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Research Article / Araştırma Makalesi

A Shorter Form of the Game User Experience Satisfaction Scale in Turkish: GUESS-20-TR

Oyun Kullanıcı Deneyimi Tatmin Ölçeği Türkçe Kısa Versiyonu: GUESS-20-TR

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ABSTRACT

Games User Research (GUR) has become an important subdomain of the Human-Computer Interaction field within the last few years, as gaming has becomes a daily entertainment for many people rather than being in the interest of a few game enthusiasts. Researchers require specific tools to measure the users' responses and attitudes towards the games. Game User Experience Satisfaction Scale is one of the recent additions to GUR tools, which had already been adapted into Turkish as GUESS-TR. Through this study, we aimed to verify a shorter form of GUESS-TR which is compatible with a currently existing English shorter version with 18 items that measure game user experience through 9 factors. Data revealed that a 20-item version resembling 10 factors, namely GUESS-20-TR, is a valid and reliable measure of game user experience. We provided evidence for construct validity through confirmatory factor analysis. Spearman-Brown prophecy coefficients indicate that the 2-item subscales are reliable. Heterotrait - monotrait ratios show that items indicate different constructs, i.e. discriminant validity. Based on Pearson correlation, the mean scores obtained with the short form GUESS-20-TR are highly consistent with the 51-item Turkish version.

Keywords: Games user research, games user experience, scale adaptation

ÖZ

Oyunların sadece tutkunlarına özel bir alan olmaktan çıkıp pek çok insan için gündelik bir eğlence haline gelmesi ile, Oyun Kullanıcı Araştırmaları (OKA), İnsan-Bilgisayar Etkileşimi alanının önemli bir alt dalı haline gelmiştir. Araştırmacılar, oyuncuların oyunlara verdikleri tepkileri ve oyunlara karşı tutumlarını ölçmek için özelleştirilmiş araçlara ihtiyaç duymaktadırlar. Oyun Kullanıcı Deneyimi Ölçeği (GUESS) de son yıllarda OKA araçlarına eklenmiş olup, GUESS-TR adı ile Türkçe'ye de çevrilmiştir. Bu çalışmada, 51 sorudan oluşan GUESS-TR'nin kısa bir versiyonu geliştirilmiştir. Halihazırda 9 faktörü ölçen 18 soruluk kısaltılmış GUESS-18 versiyonu da göz önüne alınarak, 20 sorudan oluşan ve 10 faktörü ölçen bir varyant ortaya konmuştur. Onaylayıcı faktör analizi ölçüm modelinin yapısal geçerliliğinin sağlaması yapılmıştır. İki sorudan oluşan ölçekler için önerilen Spearman-Brown korelasyon katsayısı alt ölçeklerin güvenilirliğine delalet etmektedir. Heterotrait- monotrait oranları, her bir ölçeğin farklı yapıları ölçtüğünü, yani ayrımlayıcı geçerliliği ortaya koymaktadır. Pearson korelasyon katsayıları göstermektedir ki, her bir faktör için 2 soru olmak üzere 20 soru ile elde edilen ortalama skorlar, 51 sorudan oluşan uzun ölçek ve alt ölçeklerinin ortalama skorları ile yüksek seviyede tutarlılık göstermektedir.

Anahtar Kelimeler: Oyun kullanıcı araştırması, oyuncu deneyimi, ölçek adaptasyonu

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1. INTRODUCTION

The field of Game User Research is a rapidly developing direction within the scope of human-computer interaction. Many different researchers have attempted to evaluate game user experience and proposed methods to measure player experience from different perspectives. The methods used to evaluate the user experience with the conventional approaches are effective for evaluating the applications with the aim of productivity in the most basic sense. However, they are insufficient in examining the user experience in games, since games are deliberately designed to be challenging, unlike productivity applications. The techniques and approaches in the field of user experience basically aim to minimize possible problems or obstacles in the application. On the contrary, obstacles and difficulties in digital games appear as elements of fun. (Aker, Rizvanoglu, & Bostan, 2017).

As given in the Related Studies section, researchers from different disciplines have different approaches to user experience in games and aim to analyze experience with heuristic methods through expert evaluation, assessment based on players' performance, ad hoc surveys, usability questionnaires or game-specific scales such as GUESS (Phan, Keebler & Chaparro, 2016). Undoubtedly, understanding the player experience is also essential for the gaming industry. In the face of increasing competition, many game companies are trying to make inferences from the field of player experience. An approach that is preferred today and which is increasingly common in game studies is based on analyzing the player experience through mixed methods, especially with the methods using game heuristics in expert evaluations. However, contrary to this qualitative perspective in the field, quantitative approaches are very few. The Game User Experience Satisfaction Scale (GUESS), which was introduced to fill this gap, is a relatively recent addition to the game user research toolkit. It has become one of the most used player experience evaluation methods in recent years. In this study, a short version of the GUESS was collated and its suitability was examined, using the Turkish GUESS-TR items and data obtained by Berkman, Bostan & Senyer (2022a; 2022a), considering the 18-item short-form version suggested by Keebler et al. (2020). GUESS-18 is validated for its construct validity, convergent validity, discriminant validity and reliability.

Phan et al. (2016), suggested the following definition for the term playability/usability: "The ease with which the game can be played with clear goals and objectives in the user's mind, without being hindered by the user interface and controls, with minimal cognitive interference". As for the scale suggested by Keebler et al. (2020), only items related to the game interface were included, and items related to controls and clarity of game objectives were not. On the other hand, Berkman et al. (2022a) suggested that some of the items of "usability" are about the game interface and controls. On the other hand, they also examined the items related to game objectives as a separate dimension under the title of "playability". It was emphasized that the scale, named GUESS-TR after different validation analyses, is a valid and reliable tool for the field of game user research. This study also overcame the language barrier and produced usable results. However, the adaptation of the GUESS scale to other languages has not gained much popularity, as it is still considered new and is not among the classical scales like GEQ (Game Experience Questionnaire) (Ijsselstein, de Kort and Poels, 2007) or System Usability Scale (SUS) (Brooke, 1996). For that reason, we aimed to present a short and localized version of the GUESS scale based on the recently translated GUESS-TR scale and the short-form GUESS-18. With this scale, which can be put forward in light of the data obtained from our previous research, a useful and up-to-date method can be suggested that would benefit both the industry in the country and academia. This will be presented through the Turkish version of the short GUESS scale, which is considered much more practical, fast, and effective. In order to achieve this, the Turkish translation study and the 18-item version of GUESS will be used.

We decided to create a short version of GUESS in Turkish for several reasons. First of all, it had already been adapted into Turkish with 51 items measuring 10 factors, and the dataset was available as open data. In addition, the original scale was developed by analyzing a large spectrum of prior research. Thirteen surveys on gaming experience, 15 game heuristic lists and, 3 user satisfaction surveys of human-computer interaction were explored to determine the original GUESS items, ensuring the content validity of the measurement tool. Furthermore, there is already a short-form version based on the English version, suggesting that a short-form version is viable, as well as providing a starting point for selecting the smaller set of items.

The impact of technological developments in the gaming industry should also be considered. Due to the rapidly developing technology, the questionnaires used in the assessment of human-computer interaction tend to become outdated. A recently developed measurement tool is more likely to gratify state-of-the-art requirements. Localization is also necessary in the implementation of the scale in order to ensure widespread use and overcome the language barrier.

2. METHODS OF EVALUATING GAMES FOR USER EXPERIENCE

Many of the methods used in Games User Research are inherited from Human-Computer Interaction and usability studies and these methods mainly focus on either users' behavior or users' attitude (Medlock, 2018). Some methods can be applied early in the lifecycle of the game design such as focus groups, interviews, or ethnographic field studies as well as card sorting, personas, and online surveys to envision what the game is going to be like. During the design and development phase, usability tests, physiological measurements, expert reviews, and heuristic evaluations can be used to assess users' behavior, whereas surveys and playtests with interview sessions help to understand users' attitudes. When the game is being released, telemetry analysis on the gameplay data, benchmark tests, and unmoderated usability tests can be used. After the release, A/B tests are employed to explore further updates. Some of these methods are for understanding the target user group of the end product, and others are for determining the product's attributes. Furthermore, these methods may help to identify the business model and provide valuable information about how the product is supposed to be built. Since standardized questionnaires such as GUESS are used in the design and development phase along with other methods, below we provide a review of methods that are mainly used in the design phase.

2.1. HEURISTIC APPROACHES

Malone (1982) proposed a set of heuristics for instructional games and suggested that there were three main heuristics for achieving entertainable interfaces. Three empirical tests were employed to understand what gamers like with a total number of 81 participants. As a result, he proposed the three heuristics categories; challenge, fantasy, and curiosity. Desurvire et al. (2004), proposed the Heuristics of Playability (HEP) framework and prepared a heuristics set of 43 items, based on literature and reviewed by several experts. During the study, the researchers conducted a user-testing method for validating and comparing the results from the heuristic evaluation. Federoff (2002) explored existing game heuristics and collated them to analyze the 'fun' aspect of the games. Five people from a game development team were observed and interviewed to suggest a set of heuristics for the evaluation of video games. On the other hand, Korhonen & Koivisto (2007;2006) were the first to publish playability heuristics for mobile games. They proposed a modular structure for their playability heuristics. There were two phases of the study; the first part involved the use of the three categories of heuristics with different mobile games. Four experts analyzed five mobile games in total. In the second phase, the set was iteratively improved and the experts conducted the test for the second time, but with different games. In their latter study, they included another module for the multiplayer aspect of mobile games. They prepared the heuristics for the multiplayer category by examining three multiplayer mobile games and by conducting a literature study. Schaffer (2008) suggested evaluating usability in video games. The aim of his study was to suggest a guideline for evaluating games. It was indicated that with both the utilization of user tests and expert evaluation methods, it would be possible to analyze the usability of games. 21 heuristics were suggested with five categories: general, graphical user interface, gameplay, control mapping and level design.

2.2. PERFORMANCE-BASED EVALUATIONS

The status of the player and game -world, which can be further analyzed through gameplay videos are widely used indicators of players' performance, where the player achievements and failures can be clearly observed. The in-game scores, which are obtained in many games, are also very easy to acquire for research purposes (Desurvire and Wixon, 2018). Both the gameplay status and the scores can be acquired via telemetry, where game software records the events in the game and reports them to the researchers (Drachen & Connor, 2018). Using game analytics, researchers can acquire performance measures, e.g. time spent on challenges and tasks, in-game objects that were mostly interacted with, or the number of failures in a gameplay session until the player quits the game.

2.3. PHYSIOLOGICAL MEASURES

Physiological measures are usually considered as an indicator of users' emotional state, whereas some measures also indicate the cognitive effort of users (Akan & Berkman, 2020). Although they may include noise and can be difficult to interpret, they are suggested to be immune to researcher or participant bias (Kivikangas et al., 2011). Cardiovascular measures such as heart rate, heart rate variability, and blood pressure can be acquired non-invasively during gameplay, and can be used as an indicator of valence and arousal. Brain-computer technologies such as EEG (electroencephalography) and fMRI (functional magnetic resonance imaging) have been used in game user studies. EEG can be employed to assess the emotional changes and cognitive activities of the players during gameplay (Hafeez et al.,

2021). fMRI mainly depicts cognitive aspects such as immersion, flow, challenge but also reveals data on affection (Ju & Wallraven, 2019). The facial expressions, which can be detected either via electromyography or image processing are assessed as indicators of emotions in several studies (e.g. Isman, Prasasti & Nugrahaeni, 2021). Furthermore, measures of electrodermal activity are employed in game user studies as indicators of emotional changes, however, obtained results are mixed, as some studies did not detect any changes in measurements due to gameplay conditions or could not identify a correspondence between subjective measures. Eye-Related measures, such as fixations and movements of the eye were found to be related to cognitive activity (e.g Jennet et al., 2008; Mueller, Jackson & Skelton., 2008; Alkan & Çağıltay, 2007) and pupil size indicated the emotional changes (Mojzisch et al., 2006).

2.4. STANDARDIZED QUESTIONNAIRES

Some widely known examples of questionnaires used in the evaluation of gameplay experiences are "Game Experience Questionnaire (GEQ)" (IJsselsteijn et al., 2007), "Gameplay Experience Questionnaire" (Ermi & Mäyrä, 2005), "Player Experience of Need Satisfaction (PENS)(Ryan, Rigby & Przybylski., 2006) and Immersion questionnaire (Jennett et al., 2008). Phan et al. (2016) criticized the lack of psychometric validation for some of the GEQ (Game Experience Questionnaire (IJsselsteijn et al., 2007) and PENS (Ryan et al., 2006). Some subsequent studies provided partial evidence of the psychometric qualities of the GEQ and PENS (Johnson, Gardner & Perry, 2018; Law, Brühlmann & Mekler, 2018; Berkman & Bostan, 2017) and it is suggested that the GEQ scale is not fully effective in measuring experience (Aker et al., 2017).

Some of the other questionnaires focus on only a single aspect of gaming or are designed to assess specific types of game genres such as interplayer interactions in serious games (Gorsic et al., 2019), attitudes toward game narrative (Qin, Patrick-Rau & Salvendy, 2009) or social presence (de Kort, IJsselsteijn & Poels, 2007). The PLEXQ (Playful Experiences Questionnaire) (Boberg et al., 2015) is not intended only for assessing game user experience, but it is a measure of playfulness, which can also be applied to games.

PXI (Player Experience Inventory) is another recent addition to the GUR toolbox (Abelee et al., 2020), which is highly similar to GUESS in its content. Aiming to assess player experience based on game design choices, there are 10 sub-dimensions with three items each; "meaning," "mastery," "immersion," "autonomy," "curiosity," "ease of control," "challenge," "progress feedback," "audio-visual appeal," and "goals and rules." Thus, it has similar characteristics with GUESS, in terms of its focus on the relationship between game design elements and player experience. It should be noted that GUESS has more dimensions querying about the game design elements such as narratives and social interaction.

3. STUDIES RELATED WITH THE GUESS

The original GUESS is a 55-item tool that defines video game satisfaction/satisfaction and evaluates nine different constructs. Phan et al. (2016) introduced this psychometrically validated scale for the purpose of comprehensive measurement of video game satisfaction. More than 450 different games with more than 1,300 participants were evaluated in their study. As a result, they produced a 55-item satisfaction scale with nine constructs: Usability/playability, Narrative (NA), Player Engrossment (PE), Enjoyment (EN), Creative Freedom (CF), Audio Aesthetics (AA), Personal Gratification (PG), Social Connectivity (SC), and Visual Aesthetics (VA). The Usability/Playability dimension refers to the ability to play the game without any hindrance due to the game's interface or controls, as well as the ease of setting and determining goals. The Narrative dimension includes storytelling elements such as characters, events, and fictional elements. The Player Engrossment dimension deals with how much value and dedication the player gives to the game. The Enjoyment, as its name suggests, indicates how much delight the player has and/or enjoys playing. The Creative Freedom dimension asks the players about the extent that they can express themselves as individuals in the game, as well as their curiosity motive. The Audio Aesthetics dimension examines the effect of the sound and music used in the game on the experience, and the Visual Aesthetic dimension expresses the contribution of the visual elements with the same regard. The Personal Gratification dimension relates to the motivations that support the player's sense of achievement that the game offers. Finally, the Social Connection dimension was introduced to query the players' thoughts on playing games with other people.

The GUESS has been used in many studies and has succeeded in producing useful results. For example, it has been used previously to evaluate the application of procedural content generation for video games (Wijaya, Hansun & Kristanda, 2019). Xu et al. (2019) used GUESS in a study in Japan to evaluate the effect of "Player Domination Adjustment" on the gaming experience. The same scale was also assessed in the context of various VR games (e.g. Shelstad, Smith, and Chaparro., 2017; Yildirim et al., 2018; Aksayim & Berkman, 2020). Ali, Arumugam & Kumaran

(2021) used GUESS to assess the gamification elements in a medical rehabilitation program. A serious game within the novel concept of "audience participation game with a purpose" had also been evaluated through GUESS dimensions (Nguyen et al., 2020) as well as it was used for assessing a board game (Thevin et al., 2021). Studies show that GUESS is being used not only in GUR studies but also gaining demand in gamification and serious game research.

Findings of these studies also provide evidence for the sensitivity of GUESS, i.e. it is capable of producing significantly different scores regarding the attributes of the games evaluated. Although it is possible to use each dimension of GUESS as an independent measurement tool, responding to 55 items is cumbersome when repeated assessments are required (Keebler et al., 2020). On the other hand, one of the important advantages of GUESS is that each subscale can be used independently from the other, based on the requirements of the researcher. However, a 55-item scale is not practical to obtain an overall game user experience score. Hence, the necessity of introducing a much shorter version of the GUESS emerged, and Keebler et al. (2020) suggested an 18-item version, in which each of the 9 dimensions of the original GUESS is assessed through two items. A configurable 55-item model and an initial 18-item model of the GUESS were assessed based on the data obtained from 419 valid surveys from participants aged between 18 to 72 (M = 35.11, SD = 11.63). The final 18-item model was assessed through a total of 197 valid responses from participants ages ranging from 18 to 68 (M = 33.21, SD = 10.90). The final scale, which is called GUESS-18, is a valid and reliable measure and it is stated that it can be acquired as a short, practical, and comprehensive measure of game satisfaction for practitioners and researchers.

4. TRANSLATING THE GUESS INTO TURKISH

As mentioned before, removing the language barrier is also an important factor in practice. Non-English survey respondents can belikely to experience a foreign language as confusing, even if they are bilingual. For this reason, it should be considered an important criterion for the aforementioned scale's practicality which should be adapted to Turkish, to be presented to Turkish gamers. Although heuristics and in-depth interviews meet some of the industry's needs, the growing game industry in Turkey and the increase in game user research initiatives need reliable and valid measurement tools such as GUESS. However, employees and teams in the industry have difficulties in implementing this scale, which is not available in their users' mother tongue. The GUESS, which is used much more frequently today compared to other scales, was translated into Turkish by Berkman et al., (2022a) for this very reason. In the study, whereas the GUESS was translated into Turkish through a series of expert reviews and back-translation processes, the translated set was tested in the laboratory environment and in the participants' homes, which can be considered their natural environment for playing games. During the translation, they received feedback from three different English language experts and ensured that the language of the scale was translated properly. In the study, it was underlined that it is insufficient to simply translate materials for adaptation research since the translators should have an in-depth understanding of the subject matter and culture. Hence, in the abovementioned study, two of the authors took on the role of translators and translated GUESS items in Turkish, paying close attention to the original statements and Turkish gamers' understanding and vocabulary. The translated version was then presented to three English language specialists who were either licensed translators or foreign language instructors. They gave each translation a grade ranging from 1(proper) to 3 (improper), and if they gave the translation of an item a grade other than "1", they were invited to give an alternative translation (Berkman et. al., 2022a). Subsequently, six different games were examined in their study. The Turkish version of the entire 55-item set of GUESS was tested with Turkish participants. As a result of the measurements made with the data set consisting of 449 questionnaires, in which 121 participants evaluated 6 games in total, 51 items were retained, but it was pointed out that the 'Playability (PL) and the Usability (US) factors should be kept separately, both structurally and conceptually.

5. METHODOLOGY

5.1. DATA SET & PARTICIPANTS

The data set used by Berkman, et al. (2022a) and published openly (Berkman, Bostan & Şenyer, 2022b) was employed in our analysis. As mentioned above, 6 games were evaluated by 121 participants in the study. One game was played on a game console platform whereas one was played on a mobile platform, in the laboratory prepared for play testing. The other four games were played on the participants' personal computers at their homes. As for the selection of the games, similar to studies of Phan et al. (2016) and Kebbler et al. (2020), it is not left to the player's own choice, and the games chosen by the researchers are requested to be played. The game design students forming the sample are relatively more qualified in terms of domain knowledge than other players. The list of games as given by Berkman et al. (2022a) is summarized below in Table 1.

Table 1. The list of games and their attributes, Berkman et al. (2022a)

Game	Company/ Year	Platform	Genre	Environment	Narrative
Super Mario Odyssey	Nintendo, 2017	Nintendo Switch	Platformer and action game	Cartoonish and vivid colors	Level-based narrative with environmental cues
Sniper Elite 4	Rebellion, 2017	PlayStation 4	Third-person tactical shooter stealth game	Realistic	Fast-paced, action-oriented storytelling with fast beats
Contrast	Compulsion Games, 2013	PC	Indie puzzle and adventure game	Gloomy and cartoonish	Slow-paced storytelling relying on the puzzles and the environment
Control	Remedy Entertainment, 2019	PlayStation 4	Supernatural action-adventure game	Realistic, dark, and red colors are highly used to give a mysterious and dangerous atmosphere	Mixed-paced (slow and fast) storytelling around the challenges
Hellblade: Senua's Sacrifice	Ninja Theory, 2017	PC	Action-adventure game	Realistic, gloomy, and mysterious atmosphere	Fast-paced, action-oriented storytelling as the player fights through the world
The Council	Big Bad Wolf, 2018	PC	Adventure role-playing game	Gloomy and semi-realistic	Complex, slow-paced storytelling enriched by deep characters

As a part of a course they took, the participants were asked to play the above games and write a report on the narratives of these games, and they were also asked to answer the GUESS items given in Turkish. As participants, there were 24 females and 97 males between the ages between 19 and 32 (M = 21.01, SD = 1.86). Approximately one-third of the participants (N=35) evaluated all the games (210 evaluations), which corresponds to half of the evaluations. 20 participants evaluated five of the games (100 evaluations), 5 participants evaluated four, 15 participants evaluated three, 28 participants evaluated two, and 18 participants evaluated only one of the games.

6. ANALYSIS

Our analysis included both the 10-factor solution (Berkman et al., 2022a) through 20 items and the 9-factor solution (Keebler et al., 2020; Phan et al., 2016) through 18 items comparatively. Indicators are reported also in comparison with the results obtained for long-form scales.

Cronbach's alpha is reported as an indicator of reliability for the 18 and 20 items as an overall measure. As the short version has 2 items per dimension, the Spearman-Brown Prophecy Formula was used instead of Cronbach's alpha, as it is suggested for two-item scales (Eisinga, Grotenhuis & Pelzer, 2013). Cronbach's alpha values are reported only to be compared with previous short-form studies, but they were not intended as a valid indicator of reliability for two-item subscales.

Standardized Root Mean Squared Residual (SRMR), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and Root-mean-square error of Approximation (RMSEA) values are reported as indicators of model fit for assessment of construct validity, using the widely accepted threshold values (see Hooper, Coughlan & Mullen, 2008).

For discriminant validity, the Fornell-Larcker criterion regarding the comparison of Average Variance Extracted (AVE) and Maximum Shared Variance (MSV) is employed to provide results that can be compared with the findings of Keebler et al. (2020). However, we have taken the Heterotrait Monotrait (HTMT) ratio as the main method of assessing discriminant validity, as it is suggested to be superior to the Fornell-Larcker criterion (Henseler, Ringle & Sarstedt, 2015). In order to determine the convergent validity mean scores obtained from the 51-item GUESS-TR and 20-item GUESS-20-TR are compared through Pearson correlations. Item E03 is reverse coded before the analysis since it has a

negative statement. The overall score and the scores for the subscales are calculated as mean values of the corresponding items.

7. RESULTS AND DISCUSSION

7.1. CONSTRUCT VALIDITY

Both the 9-dimension (18 items) Phan-Keebler model and the 10-dimension (20 items) Berkman et al. (2022a) model lead to a Heywood case on the Social Connectivity dimension, with a negative variance estimate on the SOC2 item. Since having a negative variance is impossible, the model should be corrected. Reasons for a Heywood case could be the small-sized sample for adequate estimation of parameters, a dataset that is not normally distributed or has many outliers, or a misspecified model. Furthermore, very high and very low correlations are also suggested as a reason for the Heywood cases (Rindskopf, 1984). Since the model is known to be working with other datasets (Keebler et al, 2020) and different measurement items on the same dataset (Berkman et al, 2022b), we explored the data quality of the Social Connectivity items. As given in Table 2, the Shapiro-Wilk tests greater than 0.05 indicate a normal distribution of data. However, skewness is greater than |2| for the SC01 item. The relatively lower standard deviation (SD) of 1.65 also indicates a lesser variance compared to other items. Furthermore, the item is very close in content to the item SC02. Besides, there is a higher correlation between SC02 and 03 (r=.657, p<0.001) compared to the correlation between SC01 and SC03 (r=412, p<0.001). Considering these issues, we decided to replace item SC01 with item SC03 and keep the SC02 item.

Table 2. Descriptives for Social Connectivity Items

	SC01	**SC02**	**SC03**
N	292	272	327
Missing	157	177	122
Mean	3.27	3.99	3.94
Median	3.00	4.00	4
Standard deviation	1.65	1.75	2.05
Skewness	0.355	-0.109	-0.00343
Std. error skewness	0.143	0.148	0.135
Kurtosis	-0.704	-0.776	-1.27
Std. error kurtosis	0.284	0.294	0.269
Shapiro-Wilk W	0.923	0.930	0.905
Shapiro-Wilk p	< .001	< .001	< .001

This helped us to achieve validity for both the 9-dimension and 10-dimension measurement models, without any parameter estimate having an impossible value. Many of the model fit indicators given in Table 3 provide evidence that both measurement models with Turkish items have construct validity except the TLI value. However, it is also close to the suggested threshold of 0.95, but lower than the values observed in Kebbler et al. (2020) findings with initial and final short models. Since other studies did not report their findings on TLI, it is not possible to make a comparison. However, we observe a minor improvement in TLI values and SRMR indicator when the model is based on 18 Turkish GUESS items measuring 9 dimensions, compared to the 20-item model measuring 10 dimensions. When the CFI and RMSEA are compared to the previous studies, our findings are very similar to the observation of Phan et al. (2016) based on 55 items measuring 9 dimensions but slightly poorer than Keebler et al. (2020) findings.

Table 3. Model Fit Indicators

	SRMR (.05<, <.08)	NFI closer to 1	TLI (>.95)	CFI (>.95)	RMSEA (<.08/<.05)	**χ2, df, p**
GUESS-20-TR	0.035	0.932	0.94	0.96	0.052	278, 125, p<0.001
GUESS-18-TR	0.032	0.938	0.942	0.962	0.055	234, 99, p<0.001
GUESS-TR 10 dimension	0.089	0.705				4821.087, NA, p<0.001
Original GUESS				0.82	0.053	4428.63, 1394, p<0.001
Kebbler's configural model			0.866	0.875	0.050	2827.186, 1391, p<0.001
Kebbler's initial short model			0.96	0.975	0.042	171.966, 99, p<0.001
Kebbler's final short model			0.961	0.974	0.043	137.015, 100, p<0.001
GUESS-GA-18			0.932	0.957	0.041	179.077, 108, p<0.001

7.2. RELIABILITY

Although the previous studies reported Cronbach's alpha as the indicator of reliability, we embraced the Spearman-Brown Prophecy Formula which is recommended for 2-item scales as a better indicator of reliability compared to Cronbach's alpha (Eisinga et al., 2013), as the Brown formula assumes that the split-halves are parallel measures. Whereas its first row reports the Spearman-Brown correlations for each subdimension, Table 4 also depicts the Cronbach's alpha values of 18 and 20-item versions in comparison with previous studies.

Results show that all of the values are above the generic threshold of .70 for reliability for the Spearman-Brown correlation values, except the Usability dimension. However, it is at an acceptable level to consider the two item measurement as a reliable scale

Table 4. Reliability indicators for each dimension

	PL	US	NA	VA	AA	CF	EN	PE	PG	SC
GUESS-20-TR / Sp.Br. r	0.765	0.680	0.889	0.915	0.81	0.888	0.884	0.923	0.802	0.881
GUESS-20-TR / Cr0. α	0.620	0.515	0.8	0.843	0.68	0.799	0.792	0.857	0.670	0.793
GUESS-TR 10 dimension	0.744	0.823	0.869	0.844	0.832	0.84	0.923	0.92	0.801	0.786
Original GUESS		0.83	0.85	0.79	0.89	0.86	0.8	0.81	0.72	0.86
Kebbler's final short model		0.769	0.809	0.818	0.890	0.819	0.8	0.722	0.771	0.794
GUESS-GA-18 / Sp.Br. r		0.665	0.807	0.722	0.777	0.61	0.56	0.575	.645	0.545

When the overall items' reliability is assessed through Cronbach's alpha, the GUESS-20-TR reveals a value of 0.902, slightly lower than the 18-item version with 0.907. The original 55-item GUESS is reported to have a Cronbach's alpha value of 0.93 (Phan et al, 2016) and the Keebler et al. (2020) final 18-item model revealed a score of 0.785.

The following Figure 1 shows the factor loadings for the 20-item version with 10 dimensions, revealing that items have strongly loaded on their intended latent variable, which is also a common indicator of construct validity.

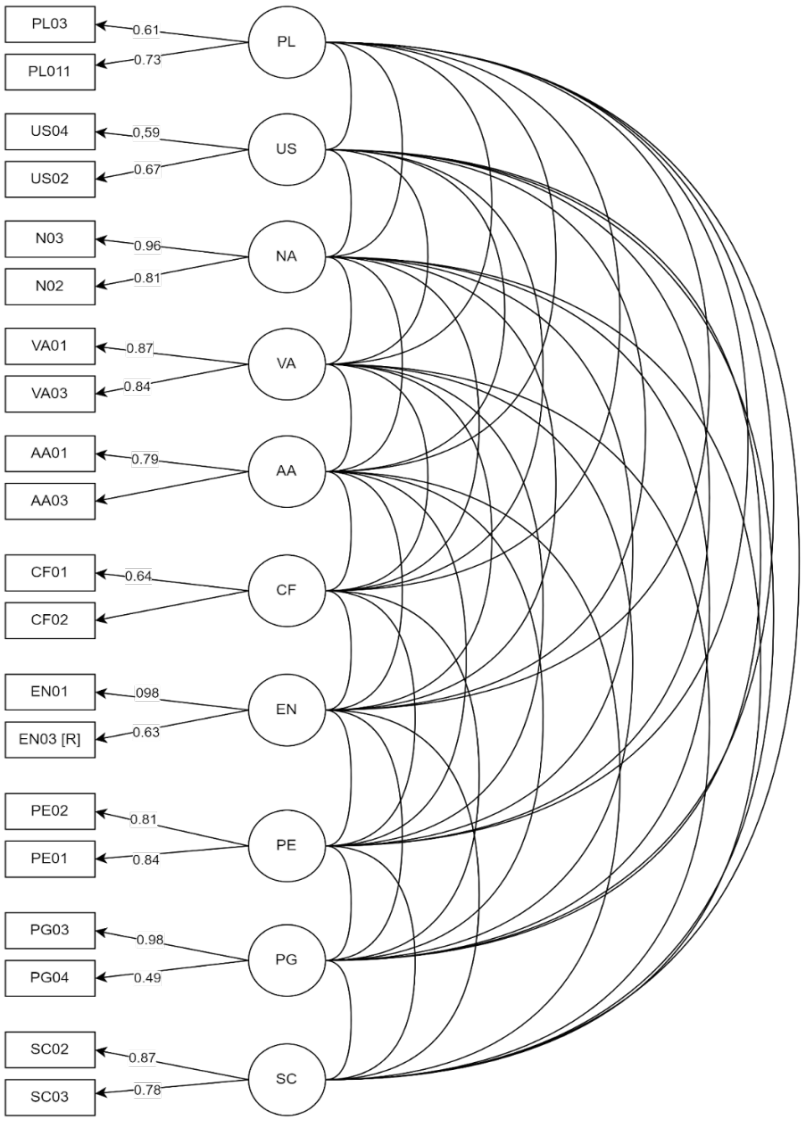

Figure 1. Measurement Model and Factor Loadings. See Table 5 for Factor Correlations

7.3. DISCRIMINANT VALIDITY

We evaluated both the 18-item and 20-item versions of GUESS-TR through the Fornell-Larcker criterion to provide results that are comparable to Keebler et al. (2020) and Berkman et al. (2022a). However, the HTMT ratio is shown to be a superior method of assessing discriminant validity, compared to the Fornel-Larcker criterion (Henseler et al., 2015). We also evaluated GUESS-18-TR and GUESS-20-TR through a conservative HTMT ratio criterion of 0.85.

According to the Fornell-Larcker criterion, the $\sqrt{}$AVE values of each dimension should exceed its correlation to any of the other dimensions. As given in Table 5, our two-item short version GUESS-TR meets this criteria, except the $\sqrt{}$AVE of Playability dimension being lower than the correlation of Playability with Usability and Enjoyment. It should be remembered that Playability is suggested by Berkman et al. (2022a), by separating the united Usability/Playability dimension suggested by Phan et al (2016) and embraced by Keebler et al. (2020). According to the Fornell-Larcker criterion, the two-item Playability dimension is not a unique measure, although it appeared to be discriminated from other dimensions in Berkman et al (2022a) study, with a $\sqrt{}$AVE of .748 value which is higher than its correlations with other dimensions.

On the other hand, the HTMT ratio values we observed in the 10-dimension model confirm the discriminant validity

Table 5. AVE and Factor Correlations. √ AVE values are given in bold and italic.

√ AVE	Playability	Usability	Narratives	VisualAesth	AudioAesth	CreativeFree	Enjoyment	PlayerEngross	PersonalGrat	SocialConnect
Playability	***0.567***	0.836	0.448	0.285	0.433	0.424	0.638	0.299	0.514	0.162
Usability		***0.848***	0.437	0.555	0.455	0.398	0.567	0.373	0.358	0.171
Narratives			***0.844***	0.575	0.645	0.618	0.732	0.624	0.544	0.201
VisualAesth				***0.732***	0.696	0.393	0.525	0.492	0.455	0.208
AudioAesth					***0.803***	0.423	0.686	0.533	0.572	0.303
CreativeFree						***0.824***	0.536	0.642	0.542	0.128
Enjoyment							***0.867***	0.607	0.608	0.302
PlayerEngross								***0.736***	0.554	0.163
PersonalGrat									***0.792***	0.191
SocialConnect										***0.661***

for all dimensions. As shown in Figure 2, none of the HTMT ratio values exceed the conservative threshold of 0.85. In Berkman et al. (2022a) study, the HTMT ratio of Narratives to Creative Freedom was reported to be 0.89, but still in line with the more liberal 0.90 HTMT ratio threshold.

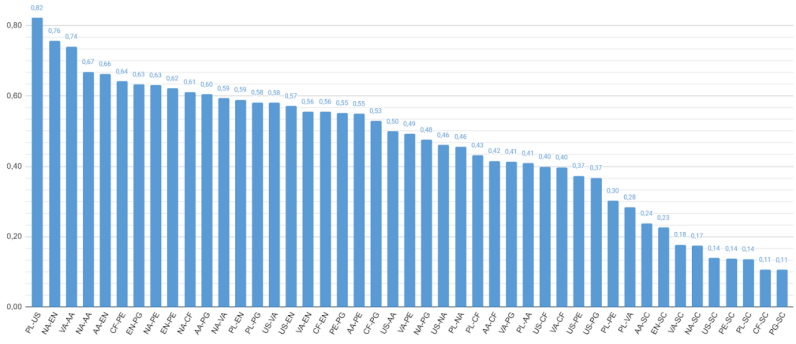

Figure 2. Heterotrait - Monotrait ratios of subscales from highest to lowest

7.4. CONVERGENT VALIDITY

Mean scores obtained with the 51-item GUESS-TR and the short form 20-item GUESS-20-TR scores are compared to assess the convergent validity of the short version. The overall mean scores are strongly correlated at a significant level; r=0.975; p<0.001. The weakest correlation is observed on the Creative Freedom dimension; r=0.856, p<0.001, but still shows a strong correlation between measurement made with 7 items in GUESS-TR and the two-item short version. Another relatively weaker correlation is observed on Personal Gratification; r=0.884, p<0.001, which is measured via 5 items in the long-form scale. The Usability mean scores also correlate at 0.887 (p<0.001). The other 7 dimensions have strong correlations between 0.91 to 0.965 at a significant level (p<0.001). These results show that the 20-item GUESS-20-TR is capable of producing results that are very similar to the 51-item version.

8. CONCLUSION

Our results show that the 20-item short version of GUESS-TR, given in Appendix-I, is a valid and reliable measure of game user experience with two items per dimension. The Turkish dimension names are given as suggested by Bostan (2022). Although GUESS-TR is shown to be applicable with 18 items indicating a 9-factor model, the additional Playability dimension is determined to be different from the other 9 dimensions. Both models are verified for their construct validity according to several model fit criteria. For the 10-dimension model with 20 items, Playability fails to be distinguished from Usability according to the Fornell- Larcker criterion, but the novel HTMT approach provides evidence that the two-item measure of Playability is different from the two-item measure of Usability. As previously discussed in Berkman et al. (2022a), these item sets are conceptually different. The Usability items query the user about the ergonomics of the interface elements and the controls, whereas the Playability items ask about the clarity of goals and self-confidence of the player about the actions that need to be taken to achieve these goals. In other words; Usability is about the user interface but Playability is about the game mechanics. Based on our findings, we suggest using the

20-item measure, namely GUESS-20-TR for assessing the game user experience and reporting the measurements in 10 dimensions including Playability. Please note again that the items in the Usability dimension of GUESS-20-TR are the same as the so-called Playability/usability dimension of GUESS-18 (Keebler et al., 2020). However, our additional two items indicate another dimension, Playability; which is conceptually different and can be statistically discriminated from Usability.

Although the reliability of the dimensions seems to be decreasing when the number of items per dimension is limited to two, indicators obtained through the Spearman-Brown Prophecy Formula suggest an acceptable level of reliability for the dimensions based on Turkish items.

Pearson correlations obtained between the short and long versions of GUESS-TR reveal that similar mean scores can be achieved with either of the scales. However, further studies are required in order to compare their sensitivity, i.e. the scale's capability of producing significantly different scores for games that provide different qualities in terms of user experience. The GUESS dimensions are reported to be sensitive to the differences between games (Aksayim & Berkman, 2020), yet there is no evidence on the sensitivity of the GUESS-18, the GUESS-TR, and the GUESS-20-TR. We suggest researchers use the subscales of the 51-item version GUESS-TR to obtain a higher sensitivity when their study does not require the assessment of all dimensions.

This study shows that the 10-factor model of Berkman et al. (2022a) measured via 51 items is applicable in a shorter form of GUESS. However, the model is only tested on the data collected with Turkish-translated items. Future studies employing GUESS in English should consider assessing the 10-factor model. Furthermore, future adaptation studies into other languages should also consider the 10-factor model. However, it should be noted that the factor model is assessed using a data set that is collected through a study in which the participants played the games they were asked to play. They are different from 9-factor model studies (Phan et al., 2016, Keebler et al, 2020) where participants were evaluating a game of their choice that they have recently played. Since most of the participants are likely to evaluate a game that they love to play, the indicators may reveal a lesser amount of variance that affects the granularity of the data.

Furthermore, both shorter form and full-length GUESS versions should be assessed against other criteria, such as PXI (Abelee et al., 2020), measures obtained regarding the player performance such as time on task, tasks completed and the score achieved in the game, as well as the measures obtained through biometric methods used in game studies (Akan & Berkman, 2020).

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Appendix I - GUESS-20-TR items

Audio Aesthetics / Ses Estetiği
A01 Bu oyundaki ses efektlerinden keyif alıyorum.
A03 Bu oyunun seslerinin (örneğin ses efektleri, müzik) oyun deneyimimi arttırdığını hissediyorum.

Creative Freedom / Yaratıcılı Özgürlük
CF01 Bu oyunun hayal gücümü kullanmama olanak sağladığın düşünüyorum.
CF02 Bu oyunu oynarken kendimi yaratıcı hissediyorum.

Enjoyment / Eğlence
E01 Bu oyunun eğlenceli olduğunu düşünüyorum.
E03 Bu oyunu oynarken sıkılıyorum. [R]

Narratives / Anlatı
N02 Bu oyunun hikayesini başından itibaren çekici buluyorum.
N03 Bu oyunda sunulan fanteziden veya hikayeden keyif alıyorum.

Player Engrossment / Oyun Meşguliyeti
PE01 Bu oyunu oynarken dış dünyadan kopmuş hissediyorum.
PE02 Bu oyun sırasında gerçek dünyada olan biteni umursamıyorum.

Personal Gratification / Kişisel Tatmin
PG03 Bu oyunu elimden geldiğince iyi oynamak istiyorum.
PG04 Bu oyunu oynarken kendi performansıma çok odaklanırım.

Social Connectivity / Sosyal Bağlanırlık
SC03 Canim isterse bu oyunu diğer oyuncularla oynayabilirim.
SC02 Bu oyunu diğer oyuncularla birlikte oynamak hoşuma gidiyor.

Visual Aesthetics / Görsel Estetik
VA01 Bu oyunun grafiklerinden keyif alıyorum.
VA03 Bu oyunun görsel olarak çekici olduğunu düşünüyorum.

Usability / Kullanılabilirlik
US02 Bu oyunun kontrollerini apaçık anlaşılır buluyorum.
US04 Bu oyunun arayüzünü gezinmesini kolay buluyorum.

Playability / Oynanabilirlik
PL03 Bu oyunda hedeflerime/amaçlarıma nasıl ulaşacağımı her zaman bilirim.
PL11 Bu oyunu oynarken kendime çok güveniyorum.

Participants respond to the items through a Likert scale from "1 – Hiç katılmıyorum" (Strongly Disagree) to "7 – Tamamen katılıyorum" (Strongly Agree).

[R] marked item E03 should be reverse coded for scoring.

Item numbers/names are given according to the 51-item GUESS-TR (Berkman et al. 2022a; 2022b).

See Berkman et al. (2022a; 2022b) for the 51-item version, which can be used separately for each dimension regarding the requirement of the researchers.