficients.

	1	2	3
1. Satisfaction of Basic Psychological Needs	—		
2. Social Emotional Learning (SEL)	.647 [a]	—	
3. Technology Addiction	-.284 [a]	-.292[a]	—
Mean ($\bar{x}$)	45.62	77.25	46.37
Min. - Max.	12 - 60	20 - 100	24 - 120
Standard deviation	6.86	11.69	12.01
Skewness	.110	-.154	.358
Kurtosis	-.547	-.620	-.410
Cronbach Alpha	.88	.87	.79

Table 1 shows that there are statistically significant relationships between all variables in the hypothetical model. There are negative relationships between technology addiction and satisfaction of basic psychological needs [r = -.284; p<.01] and SEL [r = -.292; p<.01]. There is a positive relationship between satisfaction of basic psychological needs and SEL [r = .647, p<.01].

Measurement Model

Before testing the hypothetical model, the measurement model was tested. The fit values of the measurement model [$\chi 2(n = 592) = 208.46$, df = 51, p = .00, $\chi 2$ /df = 4.08, RMSEA = .07, SRMR = .04, CFI = .95, TLI = .93] were found to be sufficient (Brown, 2015). Since the fit values were sufficient, no modification was made to the measurement model.

Structural Model

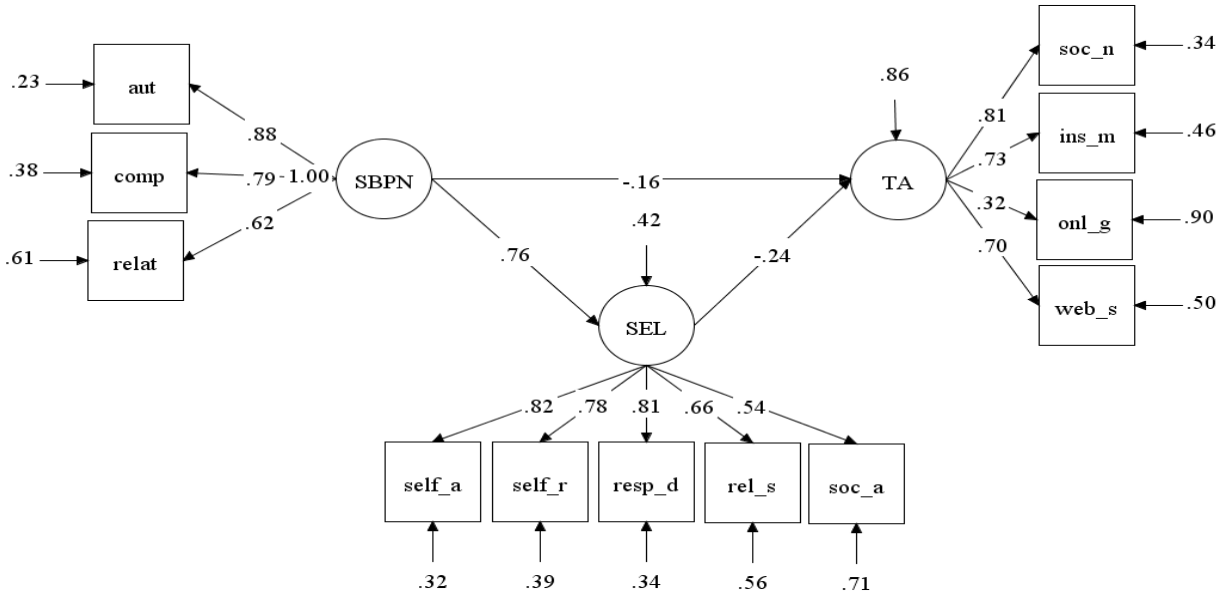

Figure 1. Structural model

Note. [a]= p<.01, SBPN= Satisfaction of Basic Psychological Needs, aut= autonomy, comp= competence, relat= relatedness, SEL= Social Emotional Learning, self_a= self-awareness, self_r= self-regulation, resp_d= responsible decision making, rel_s= relationship skills, soc_a= social awareness, TA= Technology Addiction, soc_n= social network addiction, ins_m= instant messaging addiction, onl_m= online gaming addiction, web_s= web site addiction.

After the measurement model was tested, the structural model was tested, and the model fit values [$\chi 2$ (n = 592) = 208.46, df = 51, p =.00, $\chi 2$ /df = 4.08, RMSEA = .07, SRMR = .04, CFI =.95, TLI = .93] were found to be adequate (Brown, 2015). The relationships between latent variables in the model were examined by considering t values and standardized beta coefficients. Although the fit values of the model were acceptable, the standardized beta coefficient between the satisfaction of basic psychological needs and technology addiction was not significant (β = -.156, p>.05) (Table 2).

Table 2. Standardized direct effects and t values for Structural Model

Structural Relations			*B*	*S.E*	*t*	*p*
SBPN	→	TA	-.156	.084	-1.86	.066
SBPN	→	SEL	.758	.026	29.63	.000
SEL	→	TA	-.244	.008	-2.94	.004

Note. SBPN= Satisfaction of Basic Psychological Needs, SEL= Social Emotional Learning, TA= Technology Addiction.

Therefore, the direct path between the satisfaction of basic psychological needs and technology addiction was removed from the model, and the alternative model was created by considering the theoretical framework (Figure 1).

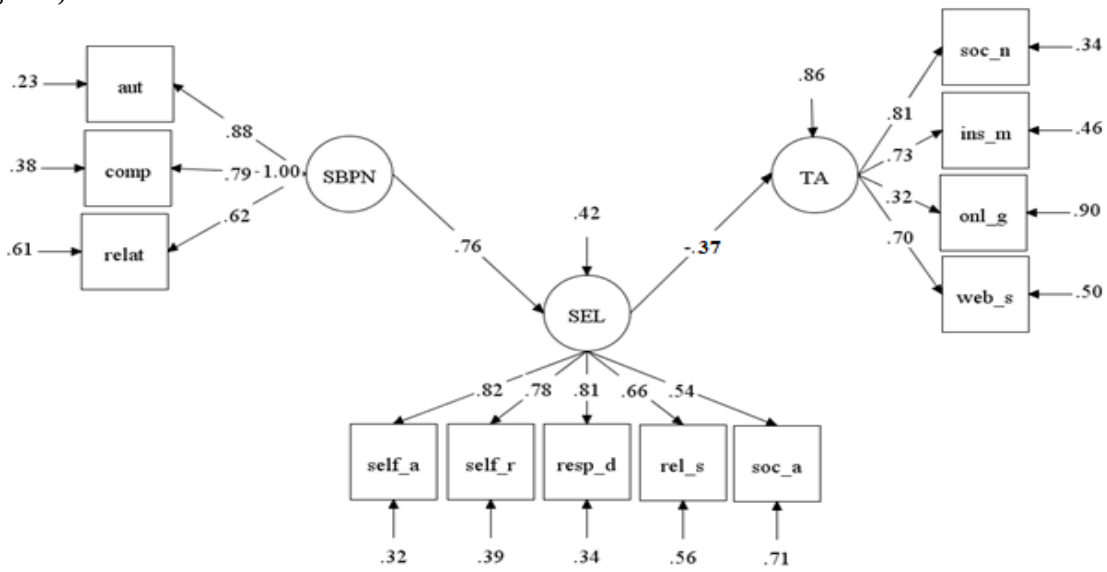

Figure 2. Alternative model

Note. [a]= p<.01, SBPN= Satisfaction of Basic Psychological Needs, aut= autonomy, comp= competence, relat= relatedness, SEL= Social Emotional Learning, self_a= self-awareness, self_r= self-regulation, resp_d= responsible decision making, rel_s= relationship skills, soc_a= social awareness, TA= Technology Addiction, soc_n= social network addiction, ins_m= instant messaging addiction, onl_m= online gaming addiction, web_s= web site addiction.

After the direct path between the satisfaction of basic psychological needs and technology addiction was removed from the model, partial improvements were observed in the fit values. The fit values of the alternative model [$\chi 2$(n = 592) = 211.84, df = 52, p = .00, $\chi 2$ /df = 4.07, RMSEA = .07, SRMR = .04, CFI = .95, TLI = .93] were better. The most appropriate model between the structural model and the alternative model was decided by looking at the Bayesian Information Criterion (BIC) value. A decrease of two or more units in the BIC value is an appropriate criterion for choosing between models (Raftery, 1995). The BIC value was calculated as 33828.734 for the structural model and 33825.728 for the alternative model. It was decided that the alternative model was the appropriate model due to a decrease of approximately three units. The statistical significance of the relationships between the latent variables in the model was interpreted by looking at the t-values and standardized beta coefficients (Table 3).

Table 3. Standardized direct effects and t values for Alternative Model

Structural Relations			*B*	*S.E*	*t*	*p*
SBPN	→	SEL	.762	.025	30.11	.000
SEL	→	TA	-.373	.043	-8.64	.000

Note. SBPN= Satisfaction of Basic Psychological Needs, SEL= Social Emotional Learning, TA= Technology Addiction.

Satisfaction of basic psychological needs directly predicted SEL (β = .762, t = 30.11, p<.01), and SEL directly predicted technology addiction (β = -.373, t = -8.64, p<.01). Moreover, SEL had an indirect effect on the relationship between satisfaction of basic psychological needs and technology addiction. To test the indirect effect, the method developed by Hayes (2018) was used, and the indirect effect and standard error were calculated using 2000 bootstrapping at 95% confidence intervals. The absence of zero in the confidence intervals showed that the indirect effect was statistically significant (Table 4).

Table 4. Indirect effects among latent variables

Structural Relations	*B*	*S.E*	*t*	*p*	R^2	95% GPA	
						Lower	Upper
SBPN ⟶ SEL ⟶ TA	-.351	.053	-6.588	.000	.139	-.456	-.248

Note. SBPN= Satisfaction of Basic Psychological Needs, SEL= Social Emotional Learning, TA= Technology Addiction.

Satisfaction of basic psychological needs predicted technology addiction via SEL (β = -.351, 95% CI = -.456, -.248, p<.01) (Table 4). Moreover, the model explained approximately 14% of the total variance in technology addiction.

Discussion

This study aimed to test the hypothetical model, including technology addiction, basic psychological needs, and SEL skills. The results of the analysis supported the model. According to one finding of the study, there was a negative relationship between technology addiction and satisfaction of basic psychological needs. In other words, the increase in the level of technology addiction was related to the insufficient satisfaction of autonomy, competence, and relatedness needs. One reason for this result may be real-life social environments. According to self-determination theory, the satisfaction of basic psychological needs is essential for personal development, well-being, and self-actualization (Vansteenkiste & Ryan, 2013), and the social environment plays an important role in supporting the healthy development of individuals (Ryan & Deci, 2017).

If individuals' basic psychological needs are not satisfied in one social context, they become maladaptive and are motivated to seek satisfaction in other social contexts (Deci & Ryan, 2000). This leads to the encouragement of rigid behavior patterns and compensatory behaviors (Vansteenkiste & Ryan, 2013), and the individual may turn to an activity that offers the best at that moment (Deci & Ryan, 2011). In the literature, it is stated that unmet psychological needs in real life are one of the main causes of technology addiction (Allen & Anderson, 2018; Casale & Fioravanti, 2015; Gugliandolo et al., 2019; Li et al., 2016; Scerri et al., 2018; Wong et al., 2015; Wu et al., 2013; Yu et al., 2015).

Another reason may be the attractiveness of online environments. Online games and social media platforms are examples of this. Online games are designed to intensively satisfy basic psychological needs (Rigby & Ryan, 2011). Griffiths et al. (2004) state that the most attractive aspect of online games is sociability. As individuals level up in online games, they chat, build relationships, achieve success and competence, and gain autonomy and freedom by accessing the virtual environment they want without restrictions (Allen & Anderson, 2018; Griffiths et al., 2004). People have a natural tendency to seek new challenges in games just to experience a sense of competence, even when there is no external reward to be gained (Oliver et al., 2016). Performance-based rewards in games, such as rankings, tiers, badges, leaderboards, etc., fulfill a sense of competence. The interaction with teammates fulfills a sense of social connectedness (Sailer et al., 2017). Similarly, social media platforms offer individuals the opportunity to have fun, maintain relationships, express themselves, and communicate with others without the need for real identity information (Nadkarni & Hofmann, 2012; Park & Lee, 2014).

Another finding is that SEL has an indirect effect on the relationship between satisfaction of basic psychological needs and technology addiction. In other words, the satisfaction of basic psychological needs predicts technology addiction via SEL. Moreover, the model explained about 14% of the total variance in technology addiction. This result may be due to the content of SEL skills. SEL skills consist of self-awareness, social awareness, self-management, responsible decision-making, and relationship skills. These skills are highly associated with supporting healthy development and reducing behavioral problems (Ağırkan, 2021; Ağırkan & Ergene, 2021).

Social and emotional inadequacies such as the inability to express their emotions in real life, loneliness, the inability to socialize, etc. are among the causes of technology addiction. According to Yao & Zhong, (2014),

people try to share their emotions with others in the virtual world due to their insufficient social connections in the real world. Similarly, researchers have found that people spend more time on social networks to express their emotions (Lin et al., 2014), socialize and spend their leisure time (Kesici & Şahin, 2009), or escape from their negative emotions (Ümmet & Ekşi, 2016). Therefore, the development of SEL skills contributes to the establishment and maintenance of positive relationships in real environments. Therefore, it may have a regulatory effect on technology addiction.

Findings from a large body of research have emphasized the importance of developing SEL skills and the positive effects of SEL-based interventions. These interventions are effective in both increasing positive behaviors such as well-being and prosocial behavior, etc., and decreasing negative behaviors such as behavioral problems and emotional distress, etc. (Ağırkan & Ergene, 2022; Durlak et al., 2011; Taylor et al., 2017). Therefore, SEL skills are likely to be effective in preventing or reducing technology addiction, which is a type of behavioral disorder. The negative relationships between SEL skills and internet addiction (Chen et al., 2021), social media addiction (Affouneh, 2021; Atın, 2022), and digital game addiction (Tilki, 2021) also support this idea.

People who recognize their emotions, are sensitive to their environment, take initiative, build positive relationships with others, and make effective decisions are not engaged in addictive behaviors. These positive behaviors are evidence of developed SEL skills. Symptoms of technology addiction, such as withdrawal, excessive preoccupation, lack of control, etc. (Zhou et al., 2014), are not consistent with the content of SEL skills. Individuals with high technology addiction have low levels of decision-making ability (Pawlikowski & Brand, 2011), empathy (Lachmann et al., 2018), social support (Varol-Afo & Mortan-Sevi, 2019), self-esteem (Aydm & San, 2011), and social competence, self-esteem, and loneliness (Lemmens et al., 2011). This indicates that SEL skills are not sufficiently developed in these individuals. Similarly, behavioral problems in individuals with high technology addiction (Cho et al., 2013; Gerçel & Çağlar, 2016; Volpi, 2012) are not consistent with the positive outcomes of SEL skills. Therefore, this result of the study supports the idea that SEL skills have a determining effect on technology addiction, which is a type of behavioral problem.

Implications and Recommendations

With the development of online applications, time spent in front of a screen has increased significantly. This has caused significant changes in interpersonal communication both in the family and in society. It is known that both personal and social variables are effective among the causes of technology addiction. Therefore, it is important to raise awareness about the use of technology.

Research reports that awareness or education could be an effective factor in preventing technology addiction and reducing its harm. At this point, digital parenting practices regarding technology use can be effective. Parents could take a more active role in creating an environment where their children's basic psychological needs are satisfied. Moreover, they could provide positive, supportive, and trusting family relationships that will enable their children to develop SEL skills. Based on the effectiveness of SEL-based programs in preventing addiction, researchers and educators could carry out interventions for individuals in the risk group.

Limitations and Future Directions

This study had several limitations. First, the findings were based on participants' self-reported data. This may cause participants to fall into personal bias when scoring the scales. Therefore, future studies could support self-reported data with participants' observations. Another limitation was the type of sample used in the study. The fact that the participants were only in a certain age range (18–27 years old) suggested that the findings could be generalized to groups with similar characteristics. Finally, another limitation was that the findings were limited to cross-sectional data. Therefore, future studies can increase the reliability of their results by collecting longitudinal data.

Scientific Ethics Declaration

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

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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
https://doi.org/10.55549/jeseh.1381117

Vulnerable Narcissism and Internet Addiction: Exploring Mediating Pathway through Vengeance

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Article Info

Article History

Published:
01 October 2023

Received:
12 March 2023

Accepted:
18 August 2023

Keywords

Vulnerable narcissism
Vengeance
Internet addiction

Abstract

The present study aimed to explore the mediating pathway on internet addiction through vengeance. The sample was consisted of 392 university students (N female = 242, 61.7% and N male = 150, 38.3%). The ages ranged between 18 and 35, with a mean age of 21.6 (SD = 1.95). The sample completed Young's Internet Addiction Test-Short Form, The Vengeance Scale, and Hypersensitive Narcissism Scale. According to mediation analysis results using structural equation modeling and bootstrapping, vengeance partially mediated vulnerable narcissism-internet addiction association. The results of the present study intimated the importance of the effects of individual differences and communication styles or preferences on internet addiction. The possible potential therapeutic power of vulnerable narcissism, which may lead to a direct increase in vengeance and an indirect increase in internet addiction through vengeance, appeared in line with this perspective. Finally, the results provided beneficial outcomes for clinical experts.

Introduction

People, by nature, share a life with other people. Although it is desired for the individuals to gain resources from this sharing, sometimes their interaction with others may reveal disagreements. These disagreements can also bring conflict or injustice. In these cases, the individual may reorganize their relationships or want to make the people associated with the conflict or injustice pay the price (McCullough et al., 2001). In line with this perspective, vengeance was defined as the sum of aggressive feelings towards other people due to thoughts of being injured. At the same time, the sense of vengeance was associated with the perception of injustice, and vengeance might be defined by the individual's responses to resolve this injustice (Bradfield, & Aquino, 1999; Cota-Mckinley et al., 2001). Studies in the literature examine associations between narcissism and vengeance (Brewer et al., 2015; Brown, 2004). Sometimes people decide to take vengeance on people they find guilty. Forgiveness is at the other end of this vengeance process (Uzun, 2018). There can be many reasons for a person to be passionately embraced with a sense of vengeance and not to behave in forgiveness (Johnson et al., 2010). One of these reasons was closely related to the personality traits. When the association between personality traits and vengeance was examined, many studies found that the feeling of vengeance was related to psychotic and neurotic personality traits (Johnson & Butzen, 2008; Bellah et al., 2003; McCullough et al., 2001). There were also several research findings regarding the negative association between empathy and narcissism (Giammarco & Vernon, 2014; Macaskill et al., 2002). In line with the findings of empirical studies, it can be concluded that vulnerable narcissistic traits may be an indicator of a tendency to take vengeance. It would be stated that the emotional and behavioral responses of narcissists can be effective in separating the individual who wants to take vengeance and the individual who does not want to take vengeance (Brown, 2004).

Research reports that narcissists can harm others with aggression (Bushman & Baumeister, 1998; Rhodewalt et al., 1998; Twenge & Campbell, 2003). It was thought that vulnerable narcissists could act by staying behind in the background rather than being in front of the scene. Due to their introverted nature, vulnerable narcissists may want to perform their hostile attitudes without much stress, that is, without interacting with people too much. The vulnerable narcissist, who does not want to communicate with others face to face and wants to take vengeance, can resort to different methods. Online social interaction can be considered one of the significant achievements of modern life. It was predicted that vulnerable narcissists could use social media or the internet rather than face-to-face communication. The behaviors of narcissists in internet-based applications were not surprising. Narcissists have been determined to tend to share pictures of their material (Scott et al., 2018), update the status of their achievements (Marshall et al., 2015), and post more selfies (Kim & Chock, 2017). In addition, vulnerable narcissists would be more likely to use the internet in an addictive way (Andreassen et al., 2017). At the same time, vulnerable narcissists may be willing to use the internet because of the opportunities.

Internet would be assessed as a tool that allows vulnerable narcissists to feel valuable and to confirm themselves (Sheldon & Bryant, 2016). By means of the internet, vulnerable narcissists can reflect themselves to others in a much more controlled (Uski & Lampinen, 2016). As seen, the vulnerable narcissist has many reasons to use the internet. The vulnerable narcissists who want to satisfy themselves more can start using the internet excessively. This situation would be handled as a predisposing factor in addictive behaviors. In the simplest form, excessive use of the internet can lead to the development of internet addiction. However, there were significant issues to be considered here. The processes that cause excessive time on the internet should be examined.

According to the generalized internet addiction model, the troubled functioning of the reinforcement mechanisms in the control processes may cause the development of internet addiction (Brand et al., 2014; Brand et al., 2016). In other words, specific cognitions determine internet usage. In individuals who cannot use positive reinforcement processes while using the internet, dysfunctional coping styles would be active and internet addiction would occur. It was thought that vulnerable narcissists could use the internet for gains that they cannot obtain from face-to-face communication. Furthermore, the Internet would be a safe tool that vulnerable narcissists can use as a means of vengeance. Vulnerable narcissists can spend more time on the internet to attain gains from vengeance or develop dysfunctional coping strategies. At the end of this process, it might be possible that the vulnerable narcissist would be an internet addict. According to the literature, it was clear that there was an association between narcissism and addicted behavior. Alcohol use disorder (Luhtanen & Crocker, 2005), gambling disorder (Rogier & Velotti, 2018), internet addiction (Pantic et al., 2017) were addictive behaviors associated with narcissism. Although there were strong relationships between narcissism and addicted behaviors (Ronningstam, 2005), the mechanism of risk association between narcissism and addiction wasn't precisely known (Bilevicius et al., 2019). Giordano et al. (2019) stated that narcissistic traits may have an essential effect on excessive use of social media. Grandiose narcissists may use social media to attract other people's attention (Casale & Fioravanti, 2018).

In contrast, vulnerable narcissists would prefer social networks because they wouldn't be willing to communicate face-to-face (Casale et al., 2016). It can be concluded that vulnerable narcissists constantly compare themselves with other people (Ozimek et al., 2018). At the same time, individuals with vulnerable narcissistic characteristics have an arrogant view of themselves, just like grandiose narcissists. However, literature revealed that vulnerable narcissists might have a sense of shame due to this point of view and may avoid social relations because of the anxiety of rejection or exclusion (Blachnio et al., 2016; Dickinson & Pincus, 2003). This circumstance may limit the social relationship patterns that they can compare. However, internet technologies offer vulnerable narcissists another social environment where they can experience fewer feelings of shame and rejection. Over time, the internet would become an ideal self-comparison platform for vulnerable narcissists.

According to the social compensation hypothesis, introverted individuals would benefit more from the internet (Grieve et al., 2017). Studies conducted based on this hypothesis reported that hiding the identity of an introverted person on the internet helps reduce the anxiety of rejection and ridicule. Thus, these individuals may exhibit more self-disclosure behavior in online experiences (Grieve et al., 2017; Zywica & Danowski, 2008). Given the introverted structures of vulnerable narcissists, internet addiction would be an essential risk factor for vulnerable narcissists. According to another theory, using social media accounts by narcissists would help them express their ambitions. This method also might allow them to announce their achievements to life to a large audience. Accordingly, receiving positive feedback from other users for narcissists might be an essential reward and this circumstance may lead them to introduce their selves to other individuals (Andreassen et al., 2017). As a result, internet addiction may be a possible result in vulnerable narcissists. Many studies investigated the association between internet addiction and narcissism (Choi et al., 2011; Eksi, 2012; Ksinan, & Vazsonyi, 2016; Pantic et al., 2017). Many studies also explored the associations between social media addiction and narcissism (Bergman et al., 2011; Casale & Fioravanti, 2018; Müller et al., 2016; Ozimek et al., 2018). This study will investigate the association between vulnerable narcissism, one of the dimensions of narcissus, and internet addiction.

The behavioral and cognitive systematic of fragile narcissism would make individuals more prone to take vengeance. However, the narcissist who wants to avoid face-to-face interaction can use the internet to possess gains. This interaction expressed in this research was discussed. Investigating the mediation role of vengeance in the association between vulnerable narcissism and internet addiction represents the originality and novelty of the present study (Fig 1). The present paper is the initial research to quantitatively examine the associations among vulnerable narcissism, internet addiction, and vengeance. This is the first to explore an indirect association between vulnerable narcissism and internet addiction through vengeance. It was hoped that this

study would contribute to the literature regarding the role of vulnerable narcissism in predicting internet addiction through vengeance. The following hypotheses were tested in line with this purpose.

Hypothesis 1: Vulnerable narcissism would be positively associated with internet addiction.
Hypothesis 2: Vulnerable narcissism would be positively associated with vengeance.
Hypothesis 3:Vengeance would mediate the relation between vulnerable narcissism and internet addiction.

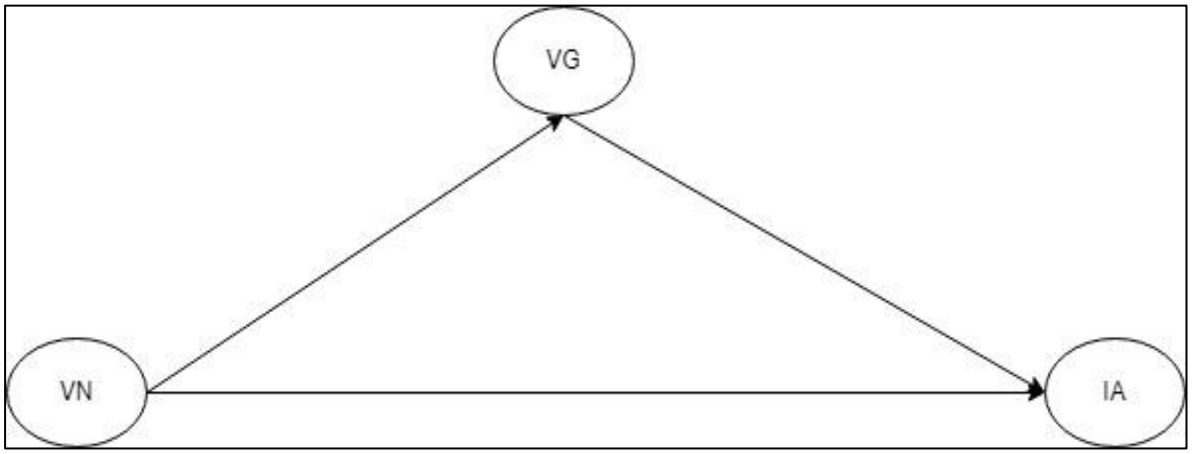

Figure 1. Hypothetical model

Method

Sample

The sample consisted of 392 Turkish university students (N female = 242, 61.7% and N male = 150, 38.3%). The ages ranged between 18 and 35, with a mean age of 21.6 (SD = 1.95). The information in relation to the sample provided impressive outcomes. There were results such as having a smartphone (N = 379, %97.2) and having an internet package for smartphone (N = 357, %91.3). Additionally, there were also results as to the daily internet use time. Accordingly, 48 of university students (12.3 %) used the internet for more than one hour per day, 138 (35.5%) used the internet for 1-3 hours per day, 110 (28.3%) used the internet for 3-5 hours per day, and 91 (23.4%) used the internet for more than 5 hours per day. Some students in the sample did not state their daily internet usage period (N =2, 0.5%).

Procedure and Ethical Approval

The 2013 Helsinki Declaration was the basis of the ethical standards of this study. In the study, self-report paper-pen measures were used, which were answered by the participants in an average of 20 minutes. The printed forms prepared for the application were administered to the students mainly in the classroom and only volunteer participants were included in the process. In addition, after the written approval of each participant was obtained, the data collection process was started.

Measures

Young's Internet Addiction Test-Short Form

The Young's Internet Addiction Test-Short Form was developed by Young (1998) and adopted into a short form by Pawlikowski et al. (2013). The scale consists of 12 items assessed in 5-point Likert type (e.g. "How often do you find that you stay on-line longer than you intended?"). The validity and reliability of the Turkish form of the scale were performed by Kutlu et al. (2016). The Turkish adaptation study used two different samples (university students and adolescents). The internal consistency coefficients obtained in the reliability study were found as (α) .91 in university students and (α) .86 in adolescents. Within the current study, Cronbach's alpha for the whole scale was .85.

The Vengeance Scale

The original form of The Vengeance Scale was developed by Stuckless and Goranson (1992). The single-factor model of Vengeance scale consists of twenty items (e.g., "Revenge is fun", "The desire for revenge embarrasses me"). In addition, the scale has a Likert-type assessment. (1 = strongly disagree 7 = strongly agree). The validity and reliability of the Turkish form of the scale were performed by Satıcı et al. (2015). The Cronbach Alpha internal consistency coefficient of the adaptation of the scale to Turkish was found to be 0.91. Within this research, the internal consistency coefficient (α) of data from the study group was found to be .91.

Hypersensitive Narcissism Scale

The Hypersensitive Narcissism Scale (HSNS) was used to measure the concept of Vulnerable Narcissism. The original HSNS was developed by Hendin and Cheek (1997) to evaluate vulnerable narcissism. The measure consists of 10 items (e.g., "I can become entirely absorbed in thinking about my personal affairs, my health, my cares or my relations to others;" "My feelings are easily hurt by ridicule or the slighting remarks of others"). With a single factor, the measure has a five-point Likert-type assessment (1 = very uncharacteristic…. 5 = very characteristic). The validity and reliability of the Turkish form of the scale were established by Sengul e al. (2015). Using Cronbach's alpha, the reliability analysis demonstrated that the Turkish version of the HSNS was a reliable measure (α=0.66). The Cronbach's alpha for HSNS was found as .60 for the present study.

Analytical Approach

Using IBM AMOS Graphics, structural equation modeling with maximum likelihood estimation was applied to assess the hypothesized conceptual mediation model. The current paper examined vengeance as a mediator variable in the association between vulnerable narcissism and internet addiction. The item parceling method was used to reduce the number of observed variables in the mediation analysis. In addition, item parcellation can increase the reliability and normality of the measures (Alhija & Wisenbaker, 2006). In the current study, the balanced item parceling method was preferred. In line with the results of the exploratory factor analysis, the factor loadings of the items constituting the measures were ranked from largest to smallest. Then, the items with the highest and lowest factor loadings were assigned to the first parcel and the other parcels were formed respectively (Little et al., 2002). A two-stage approach was adopted to prefer which model was more appropriate. This approach tested partial and full mediation models after the measurement model was validated (Anderson & Gerbing, 1988). While deciding which model is more appropriate, several fit indices were used, as well as a chi-square difference test. These fit indices included x2/df, Comparative Fit Indices (CFI), Tucker and Lewis index (TLI), Goodness of Fit Index (GFI), Bentler-Bonett Normed Fit Index (NFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Akaike's Information Criterion (AIC), and Expected Cross-Validation Index (ECVI). To determine the extent to which the models are fit to the data, fit indices were examined based on some boundary values. Accordingly, x2/df less than 5, CFI, TLI, GFI, NFI are greater than 0.90, and SRMR is less or equal than 0.05 provides empirical evidence that the model showed an acceptable fit to the data (Tabachnick & Fidell, 2006). As for AIC and ECVI, the model which indicated lower values was accepted as more appropriate (Burnham & Anderson, 2004). Finally, because large samples may be more useful in assessing indirect effects, confidence intervals were calculated with 10.000 bootstrap samples (Preacher & Kelly, 2011).

Results

Preliminary Analysis

Within the scope of the preliminary analysis, the kurtosis and skewness values were evaluated. Relevant literature revealed that kurtosis and skewness values between -1.5 and + 1.5 indicate that the distribution does not deviate excessively from normal (Tabachnick & Fidell, 2006). For multicollinearity analysis, the associations among the variables were examined, and it was found that the correlation coefficients varied between .21 and .40. If there is a high level of correlation between variables, the variable or variables that cause this problem should be removed from the model (Field, 2013). Therefore, it was concluded that there was no multicollinearity problem between variables in the model. Correlation analysis revealed that internet addiction was positively associated with vengeance (r = .21, p < .01; 95% CI [.11, .30]) and vulnerable narcissism (r =

.40, $p < .01$; 95% CI [.31, .49]). Additionally, vulnerable narcissism was positively associated with vengeance ($r = .24$, $p < .01$; 95% CI [.14, .33]) (Table 1).

Table 1. Descriptive statistics and correlations among variables

	M	SD	Kurtosis	Skewness	1	2	3
VN (1)	21.00	7.17	-.31	-.04	1		
VG (2)	46.76	7.14	.09	.52	.24**	1	
IA (3)	74.05	9.03	-.59	.22	.40**	.21**	1

Note. N = 392, $k = 10000$, ** $p < .01$; VN = Vulnerable Narcissism; VG = Vengeance; IA = Internet Addiction

Measurement Model

The measurement model includes three latent variables (vulnerable narcissism, vengeance and internet addiction) and nine observed variables. The measurement model indicated acceptable fit to the data. $\chi 2_{(df = 25, N = 392)} = 56.94$, $p < .05$; $\chi 2/df = 2.27$, *CFI* = .98, *TLI* = .97, *GFI* = .97, *NFI* = .96; *RMSEA* = .05 90% CI [.038, .077]; *SRMR* = .04. Factor loadings of variables were all significant and ranged from .52 to .88. The t values of the measurement model were given in Table 2. This result supported that observed variables were indicators of latent variables. The path diagram of the measurement model was presented in Figure 2.

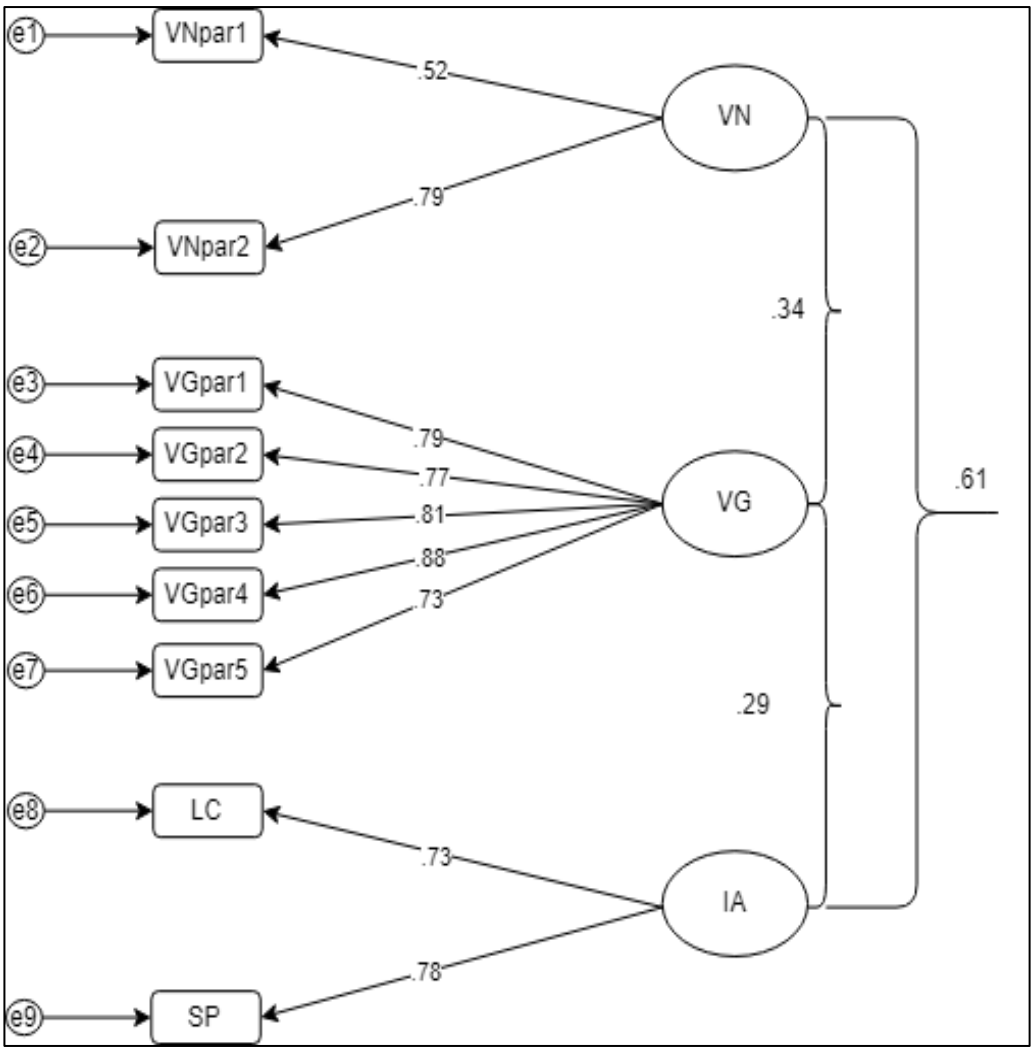

Figure 2. The path diagram of the measurement model.

Note. VN = Vulnerable Narcissism; VG = Vengeance; IA = Internet Addiction; VNpar1, VNpar2 = Parcels of Vulnerable Narcissism; VGpar1, VGpar2, VGpar3, VGpar4, VGpar5 = Parcels of Vengeance; LC = Locus of Control; SP = Social Problems

Table 2. Parameter estimates of the measurement model

Path	Unstandardized Regression Coefficient	Standardized Regression Coefficient	t value	Error variance
VNpar1 ← VN	1.00*	.52	------	.27
VNpar2 ← VN	.59	.79	6.04***	.62
VGpar1 ← VG	1.00	.79	------	.63
VGpar2 ← VG	1.20	.77	16.92***	.59
VGpar3 ← VG	1.06	.81	15.66***	.65
VGpar4 ← VG	1.04	.88	144.88***	.77
VGpar5 ← VG	1.10	.73	15.34***	.54
LC ← IA	3.55	.73	19.68***	.53
SP ← IA	3.55	.78	19.68***	.61

Note. *These values were set equal to zero for estimation. *** p < .001, VN = Vulnerable Narcissism; VG = Vengeance; IA = Internet Addiction; VNpar1, VNpar2 = Parcels of Vulnerable Narcissism; VGpar1, VGpar2, VGpar3, VGpar4, VGpar5 = Parcels of Vengeance; LC = Locus of Control; SP = Social Problems

Structural Model

In the current paper, the full mediation model (Model 1), including a mediator, vengeance, and no direct path from vulnerable narcissism to internet addiction was tested. The fit indices for full mediation model (Model 1) were as follows: $\chi 2_{(df = 25, N = 392)} = 98.85$, $p < .05$; $\chi 2/df = 3.95$, *CFI* = .95, *TLI* = .93, *GFI* = .95, *NFI* = .93; *RMSEA* = .09 90% CI [.069, .105]; *SRMR* = .08; *AIC* = 138.85, *ECVI* = .36 90% CI [.286, .443]. All paths in full mediation model were significant. Secondly, partial mediation model was tested (Model 2). Model 2 revealed sufficient fit to the data: $\chi 2_{(df = 24, N = 392)} = 33.94$, $p > .05$; $\chi 2/df = 1.41$, *CFI* = .99, *TLI* = .99, *GFI* = .98, *NFI* = .98; *RMSEA* = .03 90% CI [.010, .056]; *SRMR* = .03; *AIC* = 75.94, *ECVI* = .19 90% CI [.169, .244]. To investigate which model may be more efficient in explaining the mediation role of vengeance, model 1 and model 2 were compared. In the comparison process, AIC and ECVI values enable us to determine a better model. The AIC and ECVI values were lower in model 2 (*AIC* = 75.94, *ECVI* = .19) than in model 1 (*AIC* = 138.85, *ECVI* = .36). Additionally, the chi-square difference test was performed to provide more evidence for model comparison. The path from vulnerable narcissism to internet addiction improved the model fit ($\Delta\chi 2_{[1]} = 64.91$, $p = .001$). According to these results, vengeance was determined as showing a partial mediation role in the association between vulnerable narcissism and internet addiction (Table 3, Fig. 3).

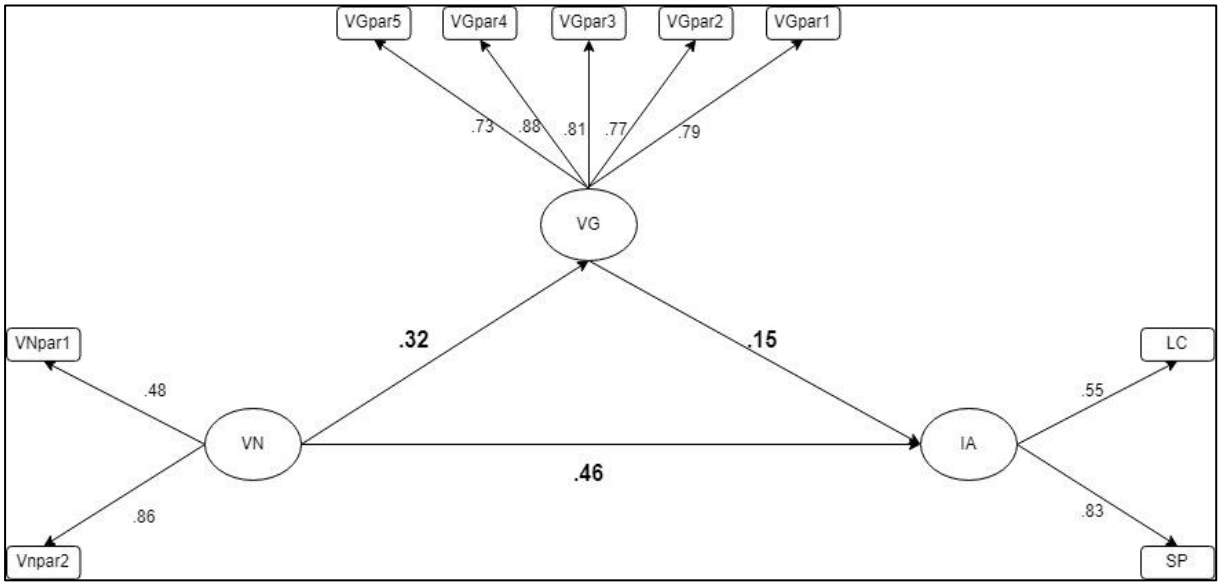

Figure 3. Mediation model from vulnerable narcissism to internet addiction through vengeance

Note. VN = Vulnerable Narcissism; VG = Vengeance; IA = Internet Addiction; VNpar1, VNpar2 = Parcels of Vulnerable Narcissism; VGpar1, VGpar2, VGpar3, VGpar4, VGpar5 = Parcels of Vengeance; LC = Locus of Control; SP = Social Problems

Table 3. Direct and indirect effects of among latent variables

Model pathways	Effect	95% BCa		S.E	C.R.
		Lower	Upper		
Direct effect					
VN→VG	.32	.21	.42	.13	4.18**
VG→IA	.15	.05	.24	.06	2.71*
VN→IA	.46	.28	.61	.18	4.97**
Indirect effect					
VN→VG→IA	.05	.02	.08	---	---

Note: Bootstrapping process was confirmed with 10.000 bootstrap samples.
VN = Vulnerable Narcissism; VG = Vengeance; IA = Internet Addiction $^{**}p < .001$ $^{*}p < .01$

Discussion

The results of the study showed that there was a relationship between vulnerable narcissism and internet addiction. This result rejected the null hypothesis of hypothesis 1 and confirmed the alternative hypothesis. It also demonstrated that vulnerable narcissism would have a role in accounting for internet addiction. In this respect, vulnerable narcissism may be considered an essential variable in the development or increasing the level of internet addiction. A study conducted on individuals with grandiose and vulnerable narcissistic traits determined that vulnerable narcissists use social media networking sites more intensively and prefer online social interactions more (Casale et al., 2016). Based on this finding, orientation to the internet or social networking sites could be considered a secondary problem that may develop due to a vulnerable narcissistic pattern. The present study supported the social compromise hypothesis. In other words, it can be assumed that vulnerable narcissistic people can exhibit themselves more easily in online environments because of their introversion.

Ahn et al. (2015) stated that individuals with high levels of vulnerable narcissism avoid processes that threaten privacy on social networking sites. From this perspective, it can be concluded that vulnerable narcissists refrain from being rejected or ridiculed by hiding their identities and keeping privacy. Thus, they may avoid negative evaluations of their self. Individuals with high levels of vulnerable narcissism experience more problems in their social relationships, so they may be reinforced to the preference of online social interactions (Ksinan & Vazsonyi, 2016). At this point, Caplan's (2005) online social interaction model becomes functional. According to this model, people prefer online environments due to problems in social interactions. The interactions of individuals preferring online interactions in real life may be seriously damaged. This situation and vulnerable narcissistic traits may lead to overusing the internet by preferring online social interactions again. Preferring online social interactions is known to be associated with social interaction anxiety and low social self-efficacy (Ksinan & Vazsonyi, 2016). Kim et al. (2009) emphasized that in this way, the individual may come up against a negative circle and that this process may reinforce the development of internet addiction. As can be seen, the vulnerable narcissistic trait may interact with multiple mechanisms and lead to excessive use of the internet. So, what other factors may affect the association between Internet addiction and vulnerable narcissism? One of the possible answers to this question was vengeance, and the mediator role of vengeance between vulnerable narcissism and internet addiction was discussed below.

Hypothesis 2 was tested to achieve the main aim of the study. The results showed the partial mediation role of vengeance in the association between vulnerable narcissism and internet addiction. In other words, vulnerable narcissism had a positive indirect effect on internet addiction through vengeance. According to this result, it would be stated that vulnerable narcissism has an explanatory function on internet addiction and the mediator variable (vengeance). Mediation analysis provides an understanding of the interactions of the independent variable and the other variable (s) (mediator), which have a descriptive role on the dependent variable. Therefore, the results may be interpreted that the increase in the level of vulnerable narcissism may lead to an increase in the level of vengeance and that the increase in the mediator variable, based on the increase from vulnerable narcissism, may increase the level of internet addiction.

The mediation analysis results supported the problem behavior theory. According to problem behavior theory, personality, environment, and behavior are evaluated interactively (Jessor, 1987). In the present study, internet addiction was considered a behavioral experience. An individual with vulnerable narcissistic characteristics must maintain his / her self-identity (Malesza & Kaczmarek, 2018). The most critical process in the emergence of vengeance is the loss of self-identity (Bechwati & Morrin, 2007). Vulnerable narcissists may turn to

vengeance when subjected to an attack on themselves. Brown (2004) found significant relationships among narcissistic personality traits, vengeance, and forgiveness. The internet may be an effective tool for the person seeking vengeance if it is inaccessible or if the narcissist wants to conceal his identity while taking revenge.

Therefore, the individual who can use the internet as a tool for a purpose may not be able to control the time spent on the internet. According to another perspective, the self-perception and cognition of the vulnerable narcissist who interacts negatively with the environment to take vengeance were thought to be negative. It was assumed that the individual may turn to the internet to escape these negativities. The findings obtained in the current study supported this perspective of Davis (2001). When the findings related to the second hypothesis were discussed, it was thought that there was another model that could be functional. In the generalized internet addiction model, some of the individual's unique cognitions cause excessive internet use. According to this model, control processes play an essential role in developing internet addiction and enable positive or negative reinforcement systems to work. An individual who uses the internet to take vengeance can give negative reinforcement as it is directed to a purpose. In other words, the failure of the control processes may cause excessive internet use.

Limitations and Recommendations

The research design limited the causal relationship among the variables. In this context, future studies should be conducted in a longitudinal and experimental design, primarily to determine the cause-effect relationships among variables. The following limitation was the sample of the study. In order to increase the generalizability of the study results, it is considered appropriate to conduct research in different and large samples. Response bias and social desirability were among other significant limitations. In addition to the necessity of longitudinal and experimental studies in the future, future studies based on different research approaches may facilitate understanding the more qualified interactions among variables.

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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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
https://doi.org/10.55549/jeseh.1381214

Interpersonal Cognitive Distortions: What is the Role of Childhood Trauma and Attachment?

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Article Info

Article History

Published:
01 October 2023

Received:
08 April 2023

Accepted:
01 September 2023

Keywords

Childhood trauma
Interpersonal cognitive distortions
Mediation

Abstract

The aim of this study is to investigate the mediating role of attachment styles in the relationship between childhood trauma and cognitive distortion. The sample comprised 358 (44.7 % males) university students. Participants completed the Childhood Trauma Questionnaire, the Three-Dimensional Attachment Style Scale, and the Interpersonal Cognitive Distortions Scale. According to the results, other variables, except for physical neglect, did not differ in terms of gender. According to other results of the research, childhood trauma and anxious attachment predicted interpersonal cognitive distortions. In addition, anxious attachment mediated the relationship between childhood trauma and interpersonal cognitive distortions. These findings provide evidence that childhood trauma, mediated by anxious attachment, might contribute to interpersonal cognitive distortions in adulthood. However, secure and avoidant attachment had no statistically meaningful direct impact on interpersonal cognitive distortions. Findings were discussed in line with the relevant literature and some suggestions were presented to the researchers in the context of planning treatment, including assessment of prognosis and treatment needs.

Introduction

Some childhood traumas are based on experiences of preadolescence abuse and neglect (Ballard et al., 2015). The majority of individuals with psychological disorders caused by trauma experience abuse before they were in adolescence (Black et al., 2012). Childhood trauma may cause some psychiatric disorders such as depression (Gladstone et al., 2004), post-traumatic stress disorder (PTSD) (Perry et al., 1995), and obsessive-compulsive disorder (Carpenter & Chung, 2011; Lonchner et al., 2002), but it also affects health problems in daily life such as addiction, risky sexual behavior and obesity (Hillis et al., 2001). Moreover, childhood trauma was examined with both adult attachment styles (Kong et al., 2018; Purnell, 2010) and interpersonal cognitive distortions such as unrealistic relationship expectation in interpersonal relationships, current perceptions of hopelessness and helplessness, and avoidance of intimacy (Briere & Elliott, 1994; Browne & Winkelman, 2007; Owens & Chard, 2001; Strickland, 2008).

It is quite prevalent to experience cognitive distortions after traumatic events (Daniels et al., 2011). Cognitive distortions are defined as systematic errors that lead to misunderstandings (Beck & Weishaar, 2008). Interpersonal cognitive distortions, on the other hand, are assessed as rigid, exaggerated, illogical, and perfectionist thoughts in the relational process (DiGiuseppe & Zee, 1986). Trauma in early life can impair regulation of emotions, coping with stressful stimuli, development of the capacity to maintain interpersonal relationships, and triggers psychobiological alterations that affect emotions and cognition (Schore, 2001). Therefore, it can be said that childhood trauma has profound impact on cognitive functions (Berthelot et al., 2015; Perry et al., 1995). In other words, childhood trauma distorts the victims' cognition (Briere, 1996). In this process, childhood traumas can cause distortion of cognition by distorting assumptions about both the future/the environment and themselves/others. Accordingly, it is known that interpersonal cognitive distortions associated with internal attribution (self-criticizing and self-blaming), perceptions of hopelessness and helplessness, and worry about danger are related to childhood trauma (Briere, 1996).

In addition to interpersonal cognitive distortions having a tendency to recur with high periodicity and persist for a long time, they are very difficult to control (Weismoore & Esposito-Smythers, 2010). Therefore, victims of childhood trauma experience lifelong difficulties related to addiction and cognitive distortions in their relationships (Lawson & Quinn, 2013). Victims experience more interpersonal problems due to these lifelong difficulties (Huh et al., 2014). Briere and Elliott (1994) also suggest that childhood abuse is a significant risk factor for various problems, and this abuse affects a number of broad categories such as interpersonal cognitive distortions and interpersonal difficulties. In this context, childhood traumas can cause interpersonal cognitive

distortions in interpersonal relationships. When the literature is examined, there are many studies examining both direct and indirect effects of childhood trauma on interpersonal cognitive distortions. Studies examining direct effects found that childhood trauma is related to interpersonal problems owing to cognitive distortions (Huh et al., 2014; Williams et al., 2012). In studies examining indirect effects, it seems that interpersonal cognitive distortions play a mediating role in the relationship between childhood traumas and non-suicidal self-injury (Weismoore & Esposito-Smythers, 2010) and the relationship between psychological distress and PTSD on individuals with childhood trauma experiences (Fang & Chung, 2019). According to another study examining the indirect effects, both cognitive distortions and attachment have a mediating role in the relationship between childhood trauma and psychological adjustment (Browne & Winkelman, 2007). Other studies with mediation by attachment examined the relationship between adult dissociation and childhood trauma (Kong et al., 2018) and between childhood trauma and obsessive-compulsive disorder (Carpenter & Chung, 2011). It is known that individuals with childhood trauma experience more insecure attachment in young adulthood, and different attachment styles can involve varying cognitive distortions (Purnell, 2010). Considering whether young adults have secured or insecure attachment, this study deals with the mediating role of attachment styles between childhood trauma and interpersonal cognitive distortions.

Attachment affects perception of the outside world and the relationships. Thus, it creates dynamic mental representations of others and self (Kong et al., 2018). As attachment mechanisms are also encountered in later stages of life, secure or insecure attachment styles are also observed in adults. Insecure attachment styles in adults can be classified as avoidance and anxiety dimensions (Mikulincer & Shaver, 2008). Attachment avoidance means a degraded tolerance for interpersonal intimacy and importance given to autonomy. Attachment anxiety is characterized by a remarkable need for interpersonal intimacy and worry related to self-worth (Kong et al., 2018). In the literature, trauma in itself does not lead to insecure attachment. In the other word, childhood traumas may be one of the effective factors in their experience of insecure attachment. Children who encounter a traumatic situation will have secure attachment styles in the future when they think that they are protected against dangers by their caregivers (Purnell, 2010). In addition, trauma experienced in situations where the object bond to the caregiver is weak affects attachment disorders in the later stages of life (Schore, 2001).

Childhood trauma and insecure attachment may later cause dysfunctional cognitions (Spangler & Grossmann, 1999). Furthermore, since it is known that insecure attachment has an effect on the individual's negative self-evaluation, constant blaming, and repeating this process (Bockers et al., 2014), individuals with this attachment style tend to create interpersonal cognitive distortions by evaluating themselves negatively. In the study conducted by Browne and Winkelman (2007), childhood trauma affected attachment and interpersonal cognitive distortions were the only variable predicting trauma symptoms in later life for adults who reported experiencing childhood trauma. Accordingly, we suggest that attachment styles may describe how childhood trauma causes interpersonal cognitive distortions in young adults. In addition, we think that the gender factor may also have an impact on this process.

It is seen that there are different results in terms of gender in attachment, childhood traumas and interpersonal cognitive distortions. Among these, in the literature, there are different results in terms of gender regarding childhood traumas, and in some studies males (Charak & Koot, 2014; Choo et al., 2011; Jirapramukpitak et al., 2005; Zeren et al., 2012) and in some other studies women (James et al., 2016; Murty et al., 2003) are exposed to more abuse and neglect during childhood. In some studies, it has been determined that childhood traumas do not differ in terms of genders (Godinet et al., 2014; Grilo & Masheb, 2001). When the types of childhood traumas are examined in the relevant literature, it was seen that childhood traumatic experiences, physical neglect, physical abuse, emotional abuse, and sexual abuse can be experienced by both women (Meyerson et al., 2002; Stoltenborgh et al., 2011; Tang, 2002) and men (Güneri Yöyen, 2017; Kalkan & Özbek, 2011; Sofuoğlu et al., 2014; Thompson et al., 2004). Although it is seen in some studies mentioned above that men or women experience higher levels of childhood neglect and abuse, it is known that men report such negative experiences more and silence themselves less (Power et al., 2016).

In the literature, it is known that interpersonal cognitive distortions have different results in terms of genders. For example, while women experience higher scores on irrational beliefs, approval and addiction subscales, men have a higher tendency to blame (Ganong & Coleman, 1992). However, it is noteworthy in studies that generally men have more interpersonal cognitive distortion (Al-Salameh, 2011; Avcı Çayır & Kalkan, 2018; Çam & Şahin Çelik, 2018). In addition, there are also studies revealing that there is no significant difference between interpersonal cognitive distortion scores according to gender (Çoban & Karaman, 2013; Demir & Kaya, 2016). When the attachment literature was examined in terms of genders, it was seen that there were also different results. For example, in some studies men (Barry et al., 2015; Del Giudice, 2011; Weber et al., 2022; Wongpakaran et al., 2012) scored higher, while women (Li et al., 2019) scored higher in some other studies.

Similarly, there are studies showing that both men (Wongpakaran et al., 2012) and women (Del Giudice, 2011; Li et al., 2019; Weber et al., 2022) have higher scores in the anxiety dimension. On the other hand, it was determined that there were no differences between men and women in their secure or fearful ratings (Bartholomew & Horowitz, 1991), anxiety dimension (Barry et al., 2015; Shu et al., 2017), avoidance dimension (Shu et al., 2017). Similarly, no gender differences were found in the dismissive and preoccupied attachment dimensions (Bakermans Kranenburg & van IJzendoorn, 2009). In this context, it is noteworthy that the variables in question show different results in terms of gender. Therefore, in the current study, which will examine whether attachment has a mediated role in the relationship between childhood trauma and interpersonal cognitive distortion, the role of gender has been a matter of curiosity.

Basically, cognitive theory states that people's emotions and behaviors are affected by the way they interpret events. According to this theory, the factor that determines the emotions of individuals is not the event itself, but the meaning ascribed to the event in one's own thought system (Beck, 1995). The interpersonal schema that emerges in the early period, as a representation of the interaction between the self and others, guides the later relationships. Due to these schemas, the individual often has difficulty adapting to new situations and creates repetitive cycles in interpersonal relationships. These cycles, on the other hand, cause repetitive, maladaptive and dysfunctional behaviors to emerge continuously (Safran & Segal, 1996). Based on these considerations, schemas are formed on the basis of the individual's relationship with the attachment figure in the early period. Psychologically healthy people tend to have interpersonal schemas without risk the interpersonal relationship. In some cases, the individual may constantly react in a maladaptive way due to dysfunctional expectations of others' interpersonal behavior (Young et al., 2003). As a result, according to both attachment theorists (Bartholomew & Horowitz, 1991) and those adopting the cognitive approach (Beck, 1995), the experiences of individuals in the early period affect the interpersonal relationships in the later stages of their lives. In addition, gender theorists emphasize that men and women are different in relational processes and intimate relationships, and they argue that this process is dynamic (Fivush, 2002). Studies have generally shown that attachment style has an effect on interpersonal cognitive distortions (Gamble & Roberts, 2005; Rogers et al., 2019; Stackert & Bursik, 2003) and that attachment plays a mediating role between childhood traumas and cognitions (Carpenter & Chung, 2011). While prior works have examined childhood traumas and cognitions (Carpenter & Chung, 2011; Huh et al., 2014; Williams et al., 2012), no studies have tested the mediating role of attachment between childhood trauma and interpersonal cognitive distortions and interpersonal cognitive distortions and examined these variables in terms of gender. The current study addresses this gap in the literature. Based on the literature, there are three research questions in the study.

1. Do childhood trauma, interpersonal cognitive distortions and attachment differ according to gender?
2. Is there a relationship between childhood trauma and interpersonal cognitive distortions?
3. Does attachment play a mediating role in the relationship between childhood trauma and interpersonal cognitive distortions?

Method

Study Design

For the purpose of the study, the parallel mediation model regarding the mediating roles of attachment styles in the relationship between childhood maltreatment and interpersonal cognitive distortions were tested (Figure 1).

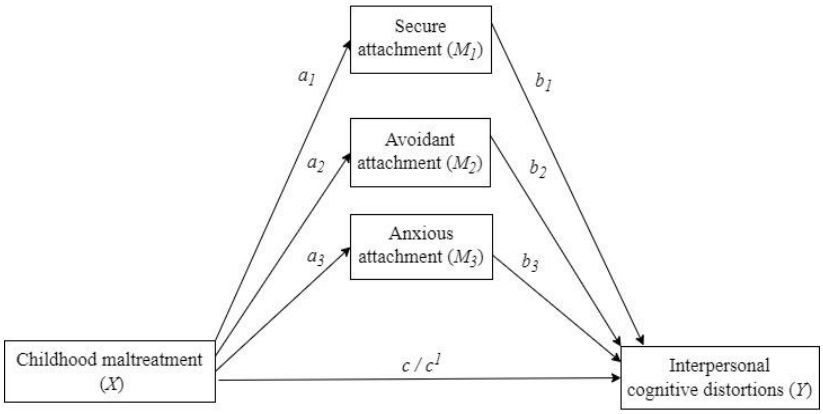

Figure 1. Mediating effect of attachment styles

Participants

The convenience sampling method was used to choose the students to participate in the study. Convenience sampling is a type of sampling used in situations where random or non-random sampling is difficult. The group in this sample has the feature of being easily accessible (Fraenkel et al., 2012). In this study, there were 358 (44.7 % males) students at university with an average age (*M*ean= 20.27, *SD* = 1.50). Of the participants, 85 (23.70 %) people received psychological support before or ongoing, 273 (76.30 %) people did not receive psychological support. In addition, 36 (10.10 %) of the participants stated that they used a psychiatric drug before and 322 (89.90 %) of them stated that they did not use any psychiatric medication.

Procedure and Ethical Approval

This study was conducted in accordance with the 1975 Helsinki Declaration. After the required permission and ethics committee approval were completed, the researchers announced via a brochure that a scientific study was carried out in the places where the students were concentrated and that volunteer participants were sought. The brochure included information about who did the study, whom it would be carried out, between which dates it continued, and how to access the research. Then, in the prepared form, it was accepted to participate in the study voluntarily by ticking a box of informed consent. The information was presented in Turkish. In addition, the study was conducted face-to-face in the campus of the university. In other words, the forms were applied to the students who wanted to participate in the study voluntarily, both in the office environment and in the campus areas, by means of paper and pencil. Then, the students participating in the study signed the consent form.

Measures

Sociodemographic Data Form

This form developed by the researchers recorded individuals' age, gender, whether they had a traumatic experience with any person, whether they received any psychological help, and whether they took any medication therapies. Since it is assumed that the university where the participants are located is not heterogeneous in terms of ethnicity, questions regarding ethnicity or race were not asked to the participants.

Childhood Trauma Questionnaire (CTQ)

CTQ is a self-report scale designed by Bernstein and Fink (1998) to evaluate experiences of abuse and neglect. It is a 5-point grading type scale consisting of 25 items in total. Each item on the CTQ is scored via a 5-point Likert scale (1 = never true, 2 = rarely true, 3 = sometimes true, 4 = often true, 5 = very often true). There are 5 dimensions in the scale: emotional abuse (i.e., "I thought that my parents wished I had never been born"), physical abuse (i.e., "I believe I was physically abused"), physical neglect (i.e., "I didn't have enough to eat"), emotional neglect (i.e., "I felt loved (R)."), and sexual abuse (i.e., "I believe that I was sexually abused"). Total scores for each scale range from 5 to 25, with higher scores indicating greater severity of abuse. Child maltreatment severity was calculating by summing all categories of maltreatment (e.g., Ernst et al., 2022; Powers et al., 2021; Rek et al., 2022). The Turkish adaptation of the scale was carried out by Şar et al. (2012) on a clinical and non-clinical sample group. As a result of the adaptation study, it was determined that the scale was validated with a Turkish sample. As a result of the reliability analysis of the scale, Cronbach's alpha was 0.93 (Şar et al., 2012). In this study, the Cronbach's alpha was 0.72.

Three-Dimensional Attachment Style Scale (TDASS)

The 18-item self-report measure of TDASS is scored via a 5-point Likert scale (1 = never true, 2 = rarely true, 3 = sometimes true, 4 = often true, 5 = very often true). The scale consists of three factors: secure attachment, avoidant attachment, and anxious attachment (Erzen, 2016). Avoidant attachment style determines attitudes in which the individual rejects the value of others by keeping self-worth high. For example, 'The people around me are not as valuable as me'. In the secure attachment style, individuals consider both themselves and the others as valuable assets. For example, 'I can understand the sadness of others'. The third dimension, anxious attachment, consists of a combination of fearful preoccupied attachment styles. In other words, it includes the attitudes of both wanting to be together with the individuals in front of them by assessing themselves as worthless and

avoiding being together with them due to the harm that may come from them. For example, 'I stay away from people because they can make me suffer'. High scores obtained from each factor mean that the relevant attachment style is highly displayed, lower scores indicate less display of that style. As a result of the reliability analysis of the scale, the Cronbach alpha values were found to be 0.69 for the secure attachment, 0.80 for the avoidant attachment and 0.71 for the anxious attachment (Erzen, 2016). In this study, the Cronbach alpha values were 0.62, 0.64, and 0.63.

Interpersonal Cognitive Distortions Scale (ICDS)

ICDS was developed by Hamamcı and Büyüköztürk (2004) to assess the cognitive distortions that individuals have in their interpersonal relationships. The ICDS was developed as 19 items rated on a 5-point Likert scale (1 = never true, 2 = rarely true, 3 = sometimes true, 4 = often true, 5 = very often true). There are three sub-scales: interpersonal rejection, unrealistic relationship expectation and interpersonal misperception. The sample item is 'There are no real friends in this life' for the interpersonal rejection sub-dimension, the item 'I always want somebody to be around me' for the unrealistic relationship expectation sub-dimension, and the item 'I feel what they think even if people do not show it' for the interpersonal misperception sub-dimension. As a result of the sum of the three dimensions of the scale, the total score of interpersonal cognitive distortions is obtained. The high total scores indicate that interpersonal cognitive distortions are high. The reliability of the scale was estimated by performing a test-retest correlation (0.74) and Cronbach alpha was 0.67 (Hamamcı & Büyüköztürk, 2004). In the present study, Cronbach alpha was 0.74.

Analysis of Data

First, the data set was checked in terms of data entered using frequency, minimum and maximum values. Afterward, the variables examined in the study were tested whether they showed a difference in terms of gender. As seen in Table 1, the variables showed a normal distribution. At this point, the independent samples t-test, which is one of the parametric tests, was employed to test the variables whether they showed differences in terms of gender. Mediation analyses were performed on SPSS Version 23 (IBM Corp., 2015) and the PROCESS macro (model 4) for SPSS (Hayes, 2013), which employs a regression-based approach to mediation. We tested various assumptions of this test before starting the regression-based mediation test. In the literature, these assumptions are expressed as linearity, homoscedasticity, normality of estimation error, and independence of observation (Hayes, 2013).

A loess curve was added to the scatter plot to test linearity and homoscedasticity assumptions. It is a way of installing a non-parametric curve between variables to show the relationship between them (Jacoby, 2000). As can be seen in Figure 2, the regression appears fairly linear since the Loess curve centres close to zero along the entire X axis. As seen in Figure 2, it was determined that the data did not form a clear pattern in the scatter plot. In other words, the data spread evenly along the X-axis. This shows that the homoscedasticity assumption was met. Also, the assumption of the normality of estimation error was examined with the Q-Q plot with the residuals (Figure 3). Our data were found to have a good fit with the diagonal line, which showed normality. In addition, the skewness and kurtosis values were examined for normality. Because of having the skewness and kurtosis values between ± 3 and ± 10 for normality (Kline, 2016), the data showed normal distribution. The analysis results should not be influenced in cases of minor violations of this assumption, except that the study has a small sample size (Hayes, 2013). Finally, the independence of observations was tested. The error related to each data point (i.e., one case) should not have a connection with the error of other cases (Hayes, 2013). This particularly applies to studies that use cluster sampling procedures or dyadic data research (Hayes, 2013), in which cases may be interrelated as they share some characteristics or context. In the case of nonindependence of observations, a smaller or larger standard error of the regression coefficients can be seen (Hayes, 2013). Whether data meets the independence assumption can be determined provided that the data collection method is known. As we recruited our subjects from a pool of undergraduate students at the same university, we are not expecting to have underlying common characteristics that might compromise the independence of our estimation error.

Correlation analysis was used to determine the relationships between variables. Then, the mediating role of attachment styles between childhood trauma and interpersonal cognitive distortions related to relationships was tested with the PROCESS macro for SPSS. In testing the significance of mediation analysis, the sample size was tested with the reconstructed bootstrap method as 10000 at 95% confidence interval. Thus, more reliable results were obtained by performing analyses on larger data sets produced by resampling (MacKinnon et al., 2004).

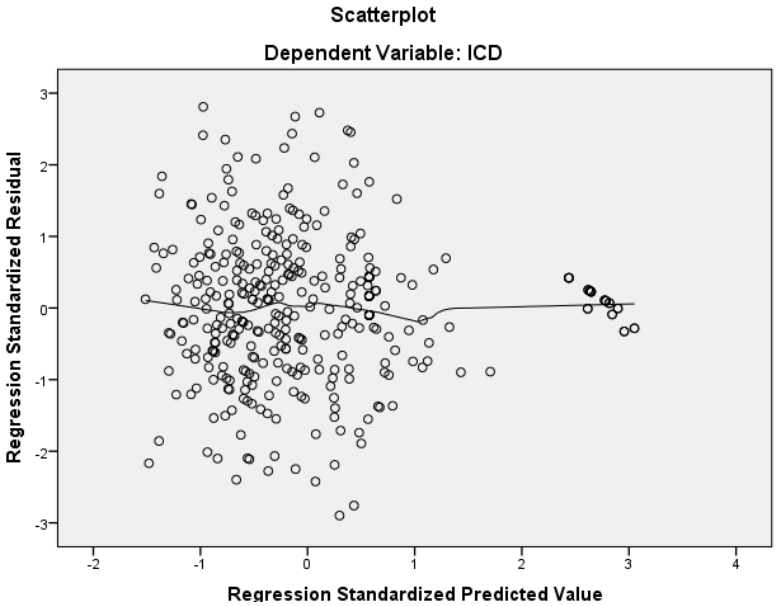

Figure 2. The results of scatterplot

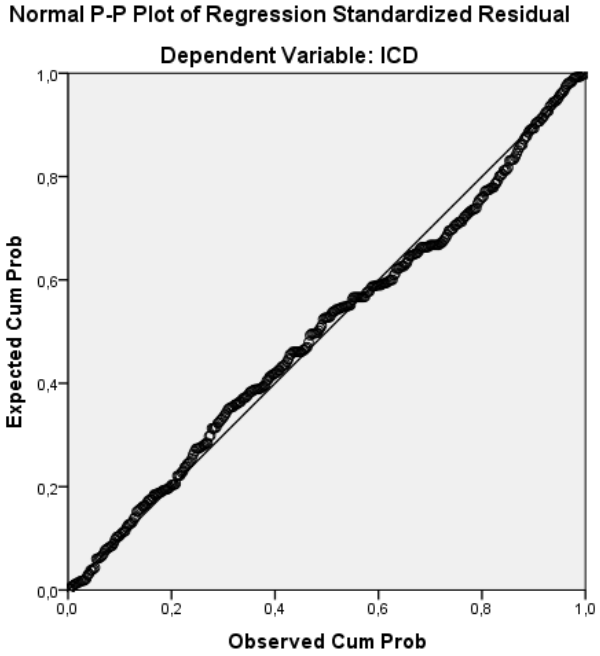

Figure 3. Normal P-P plot of regression standardized residual

Results

Gender Differences

The independent samples t-test was used to test whether the variables examined in the study showed a difference in terms of gender. According to the t-test results, there was a significant difference between males and females in terms of physical neglect [t (356) = −2.267; p = 0.024]. Accordingly, the examination of Table 1 shows that male participants (*Mean*= 7.485; *SD*= 2.241) reported a higher mean score than female participants (*Mean*= 6.878; *SD*= 2.591) in terms of exposure to physical neglect. On the other hand, it was found that emotional neglect [t (356) = −0.828; p = 0.404], emotional abuse [t (356) = 0.224; p = 0.823], physical abuse [t (356) = 0.125; p = 0.900], sexual abuse [t (356) = 1.649; p = 0.100], total childhood maltreatment [t (356) = −0.496; p = 0.620], interpersonal cognitive distortions [t (356) = −0.693; p = 0.489], avoidant attachment [t (356) = −1.152; p = 0.129], secure attachment [t (356) = −1.412; p = 0.159], and anxious attachment [t (356) = −0.024; p = 0.981] did not differ in terms of gender.

Correlational Statistics

The correlation values in the study and the descriptive statistical values of the variables are presented in Table 1.

Table 1. Mean scores and zero-order correlations

	1	2	3	4	5	6	7	8	9	10
1. Emotional abuse (CTQ)										
2. Physical abuse (CTQ)	0.558#									
3. Sexual abuse (CTQ)	0.499#	0.457#								
4. Emotional neglect (CTQ)	0.271#	0.285#	0.347#							
5. Physical neglect (CTQ)	0.669#	0.466#	0.402#	0.381#						
6. Total childhood maltreatment (CTQ)	0.825#	0.695#	0.695#	0.648#	0.816#					
7. Secure attachment (TDASS)	−0.554#	−0.570#	−0.429#	−0.272#	−0.511#	−0.620#				
8. Avoidant attachment (TDASS)	0.592#	0.421#	0.360#	0.215#	0.532#	0.578#	−0.322#			
9. Anxious attachment (TDASS)	0.586#	0.442#	0.434#	0.225#	0.485#	0.585#	−0.370#	0.817#		
10. Interpersonal cognitive distortions (ICDS)	0.577#	0.491#	0.420#	0.323#	0.491#	0.620#	−0.392#	0.551#	0.595#	
Female Mean	7.096	5.651	6.010	7.873	6.878	33.510	15.838	18.414	19.994	55.368
Female SD	2.943	1.519	1.895	2.602	2.591	9.089	3.234	5.340	4.660	11.389
Skewness	1.434	2.667	1.607	0.788	1.459	1.573	−1.281	0.804	0.654	0.351
Kurtosis	0.829	8.199	1.071	0.274	0.913	1.581	1.197	−0.243	−0.352	−0.603
Male Mean	7.031	5.631	5.693	8.106	7.487	33.950	16.281	19.243	20.006	56.125
Male SD	2.422	1.519	1.686	2.688	2.441	7.326	2.557	4.845	4.115	8.676
Skewness	1.216	3.018	2.614	0.999	0.766	1.539	−1.501	0.246	0.447	−0.075
Kurtosis	0.843	10.668	6.102	0.594	−0.471	3.013	3.105	−0.755	−0.452	0.104
Total Mean	7.067	5.642	5.868	7.977	7.150	33.706	16.036	18.784	20.000	55.706
Total SD	2.719	1.517	1.809	2.639	2.540	8.339	2.955	5.134	4.419	10.259
Minimum	5.000	5.000	5.000	5.000	5.000	25.000	8.00	7.00	11.00	29.00
Maximum	15.00	15.00	13.00	17.00	14.00	60.000	22.00	34.00	30.00	77.00
Skewness	1.39	2.81	1.98	0.89	1.13	1.564	−1.40	0.57	0.58	0.22
Kurtosis	0.97	9.15	2.67	0.43	0.15	2.058	1.93	−0.52	−0.36	−0.33

Note: # p < .001

Parallel Mediation Results

Results of regression analyses, examining direct and mediation effects and controlling for gender, are presented in Table 2.

Table 2. Direct and indirect effects

IV: Childhood maltreatment					
DV: Interpersonal cognitive distortions	*B*	SE	*β*	*t*	*p*
Gender (control variable)	−0.443	0.812	−0.021	−0.545	0.585
Childhood maltreatment to secure attachment (path a_1)	−0.220	0.014	−0.622	−15.031	< .001
Childhood maltreatment to avoidant attachment (path a_2)	0.354	0.026	0.576	13.336	< .001
Childhood maltreatment to anxious attachment (path a_3)	0.310	0.022	0.585	13.591	< .001
Secure attachment to interpersonal cognitive distortions (path b_1)	−0.054	0.173	−0.015	−0.312	0.754
Avoidant attachment to interpersonal cognitive distortions (path b_2)	0.140	0.139	0.070	1.005	0.315
Anxious attachment to interpersonal cognitive distortions (path b_3)	0.701	0.162	0.302	4.316	< .001
Total effect of childhood maltreatment (path c)	0.762	0.051	0.619	14.888	< .001
Direct effect of childhood maltreatment (path c')	0.483	0.071	0.392	6.734	< .001
	$F(5, 352) = 62.161$, $R^2 = 0.468$, $\mathbf{p < .001}$				
Bootstrap results for indirect effects					
	Effect	SE		Lower CI	Upper CI
Childhood maltreatment to interpersonal cognitive distortions via secure attachment	0.012	0.036		−0.062	0.082
Childhood maltreatment to interpersonal cognitive distortions via avoidant attachment	0.049	0.055		−0.062	0.155
Childhood maltreatment to interpersonal cognitive distortions via anxious attachment	0.217	0.063		**0.100**	**0.346**

Notes: Statistical significance indicated in bold. Gender: 1 for females, 0 for males. CI = 95% percentile bootstrap confidence interval. Bootstrapping process was confirmed with 10,000 bootstrap samples.

A significant indirect effect was found for childhood maltreatment, in that the relationship between childhood maltreatment and interpersonal cognitive distortions was mediated by anxious attachment. The completely standardized indirect effect of childhood maltreatment was estimated as (*ab*) = 0.176, *SE* = 0.051, 95% CI [0.084, 0.282], indicating that a one standard deviation increase in severity of childhood maltreatment would yield a 0.176 standard deviation increase in interpersonal cognitive distortions severity through the mediating effect of anxious attachment. On the other hand, it was found that secure attachment and avoidant attachment did not have a mediating role in the relationship between childhood maltreatment and interpersonal cognitive distortions. In line with the purpose of the study, the parallel mediation results regarding the mediating roles of attachment styles in the relationship between childhood maltreatment and interpersonal cognitive distortions are shown in Figure 4.

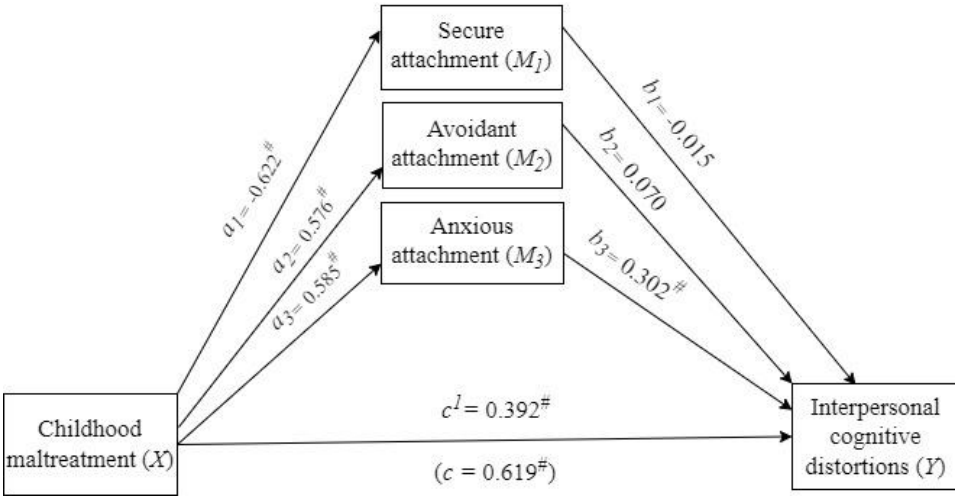

Figure 4. Results of parallel mediation

Note: c' is direct effect of childhood maltreatment on interpersonal cognitive distortions, c is total effect of childhood maltreatment on interpersonal cognitive distortions, $^{\#}p < .001$.

Discussion

Gender Differences

The primary aim of the study was to examine whether childhood traumas, interpersonal cognitive distortions, and attachment styles differed in terms of gender. As a result of the research, it was found that the levels of emotional neglect, emotional abuse, physical abuse, sexual abuse and total childhood maltreatment did not differ according to gender and that the dimension of physical neglect differed in favour of men. A review of the literature indicated that there were studies showing that boys were physically abused more than girls (Malgaz Güçlü & Acemioğlu, 2020; Metin et al., 2021; Sofuoğlu et al., 2014; Thompson et al., 2004). However, there were also studies that showed results different from those of the current research. In these studies, it was revealed that girls were exposed to more abuse and neglect in their childhood (Çöpür et al., 2012; James et al., 2016; Murty et al., 2003; Sofuoğlu & Nalbantçılar, 2018; Topal et al., 2018; Zoroğlu et al., 2001). On the other hand, there were some studies indicating that there were no differences between males and females in terms of physical abuse (Bostancı et al., 2006; Çeçen-Eroğul & Türk, 2013; Güneri Yöyen, 2017; Kalkan & Özbek, 2011; Meyerson et al., 2002; Stoltenborgh et al., 2013). In addition, some studies showed that boys in general were exposed to more abuse and neglect during childhood (Charak & Koot, 2014; Choo et al., 2011; Jirapramukpitak et al., 2005; Zeren et al., 2012) and that they experienced more physical neglect and sexual abuse than female students (Güneri Yöyen, 2017). Some other studies showed that males were more likely to report emotional abuse and sexual abuse (Çeçen-Eroğul & Türk, 2013; Kalkan & Özbek, 2011) and more emotional neglect than females (Power et al., 2016). On the other hand, interpersonal cognitive distortions did not differ in terms of gender in this study. When the literature was examined, it was seen that there were studies with similar results (Çoban & Karaman, 2013; Demir & Kaya, 2016). In addition to studies showing that females had higher irrational beliefs (Ganong & Coleman, 1992; Şahan & Eraslan Çapan, 2017), there were studies indicating that male students had higher irrational beliefs (Al-Salameh, 2011; Avcı Çayır & Kalkan, 2018; Çam & Şahin Çelik, 2018).

In addition, it was determined that there was no difference between genders in terms of avoidant attachment, secure attachment, and anxious attachment. When the literature was examined, it was seen that there were studies showing similar results (Bakermans-Kranenburg, & van IJzendoorn, 2009; Barry et al., 2015; Bartholomew & Horowitz, 1991; Shu et al., 2017). In addition to these studies, there were other studies with results that were not consistent with the results of the present study. These studies showed that males had higher scores on the avoidance dimension than females (Barry et al., 2015; Del Giudice, 2011; Li et al., 2019; Weber et al., 2022; Wongpakaran et al., 2012) or females had higher scores on the avoidance dimension (Li et al., 2019), males scored significantly lower than women on the anxiety dimension of attachment (Del Giudice, 2011; Li et al., 2019; Weber et al., 2022), or that males scored higher than females on the same dimension (Wongpakaran et al., 2012).

Parallel Mediation

This study was performed with the purpose of examining the mediating role of avoidant attachment, secure attachment, and anxious attachment on the relationship between childhood trauma and interpersonal cognitive distortion. It was found that the anxious adult attachment style partially explains the interpersonal cognitive distortions in adults with a history of childhood trauma, but the avoidant adult attachment style and secure attachment style do not explain the relationship between childhood traumas and interpersonal cognitive distortions in these adults.

Findings regarding the first hypothesis of the study showed that individuals with high levels of childhood trauma have more interpersonal cognitive distortion. This finding is similar to many studies. Perry et al. (1995) suggested that childhood trauma has a profound effect on behavioral, emotional, physical, social and cognitive functions. In the study conducted by Briere (1996), cognitive distortion regarding internal attribution, perceptions of hopelessness and helplessness, and worry about danger were seen to be associated with childhood trauma. Purnell (2010) also reported that individuals with trauma have more cognitive problems. In this context, it can be said that childhood trauma impairs cognition (Briere, 1996). As a result, this finding in the current study is in parallel with many studies in the literature (Briere & Elliott, 1994; Daniels et al., 2011; Huh et al., 2014; Lawson & Quinn, 2013).

The mediation hypothesis of the study was that childhood traumatic experiences of adult individuals would have indirect effects on their interpersonal cognitive distortion levels through attachment styles. Research findings revealed that adults with childhood traumatic experiences have less secure attachment styles, on the other hand, they have more anxious and avoidant attachment styles. On the other hand, it was determined that adult individuals who had a traumatic experience in childhood had more anxious attachment style, and at the same time, their interpersonal cognitive distortion levels increased indirectly. Contrary to this situation, it was determined that the individuals had more avoidant attachment style, but there was no increase in the interpersonal cognitive distortion levels indirectly. Similarly, it was determined that adult individuals with childhood traumatic experiences had less secure attachment styles, but there was no increase in the levels of interpersonal cognitive distortions indirectly. As a result, anxious attachment mediates the relationship between childhood trauma and interpersonal cognitive distortion. It was found that individuals with high levels of childhood trauma experience higher levels of anxious attachment, resulting in higher interpersonal cognitive distortions. According to Purnell (2010), this is the result of past traumas keeping the individual vigilant to danger by weakening attachment and then developing an insecure attachment style and experiencing cognitive distortion and arousal in this process. The result obtained from the current study is similar to many studies. In the study conducted by Kong et al. (2018), path analysis of trauma subtypes found that anxious attachment mediated the relationship between childhood emotional abuse, physical abuse, and physical neglect and adult dissociation. Considering that it is possible to have thoughts about relationships in the process of adult dissociation, it can be said that this study is similar to the current study. Moreover, the current study is similar to the study by Carpenter and Chung (2011), which found that insecure attachment plays a mediating role in the relationship between childhood trauma and obsessive-compulsive disorder. Considering that obsessive-compulsive disorder also has false cognitions, the related study partially supports the current study because it was observed that anxious attachment was a mediator in the current study while avoidant attachment mediated in the study by Carpenter and Chung (2011). Although both are types of insecure attachment, it can be said that this study partially differs from the current study. In another study, the effects of attachment styles and personality organization on emotional functioning were examined in those who experienced childhood trauma, and it was determined that childhood traumas increase anxious attachment and indirectly experience more feelings of sadness and care (Fuchshuber et al., 2019).

Similarly, anxious attachment is reported to be mediator of the effect of childhood trauma on relational domains, identity integration, and self-control (Cohen et al., 2017). In addition, according to Tasca et al. (2011), individuals with childhood trauma and anxious attachment style should focus on protecting self-integrity in identity development to obtain the desired results from treatment. When the identity literature is examined, it is known that there is a sense of continuity with past life in an integrated identity, negative emotions such as regret and despair are accepted (Marcia, 2014), and there is integrity between beliefs, values and thoughts (Adams & Marshall, 1996).

In addition to these findings, there are studies showing that as the anxious attachment levels of individual's increase, dysfunctional attitudes (Andersson & Perris, 2000) and interpersonal problems (Stepp et al., 2008) also increase. The results of a similar study showed that anxious attachment positively predicted unrealistic relationship expectation and mind reading sub-dimension of interpersonal cognitive distortions (Deveci Şirin, 2017). In addition, it has also been found that anxious attachment leads to an increase of cognitive distortions (Rogers et al., 2019). On the other hand, trauma itself does not determine attachment style and can only be considered a factor when trauma is an integral part of the pattern of interaction with the primary caregiver. Therefore, it can be said that individuals who have experienced childhood trauma may act with more insecure attachment to other people in adulthood, and thus they may have more interpersonal cognitive distortion.

Furthermore, the current study findings indicate that avoidant attachment and secure attachment do not mediate the relationship between childhood trauma and interpersonal cognitive distortion. In other words, individuals with high levels of childhood trauma have higher levels of avoidant attachment and lower secure attachment; however, it was observed that there was no change in the interpersonal cognitive distortion of these individuals. In parallel with the literature, childhood trauma increases avoidant attachment (Browne & Winkelman, 2007; Carpenter & Chung, 2011). In addition, it is suggested that childhood trauma reduces secure attachment (Erozkan, 2016). These studies support the current study about the direct effect of childhood trauma; on the other hand, they differ in relation to the indirect effect findings.

In the current study, there may be some reasons why only anxious attachment is mediated. This study was primarily conducted on individuals exposed to interpersonal trauma. The study also focuses not on cognitive distortions in general, but on a more specific case of cognitive distortions in interpersonal relationships. However, the original three-dimensional attachment styles scale (Erzen, 2016) was developed on a normal sample aged between 12 and 25 years (history of traumatic experience was not questioned). Current study, on the other hand, shows slightly different characteristics than the normal sample. In general, it was determined that insecure attachment levels of current study were higher than the study of the conducted by Erzen (2016). For this reason, it is thought that the reason for such a difference may be sample differences. In addition, since extremely rigid, exaggerated, irrational and perfectionist thoughts in social relations affect how the individual will behave in intimate relationships, such thoughts are called interpersonal cognitive distortions (DiGiuseppe & Zee, 1986). Individuals with avoidant attachment tend to be uncomfortable with intimacy and dependency. They have pessimistic beliefs about others and relationships. They tend to ignore the importance of intimacy and interdependence in intimate relationships and instead assert their independence and self-confidence (Locke, 2008). In contrast, individuals with anxious attachment worry about rejection and abandonment, along with a negative self-image and excessive need for approval from others. At the same time, the thoughts, feelings, and actions of anxiously attached individuals tend to focus on their partners (Berry et al., 2006; Collins, 1996; Hazan & Shaver, 1987). Because of these conflicting perceptions, anxious individuals question their values, worry about losing their partner, and display behaviors such as being alert to signs that their partner may be moving away from them (Cassidy & Berlin, 1994). Based on the above statements, it can be explained that avoidant attachment style does not mediate the relationship between childhood traumas and interpersonal cognitive distortions.

Another reason why anxious attachment mediated the relationship between childhood traumas and interpersonal cognitive distortions, and that other attachment styles were not mediated in the study, may be that items assessing interpersonal cognitive distortions had more consistency with items assessing anxious attachment than items assessing other attachment styles. All these situations may explain that anxious attachment has a mediating role in the relationship between childhood traumas and interpersonal cognitive distortions and that other attachment styles are not mediated. So, the present study's differing results may be due to various reasons. These may be the measurement tool used, the difference in the sample, and the focus of this study on cognitive distortions in interpersonal relationships. The findings of the study indicate that we need to further investigate the relationship between secure attachment and avoidant attachment styles and interpersonal cognitive distortions in individuals with childhood trauma.

Limitations and Recommendations

There are several limitations to the current study. Firstly, findings were collected from university students rather than from a clinical setting. Evaluation of childhood trauma is important in clinical practice for determining risk of suicide and planning the treatment. According to Kongerslev et al. (2019), such recognition can be helpful for individuals when planning treatment, including assessment of prognosis, treatment needs, and suicide risk. Secondly, the current study is cross-sectional. Future research can examine the relationship between childhood trauma and interpersonal cognitive distortions mediated by attachment styles that may change over time. In addition, attachment may be the starting point in future studies, followed by childhood traumas and cognitive distortions. Young adults were included in the study. Research can also be conducted with individuals in middle age to examine the mediating effect of adult attachment style. As another limitation, a self-report questionnaire was used to assess adult attachment styles in the current study. It will be an important contribution to expand the current study, which is quantitative research, by developing mixed methods in order to determine the depth and breadth of the subject in future studies. Thus, the opportunity to refer to the narratives of individuals will be provided. Since attachment styles in adulthood are open to change, talking about the unresolved trauma of the individual can ensure their transition to a secure attachment style by developing strategies to cope with close relationships in the future.

Conclusion

Understanding the relationship between childhood trauma and interpersonal cognitive distortion and examining the role of attachment in this relationship is considered important in determining risk factors. The findings of this study show that anxious attachment had a meaningful mediating role in the relationship between childhood trauma and interpersonal cognitive distortion.

Declarations and Ethics Statements

Compliance with Ethical Standards

The authors have no potential conflicts of interest to disclose. This study was conducted in accordance with the 1975 Helsinki Declaration. Firstly, ethics committee permission was obtained from Ataturk University Institute of Social Sciences.

Scientific Ethics Declaration

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

Availability of data and material (data transparency):

The data that support the findings of this study are openly available in [open science framework] at http://doi.org/10.17605/OSF.IO/E5U67.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
https://doi.org/10.55549/jeseh.1381234

The Reflection of Online Education during the Covid-19 Pandemic on Nursing Students' Care Behaviors and Stress

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Article Info

Article History

Published:
01 October 2023

Received:
10 January 2023

Accepted:
27 June 2023

Keywords

Covid-19,
Nursing education,
Care behaviors,
Stress

Abstract

The pandemic period creates a feeling of inadequacy in applying the education that students receive. During this period, students who receive online education seem to feel inadequate and experience stress in a practical lesson. It aims to evaluate the level of changing the care behaviors of undergraduate nursing students and the stress they experience during the Covid-19 process. This research was completed with a nursing student in 2192 in Turkey. The research is descriptive and relationship-seeking. Data were collected at the end of the semester with the caring behaviors competency and the stress scale. t-tests, Kolmogorov-Smirnov tests, and correlation tests were used in the analysis of the data. Bachelor of Science in Nursing (BSN) students are predominantly in the first year of study. A significant difference was found in the perceived stress level according to the variables of gender, education level, perceived care sufficiency, and the type of university attended. It was determined that the caring behaviors of male students were higher than females, and those in private schools were higher than those in public universities. Nursing students' age, class, and perceived stress scores significantly affect their care behavior. Nursing education in Turkey focuses on care-based education which emphasizes skill development across the BSN program, establishing measurable care behavior, and ensuring that managing student stress is part of the curriculum content.

Introduction

Nursing education is a planned program with theoretical and clinical infrastructure that aims to provide a Professional (Sheu et al., 2002). Nursing educators play a critical role in training nurses ready to work in the current pandemic conditions (Taylor et al., 2020). Student education in this period; is carried out through online platforms and innovative methods are developed to explain the processes (Aggarwal et al., 2020). Strategies determined in the continuation of nursing education aim to provide practice related to clinical infrastructure rather than continuing education. For this reason, trainers make significant efforts for the active use of different application tools and methods.

Care, which is the basic component of nursing practices, is considered a competency that should be taught to students (Begum & Slavin, 2012). It constitutes the necessity of creating, developing, and adopting the concept of care in the nursing curriculum as an important field of study (Begum & Slavin, 2012; Schoenhofer, 2001). To evaluate the effects of nursing care on the patient and the quality of their care, it is necessary to determine the care behaviors of nursing students, especially during the pandemic period.

In nursing programs where the individual's knowledge, attitudes, and skills are applied, students are faced with stress factors that affect their academic performance (Pulido-Martos et al., 2012; Sheu et al., 2002). Learning stress can create different results, especially in an environment where different stressor factors such as pandemics exist. It is stated that the thinking and decision-making competencies of the students change, their health is adversely affected, and even the negative effects of their professional motivation reduce their professional competence (Altıok & Üstün, 2013; Edwards et al., 2010).

Continuing nursing education during the pandemic is important both to ensure the continuity of professional development and to meet the need for personnel who can work in the field. Research; is a descriptive study that seeks relationships, aiming to evaluate the effects of the online training that Undergraduate BSN students receive during the Covid-19 process on their care behaviors and stress.

Method

This study determines and evaluates the care behavior competence of students after the care training given within the scope of Covid-19. Quantitative data was collected from students receiving online education.

Participants and Data Collection

The research was completed without sampling with 2192 BSN students who met the research acceptance criteria, which can be accessed from online platforms between January and June 2021. BSN students aged 18 and over, training in Turkey, reading and understanding Turkish, and taking at least one semester of online nursing care training were accepted for the study. In the power analysis performed using the GPOWER package program, the mean scores of the care behaviors scale, which is the dependent variable of the research, were used. As a result of the analysis, the sample power was found to be 99.9% at the 0.05 significance level.

Data Collection Tools

The Caring Behaviors Scale-24, which is a quantitative assessment criterion, was used to evaluate care outcomes. Nursing students' perceived stress scale was used to determine the stress in students. In addition, demographic information was collected and included the participant's age, gender, race/ethnicity, and year of employment. The study was reviewed and approved by the central university ethics committee. Completing the questionnaires submitted on the online platform was accepted as informed consent.

The questionnaire prepared on the online platform (Google Forms) was sent to the students who met the sampling criteria via WhatsApp, Instagram, LinkedIn, Facebook, and e-mail. In the questionnaire, there are students' introductory characteristics, caring behavior development scale, and nursing students' perceived stress scale.

1. Introductory Features Questionnaire

It consists of nine questions that will determine the socio-demographic characteristics of the students (age, gender, educational status, etc.).

2. Caring Behaviors Scale-24 (CBS-24)

The validity and reliability study of the scale developed by Wolf et al. (Wolf et al., 1994), made with patients and nurses, and consisting of 42 items in its original version, was conducted by Kurşun and Kanan (2012) with patients and nurses (Kurşun & Kanan, 2012). The internal consistency of the scale ranged from 0.96 for both patients and nurses and between 0.82 and 0.92 for subgroups. The scale consists of 24 items and 4 sub-dimensions (assurance, knowledge-skill, respect, commitment). After the scores of all items are summed, the total scale score between 1-6 is obtained by dividing the collected score by 24. The high mean score obtained from the scale indicates that the perception of nursing care is high, and the low mean perception of nursing care is low (Kurşun & Kanan, 2012). The Cronbach alpha value of the scale in our study was determined as 0.98.

3. Nursing Students' Perceived Stress Scale (PSS):

The original scale is in Chinese and consists of 29 items (Sheu et al., 2002). The six-factor structure of the scale, whose English version was used in the original study, explains 50.7% of the total variance. In the original study, Cronbach's alpha found 0.89, sub-dimensions 0.87–0.89(Chan et al., 2009). The scale was adapted to Spanish as 30 items and the total variance was 56.1% and the Cronbach's alpha coefficient was 0.85-0.70(Jimenez et al., 2010). The Cronbach alpha value of the scale, which was validated in Turkish by Karaca et al., was found in the range of 0.67-0.93 (Karaca et al., 2015).

In the evaluation of the items; A five-point Likert-type assessment was used, with '4– Very stressful for me, 3, 2, 1, 0– Not stressful for me. Sub-dimensions: stress caused by lack of professional knowledge and skills, stress experienced while caring for the patient, stress caused by homework and workload, stress caused by lecturers

and nurses, stress caused by the environment, stress caused by peers and daily life. Total score; It ranges from 0 to 116. A high score indicates a high degree of stress (Sheu et al., 2002). The Cronbach alpha value of the scale in our study was found to be 0.97.

Data Analysis

The data obtained from the research were analyzed using the SPSS (Statistical Package for Social Sciences) 25.0 program. Percentage, the significance of the difference between two means in dependent-independent groups, one-way analysis of variance, and correlation test were used in the evaluation of the data. The compatibility of the data with the normal distribution was determined by the Kolmogorov-Smirnov test. Obtained data were evaluated at a 5% significance level with a 95% confidence interval.

Results and Discussion

The research sample (N=2192) includes students who continue their nursing education. The mean age of the participants was 20.5±1.6 and most of them were women (87.5%). 42.5% of the participants represented the Mediterranean, 17.3% Southeastern, 13% Black Sea, 8.1% Central Anatolia, 7.3% Aegean, 7.1% Marmara, and 4.7% Eastern Anatolia Region. It was seen that 55% of all participants were first graders, 10.2% were second graders, 17% were third graders and 17.8% were fourth graders. The students felt sufficient in caregiving at 3.06±0.9 (min:1, max:5). While 91.9% of all participants stated that they liked their profession, they expressed their concern with 3.31±1.1 (min:1, max:5).

Table 1. Distribution of nursing students' average scores obtained from the CBS-24

Characteristic		Assurance	Knowledge-skills	Respect	Commitment	Total
	N (%)	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Gender						
Female	1197 (87.5)	5.59±0.77	5.39±0.92	5.60±0.77	5.51±0.85	5.52±0.78
Male	275 (12.5)	5.78±0.39	5.65±0.48	5.76±0.30	5.66±0.46	5.71±0.57
	2192 (100)	t=4.03 p<0.0001	t=4.51 p<0.0001	t=3.44 p<0.0001	t=2.80 p<0.0001	t=3.95 p<0.0001
Education level						
First	1206 (55.0)	5.74±0.53	5.57±0.68	5.72±0.49	5.66±0.58	5.67±0.52
Second	223 (10.2)	5.58±0.52	5.35±0.66	5.65±0.56	5.58±0.52	5.54±0.50
Third	372 (17.0)	5.52±0.64	5.26±0.67	5.57±0.67	5.41±0.91	5.44±0.68
Fourth	391 (17.8)	5.35±1.23	5.16±1.44	5.35±1.24	5.23±1.25	5.27±1.24
	2192 (100)	F=31.64 p<0.0001	F=28.18 p<0.0001	F=27.05 p<0.0001	F=32.12 p<0.0001	F=33.05 p<0.0001
Perceived caregiving competence						
Good	172 (7.8)	5.31±1.70	5.22±1.67	5.28±1.69	5.28±1.69	5.27±1.68
Acceptable	1905 (86.9)	5.66±0.56	5.49±0.69	5.67±0.55	5.57±0.68	5.60±0.57
Weak	115 (5.2)	5.37±0.73	4.64±0.69	5.26±0.69	5.24±0.74	5.13±0.76
	2192 (100)	F=24.55 p<0.0001	F=58.55 p<0.0001	F=38.11 p<0.0001	F=18.46 p<0.0001	F=35.47 p<0.0001
Perceived anxiety						
Very	436 (19.9)	5.30±0.82	4.91±0.98	5.34±0.80	5.14±0.95	5.17±0.81
Acceptable	1578 (72.0)	5.73±0.45	5.58±0.63	5.74±0.45	5.67±0.54	5.68±0.46
Little	178 (8.1)	5.33±1.67	5.27±1.65	5.26±1.65	5.25±1.65	5.28±1.65
	2192 (100)	F=78.16 p<0.0001	F=111.36 p<0.0001	F=79.51 p<0.0001	F=92.60 p<0.0001	F=101.11 p<0.0001
University						
State University	1226 (55.9)	5.45±0.89	5.25±0.99	5.48±0.89	5.33±0.98	5.38±0.89
Private University	966 (44.1)	5.82±0.40	5.64±0.65	5.79±0.37	5.79±0.42	5.76±0.40
	2192 (100)	t=11.85 p<0.0001	t=10.39 p<0.0001	t=10.87 p<0.0001	t=13.34 p<0.0001	t=12.16 p<0.0001

N: number of students, SD: standard deviation, F: ANOVA, t: Independent samples-test, p: statistical significance

It was determined that the mean scores of the participants' CBS-24 items were quite close to each other. More than 60% of the participants always described the care behaviors of "Listen to the patient carefully", "Treat the patient as an individual", "Keep the patient's information confidential", "Encourage the patient to call when

he/she has a problem" and "Administer the patient's treatments and medications on time" stated. Less than 60% stated that they can always perform care behaviors such as "using tools and equipment skillfully", "Exhibiting professional/professional knowledge and skills", "responding promptly to the patient's call", and "knowing how to administer injections, IV interventions". It was determined that the caring behaviors of male students were higher than females, and those in private schools were higher than those in public universities (Table 1).

Table 2. Distribution of nursing students' average scores obtained from the PSS

Characteristic	N (%)	Stress from lack of professional knowledge and skills Mean±SD	Stress from taking care of patients Mean±SD	Stress from assignments and workload Mean±SD	Stress from teachers and nursing staff Mean±SD	Stress from clinical environment Mean±SD	Stress from peers and daily life Mean±SD	Total Mean±SD
Gender								
Female	1197 (87.5)	7.01±3.29	19.40±8.10	12.46±5.20	14.09±6.42	6.38±3.45	9.40±4.33	68.78±28.76
Male	275 (12.5)	7.08±3.40	19.61±7.85	12.58±4.39	15.05±5.56	7.09±3.51	9.70±3.58	71.13±26.19
	2192 (100)	t=0.32 p=0.74	t=0.37 p=0.22	t=0.36 p=0.003	t=2.34 p=0.01	t=3.16 p=0.002	t=1.11 p<0.0001	t=1.28 p=0.02
Education level								
First	1206 (55.0)	6.37±3.26	16.88±7.89	11.67±5.46	12.71±6.37	5.65±3.50	8.71±4.36	62.02±28.80
Second	223 (10.2)	9.26±1.85	26.13±3.05	15.43±2.71	19.41±2.81	8.51±2.30	13.30±1.87	92.06±11.55
Third	372 (17.0)	6.95±3.16	22.26±5.63	12.89±3.93	15.32±5.19	6.83±2.94	9.60±3.40	73.88±21.18
Fourth	391 (17.8)	7.82±3.50	20.82±9.08	12.88±5.29	14.82±6.73	7.47±3.60	9.35±4.39	73.17±31.45
	2192 (100)	F=61.63 p<0.0001	F=130.20 p<0.0001	F=38.41 p<0.0001	F=86.77 p<0.0001	F=64.97 p<0.0001	F=81.97 p<0.0001	F=89.01 p<0.0001
Perceived caregiving competence								
Good	172 (7.8)	5.40±4.98	15.66±11.06	9.86±6.77	10.73±9.46	5.53±4.98	6.16±5.69	53.37±42.24
Acceptable	1905 (86.9)	6.98±3.07	19.32±7.64	12.43±4.86	14.20±5.89	6.38±3.30	9.56±3.98	68.88±26.41
Weak	115 (5.2)	10.20±1.17	27.00±3.64	17.20±2.04	19.60±2.88	9.40±1.50	12.40±2.88	95.80±11.92
	2192 (100)	F=78.99 p<0.0001	F=74.07 p<0.0001	F=76.66 p<0.0001	F=72.06 p<0.0001	F=49.89 p<0.0001	F=85.74 p<0.0001	F=82.65 p<0.0001
Perceived anxiety								
Very	436 (19.9)	8.38±2.95	24.04±5.36	13.78±3.46	17.14±4.28	7.88±2.24	11.65±3.04	82.91±18.32
Acceptable	1578 (72.0)	6.78±3.07	18.62±7.48	12.47±5.04	13.63±6.00	6.11±3.38	9.06±4.14	66.70±26.95
Little	178 (8.1)	5.81±4.85	15.40±12.68	9.33±7.25	12.14±10.03	6.20±5.39	7.36±5.50	56.26±45.17
	2192 (100)	F=55.19 p<0.0001	F=111.64 p<0.0001	F=50.30 p<0.0001	F=66.64 p<0.0001	F=46.80 p<0.0001	F=93.87 p<0.0001	F=80.45 p<0.0001
University								
State University	1226 (55.9)	6.99±3.28	20.10±8.39	12.21±4.99	14.40±6.42	6.50±3.51	9.17±4.37	69.41±29.22
Private University	966 (44.1)	7.07±3.34	18.59±7.56	12.80±5.23	13.97±6.19	6.42±3.42	9.78±4.07	68.66±27.46
	2192 (100)	t=0.55 p=0.57	t=4.37 p<0.0001	t=2.68 p=0.007	t=1.57 p=0.11	t=0.52 p=0.60	t=3.33 p=0.001	t=0.60 p=0.54

N: number of students, SD: standard deviation, F: ANOVA, t: Independent samples-test, p: statistical significance

Table 2 shows the perceived stress scale total scores of the nursing students and their sub-dimension mean scores. It was determined that perceived stress caused a significant change according to gender, education level, perceived care sufficiency, perceived stress, and the type of university he/she attended.

A significant correlation was found between the nursing students' age, class, perceived stress score, and caring behavior scores. It was observed that this significance was positively correlated with perceived stress and negatively correlated with caring behaviors, both for age and class. It was determined that as the perceived stress increased, caring behaviors decreased (Table 3).

Table 3**.** Age, class, CBS-24, and PSS correlations of nursing students

Features	Age	Education level	CBS-24
Education level	R=0.769 p<0.0001		
CBS-24	R=-0.203 p<0.0001	R=-0.208 p<0.0001	
PSS	R=0.103 p<0.0001	R=0.181 p<0.0001	R=-0.238 p<0.0001

The reflectios of the distance education that nursing students received during the pandemic period on their stress and care behaviors were examined comparatively. It is seen that there is a parallelism between the stress perceived by nursing students and their scale scores during the pandemic process and that there is an inverse relationship between stress and care behaviors. It was thought that the research had a homogeneous distribution in that it included samples from every region of Turkey, from every class, and both public and private schools.

According to the CBS-24 scale mean scores, significant differences were determined according to gender, education level, perceived care behavior, perceived anxiety, and university ($p<0.05$). It was observed that more than four-fifths of the participants adopted the care behaviors of "Listen to the patient carefully", "Treat the patient as an individual", "Keep the patient's information confidential", "Encourage the patient to call when he has a problem" and "Administer the patient's treatments and medications on time". Less than three-fifths said that they did not feel good enough in care behaviors such as "using equipment skillfully", "Exhibiting professional/professional knowledge and skills", "Responding immediately to the patient's call", and "knowing how to administer injections, IV interventions". In a study conducted with nurses with a similar measurement tool, it was seen that nurses scored high in their care behaviors in items requiring skill (Uzelli Yılmaz et al., 2017). It was thought that the high scores of the students mostly in the care behavior items on communication might be due to the clinical practice deficiencies arising from online education.

It was determined that male students were higher in all CBS-24 sub-dimension mean scores. In a study using a similar measurement tool, it was seen that women had high scores in all sub-dimensions (Uzelli Yılmaz et al., 2017), in another study, it is noted that women are significantly higher (Türk et al., 2018). It was thought that this difference in the study may be due to the fact that women are more concerned about their professional competencies than men.

When the distribution of CBS-24 scores of the students according to the classes was evaluated, it was determined that the average scores of caring behaviors decreased as the class increased, but there was a negative significant correlation between them. In studies conducted with a similar measurement tool, it is seen that scale scores increase as the class increases, and this situation is associated with theoretical knowledge (Gül & Arslan, 2021; Labrague et al., 2017). It was evaluated that this adverse result in the research could be caused by stress caused by the pandemic and that the students could see their problems related to their self-efficacy more clearly as they approached graduation. In addition, it was thought that the first and second-year students thought that they had time to complete their self-efficacy and that other students were at the graduation stage.

Significant differences were found in terms of gender, education level, perceived care behavior, and perceived anxiety according to PPS scale score averages ($p<0.05$). It was seen that men had a higher stress level than women, and this level was mostly related to peers and daily life sub-dimensions. In a study conducted with a similar measurement tool, it was stated that women experienced higher levels of stress than male students in terms of all sub-dimensions and total average scores, except for the stress sub-dimension caused by a lack of professional knowledge and skills (Karaca et al., 2017). In another study, although there is no significant difference between them, it is noted that women experience more stress (Suarez-Garcia et al., 2018). In our study, it was thought that the fact that men experienced significantly more stress than women might be related to their self-efficacy. It can be considered normal for all students who have not yet completed their professional qualifications to have high professional concerns.

It is seen that as the education level of the students increases, their stress decreases. Similarly, in another study, it is observed that the stress level decreases according to the grade level (Suarez-Garcia et al., 2018). In a systematic study, it was pointed out that the professional experience of students is an important source of stress (Turner & McCarthy, 2017). It is thought that the stress levels of second-year students are significantly higher than the others, which may be associated with the pandemic. It can explain that the first-year students have not yet been aware of the university and professional equipment, but the second-year students experience higher stress than the others because they have received vocational training online for the last 1.5 years. In addition, it is thought that the group who received online education during the pandemic experienced the anxiety of not being able to perform clinical practice until graduation, which can be explained by the high-stress levels caused by the patients.

The perceived care behaviors of students with high-stress levels are also high, suggesting that stressed students attempt to provide better care services. In another study, it was determined that as students' perceived stress levels increase, their avoidance needs to increase (Karaca et al., 2017). In a study conducted with first-year students during the pandemic period, it is pointed out that management strategies where students' stress levels are high should be improved (Bhurtun et al., 2021). When the results of the research are evaluated, it is seen that the stress levels of nursing students are high and they are insufficient to cope with the advantageous and disadvantageous situations of stress in providing care services.

As age and education level increase, it is seen that the stress level creates a positive and a negative change in care behavior. It is determined that as the stress level increases, the level of developing care behaviors

decreases, and this relationship is significant. In one study, it was pointed out that there was a significant negative relationship between stress and care behaviors among nursing students (Li et al., 2020). This shows that high-stress level negatively affects caring behavior. It suggests that in cases where it is aimed to increase caring behaviors, attempts should be made to evaluate and reduce stress.

With this research, it is possible for nursing educators to evaluate the relationship between care and stress and to evaluate the online education given during the pandemic. It is seen that there are serious differences between the stress levels of the group who received active education before and the students who have never experienced active learning. It is seen that the education provided by the nursing programs, which are trained based on clinical practice, on online platforms is not sufficient to develop care behavior. In addition, it should not be forgotten that this situation is perceived as a stressor by students and is reflected in their care. Students state that they are negatively affected by the care behaviors they will offer to both their peers and patients, and they have problems in care due to stress. It is thought that the nursing education planned during the pandemic should be reviewed with these results and the stressors of the students should be considered in the curriculum plan.

Conclusion

The competency of the nursing profession is a compulsory education to be carried out practically. This situation requires careful management of the application areas from the training content. It should be foreseen that different application methods are needed in cases such as pandemics where the online education process is mandatory. Conducting nursing education remotely both causes stress and results in inadequacy in care behaviors. In this case, it is important to prepare student-centered technological environments and to maintain the application areas as soon as possible.

Limitation

This study contains some limitations. The survey included a small number of male participants relative to the number of women, but it should be noted that this widely reflected the gender distribution among all nursing schools across the country. However, the small number of male participants limited gender comparisons in this study. Another limitation is that research data is based on student self-reported data; however, a similar approach was often adopted in previous studies.

Recommendations

Patient data was required to access the findings of this study. To effectively provide online nursing education, a robust digital infrastructure, and interactive content should be utilized. Students ought to benefit from diverse digital tools to enhance their theoretical knowledge and practical skills. Regular evaluations of students' education should be conducted, accompanied by the development of improvement strategies. No input from patients or the public was necessary for the design, analysis, or interpretation of the study, or the preparation of the article. Nonetheless, the research data holds significance for the public.

Scientific Ethics Declaration

*Before the implementation of the study, the ethics committee approval and written permission from the hospital were obtained from Gumushane University on (No. 2021/11). In collecting the data, the researcher informed the nursing students about the purpose, method, and scope of the scientific research, and their consent was obtained.

* The author declares that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the author.

Acknowledgements or Notes

The author would like to thank all the participants in this study.

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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
https://doi.org/10.55549/jeseh.1381251

The Effect of Educational Robotics Applications on Students' Academic Achievement and Problem-Solving Skills in Science Education

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Article Info

Article History

Published:
01 October 2023

Received:
02 January 2023

Accepted:
01 August 2023

Keywords

Science education,
Robotics,
Problem-solving skills,
5E learning model,
O-bot

Abstract

The study explored the effects of robotic-assisted applications on the variables of academic achievement and problem-solving skills in the "Propagation of Light" unit of the 5th grade science course. The study employed the pretest-posttest control group design, one of the quasi-experimental methods. The study sample consist of 36 5th grade students attending a public school in Turkey located in a district center in the Western Black Sea region. The study was carried out in a six-week period in the 2019-2020 academic year, and 19 of the students were selected as the control and 16 as the experimental group. Robotic supported activities were applied to the students in the experimental group, and the activities prescribed by the Science Curriculum were applied to the students in the control group. Open-ended and closed-ended "Academic Achievement Test" and "Problem-Solving Skills Test" were used as pretest and posttest in both groups. The data were analyzed using the independent samples t-test. The study results revealed that the academic achievement and problem-solving skills of the students in the experimental group, in which robotic-assisted activities were used, were significantly higher in both tests compared to the students in the control group.

Introduction

The term robotics was first introduced in the 1940s by the famous science-fiction writer Isaac Asimov as a branch of science dedicated to the study of robots (Usmonova, 2021). The branch of science that combines physical activity with the decision-making process and examines machines that can replace humans while performing a task is defined as robotics (Siciliano et al., 2010). However, since the late 1980s, robotics has been used in education both as a teaching subject and as an auxiliary tool in teaching various subjects such as mathematics, science, engineering, technology, and computer (Karatrantou & Panagiotakopoulos, 2011).

Educational Robotics

Robotics is regarded as a technology with the potential to affect education by various researchers (Alimisis & Kynigos, 2009; Catlin & Blamires, 2010; Papert, 1980). An increasing number of articles, web pages, and various materials use the term Educational Robotics (ER) to refer to the use of robots in education. According to Anwar et al. (2019), 147 studies on K-12 educational robotics were published between 2000 and 2018. Despite this increase, there is no clear definition of what educational robotics is. According to Eguchi (2012), educational robotics is a unique learning tool that attracts and motivates students by creating a hands-on and at the same time fun learning environment. Stergiopoulou et al. (2016) defined educational robotics as a process in which students assemble and program their robotic systems to perform certain behaviors for educational purposes. Also, according to Angel-Fernandez and Vincze (2018), educational robotics is a field of study that aims to improve people's learning experience through the development and implementation of activities, technologies, and artifacts in which robots play an active role. From the definitions, educational robotics is a learning tool that is fun and attracts students' attention and has a high potential to be used in the teaching process. In addition to teaching certain concepts, it is used to attain skills such as robotics, problem-solving, reasoning, critical thinking, and effective cooperation (Alimisis, 2009).

For a robotic system to be functional, two types of activities must be performed namely development and programming. As a result of these activities, skills such as cognitive process skills and numerical thinking emerge, and these skills contribute to students' solving problems they encounter in real life as well as in the

school environment (Karatrantou & Panagiotakopoulos, 2011). In addition, the development process and programming of the robotic system contribute to the socialization of the students with them cooperating for the implementation of the activities (Alimisis 2009). Considering this potential of robotics, it is of great importance to include robotics in learning environments.

ER activities are very diverse in terms of both robotic tools and methods of application to students. Certain ER activities are carried out in the form of extracurricular activities or club activities that are not integrated into the lessons. These extracurricular activities are generally accepted as students' first introduction to robotics, but they are not used to meet course objectives or assess performances (Baltes & Anderson, 2005). Despite these characteristics, extracurricular ER activities offer children the opportunity to think algorithmically and even learn mathematics informally. In extracurricular ER activities, participants can learn from their successes and failures without any academic pressure. Not having clear learning objectives, or not being in clear alignment with the curriculum objectives does not prevent students from learning and developing invaluable knowledge and skills that can later be transferred to a formal educational setting. For this reason, all kinds of extracurricular activities that offer children the opportunity to discover robots are valuable for their education (Komis et al. 2017).

Theoretical Background

However, some researchers are of the opinion that ER alone cannot affect students' learning. Thus, they stated that an appropriate educational philosophy, learning environment, and teaching methodology are needed for the successful inclusion of ER in the education process (Alimisis, 2013). Although ER activities are integrated into formal education environments (usually with STEM activities) for this purpose, their level of compliance with the curriculum is variable. While designing ER activities in order to ensure subject teaching, the skills and learning objectives targeted by the curriculum should be met without departing from the main purpose of the course.

A suitable theory that could be integrated into learning environments, including the development, programming, and control of robots, was proposed by Papert (1980). This theory is the theory of constructionism, which is based on Piaget's constructivist approach. According to Ackermann (2001), while Piaget's constructivism theory explains how children's ways of doing and thinking develop over time and under what conditions children are more likely to abandon or retain the views they already hold, Papert's constructivism is more focused on the art of learning. or "learning to learn" and the importance of doing something in learning. Papert was interested in how students (themselves or others) come into contact with their work and how this communication enhances self-learning and ultimately facilitates the construction of new knowledge (Ackermann, 2001).

Various learning cycle models have been developed to use the constructivist approach in learning environments, regardless of whether they include ER activities. The constructivist learning approach aims to create rich learning experiences and to establish a student-centered democratic learning environment where students can interact with their peers (Bodner, 1986; Gürol, 2002; Sprague & Dede, 1999). Based on the relevant literature, the 5E learning model can be described as one of the most useful models of constructivist learning theory in the teaching process (Çoruhlu, 2013). The 5E model, developed by Bybee et al. (2006), is named after the English initials of the model (Engage, Explore, Explain, Elaborate, and Evaluate). In these stages, all the steps of a learning-teaching process that is based on research and inquiry are covered, and the roles of teacher and student are expressed in a rich way structurally and pedagogically throughout the process.

Problem Solving Skills

One of the main goals of the Science Curriculum used in Turkey is to provide basic knowledge specific to the field. Also, among the general objectives of our education system is the development of students' problem-solving skills (Ministry of National Education [MoNE], 2018). Problem-solving can be defined in general terms as the process of eliminating the gap between the current situation and the desired situation, hindered by known or unknown factors (Huitt, 1992). The use and development of this concept in education were introduced by John Dewey. According to Dewey, the role of the teacher is to guide the students in solving the problem according to the interests and needs of the students and to help them attain problem-solving skills (Silik, 2016). Problem-solving skills are skills such as critical thinking, decision making, and creative and reflective thinking, which enable individuals to adapt to life and make them stronger in the face of life (Demirel, 2012).

Literature Review

The adaptation studies of robotics, which started to be used as a learning tool with Papert (1980), are still continuing today. According to Talan (2020), there has been a steady increase in studies on educational robotics in the last ten years, and about three-quarters of these studies have been conducted in the field of information technologies and science. In addition, it was reported by Talan (2020) that the effects of ER on academic achievement as well as high-level thinking skills such as problem-solving, creativity, computational-thinking, and scientific-process skills were examined. The examination of the studies on the effect of robotics in subject teaching showed that robotics in subject teaching has a positive effect in general. For instance, Silva (2008), who developed robotic-assisted activities in the teaching of light and sound, revealed that students who used these activities improved their abilities in the physics course more than those who did not. Again in the field of physics, in another study on electricity, temperature, and magnetism, Badeleh (2019) obtained positive results. Song and Lee (2011) used STEM activities involving robots in math and science. At the end of 12 workshops, the academic achievement of the students in the experimental group, in which robots were used, was statistically significantly higher than the academic achievement of the students in the control group. In addition to the examples where positive results were obtained, there are also studies in which academic achievement did not increase, as in the studies of Lindh and Holgersson (2007). In the study conducted by Koray and Çakır (2020) at the 4th grade level with WeDo 2.0 robotic sets, although success and scientific process skills increased more in the experimental group, no statistically significant differences were observed.

Since the 5E learning model is a model that educators are familiar with, it has become a model used in the process of adapting robotic-assisted activities to the field of science education. Guven et al. (2022) used the 5E model in the implementation of Arduino-supported STEM activities and got positive results. Cakir and Guven (2019) developed an Arduino-supported robotics and coding activity based on the 5E learning model to teach the concept of pulse in the 6th grade science curriculum. In another study, Koray and Duman (2022) similarly developed an activity related to the concept of dynamometer in the 5th grade science lesson. Ghosh et al. (2019) reported that with the participation of 26 states in the United States, in-service trainings were given to teachers within the scope of the Next Generation Science Standards (NGSS) about STEM they were trying to develop. In these trainings, teachers adapted LEGO robotics activities to NGSS using the 5E learning model.

Considering the importance of problem-solving skills in human life, the question of whether robotic applications can be effective in the attainment of these skills has attracted the attention of educators. The examination of the studies exploring the effect of ER applications on problem-solving skills put forth that positive results are obtained in various age groups. Atmatzidou et al. (2008) observed that the problem-solving skills of middle and high school students who participated in a course aiming to increase their programming skills by using robots with a didactic approach improved. Another study conducted with 5th and 6th grade students determined that the problem-solving skills of the participants who learned to code using robots improved more than those who did not (Özer, 2019). In another study conducted with elementary school students, it was concluded that robotic applications improved students' problem-solving skills (Tatlısu, 2020). Furthermore, in his study with university students taking the Computer Programming course, Korkmaz (2016) reported that Lego Mindstorms Ev3 robot sets contributed to the development of problem-solving skills more than Scratch.

Aim of the Study

Although there is no NGSS-like study in Turkey, according to the Science Curriculum (MoNE, 2018) updated in 2018, students are expected to make applications during the year as part of the Science, Engineering, and Entrepreneurship Applications at every grade level from 4th to 8th grade. Apart from the Ministry of National Education, the preparation of development roadmaps on topics such as artificial intelligence, sensor technologies, and robotics was emphasized as part of the infrastructure works for the implementation of the National Technological Advance addressed under the title of Critical Technologies of the Eleventh Development Plan (2019) of the Presidency of Strategy and Budget of the Republic of Turkey. It is apparent that the inclusion of robotics in the education process will contribute to achieving these goals. In light of the information in the literature, it is of great importance that ER be adapted to the curriculum in order to benefit from it at the desired level. While doing this, not placing an unnecessary workload on teachers and students will make it easier to achieve the desired result. For this reason, the 5E teaching model, a teaching model that teachers are familiar with, was preferred. Robotic activities were used at different stages of the model. The experimental application was planned for the learning objectives of the 5th grade science unit of "Propagation of Light". The purpose of the study was to reveal whether robotic-assisted applications had an effect on students' academic achievement and problem-solving skills. It is known that students have difficulties in solving open-

ended questions (Öksüz & Demir 2019). Contrary to the common applications in the literature, multiple-choice and open-ended achievement tests were used together in the study, and the effect of the robotic-assisted activities used was desired to be measured in more detail. In the study, based on the subject-based curriculum approach, research-inquiry-based activities were designed in accordance with the learning outcomes. Since a robotic lesson design appropriate to the science learning objectives was used and it is an experimental study, it is believed that the study will contribute to the field literature. In addition to field-specific information, testing students' problem-solving skills is another aspect that adds value to the study. The originality of the study is that the activities were carried out with an easily programmable robot set, which has not been tested before and is suitable for children who do not have robotic experience.

Study Questions

1) Is there a significant difference between the experimental group, in which robotic applications were used, and the control group, in which the teaching was carried out in accordance with the curriculum, in terms of the multiple-choice academic achievement variable?
2) Is there a significant difference between the experimental group, in which robotic applications were used, and the control group, in which the teaching was carried out in accordance with the curriculum, in terms of the open-ended academic achievement variable?
3) Is there a significant difference between the experimental group, in which robotic applications are made, and the control group, in which the instruction is carried out in accordance with the curriculum, in terms of the problem-solving skills variable?

Method

The experimental research method, one of the quantitative research methods, was employed. The pretest-posttest control group design, a quasi-experimental research method, was utilized. Experimental studies aim to test the effect of the independent variables on the dependent variable. The main purpose of these studies is to reveal the cause-and-effect relationship between the variables. For this purpose, after random assignment to the treatment groups, the independent variable is manipulated and the variables that may affect the dependent variable are controlled (Büyüköztürk et al., 2018; Fraenkel et al., 2012). In the study, the independent variable whose effect on the dependent variables of “academic achievement” and “problem-solving skills” was examined is the “robotic applications”.

Table 1. Standard notation of the study design

Group	Measurement I	Process	Measurement II
E	AAT1	X1	AAT2
	PSST1		PSST2
C	AAT1	X2	AAT2
	PSST1		PSST2

E: The experimental group in which robotic applications were used.
C: The control group in which activities based on the science curriculum were used.
X1: Robotic-assisted activity applications.
X2: Applications offered by the curriculum.
AAT: Multiple-choice and open-ended Academic Achievement Test for the unit of Propagation of Light.
PSST: Problem-Solving Skills Test.

Study Group

The study was carried out with 5th grade students who were attending a public school in Turkey located in a district center in the Western Black Sea region in the 2019-2020 academic year. Two classrooms were included in the study. Taking into account the classroom sizes and students’ grade point averages, one of these classrooms was assigned as the experimental group and the other as the control group. While the experimental group was made up of a total of 17 students, eight females, and nine males, the control group was made up of a total of 19 students, nine females, and 10 males. The robotics-based activities were used with the experimental group students, whereas activities offered by the curriculum were used in the control group. The application times of both groups were equal and it was accepted that the groups were not affected by each other.

Research Process

Before the procedure, the Academic Achievement Test (AAT) and the Problem-Solving Skills Test (PSST) were administered to the students in the experimental and control groups as a pretest. After the experimental and control groups were randomly determined, the students in the experimental group were given basic robotics training for two weeks on the use of the O-Bot education set as part of the "Program Solving and Programming" unit of the "Information Technologies and Software" course. As part of the basic robotics training, the parts of the robot set were introduced in the first week, and information on how to use it was provided. In the second week, how to program the designed robots was explained through sample applications. During these two weeks, the activities offered by the curriculum were used with the control group students in the "Information Technologies and Software" course.

In the present study, the unit "Propagation of Light" was selected. The reason for selecting this unit was that the unit's learning objectives were believed to be compatible with the robotic activities to be done. Before starting the applications for the learning objectives, teacher instructions and student worksheets were developed for both groups. Each activity for the experimental group, in which teacher instructions and student worksheets developed based on the 5E learning model were used, was related to the learning objectives of the "Propagation of Light" unit of the 5th grade science course and required the use of O-Bot robotic sets. Robotic activities were included in the phases of explore, explain and elaborate. The same activities for the control group were adapted based also on the 5E learning model, without requiring the use of robots.

The applications designed for the unit learning objectives continued for four weeks (a total of 16 periods, four periods a week, as stipulated by the curriculum. The application was carried out by the researcher, and the course teacher participated as an observer. While the experimental group students achieved the unit learning objectives with robotic-assisted applications, the lessons were taught in the control groups by using the student-centered activities and teaching methods and techniques offered by the curriculum. In the week following the completion of the activities, the AAT and the PSST were administered to both the experimental and control group students as a posttest. The study continued for a total of six weeks, with the administration of the pretest and posttests (excluding the basic robotics training).

Data Collection Tools

In the research, the Multiple-Choice AAT, the Open-Ended AAT, and the PSST were used.

Academic Achievement Tests

Developed as open-ended and multiple-choice, the academic achievement tests cover the subjects in the "Propagation of Light" unit in the 5th grade science curriculum. In both tests, attention was paid to the equal distribution of questions related to each learning objective of the subjects, and the content validity of the tests was ensured by consulting the opinions of four field experts. The first multiple-choice academic achievement test, consisting of 32 questions, was reduced to 29 questions in line with the expert opinions, and 27 after the reliability study. Reliability studies were conducted with the Iteman software program after administering the multiple-choice achievement test to a total of 51 students, and the KR-20 value was determined as 0.739. The first open-ended academic achievement test, consisting of 17 questions, was reduced to 16 questions in line with the expert opinions. The reliability study of the open-ended achievement test was conducted with two field expert raters. The correlation coefficient between the means of the scores given to the items by the raters was found to be 0.87. In achievement tests, each question is scored equally, and the highest possible score is 100. The tests were administered to the experimental and control groups for 40 minutes as a pretest and posttest.

Problem-Solving Skills Test

Students' problem-solving skills were measured using the Daily Life-Based Problem-Solving Skills Test (DLPSST) developed by Pekbay (2017). Developed to assess the "Decision-Making", "System Analysis and Design" and "Problem-Solving" processes, the test is made up of 18 questions. Having 10 difficult, seven medium, and one easy open-ended question, the test difficulty mean was found to be 0.34. The highest score that can be gotten from the test, which is rated as 0-1-2-3, is 54 and the lowest score is 0. The Cronbach's alfa reliability coefficient of the test was 0.86.

Data Analysis

A statistical software program SPSS 20 was used in the analysis of the data. Appropriate statistical methods were tried to be determined by investigating the suitability of the data to the normal distribution and the homogeneity of the variances. Since the number of participants in each group was less than 50, Shapiro-Wilk test was used for the assumption of normality (Mishra et al., 2019). Levene test was used to determine the homogeneity of the variances of the data. As a result of the analysis, it was decided to use parametric tests because the data set had a normal distribution ($p>.05$) and the group variances were homogeneous. In this context, in order to test whether there was a significant difference between the variables, the collected data were analyzed using the t-test for independent groups. For interpretation, the significance level for the hypothesis tests was set to .05.

Threats to the Internal Validity of the Study

Interpretation of the results in this study depends on the effects of threats on the internal validity of the study. First, selection bias was examined by taking into account the grade averages and pretest results of the previous semester's science course. No difference between the groups was found in terms of these variables. Also, none of the participants participated in an activity related to robotics. The maturation effect was very limited and the groups showed differences in the posttests regarding the dependent variables. If there is a maturation effect, both groups will be the same or similar to each other in the posttests after the application. In addition, since there was no significant event related to the dependent variables of the study and the application process before the application, any past effects did not affect the study.

Measuring tool effect, as a different threat, was checked in both applications using the same items, the order of application of the tools, and the same data collector. Another issue related to the measurement tool administration is that six weeks is accepted sufficient to prevent the pretest effect. Due to official restrictions, the tools were not administered to another group only as a posttest to check for test effect. Furthermore, experimenter bias was prevented by an independent observer observing the applications in both groups.

iDea Visual Programming Flowchart and O-Bot Robot Kit

Coding refers to all commands or a part of a series of commands written on the computer, electronic circuits, or mechanical systems in order to perform an operation or achieve a specific purpose (Guven et al., 2022). Programming language, on the other hand, is a set of commands consisting of special words and symbols used so that the electronic devices and hardware used can serve the determined purposes (Arslan & Tanel, 2017). The task of writing a program, which seems to be complex, becomes much easier thanks to visual programming. Integrated Development environment for applications (iDea) is a visual programming software that has a Turkish user interface providing the development tools we need to turn an idea into an application, and enabling the preparation of algorithms in Turkish (Robotsan, 2021).

Developed by Turkish engineers, O-bot is a wheeled robot kit consisting of iDea control card and robot components that can be mounted on two carrier platforms, and are easy to install. Created based on the do-it-yourself philosophy, it is reprogrammable. Various sensors (such as light, temperature, distance, sound, and motion) and producers (such as sound, and light) that can work in harmony with the control card are offered with the robot set. The O-bot can be programmed with iDea visual programming software, whose language is Turkish.

The products of the Lego company and Arduino-based products are widely used in robotic activities. There are several reasons why O-bot is preferred in this study. First, this platform is relatively new compared to the others and has not been used before in activities aimed at the learning objectives of the science course. Second, this platform can be programmed in two different ways. The first is by using flowcharts that are appropriate for children mainly attending elementary and middle schools with no programming experience. The second is by using rsBasic programming commands based on the BASIC programming language, appropriate for those with more advanced programming knowledge (Figure 1). The third reason why we preferred this platform was that its cost was lower than the others.

The biggest drawback of this robot kit is its exterior. As mentioned above, when the robot components are mounted on carrier platforms, as in Lego Mindstorms, it does not give the robot a human-like appearance

(Figure 2). However, this disadvantage can be turned into an advantage by using the creativity of teachers and students. Robots can be transformed into the desired shape with the help of various game blocks and different stationery materials that can be mounted on the carrier platforms.

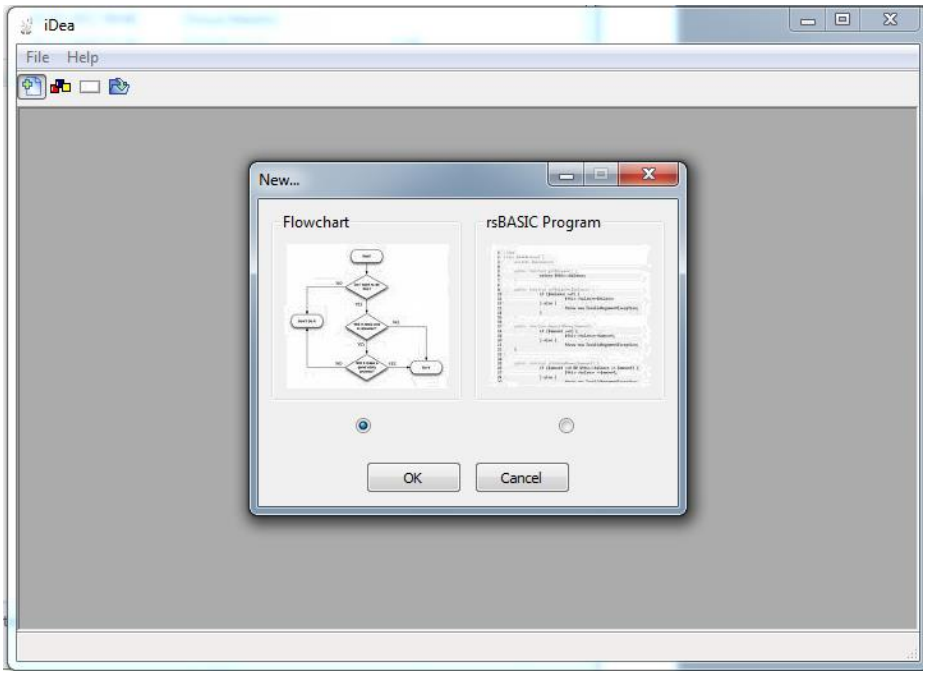

Figure 1. Flowcharts and rsBASIC options in the iDea program development environment

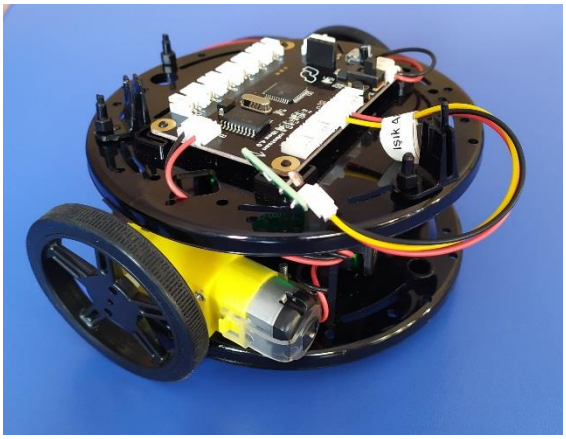

Figure 2. Installed O-bot kit.

Preliminary Analysis of the Experimental and Control Groups

In the study, the experimental and control groups, which were determined as the study group, were compared in terms of various variables. As seen in Table 2, the total number of students in the experimental group was 17 (eight females and nine males), and the number of students in the control group was 19 (nine females, and 10 males). Both groups had 47% females and 53% males. According to the data results, the distribution of students in the groups was equal in terms of number and sex.

Table 2. Descriptive information on the number of students in the experimental and control groups

Groups	Total		Female		Male	
	N	%	N	%	N	%
Experimental	17	47	8	47	9	53
Control	19	53	9	47	10	53

Independent samples t-test analysis was conducted to compare whether the students were equivalent in terms of their previous semester's science grade averages, multiple-choice AAT test scores, open-ended AAT scores, and

PSST scores. The results of the independent samples t-test analysis of the 5th grade first semester science grade averages of the experimental group and control group are presented in Table 3.

Table 3. 5th grade first semester science grade averages of the experimental group and control group

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	91.39	9.8	34	-1.70	.09
Control	19	84.54	13.68			

p<.05

As seen in Table 3, there was no significant difference between the 5th grade first semester science grade averages of the experimental and control group students. (t(34)=-1.7, p>.05). Accordingly, it can be said that the groups were equivalent in terms of their 5th grade first semester science grade averages before the application. Whether there was a significant difference between the multiple-choice AAT pretest scores of the experimental and control groups was compared using the independent samples t-test analysis and the results are presented in Table 4.

Table 4. Independent samples t-test analysis results of the multiple-choice aat pretest scores of the experimental and control group students

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	44.16	17.68	34	-.26	.80
Control	19	42.88	11.29			

As seen in Table 4, there was no significant difference between the multiple-choice AAT pretest scores of the experimental group and the control group. (t(34)=-.256, p>.05). According to these results, it can be said that the groups were equivalent in terms of their multiple-choice AAT pretest scores before the application. Whether there was a significant difference between the open-ended AAT pretest scores of the experimental and control groups was compared using the independent samples t-test analysis and the results are presented in Table 5.

Table 5. Independent samples t-test analysis results of the open-ended aat pretest scores of the experimental and control group students

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	19.81	7.18	34	-1.60	.12
Control	19	14.93	10.95			

As seen in Table 5, there was no significant difference between the open-ended AAT pretest scores of the experimental and control groups (t(34)=-1.6, p>.05). According to these results, it can be said that the groups were equivalent in terms of their open-ended AAT pretest scores before the application. Whether there was a significant difference between the PSST pretest scores of the experimental and control groups was compared using the independent samples t-test analysis and the results are presented in Table 6.

Table 6. Independent samples t-test analysis results of the psst pretest scores of the experimental and control group students

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	29.06	6.28	34	-.80	.43
Control	19	26.37	13.04			

As seen in Table 6, there was no significant difference between the PSST pretest scores of the experimental and control groups (t(34)=.80, p>.05). According to these results, it can be said that the groups were equivalent in terms of their open-ended AAT pretest scores before the application.

Findings

In this section, the findings of the study sub-problems obtained as a result of the application are presented, and the data are explained in tables. Findings, interpretations, and tables are organized in order of the study sub-problems. The results of the independent samples t-test analysis regarding the first study question are given in Table 7.

Table 7. Independent samples t-test analysis results of the multiple-choice aat scores of the experimental and control group students

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	53.03	19.10	34	-2.15	.04
Control	19	39.25	19.22			

According to Table 7, the multiple-choice AAT mean scores of the experimental group in which robotic applications were used were higher (53.03) than the multiple-choice AAT mean scores of the control group in which activities based on the science curriculum were used (39.25). This difference was statistically significant ($t(34)=-2.15$, $p<.05$). The Cohen d effect size was calculated as medium (0,72). The results of the independent samples t-test analysis regarding the second study question are given in Table 8.

Table 8. Independent samples t-test analysis results of the open-ended aat scores of the experimental and control group students

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	37.17	14	34	-3.61	.00
Control	19	20.58	13.54			

According to Table 8, the open-ended AAT mean scores of the experimental group in which robotic applications were used were higher (37.17) than the open-ended AAT mean scores of the control group in which activities based on the science curriculum (20.58). This difference was statistically significant ($t(34)=3.61$, $p<.05$). The Cohen d effect size was calculated as high (1.73). The t-test analysis results for the independent groups regarding the third study question are given in Table 9.

Table 9. Independent samples t-test analysis results of the psst scores of the experimental and control group students

Group	N	$\bar{X}$	SD	df	t	*p*
Experimental	17	36.29	7.82	29.13	-3.72	.00
Cntrol	19	22.63	13.72			

According to Table 9, the PSST mean scores of the experimental group in which robotic applications were used were higher (36.29) than the PSST mean scores of the control group in which activities based on the science curriculum were used (22.63). This difference was statistically significant ($t(34)=3.61$, $p<.05$). The Cohen d effect size was calculated as high (1.22).

Discussion

According to the general result of the present study, robotic applications used in science had positive effects on academic achievement and problem-solving skills. Based on the study findings, the results for the study questions are as follows:

1. There was a significant difference between the multiple-choice AAT scores of the experimental group in which robotic applications were used and the control group students who are taught in line with the science curriculum in favor of the experimental group.
2. There was a significant difference between the open-ended AAT scores of the experimental group in which robotic applications were used and the control group students who are taught in line with the science curriculum in favor of the experimental group.

Although the factors affecting students' academic achievement in Turkey are very varied, according to a meta-analysis study conducted by Sarıer (2016), these factors can be grouped under three categories, namely school, student, and family. In terms of effect size, it is possible to rank these groups as student, family, and school from largest to smallest. It was determined that self-efficacy and motivation factors had the greatest effect among student-based factors. Among the school-based factors, the biggest effect was determined as the attitude towards the course. According to Cohen et al. (2007), values in the range of 0.30-0.50 are interpreted as medium. The studies in which robot sets were used in classroom activities revealed that such activities increase the attitude and motivation towards the science course (Mitnik et al., 2008; Nugent et al., 2009; Uşengül, 2019). Considering these known effects of robotics, although such a determination was not made in the present study,

the increase in achievement can be associated with a possible increase in attitude and motivation towards the course.

The literature results of the studies on robotic applications put forth that robotic applications increase academic achievement (Kert et al., 2020; Yang et al., 2023). For instance, the study conducted by Özdoğru (2013) with 6th grade students in the science and technology course determined that the academic achievement of the group being taught with Lego Mindstorms NXT 2.0 robot kits increased. Similar results were found by Şimşek (2019). As a result of the work carried out by Şimşek (2019) with O-bot robot sets within the scope of the 6th grade "Matter and Heat" unit, the experimental group in which the robotic coding activities were done was more successful than the control group. Uşengül (2019) also carried out a similar study with Lego WeDo 2.0 robot sets in the 5th grade science course and determined results in favor of the experimental group.

In studies on academic achievement, multiple-choice and open-ended tests were generally administered together and not assessed separately. In our study, as mentioned in the Findings section, these tests were assessed separately. According to Tables 4, 5, 7, and 8, multiple-choice test means in both pretests and posttests were higher than open-ended test means. The literature also showed that students are generally more successful in multiple-choice questions than in open-ended questions (Öksüz & Demir 2019). In the present study, the examination of the difference between the pretest and posttest means of the experimental group for both achievement tests revealed a 17,36 points increase in the open-ended achievement test, whereas this increase was 8,87 points in the multiple-choice test. Although multiple-choice tests have many advantages, it is known that they are not as successful as open-ended tests in measuring high-level cognitive skills (Bahar et al., 2012; Üstüner & Şengül, 2004). Considering the magnitude of the increase in the open-ended test scores, it can be concluded that the high-level cognitive skills of the students were also positively affected as a result of the application.

Another conclusion that can be drawn from the study is that the 5E teaching model is very effective for teachers to implement robotic activities in the classroom environment. The 5E model allows the use of robotic activities at different stages of the course. Guven et al. (2022) developed Arduino-supported robotic activities related to energy, sound, electricity and circulatory systems and applied them to students using the 5E model. As a result of the research, it was determined that the creativity, attitude and motivation levels of the students increased with the robotic coding activities integrated into the 5E learning model applied in science subjects. In addition, it was determined that the students produced many creative ideas about using robotic coding applications in solving various problems encountered in daily life and they were very willing to use such applications in science lessons.

It was determined that there was a significant difference between the PSST scores of the experimental group in which robotic applications were used and PSST scores of the control group students who were taught in accordance with the science curriculum in favor of the experimental group. Considering that DLPSST, which was used as a measurement tool in the study, measures "decision-making", "system analysis and design" and "problem-solving" behaviors (Pekbay, 2017), it can be said that these behaviors also developed after the application. In the literature, studies examining the effect of robotic applications on problem-solving skills come second after studies examining the learning level/achievement variable. Positive results were obtained in most of these studies (Talan, 2020). For instance, Özer (2019) found that coding studies using robots improved problem-solving skills more than those that did not. Similarly, Çalışkan (2020) also revealed that robotic programming had a positive effect on students' problem-solving skills. Although positive results were generally obtained in the studies exploring the effect of robotic activities on problem-solving skills, there are also researchers who could not observe a positive effect, such as Hussain et al. (2006).

Recommendations

As seen in the study results, the use of robotic-assisted activities in science lessons has positive effects. In order for robotic-assisted activities to be more effective, it is recommended that students be given coding education in the information technology courses, and then robotics applications in the science courses should be started. Considering that robotic programming develops daily problem-solving skills, it is recommended that students are given lessons where the lessons are associated with daily life. However, the generalizability of the study results is limited due to the small number of participants. In the future, a quasi-experimental study with more participants should be planned. In addition, the present study can guide researchers in examining the effects of robotic coding applications integrated into the 5E learning model in science teaching on different variables. Furthermore, it is recommended that teachers receive in-service training for such applications and that schools

establish laboratories with sufficient technical equipment for robotic coding applications. In our research, since the students were introduced to robot sets for the first time, the programs they would use were given ready. For students who have longer experience with robotic applications, applications where they can write their own codes should be planned and their effects on various variables should be investigated by researchers. It is recommended to include these studies within the scope of engineering design applications (MoNE, 2018), which is also emphasized in the science curriculum, or STEM applications in general.

Scientific Ethics Declaration

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

Acknowledgements

This study was supported by the Scientific Research Projects Coordinatorship of Zonguldak Bülent Ecevit University with project number 2019-76962555-01. We thank the Scientific Research Projects Coordinatorship for their support.

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JESEH
Journal of Education in Science, Environment and Health
Volume 9, Issue 4, 2023
https://doi.org/10.55549/jeseh.1381263

Examining Adolescents' Technology Addiction Levels Before and After COVID-19 Pandemic

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Article Info

Article History

Published:
01 October 2023

Received:
01 March 2023

Accepted:
15 September 2023

Keywords

Technology addiction
Adolescents
COVID-19 pandemic

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

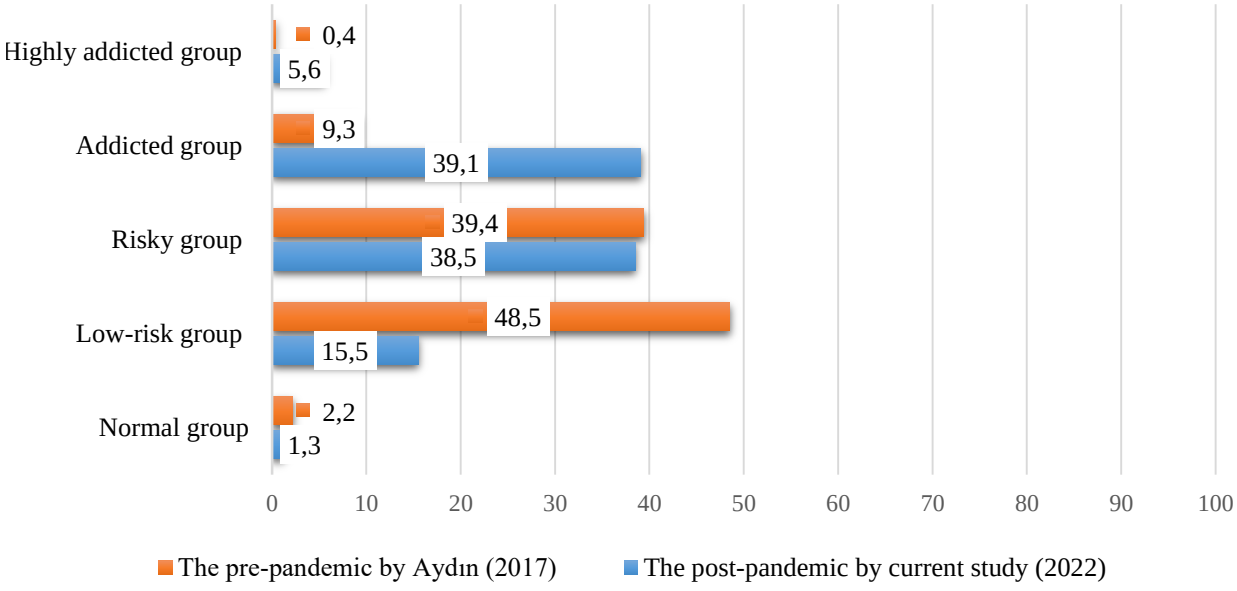

Figure 1. Percentage distribution of adolescents' technology addiction levels before/after the pandemic

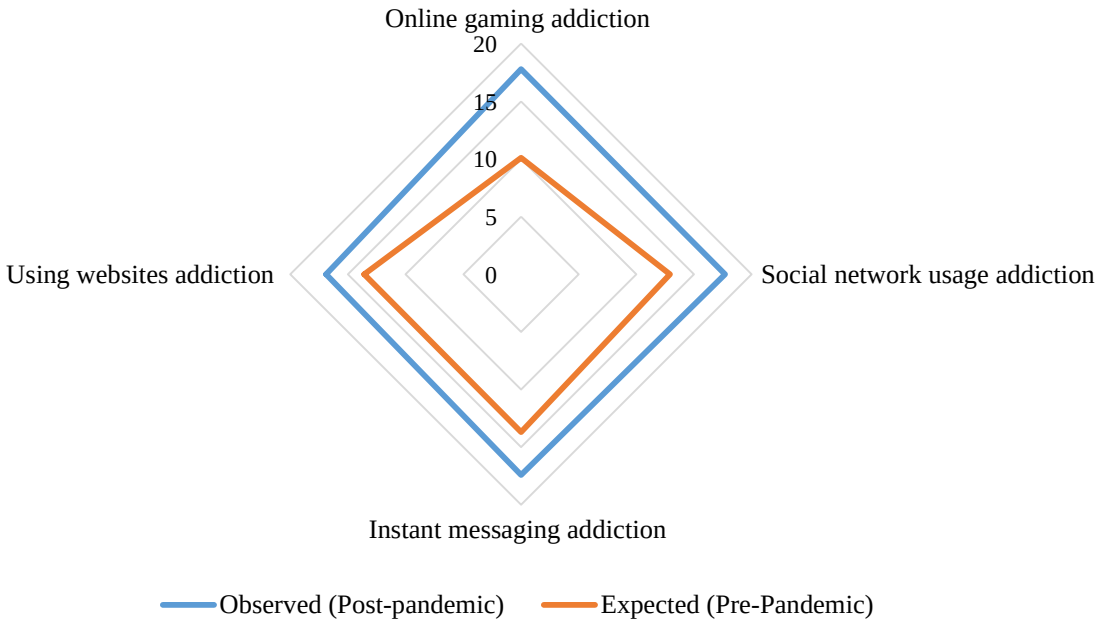

Figure 2. Findings regarding the observed and expected averages regarding technology addiction sub-factors.

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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