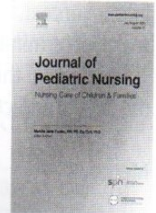




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## Determination of the psychometric properties of the digital addiction scale for children



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### ABSTRACT

**Aim:** To determine the psychometric properties of the Digital Addiction Scale for Children.

**Design and method:** This methodological study included 506 children aged 9–12 years. Data were collected using the child and family information form, the digital addiction scale for children and the digital game addiction scale for children. The data were evaluated using confirmatory factor analysis Cronbach's alpha, convergent validity, and gender-based measurement invariance analysis. Confirmatory factor analysis was applied using Mplus 8.7 with robust maximum likelihood estimation procedures.

**Results:** Confirmatory factor were performed for construct validity. The scale was found to have good model fit indicators. The factor loadings of all the components were found to be  $>0.40$ . Convergent validity of Digital addiction scale for children and digital game addiction scale showed a significant positive high correlation. The total Cronbach alpha value of the scale was determined as 0.94, and the Cronbach alpha values of the subscales as Interpersonal 0.89, and Intrapersonal 0.91.

**Conclusion:** The use of the digital addiction scale for children was determined to be a valid and reliable scale for the screening of digital device use and digital addiction in a Turkish sample.

**Practice implications:** Nurses and other health professionals have an important role in detecting situations that put children's health at risk and promoting positive behaviors. It is especially important that school health nurses use valid and reliable tools that can determine children's digital addictions. Since this scale is easy and practical, it is thought that it will contribute significantly to the literature.

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### Introduction

Digital devices have become an indispensable part of modern life. Children are generally introduced to these devices at a very young age (Samaha & Hawi, 2017). Playing with digital devices is one of the most popular free-time activities for children and adolescents throughout the world (Schulz van Endert, 2021). According to the results of the International Student Evaluation Program (PISA), the mean time spent on the internet outside school hours increased by approximately nine hours a week in the Organisation for Economic Co-operation and Development countries between 2012 and 2018 (Organisation for Economic Co-operation and Development, 2019). In addition to playing games, children use the internet for many purposes such as messaging and entering social networks (Ferrara et al., 2017).

This widespread use of digital devices by children has given rise to a series of problems, the most striking of which is digital addiction. The

psychological and physical damage experienced by children associated with overuse of devices, especially the internet, is a cause of societal concern (Basel et al., 2020). Parents frequently state their dissatisfaction with their children's obsession with mobile phones, and seek solutions to the problem (Gür & Türel, 2022). The overuse of digital devices by children and loss of control of the use has been associated with potential side-effects such as neglect of other daily activities, mood changes, and a deterioration in communication with other family members (Kanat, 2019; Kawabe et al., 2016; Peper & Harvey, 2018). Many studies have also reported that digital addiction in children is also a cause of stress, sleep disorders, and a deterioration in academic performance (Lissak, 2018; Meng et al., 2022; Peper & Harvey, 2018; Przybylski, 2019).

To be able to present recommendations to resolve potentially problematic use of technology, it is important that a valid and reliable scale is used to evaluate the use of digital devices by children. In Turkey, various scales have been developed related to different types of digital addiction, but these scales have generally focussed on adolescents aged  $>12$  years (Kesici & Tunç, 2018; Taş, 2019). There is no scale for the evaluation of the level of digital addiction of younger children.

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In this context, it is important for there to be literature on the subject of scales determining the digital addiction of younger children.

The aim of this study was to determine the validity and reliability of the Digital addiction scale for children aged 9–12 years.

## Methods

### Aim and design

To determine the psychometric properties of the Digital Addiction Scale for Children. The study was methodologically designed.

### Participants

The study comprised children aged 9–12 years in schools in the regional centre of Yozgat in the 2022 academic year. On the basis of voluntary participation, all the students who agreed to participate were included in the study. It has been reported in literature that the sample size for psychometric studies should be 200–500 subjects (Karagöz, 2017). For the current study, 506 children were reached between April and June 2022.

As a result of the analyses performed to determine whether the sample size was sufficient for the determination of validity and reliability, the Kaiser-Meyer-Olkin (KMO) coefficient was determined to be 0.962 and the Bartlett's test showed  $p < 0.001$ . From these results, it was concluded that the sample size was sufficient for the subsequent analyses.

### Data collection

Child and Family Information Form, The Digital Addiction Scale for Children (DASC), Digital Game Addiction Scale for Children (DGASFC) were used to collect the research data (Hawi et al., 2019; Hazar & Hazar, 2017).

### The child and family information form

The form consisting of 12 closed-ended questions was prepared by the researchers in line with the literature (Hawi et al., 2019; Hazar & Hazar, 2017).

### The digital addiction scale for children

The DASC, developed by Hawi et al., is a scale of 25 items to evaluate all the behaviors of children aged 9–12 years using digital devices (watching videos, playing games, using social media and messaging). Diagnostic and Statistical Manual of Mental Disorders-V (DSM-V) criteria. There are 6 addiction criteria (preoccupation, tolerance, withdrawal, mood modification, conflict, and relapse) defined by Griffiths (2005), and 3 additional criteria (problems, deception, and displacement) Responses to the items are given on a Likert-type scale as: 1 (never), 2 (rarely), 3 (sometimes), 4 (often), and 5 (always). The total points range from 25 to 125 with lower points indicating less addiction.

The DASC has 2 subscales of 13 interpersonal factors (items 4, 16, 9, 22, 6, 18, 17, 20, 10, 13, 23, 25, 14) and 12 intrapersonal factors (items 1, 11, 19, 5, 15, 24, 3, 8, 12, 21, 2, 7) (Hawi et al., 2019).

### Digital game addiction scale for children

The Digital Game Addiction Scale for Children was developed and validated by Hazar and Hazar (2017) to assess the digital game addiction behavior of 12-year-old children. It is a 24-item self-report instrument. Factor analysis has shown that the scale has a structure with four sub-factors of excessive focus and conflict on digital gaming, development of tolerance during playtime and the value attached to play, postponement of individual and social tasks/homework and psychological-physiological reflection of deprivation and playing.

All items are rated on a five-point likert scale: (1 = absolutely disagree, 5 = completely agree). Scores range from 24 to 120, with higher scores indicating higher digital game addiction. The Cronbach alpha coefficient is 0.90 for the total scale, and the test-retest correlation coefficient is 0.81 for the total scale. From the reliability analysis results, it can be said that the scale is a reliable measurement tool (Hazar & Hazar, 2017).

### Procedure

#### Language and content validity

The scale was translated into Turkish by two specialists in the field and one language specialist. The Turkish version of the scale was then back-translated into English by a language specialist. The English and Turkish statements of the scale were re-examined by two specialists in the field. After ensuring semantic validity, evaluation specialists examined the Turkish version of the form using one psychometric measurement. In the determination of the content validity of the scale items, the Polit and Beck content validity index method was used (Polit & Beck, 2006). The opinions of 5 specialists were presented for the content validity of the scale. The item content validity rate was calculated as  $\geq 0.90$  and the content validity index as  $\geq 0.90$ . A pilot application of the scale was conducted with 20 who were not included in the main study, which was performed after it was understood that the questions were clear and comprehensible.

#### Data analysis

Confirmatory factor analysis was applied to determine the factor structure of the DASC scale in Turkish culture. For parametric analyses, normality, univariate and multivariate outliers and linearity-multiple linearity assumptions were checked with satisfactory results. The CFA was performed using Mplus 8.7 with strong maximum probability estimation procedures.

In this study, the Chi-square/degree of freedom ratio ( $\chi^2/df$ ), comparative fit index (CFI), Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA) and the standardized root mean square model fit indexes (SRMR) were used (Karagöz, 2017; Şencan, 2005). To determine the best model, gender-based measurement invariance was examined, and three models of nested invariance (structural, metric, and scalar) with consecutive constraints were calculated and evaluated. Convergent validity was tested with factor loading of the marker, component reliability (CR), and the average variance extracted (AVE). The DASC and DGASFC were also tested by calculating correlations. The internal consistency reliability of the scale was examined with Cronbach's alpha and component reliability.

### Ethical aspects of the study

Permission was obtained from the scale owner to translate the scale into Turkish. The consent forms were obtained from University Ethical Commission (Decision number: 29/26, Dated: 19.01.2022) and Provincial National Education Directorate for state schools. The parents of the children were informed about the study by the school administration. In addition, the children were informed about the study and their verbal consent was obtained.

### Results

The children participating in the study comprised 261 (52%) males and 245 (48%) females with a mean age of  $11.23 \pm 0.83$  years (range, 10–12 years). The parental level of education was reported as 92 (18.2%) of mothers and 131 (25.9%) of fathers were university graduates, 189 (37.4%) of mothers and 225 (44.5%) of fathers had a high school level of education, and 225 (44.5%) of mothers and 150 (29.6%) of fathers had a primary school level of education. It was stated that 311 (61.5%) of the children had a mobile phone, and 234 (46.2%) had another digital device (tablet, computer). Facebook was used by 81

**Table 1**  
Descriptive statistics of digital addiction scale for children.

	M	SD	Skewness	Std. E.	Kurtosis	Std. E.
Interpersonal	24.01	10.48	1.143	0.109	0.929	0.217
Intrapersonal	27.12	11.26	0.836	0.109	0.104	0.217
DASC	51.14	20.88	0.991	0.109	0.577	0.217

DASC, digital addiction scale for children, M, mean; SD, standard deviation; Std. E. standard error.

(16.0%) of the children, Twitter by 56 (11.1%), Instagram by 254 (50.2%), Snapchat by 191 (37.7%), WhatsApp by 323 (63.8%), and TikTok by 188 (37.2%).

Games were played on the internet by 279 (55.1%) of the children, for 1 h a day by 184 (36.4%), for 2 h a day by 129 (25.5%), and for 3 h a day by 59 (11.7%). When asked about the duration of daily internet use, 258 (51%) of the children stated 1–2 h a day, and 106 (20.9%) stated 3–5 h.

#### Descriptive statistics of digital addiction scale for children

The mean scores, standard deviations, and skewness-kurtosis values of DASC and the subscales are presented in Table 1.

According to the descriptive statistics of the DASC score and subscales, the *intrapersonal* subscale mean score of  $27.12 \pm 11.26$  was higher than the *interpersonal* subscale mean score of  $24.01 \pm 10.48$ . There was seen to be normal distribution of the DASC and subscale mean scores and the standard deviations were similar.

#### Construct validity

The fit indices of the two-factor model were  $\chi^2(274) = 606.204$ ,  $p < 0.001$ , with the  $\chi^2/df$  ratio being 2.21, indicating a good fit, CFI = 0.92 and TLI = 0.91 both indicating a good fit, RMSEA = 0.049, 90% CI = [0.044, 0.054] indicating a good fit and SRMR = 0.043 indicating a good fit (Table 2).

The standardized parameters of the model (factor loadings and error) are presented in Table 3. The item factor loadings ranged from 0.470 to 0.752 for the *interpersonal* factor and from 0.569 to 0.725 for the *intrapersonal* factor, and these were determined to be statistically significant ( $p < 0.001$ ). The two-factor model confirmed the construct at a good level.

#### Gender measurement invariance

The results for the gender-based measurement invariance models are shown in Table 4. Cheung and Rensvold (2002) and Chen (2007) recommended that the CFI difference between the two models tested should be  $\leq 0.010$ , and Chen (2007) also suggested that a RMSEA value of  $\leq 0.015$  and SRMR of  $\leq 0.030$  are evidence of invariance. The results of the invariance models showed that scalar invariance was maintained meaning that the factor mean values can be compared between gender groups.

#### Convergent validity

The associations between the DASC and DGASFC and the subscales are shown in Table 5. The convergent validity of DASC and DGASFC

**Table 2**  
Model fit indices for confirmatory factor analysis.

Model	$\chi^2$	df	$\chi^2/df$	p	CFI	RMSEA (90% CI)	SRMR	TLI
	606.204	274	2.21	0.000	0.92	0.049 [0.044–0.054]	0.043	0.91

CFI, comparative fit index;  $\chi^2/df$ , chi-square/degree of freedom ratio; RMSEA, root-mean-squared error of approximation; SRMR, standardized root mean of the residual; TLI, tucker lewis index.

**Table 3**  
Item factor loadings, corrected item–total correlation, mean and standard deviation.

Criterion	Item no	Component		CITC	M	SD
		Interpersonal $\lambda_i$ (s.e.)	Intrapersonal $\lambda_i$ (s.e.)			
Deception	4	0.470 (0.044)		0.465	1.46	1.01
	16	0.538 (0.045)		0.544	1.65	1.18
Conflict	9	0.752 (0.024)		0.691	1.93	1.25
	22	0.734 (0.030)		0.699	1.74	1.16
Displacement	6	0.675 (0.034)		0.631	1.95	1.15
	18	0.615 (0.038)		0.586	1.76	1.17
Problems	20	0.586 (0.037)		0.521	2.25	1.41
	10	0.572 (0.037)		0.542	1.79	1.16
Preoccupation	13	0.685 (0.030)		0.649	1.97	1.27
	23	0.545 (0.042)		0.527	1.54	1.07
Relapse	25	0.733 (0.027)		0.677	2.02	1.36
	14	0.659 (0.034)		0.562	1.84	1.31
Mood modification	1		0.631 (0.030)	0.609	2.11	1.28
	11		0.687 (0.028)	0.680	2.91	1.23
Withdrawal	17	0.606 (0.040)		0.575	2.34	1.35
	19		0.725 (0.026)	0.647	2.24	1.39
Tolerance	5		0.569 (0.031)	0.566	2.68	1.50
	15		0.655 (0.032)	0.626	2.18	1.33
Relapse	24		0.593 (0.033)	0.592	2.64	1.50
	3		0.713 (0.028)	0.675	1.94	1.25
Mood modification	8		0.755 (0.026)	0.712	2.06	1.31
	12		0.731 (0.029)	0.678	1.82	1.22
Withdrawal	21		0.751 (0.025)	0.684	1.96	1.29
	2		0.641 (0.034)	0.615	2.24	1.22
Tolerance	7		0.713 (0.028)	0.661	2.11	1.28

CITC, corrected item–total correlation; M, mean; SD, standard deviation.

showed the expected significant positive, strong correlation ( $r = 0.746$ ,  $p < 0.001$ ). A high positive correlation was determined between the subdimensions of DASC and the subdimension of DGASFC.

Digital addiction scale for children was seen to have good convergent validity, as indicated by the high factor loadings (Table 3) and high CR value (Table 5). As seen in Table 5, the composite reliability values of the DASC *interpersonal* and *intrapersonal* subdimensions were 0.74, indicating ensured convergent validity of the subscales.

#### Reliability analysis

The internal consistency reliability was examined with Cronbach's alpha and composite reliability. The DASC showed excellent internal consistency of 0.94 in both subscales as the alpha values were  $> 0.89$  for the *interpersonal* factors and  $> 0.91$  for the *intrapersonal* factors. The CR scores of the *interpersonal*, *intrapersonal*, and whole scale were 0.89, 0.91, and 0.95, respectively (Table 6).

#### Discussion

One of the most frequently used scales for measuring digital addiction in children is the Digital addiction scale for children (Hawi et al., 2019), which was developed using a theoretical framework founded on Internet gaming disorder DSM-5 criteria and the components model of addiction. The aim of the current study was to assess the psychometric properties, particularly the internal factor structure, internal consistency, and convergent validity, of the Turkish DASC form.

The language of the DASC items and appropriacy to Turkish culture were evaluated by 5 specialists in this study. Consistency between the specialists was evaluated using the content validity index. It has been determined that a content validity index value  $> 0.90$  shows a high level of agreement between specialists and that the items sufficiently represent the desired area (Johnson & Christensen, 2019). The results obtained demonstrated consensus among the specialists, that the scales measured the subject to be measured sufficiently, and content validity was provided.

**Table 4**

Gender-based measurement invariance models of the digital addiction scale for children (Reference group: Female).

Model	$\chi^2$	df	p	CFI	RMSEA	SRMR	CFI	RMSEA	SRMR
Configural	935.779	548	0.000	0.909	0.053	0.052			
Metric	976.057	571	0.000	0.905	0.053	0.062			
Scalar	1014.569	594	0.000	0.901	0.053	0.062			
Metric against configural	40.491	23	0.0135				−0.004	0	0.01
Scalar against configural	78.858	46	0.0018				−0.008	0	0.01
Scalar against metric	38.199	23	0.0242				−0.004	0	0

CFI, comparative fit index; df, degrees of freedom; RMSEA, root-mean-squared error of approximation; SRMR, standardized root mean of the residual.

**Table 5**

Digital addiction scale for children convergent validity.

	Conflict	Value	Social tasks/Homework	Psychological-Physiological reflection	DGASFC
Interpersonal	0.684**	0.663**	0.664**	0.620**	0.718**
Intrapersonal	0.663**	0.726**	0.602**	0.612**	0.716**
DASC	0.701**	0.724**	0.658**	0.641**	0.746**

\* $p < 0.01$ , \*\* $p < 0.001$ . DASC; digital addiction scale for children, DGASFC; digital game addiction scale for children.

The appropriacy of the sample included in the study to factor analysis was evaluated with the KMO and Bartlett  $X^2$  tests. A KMO value  $>0.60$  and significance in the Bartlett test show that the scale is suitable for factor analysis. In the current study, as the Bartlett test was significant for the DASC Turkish version and the KMO value was  $>0.60$ , the data were seen to be suitable for factor analysis and the sample size was sufficient (Karagöz, 2017).

DASC and subscale score averages were determined to be normally distributed with similar standard deviations. To determine the construct validity of the scale in Turkish culture, CFA was performed. It has been reported in literature that model fit indexes  $>0.90$  indicate good fit. A  $X^2/df$  value  $<5$  and RMSEA value 0.08 also show good fit (Brown, 2015; Marsh et al., 2020). The CFA results in the current study were seen to be consistent with the criteria stated in literature, and were consistent with the results obtained from the original scale (Hawi et al., 2019).

The item factor loadings ranged from 0.470 to 0.752 for interpersonal factors and from 0.569 to 0.725 for intrapersonal factors, and these results were statistically significant ( $p < 0.001$ ) and higher than the recommended load value of 0.5 (Hair Jr. et al., 2009). Consequently, the two-factor model confirmed the construct at a good level. The results were seen to be similar to the results obtained from the original scale.

The gender invariance of the latent construct was evaluated with MG-CFA, and the findings indicated that scalar invariance was ultimately achieved for the two-factor structure of DASC across gender. The latent factor mean values of the male and female participants were comparable (Riordan & Vandenberg, 1994).

The DASC was determined to have good convergent validity, as indicated by the high factor loadings and high CR value. The AVE values of the DASC and its subscales were lower than the cut-off criteria. However, Fornell and Larcker (1981) stated that the convergent validity of the construct is still sufficient if the average variance is  $<0.5$ , but the composite reliability is  $>0.6$ . The relationship between the DASC and DGASFC scales was examined and the correlation coefficient obtained

was 0.74. The correlation between DASC and DGASFC was high, so convergent validity of DASC was also provided. As convergent validity was not examined in the original scale, the results could not be compared.

The Cronbach's alpha coefficient shows whether or not the same property of items is measured and whether or not the items are related to the subject to be measured. The findings of the current study indicated strong support for the two-factor model to be consistent in Turkish culture. The Cronbach's alpha and CR values of the DASC were determined to be  $>0.89$ . It is recommended in literature that this value should be between 0.60 and 1.00 (Nunnally & Bernstein, 2010). As this value should be as close to 1 as possible, a value of 0.60–0.80 shows that the scale is relatively reliable and a value of 0.80–1.00 shows that the scale is extremely reliable (Hair et al., 2014; Nunnally & Bernstein, 2010; Şencan, 2005.). According to the results obtained in this study, the Turkish version of the scale was similar to the original scale, and showed strong internal consistency. This reliability also demonstrated that there was sufficient internal consistency in each subscale.

There is no other scale in Turkey, which can be used to evaluate the level of digital addiction of children aged 9–12 years in Turkish culture.

### Practice implications

It is important for children to develop healthy habits at an early age. For this reason, it is very important to detect and control the problematic internet use of children in the early period, in order for children to be healthy adolescents and adults. In this context, the child health nurse has an important role in determining the addiction levels of children. It is very important for nurses to use valid and reliable measurement tools in determining the addiction levels of children. Since this scale is easy and practical, it is thought that it will contribute significantly to the literature.

### Limitations

The scale data are limited to the province where the data were collected. In addition, as there was no study in literature which has analyzed the validity and reliability of the scale in different languages, comparisons could not be made with other cultures.

### Conclusion

In this study, the psychometric properties of the DASC were tested, and the results obtained were seen to be consistent with the results obtained from the analysis of the original version of the scale. The internal consistency and structure validity of the scale were found to be high.

**Table 6**

Cronbach alpha, CR, and AVE of DASC.

Factors	Number of items	Cronbach alpha	AVE	CR
Interpersonal	13	0.893	0.402	0.896
Intrapersonal	12	0.911	0.466	0.912
DASC	25	0.945	0.433	0.949

DASC; digital addiction scale for children, AVE; average variance extracted, CR; composite reliability.

According to these findings, the Turkish version of the DASC can be used as a tool to objectively evaluate digital addiction in children aged 9–12 years.

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### Authorship statement

All listed authors meet the authorship criteria and that all authors are in agreement with the content of the manuscript.

### Ethical standards disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki.

### CREDIT Statement

**Sevim Çimke:** Conceptualization, Methodology, Data curation, Visualization, Investigation, Supervision, Validation, Formal analysis, Project administration, Resources, Writing – original draft, Writing – review & editing. **Dilek Yıldırım Gürkan:** Conceptualization, Methodology, Software, Data curation, Visualization, Investigation, Supervision, Software, Validation, Writing – review & editing. **Gözde Sırgancı:** Conceptualization, Methodology, Supervision, Validation, Formal analysis, Writing – review & editing.

### Declaration of Competing Interest

The authors declared no potential conflicts of interest with respect to their search, authorship, and/or publication of this article.

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