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Problematic Technology Use Scale for Young Children (PTUS-YC): Validity and Reliability Study

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Abstract: This study aimed to develop a measurement tool to identify preschool children's problematic technology use levels and contribute to Turkish literature. The study group included in the exploratory factor analysis was composed of 357 voluntary children in the preschool period. The study group included in the confirmatory factor analysis, proximal validity analysis, item discrimination analysis, and reliability analysis was composed of a total of 402 parents. Exploratory factor analysis (EFA) was conducted to present the factor structure of PTUS-YC. Confirmatory factor analysis (CFA) was performed to test the model obtained with EFA. Item discrimination values obtained as a result of the independent sample t-test was investigated to determine the internal validity of the measurement tool. Furthermore, the correlation values between PTUS-YC items and the relevant factors and the complete measurement tool were calculated, and total item correlation was used to test whether each item served a common purpose. In addition, CR and AVE values were examined in the proximal validity analysis conducted for PTUS-YC. Reliability analysis for PTUS-YC was performed using Cronbach alpha internal consistency coefficient and McDonald's Omega coefficient methods. As a result of the exploratory factor analysis, a 4-factor structure that explained 60.392% of the total variance was obtained: continuity of use, resistance to control, effects on development and deprivation-escape. Based on the results, PTUS-YC was a valid and reliable measurement tool that can be used to determine preschool children's problematic technology use levels.

1. INTRODUCTION

The rapid advances in technology in the 20th century have generated many changes in individuals' lives. Today, technological tools perform many different activities such as communication, shopping, following interactive content, benefiting from educational services and gaming. Technological tools can facilitate the lives of individuals with various access opportunities they offer. However, they can also generate problems since technology is used more and more at younger ages, and technological tools may be used in a manner that may negatively affect the development of younger users. A study conducted on the internet use of children ages 3 to 18 in the United States demonstrated that children's rate of internet use increased rapidly between 2010 and 2017 (National Center for Education Statistics, 2019).

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These rates may have increased even higher from 2017 to 2021, mainly due to the rapid technological tools and opportunities they offer. With the help of a program developed to control technology use, a study exploring the content and the time spent by children in technological environments in 2020 concluded that 39.11% of children spent extensive amounts of time watching videos and listening to music, followed by 24.16% spending time on internet communication tools and 15.98% spending time on games (Securelist, 2020). Considering the purposes of internet use by children, it can be argued that children spend a long time with many activities that may risk their development. A study conducted with parents showed that parents under the age of 12 had concerns about the time their children spent in front of the screen. In addition, 71% of the parents thought that smartphones would do more harm than good to their children's development. In the study, 80% of the parents stated that their 5-11-year-old children used tablets or interacted with them, while this rate was 48% for parents with children under five years old. 66% of the parents who participated in the study stated that parenting was more complex than in the past due to children's widespread use of technological tools. Finally, the research investigated children's screen time for various technological tools. 88% of children aged 0-11 spent time on television, 67% on tablets, 60% on smartphones, 44% on computers and 44% on gaming devices (Pew Research Center, 2020). When these studies conducted on large samples are considered in general, it can be argued that today, children often spend time with technological tools and technology development. This may pose a risk for the development of children who have not yet completed their physical, psychological and social development (Rideout et al., 2011). In this context, the American Academy of Pediatrics (2016) emphasized that newborn children should not interact with technology until 18 months of age and that technology use by children older than 18 months should be limited to 1 hour with parent-controlled content. Similarly, the Turkish Green Crescent Society (2021) draws attention to these situations in its statements. Due to a lack of knowledge and skills, children and their parents may have difficulty using technological tools in a healthy way most of the time. This points to the use of technology that may cause problems in children's lives and can be considered as "problematic technology use".

Having difficulty controlling the use of the smartphone and causing deterioration in the daily functions of the individual are considered as problematic smartphone use while experiencing these problems in digital games reveals challenging gameplay. These sub-headings are handled within the framework of problematic technology use. Based on different concepts of problematic technology use in the literature such as problematic internet use, problematic gaming disorder, problematic social media use, problematic smartphone use, problematic technology use can be defined as a concept expressing the difficulties experienced by persons in controlling their use of technological tools, the problems experienced by persons when they stay away from technological tools, and the negative effect of technology use on their physical, psychological and social lives (Caplan, 2010; Young, 2011). Children's physical, psychological and social lives can be negatively affected due to problematic technology use (Avşaroğlu & Akbulut, 2020; Mustafaoğlu et al., 2018). Relevant studies in the literature present that children's problematic technology use negatively affect their social interaction with peers (Savcı & Aysan, 2016; Yavuzer, 2019; Zorbaz & Tuzgöl Dost, 2014), their family relationships (Gunuc & Dogan, 2013; Lam et al., 2009; Lee & Chae, 2007; Wu et al., 2016), their language development (Chonchaiya & Pruksananonda, 2008; McCarrick & Li, 2007), their psychological states (Akboğa & Gürgan, 2019; Derin & Bilge, 2016; Orben & Przybylski, 2019; Plowman et al., 2010) and their academic lives (Anlayışlı & Bulut Serin, 2019; Chi et al., 2020; Geng et al., 2018; Peng et al., 2019; Soldatova & Teslavskaia, 2017; Zhang et al., 2018). In addition, problematic use of technology is associated with problems such as attention problems (Christakis et al., 2004; Kawabe et al., 2019; Soldatova & Teslavskaia, 2017), behavioural problems (Alonso & Romero, 2017; Ybarra et al., 2011), sleep problems (Bruni et al., 2015;

Calamaro et al., 2012; Cespedes et al., 2014; Fuller et al., 2017; Johansson et al., 2016; Mei et al., 2018), nutritional problems (De Jong et al., 2013; Mitchell et al., 2013; Rosen et al., 2014) as well as reductions in physical activity (Cox et al., 2012; Rosen et al., 2014) and developmental problems (Howie et al., 2017; Pagani et al., 2010).

Although problematic use of technology is a problem in all children, this study addressed the problematic use in preschool children. The preschool period includes various critical developmental tasks in regard to the physical, psycho-motor, psychological and social development of children. Sustaining this period in a healthy way is of great importance for the development of children. Technology use in preschool children is on the rise with the widespread use of technology in younger age groups in recent years, and it may pose risks for the development of preschool children.

A study conducted by Genc (2014) on parents with children in the preschool period found that children spent an average of 2-3 hours a day on technological tools. It can be argued that this time spent by preschool children by using technological tools can be defined as a risk-based on the healthy use criteria identified by international organizations (American Academy of Pediatrics, 2016). In addition, according to the study, parents stated that their children's use of technology could cause problems because of radiation, the inappropriateness of the tools regarding their developmental characteristics, possible adverse effects on their development, health hazards and social withdrawal (Genc, 2014). Many reports and studies in the literature show that the problematic use of technology in the preschool period can cause various damages in regards to the physical, psychological and social development of children (Cox et al., 2012; National Association for the Education of Young Children, 2012; Turkish Green Crescent Society, 2021). Preschool children's problematic technology use is associated with problems such as obesity, sleep disorders, behavioural problems, poor academic performance, social and language development problems (Anderson & Pempek, 2005; Christakis et al., 2004; DeLoache et al., 2010; Rogow, 2007; White House Task Force on Childhood Obesity Report to the President, 2010). In this context, it is of great importance to evaluate children's problematic technology use and ensure that parents are provided with skills regarding the healthy use of technology.

In Turkey, several measurement tools are used to identify children’s and adolescents’ problematic technology use levels (Kabadayı, 2020). The target group is mostly adolescents in these measurement tools which were developed or adapted into Turkish (Anlı & Taş, 2018; Arıcak et al., 2019; Bayraktar, 2001; Çakıroğlu & Soylu, 2019; Canan et al., 2010; Canoğulları-Ayazseven & Cenkseven-Önder, 2019; Ceyhan & Ceyhan, 2014; Eşgi, 2014; Fidan, 2016; Fırat & Balcı-Çelik, 2017; Günüç & Kayri, 2010; Güzeller & Coşguner, 2012; Ilgaz, 2015; Irmak & Erdoğan, 2015; Kaya, 2013; Kutlu et al., 2016; Ögel et al., 2015; Şar et al., 2015; Taş, 2017, 2019). In addition to these measurement tools, there are a limited number of measurement tools used to determine problematic use of various technological tools for secondary school students (Balantekin, 2009; Hazar & Hazar, 2017; Mıhçı & Çakmak, 2017; Yılmaz et al., 2017), primary school students (Horzum et al., 2008) and preschool students (Ünsal & Ulutaş, 2019). These measurement tools used in Turkey only focus on identifying children's and adolescents' problematic use of a specific technological tool such as gaming, computer, Internet and smartphone. In addition, the measurement tools to identify preschool children's problematic technology use in Turkey are somewhat limited. For instance, the measurement tool adapted into Turkish by Ünsal and Ulutaş (2019) solely aims to identify preschool children’ computer game addiction levels. Another measurement tool adapted to Turkish by Furuncu and Öztürk (2020) examines preschool children's problematic media use levels. The items in this measure were developed by considering the criteria for Internet Gaming Disorder found in DSM-V. This measurement tool, adapted to Turkish, has a 27-item long-form and a 9-item short form with one dimension in both forms. One-dimension structure, especially in the long-form in this measurement tool, can be regarded as a limitation because the problematic technology use is a complex concept with various dimensions. In the international literature, measurement tools are developed to measure the problematic technology use of individuals in different age groups (Ding et al., 2018; Foerster et al., 2015; Pancani et al., 2019). It has been observed that these measurement tools are generally developed for secondary school, high school, university students and adults (Harris et al., 2020). In addition, it is seen that the measurement tools that can measure the problematic technology use levels of young children are limited. The measurement tool developed by Domoff et al. (2019) to measure the problematic media use levels of children aged 4-11 is one. Furuncu and Öztürk (2020) adapted this measurement tool into Turkish.

Investigating the relationship between children and technology and describing their use of technological tools can be crucial in preventive and protective services in the preschool period, which includes many critical development tasks for children's development. In addition, the lack of a measurement tool with a broader framework to identify the preschool children's problematic technology use in Turkey and the world can be regarded as a shortcoming. In this context, this study aimed to develop a measurement tool to determine the level of problematic technology use of children in the preschool period and contribute to Turkish literature.

2. METHOD

This research was designed as a scale development study since the main aim was to develop a tool to measure preschool children' problematic technology use.

2.1. Study Group

Two different study groups were used in conducting the validity and reliability studies in this research. The study group included in the exploratory factor analysis of the research was composed of 357 voluntary parents (334 mothers and 23 fathers) with children in the preschool period. Among these voluntary participants, 101 parents were primary or secondary school graduates, 102 were high school graduates, and 154 were university graduates. The mean age of this parent group was 33.2. The study group included the confirmatory factor analysis, proximal validity analysis, item discrimination analysis, and reliability analysis composed of 402 voluntary parents (372 mothers and 30 fathers) with children in the preschool period. Among these voluntary participants, 103 parents were primary or secondary school graduates, 108 were high school graduates, and 191 were university graduates. The mean age of this parent group was 33.4. According to Bryman and Cramer (2011), in determining the number of participants in factor analysis, it may be sufficient to reach five or ten times the number of items in the measurement tool. Hence the study group can be argued to be large enough for both validity and reliability analyses.

2.2. Ethical Statement

The principles of scientific research and publication ethics were adhered to during the planning and implementation of this research. Approval was obtained from the Social and Human Sciences Ethics Committee of Erciyes University (Document No: 2020/176) at the beginning of the research. While collecting the data, the participants were informed about the study, an informed consent form was collected from each participant, and the data were collected based on voluntary participation. The data obtained from the research were not shared with any person or institution and were used only within the scope of this research.

2.3. Development Process of the Measurement Tool

The process of developing a psychological measurement tool can be defined as the process and procedure of creating the expressions that will stimulate the relevant characteristics of individuals that are intended to be measured and developing the appropriate response categories for these expressions (Erkuş, 2012). First of all, conducting a detailed theoretical and conceptual review of the relevant field is required so that the feature desired to be measured in individuals can be transformed into items in an appropriate manner. In this context, first of all, a detailed literature review was conducted on the topics included in problematic technology use, such as technology addiction, gaming addiction, internet addiction, problematic internet use and smartphone addiction to develop the item pool for Problematic Technology Use Scale for Young Children (PTUS-YC). In addition, the diagnostic criteria for internet addiction identified by various researchers were also taken into consideration. Also, previous studies on children's technology use in the preschool period were examined since the measurement tool developed in this study aimed to identify children's problematic technology use levels in the preschool period. Furthermore, the content developed by the American Academy of Pediatrics (2016), Turkish Green Crescent Society (Türkiye Yeşilay Cemiyeti, 2021) and the National Association for the Education of Young Children (2012), which explored the use of technology by developmental stages, were examined in detail in regards to the development of preschool children. In this framework, the risks that can be addressed in terms of preschool children's use of technology were added to the item pool by considering problematic use. An item pool was created by the researchers based on the literature review. While creating the item pool, structures related to the dimensions of problematic technology use such as duration, deterioration in functionality, tolerance, conflict and lack of control were considered. In order to ensure the content and face validity of the item pool, expert opinions were obtained from two field experts with doctoral dissertations in the field of problematic technology use and one assessment-evaluation specialist. Additionally, an expert from the field of Turkish education was consulted to ensure that the items in the item pool had proper language usage and grammar and were clear to the reader. Appropriate corrections were made within the framework of the feedback from field experts, and the first form of the measurement tool was developed as a 5-point Likert type scale with 31 items. "My child spends more than 1.5 hours a day with technological tools on average.", "My child's use of technological tools causes him to be inactive." and "When my child feels sad, he relaxes by spending time with technological tools." statements are some examples among these items. In order to understand whether these items were understandable by the respondents, six parents were asked to fill in the measurement tool within the scope of the pilot study and whether the relevant items were clear and understandable. Some expressions have been simplified within the framework of these feedbacks. Later, the measurement tool was implemented online to 357 parents with children in the preschool period to perform the exploratory factor analysis and to 402 parents with children in the preschool period to perform the confirmatory factor analysis, proximal validity analysis, and item discrimination and reliability analysis.

2.4. Data Analysis

SPSS 25.00 and AMOS 24.00 programs were used to analyze the data obtained from two different study groups to conduct this research's validity and reliability studies. An exploratory factor analysis (EFA) was conducted on the data obtained from the study group of 357 people in the first stage of the study to reveal the factor structure of PTUS-YC. First, KMO and Barlett test analyzes were conducted to determine whether the data set was suitable for factor analysis. When it was confirmed that the data obtained from the analysis were suitable for factor analysis, exploratory factor analysis was conducted. In addition, a normality test was conducted for the whole measurement tool. The principal axis factoring method was used when performing the exploratory factor analysis. Factor loadings were calculated using the Varimax rotation technique (Balcı, 2009). The process was continued by removing the items with factor loads below .30 and items with a difference between the two-factor loadings of less than .10 based on the principal axis factoring analysis (Can, 2019; Eroğlu, 2008; Kline, 2011). In the field of behavioural sciences, it was considered to be sufficient in the process of developing or adapting a measurement tool when the factor loads of the items were higher than .30, and at least 40% of the total variance could be explained with the items in the measurement tool (Kline, 2011). The factor loads of the items were taken into consideration while evaluating the factor analysis results (Balcı, 2020). In addition, common factor variance value is also known to be important in multi-factor structures. In this context, it was checked whether there was any item with a common factor variance below .20 (Çokluk et al., 2018). In the second stage of the study, the data obtained from a study group of 402 people were tested by performing a confirmatory factor analysis (CFA) to test the model obtained due to EFA. As a result of the analysis, the results were addressed based on the model fit indices' acceptable and perfect fit ranges (Schumacker & Lomax, 2004). The item discrimination values obtained as a result of the independent sample t-test were examined to determine the internal validity of the measurement tool and construct validity. Also, CR and AVE values were examined in the proximal validity analysis of PTUS-YC. Furthermore, the correlation values between PTUS-YC items and the relevant factors and the complete measurement tool were calculated, and total item correlation was used to test whether each item served a common purpose.

The reliability analysis of PTUS-YC was performed using the Cronbach alpha internal consistency coefficient and McDonald's Omega coefficient methods. Reliability was interpreted by considering that the reliability coefficients should be .70 and above for measurement tools to be reliable (Can, 2019).

3. RESULT

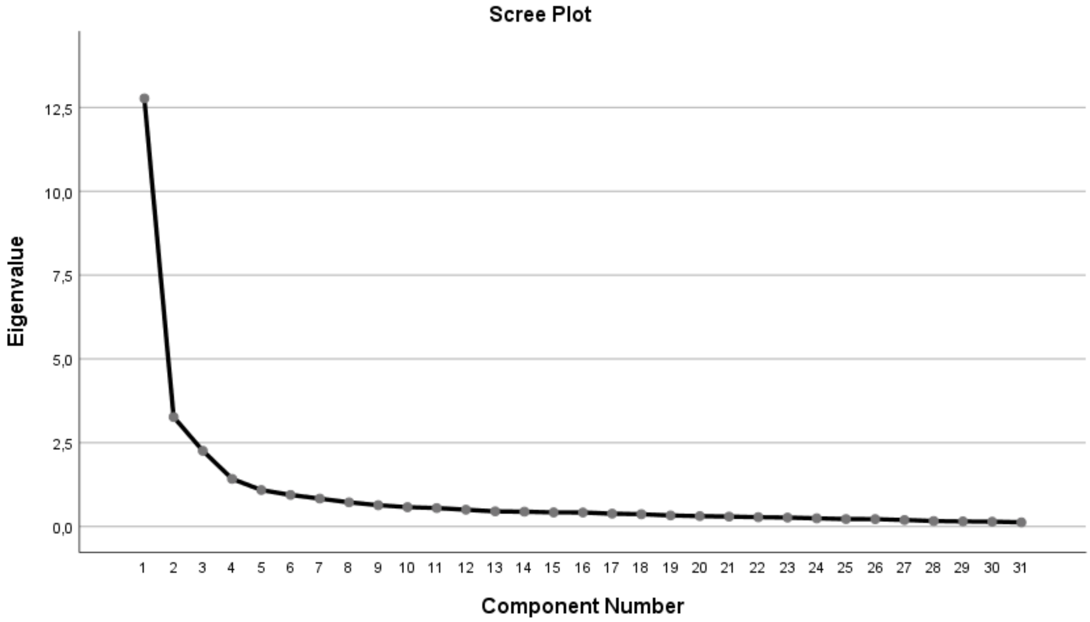
This section presents the results of the analyses conducted in line with the purpose of the research.

3.1. Construct Validity

3.1.1. *Exploratory factor analysis*

Within the scope of the research, exploratory factor analysis (EFA) was performed to examine the factor structure of PTUS-YC. KMO coefficient and Bartlett test coefficient were found to be .926 and 6328.143 (p<.001) respectively during the KMO and Barlett tests performed to determine the suitability of the data obtained from the first study group factor analysis. The finding that KMO was higher than .60 and Barlett test was significant shows that the data were suitable for factor analysis (Pallant, 2017). In addition, the skewness and kurtosis values were examined in order to comment on normality. Skewness and kurtosis values between -2 and +2 demonstrate normality of distribution (Karagöz, 2016). The skewness and kurtosis values examined for the whole measurement tool were found to be between -2 and +2, and based on these values, it was confirmed that the measurement tool had a normal distribution. When the anti-image correlation matrix was examined in order to decide whether each item was included in the factor analysis, it was observed that the values at the intersection point were over 0.5 (Can, 2019). Afterwards, Principal Axis Factoring and Varimax rotation method were used to determine whether the measurement tool was unidimensional or multidimensional. When determining the items to be included in the measurement tool in the exploratory factor analysis, attention was paid to ensure that the eigenvalue of items was at least 1.00, that the item factor load value was at least .30, that the items were included in a single factor and that there was at least .10 difference between the items with sufficient factor loading (Seçer, 2018). When the total variance values of the measurement tool and the line graph were examined, it was observed that the tool could have a 4-factor structure. A line graph was used to determine the factor number of the measurement tool, as shown in Figure 1.

Figure 1. *Eigenvalue factor plot for PTUS-YC.*



Then, using the Varimax technique, the factor load values of the items were examined by rotation, and it was found that items 11, 18, 22 and 27 were overlapping. As a result of excluding these items from the analysis, a four-factor structure that explained 60.392% of the total variance was obtained. Table 1 presents the findings obtained from the exploratory factor analysis. The result of exploratory factor analysis demonstrated that the measurement tool's items' factor load values were between .374 and .826. Considering that the factor load values of the items should be at least .30 in the measurement tool development process, it can be argued that the item factor load values of the items in the measurement tool were sufficient (Hair et al., 2006). In addition, considering that the common factor variances should not be less than .20, it can be claimed that the factor common variance values of the items in the measurement tool were sufficient (Çokluk et al., 2018).

Based on the exploratory factor analysis result, a four-factor structure that explained 60.392% of the total variance was obtained. These factors were named based on their content (see Appendix). The first of these factors, the "continuity of use" sub-dimension, was composed of 8 items. The second factor, the "resistance to control" sub-dimension, included six items. The third factor, the "effect on development" sub-dimension, had five items. The fourth factor, the "deprivation-escape" sub-dimension, consisted of 7 items.

Table 1. *Item factor loads of PTUS-YC, variances explained by sub-scales and item analysis.*

Item	Continuity of Use	Resistance to Control	Effect on Development	Deprivation-Escape	Factor Common Variance
2	.801				.690
1	.764				.589
4	.725				.667
3	.685				.643
26	.591				.716
25	.560				.619
23	.540				.546
17	.524				.503
31		.690			.611
28		.675			.628
15		.672			.475
30		.620			.673
29		.618			.616
12		.575			.656
20			.826		.702
19			.806		.704
13			.762		.607
24			.759		.599
21			.730		.662
7				.769	.683
6				.726	.731
9				.683	.646
8				.576	.613
10				.568	.615
5				.476	.566
14				.374	.389
	%17.718	%14.523	%14.603	%13.549	
Total Variance			%60.392		

3.1.2. *Confirmatory factor analysis*

The model fit of the four-factor structure obtained due to the exploratory factor analysis of PTUS-YC was examined by single-level confirmatory factor analysis. Figure 2 presents the findings obtained from the single level confirmatory factor analysis. Figure 2 shows that the factor loads of the measurement tool ranged from .59 to .85 for the continuity of use dimension, .62 to .80 for the resistance to control dimension, .77 to .85 for effect on development dimension, and .48 to .87 for the deprivation-escape dimension. In addition, when the t values were examined, the absence of red arrows indicated that all items were significant at the .05 level (Seçer, 2013). Table 2 presents the fit index values obtained from the single level confirmatory factor analysis and the acceptable fit criteria for the examined fit index values.

Table 2. *Fit values and fit index values obtained from CFA.*

Examined Fit Indices	Perfect Fit	Acceptable Fit	Confirmatory Factor Analysis Fit Indices
χ^2/sd	$0 \leq \chi^2/sd \leq 2.00$	$2.00 \leq \chi^2/sd < 5.00$	3.289
RMS	$0 \leq$ RMSEA ≤ 0.05	$0.05 \leq$ RMSEA ≤ 0.08	0.076
NFI	$0.95 \leq$ NFI ≤ 1.00	$0.90 \leq$ NFI ≤ 0.95	0.871
TLI	$0.95 \leq$ TLI ≤ 1.00	$0.90 \leq$ TLI ≤ 0.95	0.890
CFI	$0.97 \leq$ CFI ≤ 1.00	$0.95 \leq$ CFI ≤ 0.97	0.906
IF	$0.95 \leq$ IFI ≤ 1.00	$0.90 \leq$ IFI ≤ 0.95	0.907
RFI	$0.95 \leq$ RFI ≤ 1.00	$0.90 \leq$ RFI ≤ 0.95	0.850
GFI	$0.95 \leq$ GFI ≤ 1.00	$0.90 \leq$ GFI ≤ 0.95	0.852
AGFI	$0.95 \leq$ AGFI ≤ 1.00	$0.85 \leq$ AGFI ≤ 0.95	0.813

Figure 2. *Eigenvalue factor plot for PTUS-YC.*

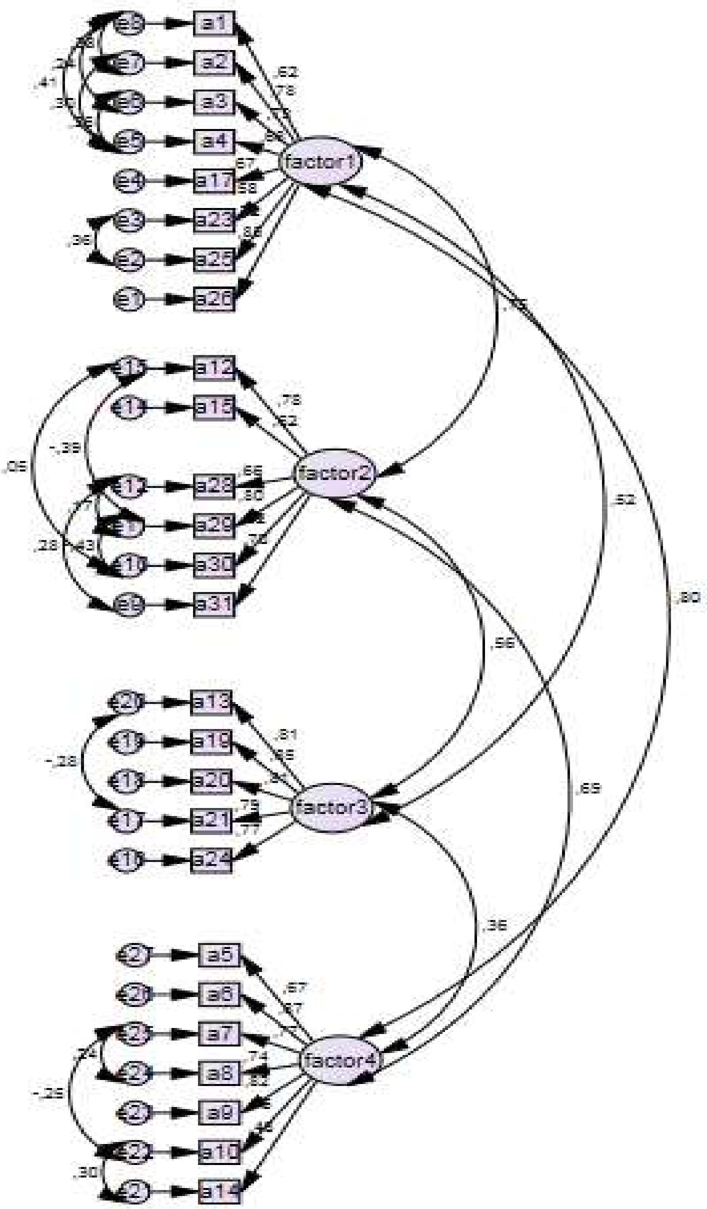


Table 2 demonstrates that the four-factor structure of PTUS-YC, with 26 items and four sub-factors, produced acceptable fit values (χ^2/sd=3.289; p=.00). The fit index values were found as RMSEA=.076, NFI=.871, CFI=.906, IFI=.907, SRMR=.071, GFI=.852 and AGFI=.813. Based on the acceptability of fit indices, the RMSA value should be less than .08; CFI, NFI, and IFI values should be greater than .90; SRMR value should be less than .09 and GFI, and AGFI values should be greater than .85 (Hu & Bentler, 1999; Kline, 2011). However, NFI and AGFI values are greatly affected by sample size (Bentler, 1990; Tabachnick & Fidell, 2007; Yadama & Pandey, 1995). Kline (2015) recommends 20 observations for each estimated parameter in the model. Therefore, smaller sample size of this study could influence NFI and AGFI values of the model. For this reason, it was decided that the relevant indices also indicated fit. Thus, it can be argued that the fit indices of this structural model created in the single-level CFA analysis were at an acceptable level. In addition, in the single-level CFA analysis, modifications were done in accordance with the suggestions between items 1 and 2, 1 and 3, 1 and 4, 2 and 4, 3 and 4, 23 and 25, 7 and 8, 7 and 10, 10 and 14, 13 and 21, 12 and 29, 12 and 30, 28 and 29, 28 and 31 and 29 and 30 and it was observed that after the modifications the model had a better fit.

3.1.3. *Correlation between dimensions*

Table 3 presents the correlation coefficient values obtained as a result of the Pearson correlation analysis performed to determine the relationship between the factors of PTUS-YC and the relationship between the factors and the total factor.

Table 3. *Correlation coefficients between factors.*

Factor	Continuity of Use	Resistance to Control	Effect on Development	Deprivation-Escape	PTUS-YC
Continuity of Use	1	.604**	.458**	.683**	.868**
Resistance to Control		1	.572**	.646**	.832**
Effect on Development			1	.387**	.733**
Deprivation-Escape				1	.829**
PTUS-YC					1

** p<.01

Examination of the correlation coefficient values between the factors demonstrated a significant relationship between the continuity of use, resistance to control, effects on development and deprivation-escape factors and the measurement tool. In addition, examination of the correlation coefficients for the sub-dimensions and the whole measurement tool pointed to a high level of significant relationship (Büyüköztürk, 2018).

3.1.4. *Item-total statistics*

The correlation values between the items of PTUS-YC and the factors in which they were included and the measurement tool were calculated, and total item correlation was used to test whether each item served a common purpose. An independent sample t-test was employed to calculate the difference between the lower 27% group and the upper 27% group to calculate the item discrimination index of the items of PTUS-YC. Table 4 demonstrates the item-total statistics values.

Table 4 shows that item-subscale correlation values varied between .688 and .853 for the continuity of use dimension; item-subscale correlation values varied between .707 and .817 for the resistance to control dimension; item-subscale correlation values f varied between .820 and .873 for the effect on development dimension the item-subscale correlation values varied between .622 and .860 for the deprivation-escape dimension. In addition, item-test correlation values for the continuity of use dimension were found to be between .574 and .813, item-test correlations for the dimension of resistance to control were found to be between.519 and .711, item-test correlations values for effect on development dimension were found to be between .487 and .656, and the item-test correlation values for the deprivation-escape dimension were found to be between .547 and .728. Furthermore, a significant positive relationship was observed among each item, the factor it belonged to and the whole measurement tool. According to this finding, it can be argued that each item was related to the factor to which it belonged and to the complete the measurement tool and functioned for the same purpose.

Table 4. *Item-total statictics.*

Item No	Factor	Item-Subscale Correlation	Item-Subscale Correlation	Upper/Lower 27% t
1	Continuity of Use	.783**	.574**	-97.502**
2	Continuity of Use	.853**	.718**	-97.502**
3	Continuity of Use	.787**	.673**	-75.184**
4	Continuity of Use	.792**	.651**	-87.093**
17	Continuity of Use	.698**	.658**	-76.112**
23	Continuity of Use	.688**	.597**	-97.502**
25	Continuity of Use	.761**	.730**	-53.368**
26	Continuity of Use	.814**	.813**	-112.158**
12	Resistance to Control	.783**	.696**	-22.166**
15	Resistance to Control	.707**	.519**	-11.167**
28	Resistance to Control	.780**	.602**	-18.268**
29	Resistance to Control	.779**	.663**	-24.712**
30	Resistance to Control	.817**	.711**	-39.434**
31	Resistance to Control	.806**	.597**	-20.049**
13	Effect on Development	.834**	.581**	-140.405**
19	Effect on Development	.873**	.656**	-99.464**
20	Effect on Development	.862**	.487**	-93.995**
21	Effect on Development	.820**	.582**	-119.190**
24	Effect on Development	.835**	.571**	-479.000**
5	Deprivation-Escape	.722**	.673**	-41.657**
6	Deprivation-Escape	.860**	.728**	-41.334**
7	Deprivation-Escape	.812**	.618**	-67.127**
8	Deprivation-Escape	.783**	.631**	-47.881**
9	Deprivation-Escape	.840**	.688**	-44.095**
10	Deprivation-Escape	.780**	.677**	-26.107**
14	Deprivation-Escape	.622**	.547**	-36.044**

**p<.01

As a result of the independent sample t-test performed between the lower 27% group and the upper 27% group of the items in PTUS-YC, the t-test values were found to be between -53.368 and -112.158 for the continuity of use dimension; between -11.167 and -39.434 for the resistance to control dimension; between -93.995 and -479.000 for effect on development dimension and between -26,107 and -67,127 for the deprivation-escape dimension.

In addition, when the significant differentiation between the groups was examined, a significant difference was observed between the group with everyday problematic technology use and the group with high problematic technology use in both sub-dimensions and in the total scores (p <.001). This finding shows that all PTUS-YC items can distinguish between children with low or high problematic technology use, and this finding demonstrates that the scale has internal validity.

3.1.5. *Proximal validity*

Proximal validity shows that the expressions associated with the variables are related to each other and the factor they form. CR and AVE values were analyzed in order to make evaluations regarding the proximal validity of PTUS-YC. Table 5 provides the CR and AVE values obtained from this analysis.

Table 5. *AVE and CR values of PTUS-YC.*

Dimensions	AVE	CR
Continuity of Use	.43	.86
Resistance to Control	.41	.81
Effect on Development	.60	.88
Deprivation-Escape	.43	.80

According to Table 5, the composite reliability (CR) values were higher than the average variance extracted (AVE) values in all dimensions of PTUS-YC, but the AVE values were not more significant than .50 except for the effect on the development dimension. It is expected that the AVE value should be higher than 0.50, the CR value should be higher than 0.60, and the condition of "CR> AVE> 0.50" should be met to ensure that the tool has convergent validity (Hair et al., 2006). When CR and AVE values were examined in terms of PTUS-YC dimensions, it was observed that while the CR values were within the acceptable range, AVE values were not within the acceptable range except for effect on the development dimension. However, in line with the views of Fornell and Larcker (1981) and Lam (2012) that convergent validity is provided when the CR value is higher than .60, it was seen that PTUS-YC had convergent validity in this study.

3.2. Reliability

Cronbach Alpha and McDonald Omega values were calculated to examine the reliability of PTUS-YC within the scope of this research. Table 6 provides the findings obtained as a result of the reliability analysis.

Table 6. *Internal consistency and split-half reliability analysis coefficients of PTUS-YC.*

Dimensions	Cronbach Alpha	McDonald's Omega
Continuity of Use	.903	.903
Resistance to Control	.876	.880
Effect on Development	.902	.902
Deprivation-Escape	.882	.886
Total	.938	.939

It was observed that all reliability coefficients obtained from Cronbach Alpha and McDonald's Omega analyses for the reliability analysis of PTUS-YC were at a reasonable level for the total scale and sub-dimensions. It can be argued that the broad-scale and its sub-dimensions met the reliability criteria. Because measurement tools are considered reliable when the reliability coefficients are .70 or above, it can be argued that the internal consistency and split-half reliability coefficients of PTUS-YC were sufficient (Can, 2019).

4. DISCUSSION and CONCLUSION

This research developed a measurement tool to determine preschool children's problematic technology use levels. There is always a need for individual diagnostic tools such as scales, tests and inventories for educational research and therapy studies conducted with children. Measurement and evaluation processes are crucial both in obtaining accurate results in scientific research and in making accurate decisions in the services to be offered to individuals. Therefore, scale development and adaptation studies are valuable. Unless psychological tests are proven to be independent of culture, they must be authentic and developed separately for each country (Tezbaşaran, 1996). Unfortunately, the number of authentically developed measurement tools is limited in Turkey compared to adaptation studies. Considering all these and focusing on the fact that the technology is becoming more and more common among very young users, it was planned to develop a measurement tool to identify preschool children's level of problematic technology use. Based on the results of various analyses, a scale was developed with 26 items and four factors. The scale was titled "Problematic Technology Use Scale for Children" and included the following sub-dimensions: continuity of use, resistance to control, effects on development and deprivation-escape.

Internal consistency and McDonald's Omega coefficients were investigated to determine the reliability of PTUS-YC. While the internal consistency coefficient for the whole PTUS-YC was found as .938, the internal consistency coefficients for the sub-dimensions were as follows: .903 for the continuity of use dimension, .876 for the resistance to control dimension, .902 for effect on development dimension and .882 for the deprivation-escape dimension. While McDonald's Omega coefficient was found to be .939 for the whole PTUS-YC, McDonald's Omega coefficients for the sub-dimensions were as follows: .903 for the continuity of use dimension, .880 for the continuity of use the resistance to control dimension, .902 for effect on development dimension and .886 for the deprivation-escape dimension. It can be argued that the measurement tool is reliable based on the reliability coefficients obtained in the analyses performed to determine the reliability of the PTUS-YC (Can, 2019).

Exploratory factor analysis, confirmatory factor analysis, convergent validity analysis, item discrimination indices and item factor correlation values were examined to determine the validity of PTUS-YC. In the exploratory factor analysis, which was performed first, the measurement tool was collected under four factors named continuity of use, resistance to control, effects on development and deprivation-escape. These four factors were found to explain 60.392% of the total variance. The confirmatory factor analysis performed later to verify this 4-factor structure showed that the model produced good fit values. The independent sample t-test conducted to determine the item discrimination index value of PTUS-YC demonstrated a significant difference between the 27%group with the highest score and the 27% group with the lowest score in all items of the measurement tool. This finding proves that the scale can distinguish children with low problematic technology use from children with high problematic technology use. In addition, when CR and AVE values were examined for the proximal validity of PTUS-YC, it was observed that the CR values were within the acceptable range while AVE values were not within the acceptable range except for effect on the development sub-dimension. However, based on the views of Fornell and Larcker (1981) and Lam (2012) that convergent validity is provided when the CR value is higher than .60, it was seen that the convergent validity criteria were met for PTUS-YC. Finally, the correlation values between the items of PTUS-YC, the factors they were involved in and the whole measurement tool were calculated, and total item correlation was used to test whether each item served a common purpose. Item-subscale correlation values were between .688 and .853 for the continuity of use dimension, item-subscale correlation values were between .707 and .817 for the dimension of resistance to control, item-subscale correlation values were between .820 and .873 for effect on development dimension, and item-subscale correlation values were between .622 and .860 for the deprivation-escape dimension. In addition, item-test correlation values for the continuity of use dimension were found to be between .574 and .813, item-test correlations for the dimension of resistance to control were found to be between.519 and .711, item-test correlations values for effect on development dimension were found to be between .487 and .656, and the item-test correlation values for the deprivation-escape dimension were found to be between .547 and .728. Furthermore, a significant positive relationship was observed among each item, the factor it belonged to and the whole measurement tool. According to this finding, it can be argued that each item was related to the factor to which it belonged and to the complete the measurement tool and functioned for the same purpose.

The validity and reliability findings obtained from the study (Furuncu & Öztürk, 2020), which was developed to measure the problematic media use of preschool children in Turkey, also show similarities and differences in some respects. In the related study, the internal consistency coefficients of both the long-form and the short form were over .90. This finding shows that the measurement tools in the related research are also reliable, just like our measurement tool. However, while a four-factor structure emerged in our study, a one-dimensional structure emerged in the related study. Considering that problematic technology use is a comprehensive concept, it can be said that the structure in our research could be stronger. In addition, while the one-dimensional structure explains 57.6% of the total variance in the related study, the four-factor structure explains 60.3% of the total variance in our study. When considered in terms of the explained variance, the findings constitute the strength of the measurement tool developed in the research. Finally, concordant validity and incremental validity analyses were performed for the related research's validity study. Evidence regarding the measurement tool's validity related to these analyses has been presented. The fact that these validity analyzes are included in the relevant research, unlike our research, constitutes a different aspect of our research.

Based on the results of this study, PTUS-YC is a valid and reliable measurement tool that can be used with the parents of preschool children to determine their children's problematic technology use level. It can be argued that PTUS-YC is a measurement tool that can meet the need for identifying preschool children's problematic technology use in fields such as preschool education, psychological counseling and guidance and child development, and it can be used in relevant research as well. It is believed that retesting the validity and reliability of the scale in future studies with different sample groups (preschool, primary school, etc.) and implementing and interpreting the scale on groups with different characteristics will significantly contribute to the power of the measurement tool.

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Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors. Ethics Committee Number: Erciyes University/Social and Humanities Ethics Committee, 2020-176.

Authorship Contribution Statement

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APPENDIX

Problematic Technology Use Scale for Young Children (PTUS-YC)

Item No	Please rank the following items considering your preschool-age child's frequency of using technological tools (computer, tablet, smartphone, television, etc.). Please check only one option for each item.	Completely Disagree	Somewhat Disagree	Undecided	Somewhat Agree	Completely Agree
1	My child spends an average of more than 1.5 hours a day with technological tools.	(1)	(2)	(3)	(4)	(5)
2	My child exceeds the time limit we have set for technology use.	(1)	(2)	(3)	(4)	(5)
3	My child often expresses a desire to spend time with technological tools.	(1)	(2)	(3)	(4)	(5)
4	There is a significant time increase between my child's early and present technology use.	(1)	(2)	(3)	(4)	(5)
5	My child starts to spend time with technological tools without fulfilling daily responsibilities.	(1)	(2)	(3)	(4)	(5)
6	My child experiences negative emotions when he/she is not spending time with technological tools.	(1)	(2)	(3)	(4)	(5)
7	My child experiences positive emotions when he/she starts to spend time with technological tools.	(1)	(2)	(3)	(4)	(5)
8	My child relaxes by spending time with technological tools when he/she feels sad.	(1)	(2)	(3)	(4)	(5)
9	My child thinks about technological tools even when he/she is not spending time with them.	(1)	(2)	(3)	(4)	(5)
10	My child prefers to spend time with technological tools instead of spending time with us or with his/her friends.	(1)	(2)	(3)	(4)	(5)
11	My child spends time on technological tools by playing games or watching movies that are not suitable for his/her age.	(1)	(2)	(3)	(4)	(5)
12	My child's technology use makes him lonely.	(1)	(2)	(3)	(4)	(5)
13	My child prefers playing games on technological tools to playing games in real life.	(1)	(2)	(3)	(4)	(5)
14	My child does not want to go to school because he/she wants to spend his/her time with technological tools.	(1)	(2)	(3)	(4)	(5)
15	My child spends time alone with technological tools	(1)	(2)	(3)	(4)	(5)
16	My child's use of technological tools negatively affects his/her interaction with his/her environment.	(1)	(2)	(3)	(4)	(5)
17	My child's use of technological tools causes problems in his/her language development.	(1)	(2)	(3)	(4)	(5)
18	My child's use of technological tools has decreased the duration of his/her sleep.	(1)	(2)	(3)	(4)	(5)
19	My child eats/wants to eat while spending time on technological tools.	(1)	(2)	(3)	(4)	(5)
20	My child's use of technological tools makes him/her sedentary.	(1)	(2)	(3)	(4)	(5)
21	My child spends time with technological tools just before going to sleep.	(1)	(2)	(3)	(4)	(5)
22	I have disagreements with my child about the duration of his/her technology use.	(1)	(2)	(3)	(4)	(5)
23	My child does not tell us or lies about what he/she is doing while using technological tools.	(1)	(2)	(3)	(4)	(5)
24	My child tries to use technological tools secretly, although we limit his/her use of technology.	(1)	(2)	(3)	(4)	(5)
25	My child is annoyed when we try to communicate with him/her while spending time with technological tools.	(1)	(2)	(3)	(4)	(5)
26	My child does not allow us to track his/her technology use.	(1)	(2)	(3)	(4)	(5)

Continuity of Use: 1-2-3-4-15-19-21-22
Resistance to Control: 11-14-23-24-25-26
Effect on Development: 12-16-17-18-20
Deprivation-Escape: 5-6-7-8-9-10-13

Turkish version of the scale:

Çocuklar İçin Problemli Teknoloji Kullanımı Ölçeği

Madde No	Aşağıda yer alan ölçekteki maddelerin okul öncesi düzeyinde eğitim gören çocuğunuzun teknolojik araçları (bilgisayar, tablet, akıllı telefon, televizyon vb.) kullanım sıklıklarını düşünerek değerlendiriniz. Lütfen her madde için yalnızca bir seçeneği işaretleyiniz.	Hiç Katılmıyorum	Kısmen Katılmıyorum	Kararsızım	Kısmen Katılıyorum	Tamamen Katılıyorum
1	Çocuğum gün içerisinde ortalama 1,5 saatten fazla teknolojik araçlarla vakit geçirir.	(1)	(2)	(3)	(4)	(5)
2	Çocuğum teknoloji kullanımı konusunda belirlediğimiz süre sınırını aşar.	(1)	(2)	(3)	(4)	(5)
3	Çocuğum teknolojik araçlarla vakit geçirme isteğini sıklıkla dile getirir.	(1)	(2)	(3)	(4)	(5)
4	Çocuğumun teknolojiyi ilk zamanlardaki kullanım süresi ile şimdiki kullanım süresi arasında kayda değer bir artış vardır.	(1)	(2)	(3)	(4)	(5)
5	Çocuğum gündelik sorumluluklarını yerine getirmeden teknolojik araçlarla vakit geçirmeye başlar.	(1)	(2)	(3)	(4)	(5)
6	Çocuğum teknolojik araçlarla vakit geçirmediği zamanlarda olumsuz duygular hisseder.	(1)	(2)	(3)	(4)	(5)
7	Çocuğum teknolojik araçlarla vakit geçirmeye başladığında olumlu duygular hisseder.	(1)	(2)	(3)	(4)	(5)
8	Çocuğum kendisini üzgün hissettiğinde teknolojik araçlarla vakit geçirerek rahatlar.	(1)	(2)	(3)	(4)	(5)
9	Çocuğum vaktini teknolojik araçlarla geçirmediği zamanlarda dahi teknolojik araçları düşünmektedir.	(1)	(2)	(3)	(4)	(5)
10	Çocuğum bizimle veya arkadaşlarıyla beraber vakit geçirmek yerine teknolojik araçlarla vakit geçirmeyi tercih eder.	(1)	(2)	(3)	(4)	(5)
11	Çocuğum teknolojik araçlar üzerinden yaşına uygun olmayan oyunlar/filmler ile vakit geçirir.	(1)	(2)	(3)	(4)	(5)
12	Çocuğumun teknoloji kullanımı onun yalnızlaşmasına neden olur.	(1)	(2)	(3)	(4)	(5)
13	Çocuğum teknolojik araçlar üzerinden oyun oynamayı gerçek yaşamda oyun oynamaya tercih eder.	(1)	(2)	(3)	(4)	(5)
14	Çocuğum vaktini teknolojik araçlarla geçirmek istediği için okula gitmek istemez.	(1)	(2)	(3)	(4)	(5)
15	Çocuğum teknolojik araçlarla tek başına vakit geçirir.	(1)	(2)	(3)	(4)	(5)
16	Çocuğumun teknolojik araçları kullanması, çevresiyle iletişimini olumsuz olarak etkiler.	(1)	(2)	(3)	(4)	(5)
17	Çocuğumun teknolojik araçları kullanması, dil gelişiminde problemlere neden olur.	(1)	(2)	(3)	(4)	(5)
18	Çocuğumun teknolojik araçları kullanması uyku süresinin azalmasına neden olur.	(1)	(2)	(3)	(4)	(5)
19	Çocuğum yemeklerini teknolojik araçlarla vakit geçirirken yer/yemek ister.	(1)	(2)	(3)	(4)	(5)
20	Çocuğumun teknolojik araçları kullanması hareketsiz kalmasına neden olur.	(1)	(2)	(3)	(4)	(5)
21	Çocuğum uyumadan hemen önce teknolojik araçlarla vakit geçirir.	(1)	(2)	(3)	(4)	(5)
22	Çocuğum ile teknoloji kullanımı süresi konusunda anlaşmazlıklar yaşarım.	(1)	(2)	(3)	(4)	(5)
23	Çocuğum teknolojik araçlar kullanırken yaptıkları hakkında bize bilgi vermez veya yalan söyler.	(1)	(2)	(3)	(4)	(5)
24	Çocuğumun teknoloji kullanımını sınırlandırdığımızda bile gizlice kullanmaya çalışır.	(1)	(2)	(3)	(4)	(5)
25	Çocuğum teknolojik araçlarla vakit geçirirken kendisiyle iletişim kurulmasından rahatsız olur.	(1)	(2)	(3)	(4)	(5)
26	Çocuğum kendisinin teknoloji kullanımının takip edilmesine izin vermez.	(1)	(2)	(3)	(4)	(5)

Kullanım Sürekliliği: 1-2-3-4-15-19-21-22
Kontrole Karşı Direnç: 11-14-23-24-25-26
Gelişime Etki: 12-16-17-18-20
Yoksunluk-Kaçış: 5-6-7-8-9-10-13