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Adaptation of Design Self-Efficacy Scale into Turkish Language

Tasarım Özyeterliliği Ölçeğinin Türkçeye Uyarlanması

Oğuzhan Atabek*

Abstract: The purpose of this study was to develop a Turkish version of the Design Self-Efficacy Scale (Beeftink, van Eerde, Rutte, & Bertrand, 2012) and to explore its psychometric properties. Design Self-Efficacy Scale may be used for measuring preservice and inservice teachers' design self-efficacy and for producing knowledge which may be useful for explaining teachers' design expertise. Participants were 510 preservice teachers enrolled in a public university in Turkey (N=510). Out of 510 preservice teachers, 269 (52.75%) participated in the first study for the exploratory factor analysis and 241 (47.25%) participated in the second study for the confirmatory factor analysis. Of all the participants, 377 (73.9%) were female and 133 (26.1%) were male. Design Self-Efficacy Scale which is an 8-item Likert-type English questionnaire was translated into Turkish by the researcher. A total of eight researchers who were expert in English language education, educational measurement and evaluation, Turkish education, elementary education, and educational technology fields participated in the back-translation and expert review processes. The experts were employed in the faculty of education of the university that the study took place. Exploratory factor analysis resulted with a single-factor model similar with the original scale. Cronbach's α coefficients was 0.877. Confirmatory factor analysis demonstrated a statistically significant model fit to the data. Results validated the factor structure of the adapted scale: χ^2/df=2.401, RMSEA=0.074, GFI=0.963, AGFI=0.922, RMR=0.023, SRMR=0.03, NFI=0.96, NNFI=0.976, CFI=0.976. All fit indices except RMSEA and AGFI were calculated to be in the best evaluation range. The present study suggested that Turkish adaptation of the Design Self-Efficacy Scale possesses adequate psychometric properties. Findings revealed that design self-efficacy did not correlate with the age of the participants and did not differ according to sex, department, or grade level of the participants.

Structured Abstract: Designing is argued to be of prime importance for innovation in teaching and education (Blândul, 2015; Brown & Katz, 2011; Brown & Kuratko, 2015; Lee, 2011; Rump, Nielsen, Andersson, & Christiansen, 2013). However, "little is known about the nature of the support offered to improve teachers' design expertise" (Huizinga, Handelzalts, Nieveen, & Voogt, 2014, p. 33) and there has been little investigation in teachers' design process (Bennett et al., 2008). Particularly, the importance of self-efficacy for designing has also been demonstrated (Gist, Stevens, & Bavetta, 1991). Measuring self-efficacy for design may contribute to achieving a better understating of competence in designing, which in turn may provide insight into improving

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education through successfully employing educational innovations. Therefore, this study aimed at adapting Design Self-Efficacy Scale (DSES, Beeftink, van Eerde, Rutte, & Bertrand, 2012) into Turkish language for providing Turkish researchers with a tool that may be used for determining self-efficacy for designing and for producing knowledge which may be useful for explaining teachers' design expertise in order to improve education through employing educational innovations.

The research was designed as a scale adaptation study consisting of two phases. First study was aimed at exploring the factor structure of the translated DSES. Second study was for confirming the factor structure. Five-hundred-ten preservice teachers who were enrolled in preschool teaching and classroom teaching programs of Akdeniz University Faculty of Education participated in both phases of the study (N=510). Out of 510 preservice teachers, 269 (52.75%) participated in the first study (N_1=269) and 241 (47.25%) participated in the second study (N_2=241). Of all the participants, 263 (51.6%) were studying in preschool teaching and 247 (48.4%) were studying in classroom teaching program. Of 510 participants, 377 (73.9%) were female and 133 (26.1%) were male. One-hundred-twenty-nine (25.3%) were first, 118 (23.1%) were second, 127 (24.9%) were third, and 136 (26.7%) were fourth graders. Participants were determined through convenience sampling at the university where the researcher is also a member of the faculty.

DSES was developed by Beeftink et al. (2012) to measure "the extent to which a person feels confident to perform well on the design aspects of the job" (p. 73). The scale is a 5-point Likert-type scale consisting of 8 items (1=Strongly disagree, 5=Strongly agree). The score range is 8 to 40, and higher scores indicate stronger design self-efficacy. Scale includes items such as "When I encounter a problem in a design, I can usually think of several solutions" (Bir tasarımda herhangi bir sorunla karşılaştığımda, genellikle birçok çözüm düşünebilirim) and "I am confident that I could deal efficiently with unexpected setbacks during the design work" (Tasarım çalışması sırasında ortaya çıkabilecek beklenmedik tersliklerin üstesinden etkin bir biçimde gelebileceğim konusunda kendime güveniyorum). DSES, which is an English questionnaire, was translated into Turkish by the researcher. Two researchers expert in English language education translated the Turkish version back into English. Two educational measurement and evaluation experts, a Turkish education expert, an elementary education expert, an English language education expert, and an educational technology expert reviewed the original and translated scales. As a result of the expert review, an 8-item Turkish scale was constructed. Thereafter, a paper-and-pencil instrument was prepared comprised of the Turkish scale and a demographics form.

Initially, an EFA was performed on the collected data. All item-correlations were lower than 0.9, hence, assumption of multicollinearity was satisfied (Field, 2018). Kaiser-Meyer-Olkin sampling adequacy measure was 0.898 and Bartlett's sphericity test was significant ($\chi^2(28)=949.267$, p=0.000). It was found that, similar with the original scale, the scale had a single factor with an Eigen value greater than 1. A single factor loaded by 8 items with values ranging between 0.645 and 0.814 explained 55.094% of the variance. Cronbach's α was calculated as 0.877 indicating that the scale was reliable (DeVellis, 2017; Field, 2018). A CFA was performed on the data for examining the validity and applicability of the hypothesized construct. Results validated the factor structure of the adapted scale: $\chi^2(17)=40.83$, p=0.001. All indices except RMSEA and AGFI were calculated to be in the best evaluation range. Hence, indices produced by CFA demonstrated a statistically significant model fit to the data.

Moreover, means of inter-item correlations (0.328-0.651) and item-total correlations (0.542-0.731) were 0.484 and 0.646, respectively. Communalities (0.416-0.663) supported a single factor structure, as well. The means of the items ranged between 3.14 and 3.82 ($\bar{x}$=3.63). Finally, a significant correlation between a global item (asking the participant to indicate how competent he or she thinks he or she is in designing) and the total score of the scale supported the nomological validity of the scale (r=0.446, n=241, p=0.000) (Edison & Geissler, 2003). Therefore, this 8-item adaptation of the original English scale was accepted as the Turkish version of DSES (Tasarım Özyeterliliği Ölçeği, TÖÖ).

In order to contextualize the Turkish version of DSES, association of the new scale with demographic variables were investigated. Spearman's rank-order correlation coefficient calculation indicated that age did not correlate with design self-efficacy, ρ=0.107, p=0.089. Mann-Whitney U tests revealed that design self-efficacy did not differ according to sex (U=6973, p=0.236) or department (U=8339, p=0.322) of the participants. In a similar vein, Kruskal-Wallis H test showed that there was not a statistically significant difference in design self-efficacy between grade levels, H(3)=1.911, p=0.591.

The findings of the current study suggested that present Turkish adaptation of DSES possesses adequate psychometric properties. Findings revealed that design self-efficacy did not correlate with the age of the

participants. Design self-efficacy did not differ according to sex, department, or grade level of the participants, either. These findings indicated that design self-efficacy is a belief that requires more than physical development or advancing from one grade to the next in an undergraduate program. It seems that, an intervention is need for increasing design self-efficacy (Carberry et al., 2010; Gist et al., 1991; Goodyear, 2015). Beeftink et al. (2012) state that organizations may help individuals to develop self-efficacy through success experiences. Competence in design can be developed at school (Luka, 2014; Mugaloglu & Sarıbas, 2010). Therefore, in order to increase preservice teachers' design self-efficacy, an instruction designed specifically for this purpose needs to be provided in teacher training institutions. Educators are designers and they need to have the competence to innovate and to help students make or use innovations. Being able to determine design self-efficacy may contribute to gaining insight about teachers' design expertise and development of intervention strategies for improving preservice teachers' competence in making and using educational innovations.

Keywords: Design for teaching, Design self-efficacy, Design thinking, Educational innovation, Scale adaptation.

Öz: Bu çalışmanın amacı, Tasarım Özyeterliliği Ölçeğini (Beeftink, van Eerde, Rutte, & Bertrand, 2012) Türkçeye uyarlamak ve psikometrik özelliklerini incelemektir. Tasarım Özyeterliliği Ölçeği, öğretmen adaylarının ve öğretmenlerin tasarım özyeterliliklerini ölçmek ve öğretmenlerin tasarım uzmanlığını açıklamak için yararlı olabilecek bilginin üretilmesinde kullanılabilecek bir ölçektir. Çalışmaya Türkiyedeki bir kamu üniversitesinde okumakta olan 510 öğretmen adayı katılmıştır (N=510). Katılımcıların 269'u (%52,75) açımlayıcı etken çözümlemesi için ilk çalışmaya, 241'i ise (%47,25) doğrulayıcı etken çözümlemesi için ikinci çalışmaya katılmıştır. Katılımcıların 377'si (%73,9) kadın 133'ü (%36,1) erkektir. Likert tipinde 8 maddelik İngilizce bir ölçek olan Tasarım Özyeterliliği Ölçeği araştırmacı tarafından Türkçeye çevrilmiştir. Çeviri ve uzman incelemesi süreçlerine; araştırmanın gerçekleştirildiği üniversitenin eğitim fakültesinde çalışmakta olup İngilizce dil eğitimi, eğitimde ölçme ve değerlendirme, Türkçe eğitimi, ilköğretim ve eğitim teknolojisi alanlarında uzman toplam sekiz araştırmacı katılmıştır. Açımlayıcı etken çözümlemesi, özgün ölçekle benzer bir biçimde tek etkenli bir model ile sonuçlanmıştır. Cronbach's α iç tutarlılık katsayısı 0,877 olarak hesaplanmıştır. Doğrulayıcı etken çözümlemesi modelin verilere uygunluğunun istatistiksel olarak anlamlı bir düzeyde olduğunu göstermiştir. Sonuçlar uyarlanmış ölçeğin etken yapısını doğrulamıştır: χ^2/df=2,401, RMSEA=0,074, GFI=0,963, AGFI=0,922, RMR=0,023, SRMR=0,03, NFI=0,96, NNFI=0,976, CFI=0,976. RMSEA ve AGFI dışındaki tüm uygunluk endekslerinin en iyi değerlendirme aralığında olduğu hesaplanmıştır. Bu çalışma, Tasarım Özyeterliliği Ölçeğinin Türkçe uyarlamasının yeterli psikometrik özelliklere sahip olduğunu göstermiştir. Bulgular, tasarım öz yeterliliğinin katılımcıların yaşı ile ilişkili olmadığı gibi katılımcıların cinsiyet, bölüm veya sınıf düzeyine göre farklılık göstermediğini ortaya koymuştur.

Anahtar Kelimeler: Eğitimsel yenileştirim, Öğretim için tasarım, Ölçek uyarlaması, Tasarım odaklı düşünme, Tasarım özyeterliliği.

Introduction

Designing is argued to be of prime importance for innovation in teaching and education (Blândul, 2015; Brown & Katz, 2011; Brown & Kuratko, 2015; Lee, 2011; Rump, Nielsen, Andersson, & Christiansen, 2013). However, "little is known about the nature of the support offered to improve teachers' design expertise" (Huizinga, Handelzalts, Nieveen, & Voogt, 2014, p. 33) and there has been little investigation in teachers' design process (Bennett et al., 2008). Universities have invested significantly to support university teachers in designing for teaching; however, there is little empirical evidence that this approach "will improve the quality of teaching and ultimately improve the quality of student learning outcomes" (Bennett et al., 2011, p. 151). On the other hand, Mugaloglu and Sarıbas (2010) reported that designing requires competence and that preservice teachers' competence in designing can substantially be improved through education. Competence is argued to be related to self-efficacy (Bandura, 1995b). Self-efficacy is reported to influence competence, for both students (Goodman & Cirka, 2009; Rahmi, Nadia, Hasibah, & Hidayat, 2017; Miller, Russell, Cheng, & Skarbek, 2015) and teachers (Hatlevik, 2017; Lauermann & König, 2016; van Dinther, Dochy, & Segers, 2015). Remarkably, Miller, Ramirez, and Murdock (2017) reported that self-efficacy of teachers influence

perceptions of students about their teachers' competence, as well. Particularly, the importance of self-efficacy for designing has also been demonstrated (Gist, Stevens, & Bavetta, 1991). Carberry, Lee, and Ohland (2010) stated that, with regards to education, there is a need to understand completely "how students learn and how to effectively teach them" (p. 71). They argued that, "knowing an individual's self-efficacy serves as a useful complement to their cognitive gains. Understanding how self-efficacy affects student learning can facilitate the development of intervention strategies to improve learning" (p. 77).

Hence, measuring self-efficacy for design may contribute to achieving a better understating of competence in designing, which in turn may provide insight into improving education through successfully employing educational innovations. Therefore, this study aimed at adapting Design Self-Efficacy Scale (DSES, Beeftink, van Eerde, Rutte, & Bertrand, 2012) into Turkish language for providing Turkish researchers with a tool that may be used for determining self-efficacy for designing and for producing knowledge which may be useful for explaining teachers' design expertise in order to improve education through employing educational innovations.

Background

Educational institutions are provided with a plethora of technologies. However, these innovations have provided "little systematic knowledge or accumulated wisdom to guide the development of future innovations" (Collins, 1992, p. 2). For example, significant growth of distance and open learning offered new opportunities for students and teachers and emphasized "the need for carefully planned and designed online learning experiences"; however, "supporting the design process and disseminating successful designs" remained a key difficulty (Bennett et al., 2008, p. 3633). Goodyear (2015) stated that even though the ways in which students study have been transformed, educators still teach the same way as they did before. Le Fevre (2014) indicated that reform initiatives aimed at educational improvement could not achieve the desired change in teacher practice. Even though innovation in education is associated with new information technologies, "it is not just the use of modern teaching technology" (Blândul, 2015, p. 485). Innovation is defined as a "planned change in response to perceived problems" (Eraut, 1975, p. 13) and refers to "redefining the whole design of teaching, learning and evaluation process" (Blândul, 2015, p. 484). Goodyear (2015) argued that teaching should invest more heavily in the planning phase of teaching activity and that "teachers' planning needs to take on more of the qualities of design for learning" (p. 28). Therefore, being competent in designing may result in being better at both innovating and utilizing educational innovations. Wright and Wrigley (2019) argued that design-led educational innovation is a "new area of research which requires a deeper understanding of the knowledge, skills and mindsets students require to thrive in the twenty-first century and beyond" (p. 1). Developing design thinking skills is a better way of increasing innovation and developing twenty-first century skills through teaching (Luka, 2014).

Design

Design is a frequently used concept in education. Within the field of educational sciences, "design" is used in the name of many approaches, models, methods, and fields such as learning design (Bennett, Agostinho, & Lockyer, 2005), learning by design (Kolodner, 2002), design-based learning (Puente, van Eijck, & Jochems, 2013), design-based instruction (Wright & Wrigley, 2019), and instructional design (Merrill, Drake, Lacy, Pratt, & ID2 Research Group, 1996). As an overarching pedagogical framework, some has regarded design "as the avenue to re-envision general education to develop capabilities required for twenty-first century citizens" (Wright & Wrigley, 2019, p. 1). In their report on the two-year study of how design is being used in pre-K–12 schools, National Endowment for the Arts acknowledges design as a catalyst for learning (Davis et al., 1997). On the other hand, design thinking is associated with developing twenty-first century capabilities of innovation in educational contexts (Luka, 2014; Razzouk & Shute, 2012), driving innovation (Owen, 2006), building creative confidence (Jobst et al., 2012), and creative self-efficacy (Tierney & Farmer 2002).

Self-Efficacy

Self-efficacy is defined as an individual's belief about his or her capability in effectively performing required behaviors to produce an outcome or effectively accomplishing a certain task (Bandura, 1977, 1995a; Pintrich, 1999). Mastery experiences, vicarious experiences, verbal persuasion as well as physiological and emotional states are sources of self-efficacy beliefs (Bandura, 1995a). Even in the face of difficulties, individuals with high self-efficacy reported to show greater persistence in maintaining and achieving a job (Schunk, 1985), and be more effective and persistent in their efforts (Pajares & Schunk, 2002). Teachers' self-efficacy beliefs have been shown to positively influence teachers' beliefs about teaching (Cho & Shim, 2013; Miller, Ramirez, & Murdock, 2017) and their thoughts and actions regarding using technology in the classroom (Abbitt, 2011). Teachers' self-efficacy beliefs are associated with the efforts they make towards teaching, the goals they set, and the persistence and resilience they show when faced with less-than-optimal conditions (Kanadlı, 2017). Therefore, self-efficacy beliefs seem to have a significant impact on the classroom instruction (Zee & Koomen, 2016). Experiences that preservice teachers gain in teacher training institutions and that they have during their student teaching are among the strongest influences on the development of teachers' self-efficacy (Hoy & Spero, 2005). Therefore, developing more effective teacher training programs which prioritize improving the self-efficacy beliefs of preservice teachers may affect their success in the classroom when those preservice teachers begin to work as inservice teachers. Understanding self-efficacy is especially beneficial for the development of intervention strategies to improve learning (Carberry, Lee, & Ohland, 2010).

Design Self-Efficacy

Design self-efficacy is defined by Beeftink et al. (2012) as "the extent to which a person feels confident to perform well on the design aspects of the job" (p. 73). Based on the self-efficacy definitions of Bandura (Bandura, 1977, 1995a) and Pintrich (1999), design self-efficacy may be defined as an individual's belief about his or her capability in effectively performing required behaviors to produce a design or effectively accomplishing a design task. Beeftink et al. (2012) stated that a higher level of design self-efficacy is related to being a more successful designer. It should be noted that design self-efficacy is especially important with regards to educational technology. One of the five educational technology standards for teachers set by International Society for Technology in Education (2014) is "designing and developing digital age learning experiences and assessments". Im and Kang (2019) demonstrated that self-efficacy for "designing and manageing online learning environment is important to online learning organizations, instructors, and administrators" (p. 120). Akbaba and Erbaş (2019) reported that determining preservice and inservice teachers' self-efficacy for designing information technology-supported instructional material is crucial for increasing the quality of learning and teaching processes. Considering the centrality of design to educational innovation, knowing preservice and inservice teachers' self-efficacy for designing may contribute to a better understanding of teachers' use of educational innovations. More importantly, it may give stakeholders ideas about how teachers can bring the innovation to education.

Method

The research was designed as a scale adaptation study with two phases. First study was aimed at exploring the factor structure of the tranlated DSES. Second study was for confirming the factor structure. Throughout the study, "Ethical Principles of Psychologists and Code of Conduct" have been followed (American Psychological Association, 2002).

Participants

Five-hundred-ten preservice teachers who were enrolled in preschool teaching and classroom teaching programs of Akdeniz University Faculty of Education participated in both phases of the study (N=510). Out of 510 preservice teachers, 269 (52.75%) participated in the first study (N_1=269) and 241

(47.25%) participated in the second study (N_2=241). Those who participated in the first study could not participate in the second one. Table 1 demonstrates demographic information of participants. Of all the participants, 263 (51.6%) were studying in preschool teaching and 247 (48.4%) were studying in classroom teaching program. Of 510 participants, 377 (73.9%) were female and 133 (26.1%) were male. Participants' agess ranged between 18 and 36 years ($\bar{x}$=21.25, s=2.49). One-hundred-twenty-nine (25.3%) were first, 118 (23.1%) were second, 127 (24.9%) were third, and 136 (26.7%) were fourth graders. Participants were determined through convenience sampling at the university where the researcher is also a member of the faculty. Only consenting individuals have participated in the research.

Table 1: Demographic Information of the Participants.

	Study 1			Study 2			Total		
	f (%)	$\bar{x}$	s	f (%)	$\bar{x}$	s	f (%)	$\bar{x}$	s
Age		21.32	2.46		21.17	2.24		21.25	2.49
Sex		0.30	0.46		0.21	.040		0.26	0.44
Female	187(69.5)			190(78.8)			377(73.9)		
Male	82(30.5)			51(21.2)			133(26.1)		
Program									
ECE	129(48.0)			134(55.6)			263(51.6)		
CT	140(52.0)			107(44.4)			247(48.4)		
Grade		2.59	1.13		2.46	1.14		2.53	1.14
1st	63(23.4)			66(27.4)			129(25.3)		
2nd	59(21.9)			59(24.5)			118(23.1)		
3rd	71(26.4)			56(23.2)			127(24.9)		
4th	76(28.3)			60(24.9)			136(26.7)		

Note: ECE and CT are abbreviations for Early Childhood Education (preschool teaching) and Classroom Teaching. f, $\bar{x}$, and s represent frequency, mean, and standard deviation, respectively. Numbers within parentheses are percentages with regard to study groups.

Design Self-Efficacy Scale

DSES was developed by Beeftink et al. (2012) to measure "the extent to which a person feels confident to perform well on the design aspects of the job" (p. 73). The scale is a 5-point Likert-type scale consisting of 8 items (1=Strongly disagree, 5=Strongly agree). The score range is 8 to 40, and higher scores indicate stronger design self-efficacy. Scale includes items such as "When I encounter a problem in a design, I can usually think of several solutions" (Bir tasarımda herhangi bir sorunla karşılaştığımda, genellikle birçok çözüm düşünebilirim) and "I am confident that I could deal efficiently with unexpected setbacks during the design work" (Tasarım çalışması sırasında ortaya çıkabilecek beklenmedik tersliklerin üstesinden etkin bir biçimde gelebileceğim konusunda kendime güveniyorum).

Procedure

DSES, which is an English questionnaire, was translated into Turkish by the researcher. Two researchers expert in English language education translated the Turkish version back into English. Two educational measurement and evaluation experts, a Turkish education expert, an elementary education expert, an English language education expert, and an educational technology expert reviewed the original and translated scales. Until complete agreement was reached, all disagreements were resolved by discussion. As a result of the expert review, an 8-item Turkish scale was constructed. Thereafter, a paper-and-pencil instrument was prepared comprised of the Turkish scale and a demographics form.

Permissions for conducting the research were received from institutional authorities. After collection, data were analyzed by statistical measures.

Data Analysis

Initially, the completed survey instruments were transferred to a computer. Statistical analyses were performed using IBM SPSS Statistics (IBM SPSS Statistics version 25) and IBM SPSS Amos (IBM SPSS Amos version 24) computer programs. An exploratory factor analysis (EFA) was conducted in order to investigate whether items of the Turkish scale were clustering into factors (Tavşancıl, 2002). For checking the reliability of the Turkish scale, Cronbach's α internal consistency estimate was computed. Finally, confirmatory factor analysis (CFA) was performed on the data for determining whether or not the factor structure could be confirmed. In addition, Mann-Whitney U test, Kruskal-Wallis H test, and Spearman's rank-order correlation coefficient were used to analyze the data.

Results

An EFA was conducted prior to CFA, since Cronbach's α estimate was not reported for the original scale and only EFA could reveal whether the items clustered differently in Turkish culture.

Exploratory Factor Analysis

Initially, an EFA was performed on the collected data. All item-correlations were lower than 0.9, hence, assumption of multicollinearity was satisfied (Field, 2018). Kaiser-Meyer-Olkin sampling adequacy measure was 0.898, indicating that the sample size was adequate (Tavşancıl, 2002). Bartlett's sphericity test was significant ($\chi^2(28)=949.267$, $p=0.000$) indicating that the sphericity assumption was not violated and that the correlation matrix among the items was not an identity matrix (Field, 2018). It was found that, similar with the original scale, the scale had a single factor with an Eigen value greater than 1. Scree plot of eigenvalues (Figure 1) suggested that a single-factor model effectively represent the data, as well.

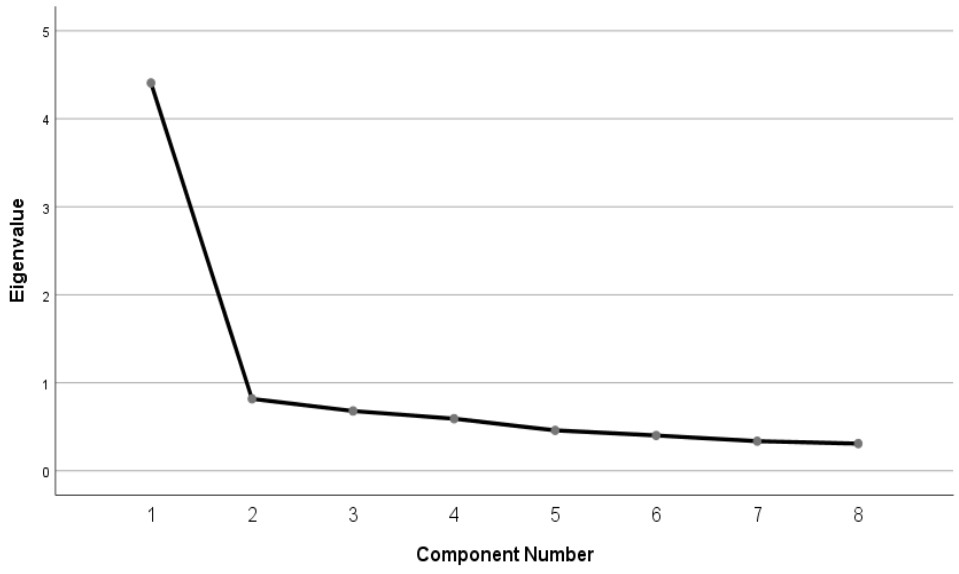

Figure 1. Scree Plot of the Turkish Scale

A single factor loaded by 8 items with values ranging between 0.645 and 0.814 explained 55.094% of the variance. Cronbach's α was calculated as 0.877 indicating that the scale was reliable

(DeVellis, 2017; Field, 2018). While conducting reliability analyses, SPSS did not suggest that the Cronbach's α would increase if any of the items was removed.

Confirmatory Factor Analysis

A CFA was performed on the data for examining the validity and applicability of the hypothesized construct. Figure 2 shows the path diagram of the Turkish scale. All items loaded significantly demonstrating an adequate convergent validity. Several indices were computed for examining the level of the goodness-of-fit of the factor model of the adapted scale. Most commonly used indices are goodness-of-fit index (GFI), adjusted goodness-of-fit (AGFI), normed fit index (NFI), and root mean square residual (RMR) –in addition to chi-square (χ^2), degrees of freedom (df), χ^2/df, and p-value (Jöreskog & Sörbom, 2001). Moreover, Bentler and Bonett's nonnormed fit index (NNFI, 1980), Steiger's (1990) root mean square error of approximation (RMSEA), Bentler's comparative fit index (CFI, 1990), and standardized root mean square residual (SRMR, 1995) were also computed.

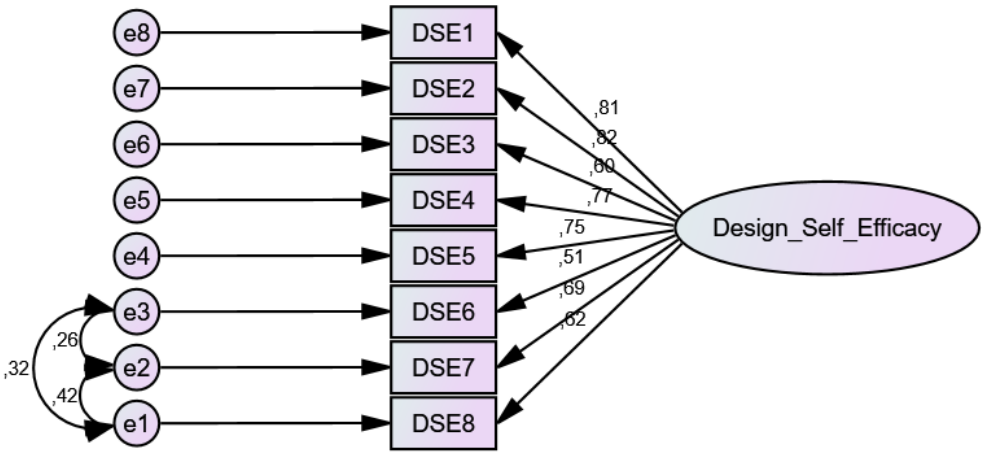

Figure 2. Path Diagram of the Adapted Scale

Results validated the factor structure of the adapted scale: $\chi^2(17)=40.83$, p=0.001. According to the evaluation criteria of Schermelleh-Engel, Moosbrugger, and Müller (2003), overview of the fit indices is illustrated in Table 2.

Table 2: Fit Indices for the Hypothesized Model

Index	Criterion	Result	Evaluation
p	>0.05	0.001	Not fit
χ^2/df	≤3 acceptable, ≤2.5 substantial	2.401	Substantial fit
RMSEA	<0.1 mediocre, <0.08 adequate, <0.05 good	0.074	Adequate fit
GFI	>0.85 acceptable, >0.90 good, >0.95 substantial	0.963	Substantial fit
AGFI	>0.80 acceptable, >0.90 good, >0.95 substantial	0.922	Good fit
RMR	Close to 0 is good fit	0.023	Good fit
SRMR	<0.1 acceptable, <0.05 good	0.030	Good fit
NFI	>0.90 acceptable, >95 good	0.960	Good fit
NNFI	>0.95 acceptable, >0.97 good	0.976	Good fit
CFI	>0.95 acceptable, >0.97 good	0.976	Good fit

Statistical significance of χ^2 confirmed the lack of a close model fit to the data. However, since χ^2 is sensitive to sample size (Hair et al., 2006), significance of χ^2 was not considered pervasive in this study. On the other hand, other indices revealed a fairly good fit of the model and were preferred for evaluating the model (Marsh et al., 1994). As summarized in Table 2, all indices except RMSEA and AGFI were calculated to be in the best evaluation range. Hence, indices produced by CFA demonstrated a statistically significant model fit to the data.

Moreover, means of inter-item correlations (0.328-0.651) and item-total correlations (0.542-0.731) were 0.484 and 0.646, respectively. Communalities (0.416-0.663) supported a single factor structure, as well. All of the items correlated with the factor supporting convergent validity. The means of the items ranged between 3.14 and 3.82 ($\bar{x}$=3.63). Finally, a significant correlation between a global item (asking the participant to indicate how competent he or she thinks he or she is in designing) and the total score of the scale supported the nomological validity of the scale (r=0.446, n=241, p=0.000) (Edison & Geissler, 2003). Therefore, this 8-item adaptation of the original English scale was accepted as the Turkish version of DSES (Tasarım Özyeterliliği Ölçeği, TÖÖ).

Relationships with Demographic Variables

In order to contextualize the Turkish version of DSES, association of the new scale with demographic variables were investigated. Spearman's rank-order correlation coefficient calculation indicated that age did not correlate with design self-efficacy, ρ=0.107, p=0.089. Mann-Whitney U tests revealed that design self-efficacy did not differ according to sex (U=6973, p=0.236) or department (U=8339, p=0.322) of the participants. In a similar vein, Kruskal-Wallis H test showed that there was not a statistically significant difference in design self-efficacy between grade levels, H(3)=1.911, p=0.591.

Discussion and Conclusion

The purpose of the study was adapting Design Self-Efficacy Scale (DSES), which was developed by Beeftink et al. (2012), into Turkish language for providing Turkish researchers with a tool that may be used for determining design self-efficacy and for producing knowledge which may be useful for explaining teachers' design expertise. Three English language education experts, two educational measurement and evaluation experts, a Turkish education expert, an elementary education expert, and an educational technology expert participated in the translation process. EFA showed that single-factor structure of the original scale was also valid for the adapted scale in the Turkish sample. All item-correlations were lower than 0.9, hence, assumption of multicollinearity was satisfied (Field, 2018). Kaiser-Meyer-Olkin sampling adequacy measure was 0.898, indicating that the sample size was adequate (Tavşancıl, 2002). Bartlett's sphericity test was significant ($\chi^2(28)$=949.267, p=0.000) indicating that the sphericity assumption was not violated (Field, 2018). All of the items of the adapted scale did load on that single factor, as well. A single factor loaded by 8 items explained 55.094% of the variance. Cronbach's α was calculated as 0.877 indicating that the scale was reliable (DeVellis, 2017; Field, 2018). CFA produced fairly good fit indices and indicated that there was a good fit for the single-factor model to the data ($\chi^2(17)$=40.83, p=0.001). Thus, the findings of the current study suggested that present Turkish adaptation of DSES –Tasarım Özyeterliliği Ölçeği (TÖÖ)- possesses adequate psychometric properties.

The original study (Beeftink et al., 2012) was conducted with a sample of architects who were employers, self-employed entrepreneurs, or in a management position within an architectural firm. The fact that the present study was conducted with a sample of undergraduate students and that the model was replicated suggested that DSES model applies to undergraduate students as well as a nonstudent sample of professional adults. However, sample of the present study was preservice teachers who were enrolled in preschool teaching and classroom teaching programs. This raises the question of whether the scale is also valid for inservice teachers. Another limitation of the current study is that the sample was

not balanced in terms of gender (30.5% were male). However, it should be noted that, design self-efficacy levels did not differ according to the sex of the participants.

Findings revealed that design self-efficacy did not correlate with the age of the participants. Design self-efficacy did not differ according to sex, department, or grade level of the participants, either. These findings indicated that TÖÖ –Turkish adaptation of DSES- is not biased by age, sex, department or grade level of the participants and the scale functions as expected. On the other hand, non-significant relationships between design self-efficcacy and age, sex, department and grade level of the participants indicated that design self-efficacy is a belief that requires more than physical development or advancing from one grade to the next in an undergraduate program. It seems that, an intervention is need for increasing design self-efficacy (Carberry et al., 2010; Gist et al., 1991; Goodyear, 2015). Beeftink et al. (2012) state that organizations may help individuals to develop self-efficacy through success experiences. Competence in design can be developed at school (Luka, 2014; Mugaloglu & Sarıbas, 2010). Therefore, in order to increase preservice teachers' design self-efficacy, an instruction designed specifically for this purpose needs to be provided in teacher training institutions. Educators are designers and they need to have the competence to innovate and to help students make or use innovations. Being able to determine design self-efficacy may contribute to gaining insight about teachers' design expertise and development of intervention strategies for improving preservice teachers' competence in making and using educational innovations. In this regard, Tasarım Özyeterliliği Ölçeği (TÖÖ), which is a Turkish adaptation of Design Self-Efficacy Scale (DSES), may be used for determining individuals' design self-efficacy and for producing knowledge which may be useful for explaining their design expertise.

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