Article

Engineering Learning Experiences: A Scale Adaptation and Validation into Turkish

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Abstract

Undergraduate students' learning experiences are thought to have a significant impact on their future career choices. The Engineering Learning Experience Scale (ELES) was created within the framework of Social Cognitive Career Theory to accurately evaluate learning experiences arising from direct or indirect learning activities in or out of school. The purpose of this research is to adapt and validate the ELES in Turkish. The scale was given to two groups of engineering students from a large public university in Turkey. In order to provide evidence of the reliability and validity of the scale, exploratory and confirmatory factor analyses were employed to analyze the psychometric properties of the instrument. According to the confirmatory factor analyses, the correlated four-factor model suited the data well. This study strengthens the standing of the ELES as a useful measurement tool in the field of engineering.

Keywords

engineering, learning experiences, social cognitive career theory, scale adaptation

Introduction

The competitive global environment necessitates accelerated technological and economic developments, which in turn require increasing numbers of newly qualified engineers to join the existing engineering workforce. This is much more critical and urgent for developing countries, such as Turkey, which needs to achieve significant growth rates in its manufacturing and service industries, as discussed in this study's emerging market economy background. Turkey needs an increasing number of qualified engineers to enhance technologies in such areas (Kleiner-Schaefer

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& Schaefer, 2022). Although potential job opportunities with the formation of new engineering jobs (e.g., genetic engineering, mechatronics engineering, biomedical engineering, etc.) (Garriott et al., 2021) lead to the increasing popularity of engineering degrees and consequently increasing enrollment in engineering programs, significant numbers of engineering students either drop out of the engineering majors or do not perform well in engineering areas when they graduate in developing countries (Ramos-Sandoval & Ramos-Diaz, 2020). Interest growth, career choice, and career success are determined by learning experiences, which is an essential intermediary construct between individual inputs such as personality and socio-cognitive mechanisms (Lent et al., 1994; Lent & Brown, 2019). Learning experiences refer to the beliefs about a specific subject within educational activities. The engineering learning experiences, according to Garriott et al. (2021), can be explored within the framework of Social Cognitive Career Theory (SCCT) research. In accordance with the SCCT research (Lent et al., 1994; 2000), persistence in an engineering career and pursuing engineering career interests depends on engineering self-efficacy. To be able to retain and engage students in engineering programs and foster their engineering career interests, it is important to assure them of their building engineering self-efficacy capacities (Lent et al., 2013). Towards that end, the engineering learning experience serves, as demonstrated by Garriott et al. (2021).

The Engineering Learning Experience Scale (ELES) showed that the engineering learning experiences of undergraduate engineering students correlate with their self-efficacies (Garriott et al., 2021). In congruence with the self-efficacy literature (Bandura, 1997; Lent et al., 1991), ELES has four factors. Perceptions and beliefs about one's success or failure in engineering domain-related tasks and activities are covered by the performance accomplishments factor (Garriott et al., 2021). The vicarious learning factor reflects one's observations of his or her significant role models' competent performance in the engineering domain. The verbal persuasion factor captures encouragement and feedback that one gets from the important parties in the engineering domain (Garriott et al., 2021). Emotional and physiological arousal describe the positive and negative effects one experiences in the engineering domain.

This study is an attempt to adapt ELES into Turkish. The existence of such an instrument as ELES will be helpful in this emerging market economy context to diagnose problems in the learning experiences of engineering students and make timely and appropriate adjustments to increase their motivation and probability of achievement. Also, the ELES could be utilized to assist engineering professors and other faculty members in the development of training materials and engineering curriculum. Furthermore, the ELES might be used to facilitate students' assessment of their exposure to each of the four sources of self-efficacy. There has not been a Turkish version of the ELES available until now. The adaptation and validation of a Turkish version of the ELES is important in order to increase our understanding of learning experiences among Turkish engineering students. Also, the research and practice of career development in Turkey could benefit from a valid Turkish version of the ELES. Furthermore, exploring learning experiences in other academic and career domains utilizing diverse populations was advised by previous research (Schaub & Tokar, 2005). Therefore, based on research by Garriott et al. (2021), this study aims to adapt and validate the ELES into the Turkish cultural context. In this regard, the adaptation employed psychometric analysis with reliability and validity evidence.

Literature Review

Engineering Learning Experiences

Because of increasing student enrollment and diversification, improving student learning experiences has been more crucial in higher education since the mid-1990s (Poon, 2013). Any course, program, or other experience in which learning occurs, whether in schools and classrooms or settings other than schools and classrooms, is referred to as a learning experience. Acknowledging human learning and growth, as well as how conscious learning experiences should be thought about, produced, performed, and assessed, requires an understanding of how learning experiences are conceptualized (Billet, 2009).

Learning experiences were described as any encounter that leads to the construction of a belief about a specific subject, whether that belief is attitudinal, knowledge-based, or skill-based. Hence, learning experiences are concerned with individuals' perceptions of the material offered and how it is delivered in the three different tertiary learning contexts, which include lectures, practical classes, and tutorials (Dalgety et al., 2003). Learning experiences are defined by Vanasupa et al. (2009) as "*anything designed by faculty to encourage students' development.*" The authors suggest that these encounters can be in numerous ways, including classroom discussions, homework, active learning exercises, a course, or an entire curriculum.

Bandura (1986) claims that efficacy perceptions of an individual are primarily obtained and altered through four major informational sources: *"personal performance accomplishments, vicarious learning, or observation of other people's performance accomplishments; social persuasion; and physiological states and reactions, which include pleasant or unpleasant emotional and physical feelings experienced while performing tasks*." These resources, colloquially known as *"learning experiences*," are regarded as vital mediators of person and contextual variables on academic and career development and are an inherent component of the SCCT model. Gender, personality, and other personal traits, as well as the individual's context, are all elements that influence learning experiences, according to the SCCT. In other words, learning experiences, according to the SCT and the SCCT, are sources of self-efficacy and predictors of outcome expectations (Lent & Brown, 2006). Thereby, learning experiences have an impact on people's career goals and actions as a determinant of self-efficacy and outcome expectations.

Individual performance accomplishments are one of the components of learning experiences. Prior experiences with success or failure in a specific field are reflected in performance accomplishments (Lent & Brown, 2006). As a result, this dimension might be considered to represent individuals' personal histories. In this regard, performance achievements are subjective. Performance accomplishments in a specific task generate enthusiasm in that task to the degree that they build an increasing sense of self-efficacy (Lent et al., 2002). According to the literature, students can learn from the experiences of others through conversation, debate, and narrative (Roberts, 2010). "*Learning through conversation, disagreement, challenge, support, and scaffolding from a more competent other*" is referred to as "*vicarious learning*" (Topping, 2005). Vicarious learning is the process of learning by seeing academic and professional role models skillfully perform field-related activities (Usher & Pajares, 2009). This factor is about the experience of learning from the experiences of others. In other words, it can also be referred to as indirect learning.

The term *"verbal persuasion"* refers to positive comments and encouragement from role models about one's domain-specific abilities. (Lent et al., 1991). Verbal persuasion is one such method that serves as a source of information regarding abilities and skills associated with predicted success (Mellor et al., 2006). Lastly, *"emotional/physiological arousal"* describes a variety of mental and physical states that people experience while performing tasks in a particular field (Bandura, 1997).

Lave and Wenger (1991) emphasize that learning entails more than just the acquisition of skills and knowledge; it also entails changes in who we become and how someone views himself or herself with respect to a specific disciplinary practice. According to this viewpoint, an individual's identity is determined by how he or she consciously defines himself or herself and is actively recognized by others within the different social domains in which he or she operates, such as friendships, families, universities, and professional situations (Stevens et al., 2008). Therefore, it may be argued that the engineering learning process and learning experiences are essential contributors to identity acquisition. The SCCT's proposed impact of learning experiences on self-efficacy beliefs and outcome expectations is supported by a limited but increasing amount of research (Tokar et al., 2007). For example, with a sample of high school students of color from diverse ethnic groups, Garriott et al. (2014) examined learning experiences as a mediator within the SCCT by assessing learning experiences' associations with both self-efficacy and outcome expectations in math and science domains. Byars-Winston et al. (2017) carried out a meta-analysis composed of 61 studies of academic self-efficacy, and they found that self-efficacy was strongly associated with performance accomplishments, moderately with vicarious learning and social persuasion, and relatively weakly with affective arousal. In their study, sources' effects on self-efficacy varied depending on the performance domain and individual differences. The structure of the four theoretical sources of self-efficacy (mastery experience, vicarious learning, verbal persuasion, and affective state) and their relationships to efficacy beliefs in science, technology, engineering, and mathematics (STEM) fields were investigated in Sheu et al.'s (2018) meta-analysis study, which included 104 studies. Their study showed that vicarious learning's relation to self-efficacy was almost non-existent while the other sources were moderately related to self-efficacy. Thus, the existence of such different findings indicates that understanding and measuring learning experiences as sources of self-efficacy in relation to the SCCT construct will be valuable. It will be possible to see the contributions of different sources of self-efficacy and study them if ELES becomes a valid assessment tool in the setting of Turkey.

Social Cognitive Career Theory

One of the most useful theories for understanding behavioral processes is the Social Cognitive Theory (SCT). The SCT developed by Bandura (1977) assumes that both external and internal influences have an impact on motivating and regulating human behavior. Bandura's general social cognitive theory is the foundation of the Social Cognitive Career Theory (SCCT). The SCCT provides a thorough framework depicting interaction of *"self-efficacy, outcome expectations, and goals with demographic variables, contextual factors, and life experiences to effect interest development, career choice, and performance"* (Lent et al., 1994). The SCCT emphasizes key experiential, learning, and cognitive processes that can assist in explaining crucially neglected, but often important, occurrences in other career theories (Lent et al., 2002).

The SCCT is concerned with the interaction of several personal, contextual, and behavioral elements that are postulated to impact the process by which individuals generate fundamental academic and career interests, formulate, and change educational and vocational plans, and attain varying levels of success in their academic and career activities (Lent et al., 2008). It hypothesizes that occupationally relevant self-efficacy beliefs and outcome expectations are influenced by individual inputs and background contextual attributes. The significant cognitive mediators that effect career behavior as a result of learning experiences are parts of the SCCT.

Learning experiences, as specified by the SCCT, are experienced antecedents of self-efficacy and outcome expectations formed by individual inputs and background contextual affordances. Consequently, learning experiences are regarded as crucial intermediary constructs between individual inputs, such as personality, and the socio-cognitive mechanisms that play such an essential role in interest development, career choice, and career success. The SCCT can also be utilized to comprehend how specific elements of individuals and their socioeconomic status are developed in order to construct specific career-related learning experiences and subsequent choice options (Lent & Brown, 2019).

Students need to be in a positive learning environment in order to develop a positive attitude about their future job. This perspective, in accordance with the SCCT, is a student's inclination that may influence the process of selecting a specific career (Rogers & Creed, 2011). Few studies have investigated the inputs of self-efficacy information in vocational development (Anderson & Betz, 2001); even fewer have looked into the function of learning events in the SCCT. The findings of Schaub and Tokar's (2005) research suggest that personality has a direct and indirect relationship with vocational interests via learning experiences and socio-cognitive variables. Learning experiences could be linked to future job and work-related decisions in this context.

Related Constructs with Engineering Learning Experiences

Garriott et al. (2021) developed the Engineering Learning Experiences Scale (ELES) having compatible dimensions with the SCCT sources, as well as provided preliminary reliability and validity data for this measure. By using the ELES, researchers will be able to properly analyze the relationships between learning experiences and self-efficacy. Garriott et al.'s (2021) study also explores the associations between the ELES and theoretically relevant variables for the purpose of verifying the scale.

Although it is not directly called "learning experiences," the "Sources of Mathematics Self-Efficacy Index," which consists of 40 items and aims to measure the mathematics self-efficacy of undergraduate students, was developed by Lent et al. (1991) in order to measure learning experiences. This measurement tool has been used in many studies examining learning experiences in the field of mathematics and their effects on outcome expectations (e.g., Lopez et al., 1997).

Schaub (2003) developed a scale called the "Learning Experiences Questionnaire (LEQ)" to measure learning experiences, which consists of a 120-item self-report questionnaire in order not to limit the scope of studies only to the fields of mathematics or science. The scale combines each of the four different sources in Bandura's (1997) self-efficacy theory with each of Holland's (1997) six personality typologies. Scores for the LEQ's realistic and investigative sub-factors have been implied in previous research (Flores et al., 2014; Garriott et al., 2017) to evaluate engineering students' learning experiences even though the studies did not reveal significant relationships between the variables and the results did not meet the propositions of the SCCT.

In accordance with the above, the theoretical concepts relevant to the ELES, which were also included in the research by Garriott et al. (2021), the developers of the ELES scale, were considered in this study as well. Prior to the development of the ELES, there was no assessment tool that measured learning experiences in detail within the SCCT framework. For validation purposes, engineering self-efficacy (Lent et al., 2005), academic major satisfaction (Jerusalem & Schwarzer, 1992), negative outcome expectations-engineering (Lee et al., 2018), positive engineering outcome expectations (Lent et al., 2003), and engineering persistence intentions (Lent et al., 2003) were used in this research.

The Turkish Context

All Turkish higher education institutions accept students based on the results of the university entrance exam administered by the Student Selection and Placement Centre (OSYM). According to the studies (Smith & Dengiz, 2010), teachers, families, counselors, and the media have the greatest influence on students' decisions to major in engineering before taking the university entrance exam. Furthermore, because families consider studying engineering to be more difficult, students in engineering receive more parental support (Işık, 2010). In Turkey, engineering is regarded as a prestigious profession, and engineers have generally felt this status through positive social reactions such as praise, affirmation, and acceptance (Pehlivanli-Kadayifci, 2018). As a consequence, engineering degrees are quite popular among students with high university entrance exam scores.

According to the data from Turkey's Council of Higher Education, the number of engineering faculties expanded from 54 to 222 between 2000 and 2021 (YOK, 2021). As a result, it may be argued that Turkey has a great deal of promise in terms of engineering education. Moreover, an increasing number of private and public universities' engineering departments either having or applying to have international (Accreditation Board for Engineering and Technology/ABET) or national (Association for Evaluation and Accreditation of Engineering Programs/MÜDEK) engineering accreditations indicates the increasing importance given to the quality improvement of engineering education in Turkey. It is expected that the ELES will be useful in the Turkish context for diagnosing difficulties in engineering students' learning experiences and making appropriate arrangements to boost their motivation and probability of achievement. According to Garriott et al. (2021), future research might employ the ELES to look at relationships between sources of engineering-related self-efficacy and fundamental SCCT variables such as outcome expectations and interests in a sample of engineering undergraduates. Due to the lack of a measurement tool to assess engineering undergraduates' learning experiences in Turkish, adaptation and validity studies of the scale were carried out in this study.

The purpose of this study is to adapt and validate the ELES for assessing engineering students' perceptions of direct and indirect learning experiences in the Turkish context. The following is the study's research question:

- Is Turkish version of the ELES a valid and reliable measurement tool?

Phase I: Exploratory Factor Analysis

The study was divided into two parts: Phase I involved the translation of the ELES scale into Turkish and exploratory factor analysis (EFA); Phase II involved confirmatory factor analysis (CFA). In Phase I, data from 284 participants who took the Turkish version of the ELES was used to conduct an EFA.

Method

Measures. The Engineering Learning Experiences Scale (ELES) was designed and developed by Garriott et al. (2021) to evaluate engineering undergraduates' self-perceptions of their learning experiences in the engineering majors. The scale consists of 22 items and four factors: "performance accomplishments" (e.g., "I have performed well or experienced success in applied experiences in engineering"), "vicarious learning" (e.g., "I have seen people whom I respect or people like me succeed in lab courses in their engineering major"), "verbal persuasion" (e.g., "My engineering professors have praised my research skills"), and "physiological/emotional arousal" (e.g., "I have felt dread while participating in engineering activities"). Responses range from 1 = "Strongly disagree" to 6 = "Strongly agree," with the higher the score, the greater the engineering learning experiences. Cronbach's alpha scores for "performance accomplishment," "vicarious learning," "verbal persuasion," and "emotional/physiological arousal" were 0.88, 0.90, 0.96, and 0.88, respectively, and the whole scale's Cronbach's alpha was 0.92 in Garriott et al.'s (2021) study.

Scale Translation Procedure

The items of the original ELES were first translated into Turkish by four bilingual (Turkish–English) academics using the translation/back-translation procedure. Four native Turkish speakers fluent in English independently translated each of the items during the translation process. They then compared the different translations to come up with a common Turkish version of each item. A professional Turkish–English translator then back-translated the Turkish translations. The items were delivered to a small group of students (n = 15) and three professors who work in the field of engineering to check whether the items were comprehensible. Three items required revisions as a result of consultations with academics and students until semantic equivalence or equivalence in item meaning was sought. For example, the initial translation of *"atmosphere"* to Turkish: as *"atmosfer"* was modified into the word *"ortam"* that gives the same meaning but is a different and more frequently used word in Turkish.

Following this stage, the items remained the same, and this version was subsequently used in the Phase I and Phase II. The questionnaire was delivered to the participants via an online survey form after the translation was validated, and sociodemographic data, including gender, major, and seniority, were also collected. The scale's content validity was assessed by comparing input from experts, teachers, and students to relevant ideas found in the literature review (Chan et al., 2017).

Participants

The dataset in the Phase I was evaluated using the data obtained from 284 engineering undergraduates (152 females and 132 males) from a large public university in Turkey. The sampling university has a large engineering faculty offering over 10 traditional engineering degrees. Since the university is located in Istanbul, the industrial capital of Turkey, the students have access to part-time employment and internship opportunities. The authors reached out to the focal university's engineering faculty's department heads and faculties for student participation. Data were collected utilizing a Google form containing survey questions during regular class schedules in the Spring semester of 2020–2021.

Students were made aware of the fact that participation was entirely voluntary and that their responses would be considered confidential. Participation was not rewarded in any way. They were from 9 engineering disciplines, namely, computer engineering (7.7%), environmental engineering (10.2%), electric and electronic engineering (7%), industrial engineering (13.4%), civil engineering (15.1%), geology engineering (8.5%), chemical engineering (19%), mechanical engineering (8.5%), and metallurgy and materials engineering (10.5%). There were 27 (9.5%) first-year students, 100 (35.2%) second-year students, 77 (27.1%) third-year students, and 80 (28.2%) fourth-year students that took part in the Phase I.

Results

Preliminary Analysis

Phase I was undertaken to facilitate the ELES's modification for use in the Phase II. The ELES comprises of four factors, namely, "performance accomplishments" (5 items), "verbal persuasion" (6 items), "physical arousal" (6 items), and "vicarious learning" (5 items). A 6-point Likert scale was utilized for all 22 items, ranging from 1 (strongly disagree) to 6 (strongly agree). In order to assess the descriptive data of the sample about the ELES, the response rates, mean, standard deviation, asymmetry, and kurtosis were determined for each of the items. Internal consistency was determined by calculating the correlation between each item and the scale total, as well as the total Cronbach's alpha values for the entire questionnaire.

In the Phase I sample of this survey (n = 284), Table 1 displays the main descriptive and internal consistency data for the 22 items in the ELES. On a scale of 1–6, the mean score for the questionnaire was 4.07 (SD = 0.914), indicating that the individuals in the study had moderate levels of engineering learning experiences.

Table 1. Descriptive Statistics

Item	Descriptive Statistics			
	Mean	S.D.	Skewness	Kurtosis
ELES1	3.95	1.515	−0.285	−0.952
ELES2	4.35	1.359	−0.728	−0.072
ELES3	4.49	1.415	−0.761	−0.263
ELES4	4.32	1.555	−0.762	−0.459
ELES5	4.64	1.367	−1.049	0.350
ELES6	3.99	1.479	−0.483	−0.678
ELES7	4.12	1.407	−0.506	−0.567
ELES8	3.67	1.445	−0.107	−0.905
ELES9	4.17	1.310	−0.458	−0.571
ELES10	3.93	1.337	−0.279	−0.673
ELES11	4.27	1.302	−0.672	−0.099
ELES12	3.64	1.405	−0.194	−0.770
ELES13	3.31	1.580	0.134	−1.069
ELES14	3.92	1.426	−0.262	−0.731
ELES15	3.56	1.597	−0.090	−1.061
ELES16	3.48	1.587	−0.021	−1.060
ELES17	4.38	1.349	−0.594	−0.321
ELES18	4.02	1.576	−0.292	−1.087
ELES19	3.56	1.645	−0.046	−1.174
ELES20	3.61	1.597	−0.099	−1.143
ELES21	3.32	1.901	0.122	−1.467
ELES22	3.54	1.727	−0.066	−1.294

Notes. SD = standard deviation; r = correlation between item score and total scale score

In order to verify a normal univariate distribution, values of skewness and kurtosis between −2 and +2 are regarded as acceptable (George, 2010). According to De Vaus (2002), subscales with a corrected item-total correlation of less than 0.30 are unacceptable. Nonetheless, 0.20 is acceptable as inter-item and item-total correlation in exploratory studies (Cristobal et al., 2007). Apart from having more than half of the retained items with total scores in the range of 0.30–0.70, the item-total correlations were found to be within 0.30–0.70, which can be regarded as satisfactory (Carmines & Zeller, 1974). In exploratory factor analysis, only items 18, 19, 21, and 22 have an item-total correlation of around 0.30. The item-total correlations of the other items were noted to be greater than 0.40. The scale reliability was found 0.91.

Exploratory Factor Analysis

An EFA was conducted in order to test the factor structure of the ELES. In cross-cultural studies, researchers may use both EFA and CFA (e.g., Bahar-Özvarış et al., 2022; Ma et al., 2022; Ulaş-Kılıç, 2021). Researchers typically employ EFA before CFA to determine whether a scale's factor structure may raise questions about its validity or generalizability if the original factor structure cannot be confirmed (Van Prooijen & Van Der Kloot, 2001). In this study, it was preferred to begin with an EFA to determine the underlying factor structure of the ELES, which should be followed by a CFA on data from another sample to assess and verify the EFA-based initial scale factor structure and psychometric properties (Costello & Osborne, 2005).Because the scale was evaluated in a different language and cultural setting than the one in which it was designed, EFA was chosen to determine whether the factor structure is four-dimensional.

SPSS 20.0 was used to analyze the data from the questionnaire. Since the variable to subject ratio satisfy the 1:5 ratio, the sample size of 284 can be regarded as sufficient for factor analysis (Gorsuch, 1990). Kaiser–Meyer–Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity shows the data's suitability for factor analysis. The Kaiser–Meyer–Olkin test (KMO = 0.89), and the Bartlett sphericity test (x^2 (231) = 3909.429; $p < 0.001$) all indicated that the matrix could be factored. Then, using Promax rotation, an exploratory factor analysis (EFA) was utilized to see how each questionnaire item mirrored the underlying construct that it was supposed to evaluate. According to Promax rotation was employed because it represents the relationship between the variables more accurately than orthogonal rotation (Brown, 2006). The communalities of the questionnaire items ranged from 0.40 to 0.95. Since there was no item with a value of less than 0.40, no statement was omitted. In addition, EFA showed that no item had more than one significant loading considering the factor loading threshold of 0.40 when the sample size is about 200, and thus, no cross-loading existed (Hair et al., 2009). The findings of the EFA for a four-factor model are shown in Table 2.

According to the eigenvalue >1 criterion, a four-factor solution was obtained through Promax rotation (Kaiser, 1974). The four variables combined accounted for 65.93% of the variance. The

Table 2. Exploratory Factor Analysis Factor Loadings and Commonalities of ELES Items.

	Factor Loadings				
Item Number	1	2	3	4	Communality
Performance Accomplishments					
ELES1	0.431				0.432
ELES2	0.648				0.666
ELES3	0.913				0.700
ELES4	0.785				0.662
ELES5	0.814				0.651
Verbal Persuasion					
ELES6		0.726			0.618
ELES7		0.699			0.648
ELES8		0.846			0.661
ELES9		0.841			0.716
ELES10		0.818			0.578
ELES11		0.800			0.706
Physical Arousal					
ELES12			0.569		0.613
ELES13			0.951		0.803
ELES14			0.856		0.723
ELES15			0.902		0.805
ELES16			0.921		0.769
ELES17			0.700		0.538
Vicarious Learning					
ELES18				0.790	0.642
ELES19				0.841	0.732
ELES20				0.842	0.739
ELES21				0.683	0.464
ELES22				0.811	0.641

pattern matrix in Table 2 shows that all four factors extracted are the same as those in the original scale by Garriott et al. (2021).

Phase II: Confirmatory Factor Analysis

Method

Measures. As mentioned previously and used in Phase I, The Engineering Learning Experiences Scale (ELES), designed and developed by Garriott et al. (2021), was used in Phase II as well. To examine the convergent validity of the ELES, Pearson's correlations between the ELES and the constructs related to engineering learning experiences based on the original scale (Garriott et al., 2021) were evaluated. Since the Engineering Self-Efficacy Scale by Lent et al. (2005), which was used for convergent validity in the original study by Garriott et al. (2021), contained items including "future tense" (e.g., "...next semester"), and this study sample included senior students, the Academic Self-Efficacy Scale by Jerusalem and Schwarzer (1992) was preferred to be used. In addition to those constructs, the Negative Outcome Expectations-Engineering Scale (NOES-E) was chosen for divergent validity based on the original study. The scales used with the ELES are listed below.

1. *Academic Self-Efficacy (ASE)* developed by Jerusalem & Schwarzer (1992) evaluates the belief in the ability to succeed academically. In difficult learning contexts, student self-efficacy appears to be more crucial (Shen et al., 2013). ASE consists of seven items and one dimension. Example items include *"Even though a test might be difficult, I know that I will pass it."* Respondents use a 5-point Likert scale, ranging from 1 = "strongly disagree" to 5 = "strongly agree") and high scores indicate high academic self-efficacy. The Cronbach's alpha was 0.87 in the original study, and Akar et al. (2018) reported an alpha value of 0.95. The current study's Cronbach's alpha is 0.86.
2. *Positive Engineering Outcome Expectations (POE)* developed by Lent et al. (2003), consists of 10 items on a 10-point scale ranging from 0 (strongly disagree) to 9 (strongly agree), and participants indicate how strongly they agree that an engineering degree would help them to achieve each outcome. According to SCCT, self-efficacy and result expectancies are important mechanisms that convert learning experiences into interests, decisions, and persistence (Lee et al., 2018). Example items include *"go into a field with high employment demand."* Higher scores reflect higher positive engineering outcome expectations. Cronbach's alpha in prior studies ranged from 0.89 to 0.91. (Garriott et al., 2021; Flores et al., 2014; Lent et al., 2003; 2005). The current study's Cronbach's alpha is 0.94.
3. *Negative Outcome Expectations Scale-Engineering (NOES-E)* developed by Lee et al. (2018) evaluates the expected negative results related to choosing an engineering major. According to Bandura (1997), positive results are regarded as incentives that promote a certain action, whereas negative consequences are perceived as dissuasive to continuing a specific behavior. The scale consists of 21 items and four subscales: "personal life and work balance, "job characteristics," "cultural-related stressors,"and "social costs." The participants' rate items using a 10-point scale (0 = "strongly disagree," 9 = "strongly agree"), with an example item being: *"Not having time to maintain current friendships or begin new ones."* Therefore, higher ratings are associated with more negative expectations regarding the outcomes of engineering. The participants' scores were obtained by averaging their responses to the scale items. The Cronbach's alpha was 0.94 in the original study by Lee et al. (2018), and Garriott et al. (2021) reported an alpha value of 0.89. Cronbach's alpha for the current study is 0.92.

4. *Engineering Academic Satisfaction Scale (EASS)* consists of seven items measuring the level of respondents' major satisfaction (Lent et al., 2007). Engineering academic satisfaction is positively related to engineering self-efficacy and interests (Lent et al., 2013). One item, for example, is *"I feel satisfied with the decision to major in engineering."* The items are rated with an application of a 5-point Likert scale, ranging from 1 = "strongly disagree" to 5 = "strongly agree." Higher scores indicate higher academic satisfaction in the engineering major. The coefficient alphas of the previous studies with engineering students ranged from 0.91 to 0.94. (e.g., Garriott et al., 2021; Flores et al., 2014; Lent et al., 2007). The current study's Cronbach's alpha is 0.90.
5. *Engineering Persistence Intentions (EPI)* developed by Lent et al. (2003) evaluates the undergraduates' persistence intentions in their major. Environmental factors, self-efficacy, outcome expectations, satisfaction, and interest are considered to effect persistence behaviors (Navarro et al., 2019). This scale consists of four items. One item, for instance, is *"I am fully committed to getting my college degree in engineering*." Respondents rate the items on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). Higher ratings show a high level of persistence intentions in engineering. Internal consistency values of 0.87–0.95 have been found in previous research with engineering students (e.g., Lent et al., 2003; 2005; Navarro et al., 2014; Garriott et al., 2021). The current study's Cronbach's alpha is 0.82.

Participants

The data set in the Phase II was evaluated using data obtained from 204 engineering undergraduates (87 females and 117 males) from an engineering faculty in Turkey. Students were made aware of the fact that participation was entirely voluntary and that their responses would be considered confidential. Participation was not rewarded in any way. They were from 9 engineering disciplines, namely, computer engineering (10.3%), environmental engineering (10.8%), electric and electronic engineering (9.8%), industrial engineering (10.3%), civil engineering (11.3%), geology engineering (9.3%), chemical engineering (9.3%), mechanical engineering (20.6%), and metallurgy and materials engineering (8.3%). There were 73 (35.8%) second-year students, 77 (37.2%) third-year students, and 49 (24.2%) fourth-year students that participated in the Phase II.

Results

Preliminary Analysis

At the beginning of the Phase II, some preliminary analyses were performed. In the initial sample of 225 engineering students, missing values, normality of distribution, and univariate and multivariate outliers were evaluated. Because the survey was conducted online and all questions had to be answered, there were no cases where data were missing. Univariate outliers were then deleted. Multivariate outliers were also removed. The CFA and validity tests included a total of 204 participants.

Confirmatory Factor Analysis

Using AMOS 21.0, confirmatory factor analysis (CFA) was performed on the second sample (n = 204). In total, five alternative models were tested. Initially, a 22-item one-factor model (Model 1, M1) was tested. The adequacy of the ELES items as indicators of a single latent variable was determined using M1, a unifactorial model. Based on the original study by Garriott et al. (2021), a two-factor model (Model 2, M2) with two factors named "direct learning experiences" (which includes "performance accomplishments," "verbal persuasion," and "physical arousal") and indirect learning (which includes "vicarious learning") was tested (2021). Model 3 (M3), which is also based on the original study, is a second-order model in which four first-order elements explain the ELES: "performance accomplishments," "verbal persuasion," "physical arousal," and "vicarious learning." The four-factor model (Model 4, M4), which consists of "performance accomplishments," "verbal persuasion," "physical arousal," and "vicarious learning" factors, was based on the study carried out by Garriott et al. (2021). Finally, Model 5 (M5) is the modified version of M4. M1, M2, M3, and M4 are displayed in Figure 1.

In this study, the following criteria were used in line with the previous research for an acceptable model fit: CFI >0.90, RMSEA <0.10, and SRMR <0.10. CFI (Comparative Fit Index) values of more than 0.95 indicate good fit and values of more than 0.90 indicate acceptable fit (Browne & Cudeck, 1993). RMSEA (Root Mean Square Error of Approximation) values lower than 0.05 indicate good fit, whereas values between 0.08 and 0.10 indicate acceptable fit (van de Schoot et al., 2012). According to Vandenberg and Lance (2000), an acceptable fit exists when the SRMR (Standardized Root Mean Square Residual) value is close to 0.10 or lower. As shown in Table 3, M1 ($\chi2$ (209) = 1879.44; CFI = 0.82; RMSEA = 0.19; SRMR = 0.13) and M2 ($\chi2$ (208) = 1522.68; CFI = 0.86; RMSEA = 0.17; SRMR = 0.13) indicate poor fit indices. This result indicates that one-factor and second-factor structures are inappropriate for the Turkish context.

The fit indices of M3 (the one-factor second-order model) ($\chi2$ (205) = 680.93; CFI = 0.94; RMSEA = 0.107; SRMR = 0.081) and M4 (four-factor model) ($\chi2$ (203) = 669.60; CFI = 0.94; RMSEA = 0.106; SRMR = 0.079) showed relatively poor fit indices. Since M4 showed a slightly better fit, the model was improved by considering theoretically explainable covariances. Based on modification indices, the errors of the items 1 and 5; 12 and 15; 21 and 22 (all pairs of items were similar in their meaning) were allowed to correlate. Following the modifications, the goodness-of-fit values of the model developed in accordance with the scale structure were determined to be as follows: $\chi2$ (200) = 746.21; CFI = 0.96; RMSEA = 0.08; SRMR = 0.08. This modified version of M4 was called Model 5 (M5). Considering the CFI value is close to 0.95 or larger, the RMSEA value is lower than 0.10 and the SRMR value is lower than 0.10 (van de Schoot et al., 2012; Vandenberg & Lance, 2000), M5 showed acceptable fit indices. Also, as seen in Figure 2, the factor loadings of M5 were equal to or above 0.50. Therefore, M5 is chosen as the ELES version that was most relevant and useful in the Turkish context.

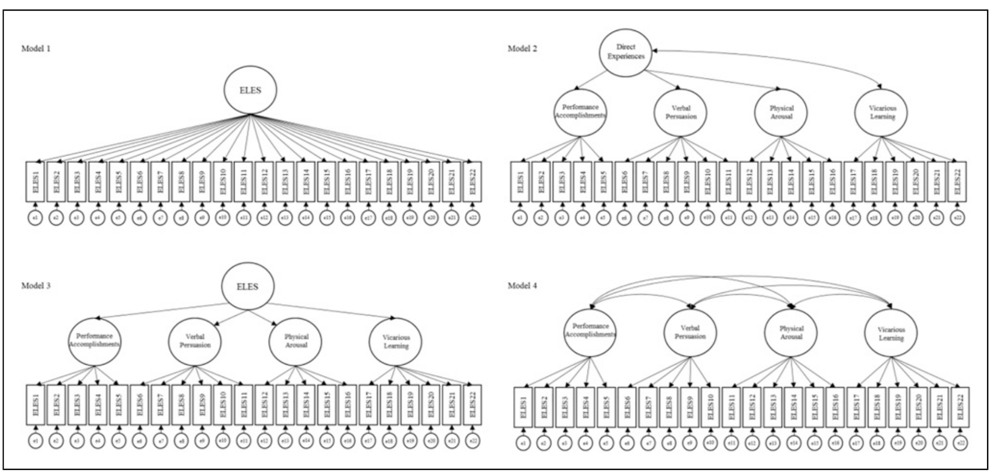

Figure 1. Alternative factor models of the Turkish version of the ELES (M1, M2, M3, and M4).

Table 3. Goodness-of-fit Index of the Tested Models.

Model	$\chi2$	df	P	CFI	RMSEA	SRMR	$\chi2$/df
M1	1879.44	209	<0.001	0.82	0.198	0.13	8.99
M2	1522.68	208	<0.001	0.86	0.176	0.13	7.32
M3	680.93	205	<0.001	0.94	0.107	0.081	3.32
M4	669.60	203	<0.001	0.94	0.106	0.079	3.29
M5	476.21	200	<0.001	0.96	0.082	0.084	2.39

Notes. M1: One-factor model (all items into one factor); M2: Two-factor model (direct learning experiences and indirect learning experiences); M3: One-factor second-order model; M4: Four-factor model (performance accomplishments, verbal persuasion, physical arousal, and vicarious learning); M5: Four-factor model with modifications; $\chi2$: Chi-square; df: Degree of freedom; p: Probability; $\chi2$/df: Chi-square/degree of freedom ratio; GFI: Goodness-of-Fit Index; CFI: Comparative Fit Index; RMSEA: Root Mean Squared Error of Approximation, SRMR: (Standardized Root Mean Square Residual)

Construct Validity and Reliability

The results of the previously stated confirmatory and exploratory factor analyses, as well as the correlation coefficients reported below, all confirmed construct validity for the Turkish version of the ELES.

Table 4 displays the descriptive data and correlation matrix for the ELES, academic self-efficacy, engineering academic satisfaction, negative engineering outcome expectations, positive engineering outcome expectations, and engineering persistence intentions for the Phase II sample (n = 204). Cronbach's alpha values are all greater than 0.74.

Concurrent validity was tested using adapted Turkish versions of the Academic Self-Efficacy Scale (ASES), Positive Engineering Outcome Expectations Scale (PEOES), Engineering Academic Satisfaction Scale (EASS), and Engineering Persistence Intentions Scale (EPIS), which were all designed to measure concepts similar to the ELES. Disregarding a non-significant correlation between ELES_VL (vicarious learning) and the measures (r = 0.2–0.13, $p > 0.05$), all ELES factors are significantly correlated with engineering academic self-efficacy, academic self-efficacy, positive outcome expectations in engineering, and engineering persistence intentions. For the ELES total, however, correlations are statistically significant in all cases (r = 0.28–0.37, $p <$ 0.01).

In this study, the Negative Outcome Expectations-Engineering Scale (NOES-E) was chosen for divergent validity since the NOES-E was found to be negatively related to the scales of engineering self-efficacy, academic satisfaction, intended persistence, and positive outcome expectations in previous studies (Lee et al., 2018). Except for the significant correlation between ELES-VL (vicarious learning) and NOES-E (r = 0.26; $p < 0.01$), no statistically significant correlations were discovered.

Discussion

The findings suggest that the Turkish adaptation of the ELES is a suitable instrument for assessing engineering learning experiences, which also supports the original study's factor structure and conceptualization. The findings of this study validated the existence of four self-efficacy sources as outlined in SCCT (Lent et al., 1994). SCCT researchers can use the ELES to design research that is theoretically accurate to understand learning experiences for engineering undergraduates. The two-factor approach supported by Garriott et al. (2021) implies that ELES scores can be assessed and characterized as *"direct and indirect learning experiences."* When the two-factor

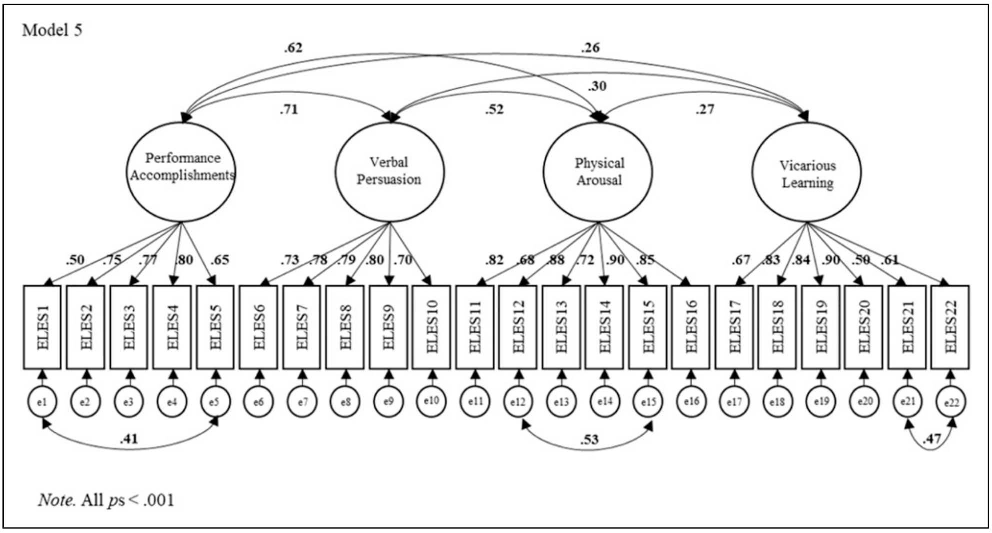

Figure 2. Final Model (M5) and standardized estimates.

model was examined in this study, however, low fit indices were found. In other words, the ELES appears to be more acceptable to utilize with four factors in the context of Turkey.

Firstly, the confirmatory factor analyses demonstrated that the study's findings provided support for ELES's four-factor structure. So, the four-factor model produced the best fit. Internal consistency was found to be adequate in all factors. Secondly, there were moderate relationships between the ELES factors and the validity scales. These findings supported the ELES's concurrent validity. However, the study results showed that the "vicarious learning" factor does not have a significant relationship with the validity scales. This could be caused by the fact that some students did not have the opportunity to observe any role models around them since they were receiving online education throughout the pandemic. In addition, students who have never pre-studied engineering or who do not have engineers in their families are also accepted into engineering departments, since in Turkey, the only criterion for university admission is a highly acceptable score on the entrance exam (Koçkar & Gençöz, 2004). Therefore, those students lack a proper base of role models. Yet, more research is required to confirm the accuracy of these arguments.

In this study, the NOES-E employed for divergent validity has a significant correlation only with the "vicarious learning" factor. In previous research (Hackett et al., 1992), academic self-efficacy for participant engineering students did not show a relationship with positive outcome expectations. Additional study is necessary to disentangle the effects of both positive and negative outcome expectations on academic and career success in engineering. Therefore, the divergent validity of the Turkish version of ELES needs further investigation.

Limitations

There were some notable limitations in this study. To begin with, the survey was only comprised of engineering faculty students from a single public university. The focal university is one of the biggest public universities in Turkey, offering a wide variety of engineering programs (more than 10) with a long history and the enrolling students having above-average university entrance exam scores, being in İstanbul with higher temporary/part-time employment and internship opportunities. Due to those advantages of the focal university as compared to the other universities in

Table 4. Intercorrelations of the ELES Factors, Total Scale, and Validity Scales.

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	Alpha
1.ELES_PA	4.47	1.10	-										0.82
2.ELES_VP	4.07	1.11	0.71**	-									0.90
3.ELES_PhA	3.80	1.24	0.62**	0.52**	-								0.91
4.ELES_VL	3.62	1.34	0.26**	0.30**	0.27**	-							0.85
5.ELES Total	3.99	0.91	0.83**	0.82**	0.80**	0.60**	-						0.92
6.EASE	3.60	0.89	0.32**	0.32**	0.41**	0.02	0.35**	-					0.90
7.ASES	3.39	0.69	0.44**	0.39**	0.45**	−0.13	0.37**	0.55**	-				0.86
8.POE-ES	6.30	1.96	0.28**	0.20**	0.40**	−0.04	0.28**	0.46**	0.42**	-			0.93
9.EPIS	4.39	0.76	0.40**	0.38**	0.24**	0.06	0.35**	0.45**	0.43**	0.21**	-		0.82
10.NOES-E	4.44	1.66	−0.13	−0.13	0.01	0.26**	0.01	−0.23**	−0.17*	−0.22**	−0.37**	-	0.92

Note. ELES: Engineering Learning Experiences Scale; EASE = Engineering Academic Self-Efficacy, ASE= Academic Self-Efficacy; POE-ES = Positive Outcome Expectations in Engineering; EPIS: Engineering Persistance Intentions Scale; NOES-E= Negative Outcome Expectations in Engineering Scale. Correlations are statistically significant at the $p < 0.05$ level.

Turkey, the study findings are not generalizable. As a result, by having a more diverse sample, the findings can be generalized to other Turkish engineering undergraduates in further studies. Future research could look into whether various sources of self-efficacy operate differently depending on the grade levels. Also, measurement invariance between genders was not investigated in this study. Future studies could reveal gender differences in ELES measurement. Another study limitation is that the third and fourth-grade students in the sample received face-to-face education for the first 2 years, whereas the second-grade students received online education as a result of the COVID-19 pandemic. It is possible that this hindered the "vicarious learning" factor. Finally, person inputs and background contextual elements, which are thought to be direct determinants of learning experiences in SCCT, were not included in this study. In future studies, other variables within the scope of SCCT can be explored in the context of Turkey.

Conclusion

The present study provides a crucial attempt to determine the ELES adaptation and its reliability and validity in the Turkish context. In contrast to the context in which the original scale was developed, its validity was tested in a non-Western and emerging market economy context. Given the importance of engineering education in Turkey, it is reasonable to assume that having a Turkish adaptation and validation study of ELES will be beneficial to the private and public stakeholders in the field of engineering. This study is expected to contribute to the studies in STEM education in Turkey and to international research in STEM education. Moreover, utilization of the ELES adaptation will be helpful in practice for interventions on a student basis, course basis, and program basis.

Learning experiences are one of the most important elements in determining self-efficacy (Bandura, 1997) and later employment decisions after graduation, according to a study of engineering students conducted by Hosaka (2014). Therefore, faculty administrators, lecturers, career counselors, and students themselves can all benefit from the ELES in several different ways. First and foremost, it can support faculty administrators in planning the curriculum and lecturers in designing the course content. Furthermore, assessing learning experiences can give an indication of how suitable the faculty's curriculum and physical conditions are for students (for example, laboratory conditions, etc.). Because self-efficacy beliefs change as students' progress through university education (Bandura, 1997), paying attention to engineering students' learning experiences as early as possible is important. Therefore, it is important to monitor the students' experiences throughout time. Thus, introductory engineering courses should be designed to enhance the student experience. On the other hand, career counselors can use ELES to identify the areas in which students need to improve. Moreover, for the Turkish context, strategies such as inviting successful engineers to lectures or professional events to increase students' learning capabilities by serving as role models can be advised.

Understanding other concepts related to outcome expectations, such as the importance of family support and locus of control factors in forming a basis of career interventions that can be prepared to increase professional outcome expectations, as well as contributing to the relevant theoretical literature, is thought to be beneficial to practitioners (Işık, 2013). Some people require the assistance and advice of others while making a career decision, and they suffer from a lack of self-efficacy (Sauermann, 2005). This emphasizes the significance of self-efficacy, one of the SCCT's individual variables, in the decision-making process. Promoting meaningful learning experiences might boost students' self-efficacy in the career decision-making stage.

The use of the ELES in engineering faculties in Turkey can be beneficial in determining whether a student's experience in the faculty is positive or negative, as well as influencing how this situation affects the student's future career. It can also be used as a diagnostic tool to improve academic and professional development as well as to make necessary course, curriculum, and student-based interventions. Also, exploring the learning experiences of engineering students may reveal key learning and experiential processes that may contribute to a better understanding of career choice, career development, and career adaptability of engineering undergraduates. The association between learning experiences and future career orientation or decisions can also be explored.

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Authorship Contribution

Merve Gerçek: Conceptualization, Methodology, Writing, Analyses – original draft. Sevgi Elmas-Atay: Conceptualization, Writing, Reviewing & Editing. Dilek Yılmaz: Conceptualization, Writing, Data Collection & Editing.

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Informed consent

Concent was received from all participants. Permission was received for all the measurement tools used in the study.

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References

Akar, H., Dogan, Y. B., & Üstüner, M. (2018). The relationships between positive and negative perfectionisms, self-handicapping, self-efficacy and academic achievement. *European Journal of Contemporary Education*, *7*(1), 7–20.

Anderson, S. L. & Betz, N. E. (2001). Sources of social self-efficacy expectations: Their measurement and relation to career development. *Journal of Vocational Behavior*, *58*(1), 98–117. https://doi.org/10.1006/jvbe.2000.1753

Bahar-Özvarış, Ş., Güçiz-Doğan, B., Konşuk-Ünlü, H., Şanver, T. M., Susuz, Ç., & Sullivan, R. (2022). Adaptation of intercultural sensitivity scale for Turkish medical students. *International Journal of Intercultural Relations*, *88*, 163–176. https://doi.org/10.1016/j.ijintrel.2022.04.010

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. https://doi.org/10.1037//0033-295x.84.2.191

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*, *4*(3), 359–373. https://doi.org/10.1521/jscp.1986.4.3.359

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman and Company.
Billett, S. (2009). Conceptualizing learning experiences: Contributions and mediations of the social, personal, and brute. *Mind, Culture, and Activity*, *16*(1), 32–47. https://doi.org/10.1080/10749030802477317
Brown, T. (2006). CFA with equality constraints, multiple groups, and mean structures. In D. A. Kennedy (Ed), *Confirmatory factor analysis for applied research* (pp. 236–319). Guilford Press.
Browne, M. W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds), *Testing structural equation models* (pp. 136–162). : Sage.
Byars-Winston, A., Diestelmann, J., Savoy, J. N., & Hoyt, W. T. (2017). Unique effects and moderators of effects of sources on self-efficacy: A model-based meta-analysis. *Journal of Counseling Psychology*, *64*(6), 645–658. https://doi.org/10.1037/cou0000219
Carmines, E. G. & Zeller, R. A. (1974). On establishing the empirical dimensionality of theoretical terms: An analytical example. *Political Methodology*, 75–96. https://www.jstor.org/stable/25791395
Chan, C. K., Zhao, Y., & Luk, L. Y. (2017). A validated and reliable instrument investigating engineering students' perceptions of competency in generic skills. *Journal of Engineering Education*, *106*(2), 299–325. https://doi.org/10.1002/jee.20165
Costello, A.B. & Osborne, J.W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Practical Assessment. *Research & Evaluation*, *10*(7), 1–9. https://doi.org/10.7275/jyj1-4868
Cristobal, E., Flavian, C., & Guinaliu, M. (2007). Perceived e-service quality (PeSQ): Measurement validation and effects on consumer satisfaction and web site loyalty. *Managing Service Quality: An International Journal*, *17*(3), 317–340. https://doi.org/10.1108/09604520710744326
Dalgety, J., Coll, R. K., & Jones, A. (2003). Development of chemistry attitudes and experiences questionnaire (CAEQ). *Journal of Research in Science Teaching*, *40*(7), 649–668. https://doi.org/10.1002/tea.10103
De Vaus, D. (2002). *Analyzing social science data: 50 key problems in data analysis*. Sage.
Flores, L. Y., Navarro, R. L., Lee, H. S., & Luna, L. L. (2014). Predictors of engineering-related self-efficacy and outcome expectations across gender and racial/ethnic groups. *Journal of Women and Minorities in Science and Engineering*, *20*, 149–169.
Garriott, P. O., Flores, L. Y., Prabhakar, B., Mazzotta, E. C., Liskov, A. C., & Shapiro, J. E. (2014). Parental support and underrepresented students' math/science interests: The mediating role of learning experiences. *Journal of Career Assessment*, *22*(4), 627–641. https://doi.org/10.1177/1069072713514933
Garriott, P. O., Hunt, H. K., Navarro, R. L., Flores, L. Y., Lee, B. H., Suh, H. N., et al. (2021). Development and initial validation of the engineering learning experiences scale. *Journal of Vocational Behavior*, *124*, 1–13. https://doi.org/10.1016/j.jvb.2020.103516
Garriott, P. O., Navarro, R. L., & Flores, L. Y. (2017). First-generation college students' persistence intentions in engineering majors. *Journal of Career Assessment*, *25*, 93–106. https://doi.org/10.1177/1069072716657533
George, D. (2010) *SPSS for Windows step by step. A simple study guide and reference*. Pearson.
Gorsuch, R. L. (1990). Common factor analysis versus component analysis: Some well and little known facts. *Multivariate Behavioral Research*, *25*(1), 33–39. https://doi.org/10.1207/s15327906mbr2501_3
Hackett, G., Betz, N. E., Casas, J. M., & Rocha-Singh, I. A. (1992). Gender, ethnicity, and social cognitive factors predicting the academic achievement of students in engineering. *Journal of Counseling Psychology*, *39*(4), 527–538. https://doi.org/10.1037/0022-0167.39.4.527
Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis*. Prentice-Hall.
Holland, J. L (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Psychological Assessment Resources.
Hosaka, M. (2014). Women's experiences in the engineering laboratory in Japan. *European Journal of Engineering Education*, *39*(4), 424–431. https://doi.org/10.1080/03043797.2014.883363

Isık, E. (2010). Career decision self-efficacy among Turkish undergraduate students. *Electronic Journal of Research in Educational Psychology*, *8*(2), 749–761.

Işık, E. (2013). Mesleki sonuç beklentisinin yordayıcıları olarak algılanan sosyal destek ve denetim odağı. *Kuram Ve Uygulamada Eğitim Bilimleri*, *13*(3), 1419–1430. https://doi.org/10.12738/estp.2013.3.1520

Jerusalem, M. & Schwarzer, R. (1992). Self-efficacy as a resource factor in stress appraisal processes. In R. Schwarzer (Ed), *Self-efficacy: Thought control of action* (pp. 195–213). Hemisphere Publishing Corp.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31–36. https://doi.org/10.1007/BF02291575

Kleiner-Schaefer, T. & Schaefer, K. J. (2022). Barriers to university–industry collaboration in an emerging market: Firm-level evidence from Turkey. *The Journal of Technology Transfer*, 1–34. https://doi.org/10.1007/s10961-022-09919-z

Koçkar, A. I. & Gençöz, T. (2004). Personality, social support, and anxiety among adolescents preparing for university entrance examinations in Turkey. *Current Psychology*, *23*(2), 138–146. https://doi.org/10.1007/BF02903074

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Lee, H. S., Flores, L. Y., Navarro, R. L., & Suh, H. N. (2018). Development and validation of the negative outcome expectations scale in engineering (NOES-E). *Journal of Career Assessment*, *26*, 52–67. https://doi.org/10.1177/1069072716679923

Lent, R. W., Brown, S. D., Schmidt, J., Brenner, B., Lyons, H., & Treistman, D. (2003). Relation of contextual supports and barriers to choice behavior in engineering majors: Test of alternative social cognitive models. *Journal of Counseling Psychology*, *50*, 458–465. https://doi.org/10.1037/0022-0167.50.4.458

Lent, R. W. & Brown, S. D. (2006). Integrating person and situation perspectives on work satisfaction: A social-cognitive view. *Journal of Vocational Behavior*, *69*(2), 236–247. https://doi.org/10.1016/j.jvb.2006.02.006

Lent, R. W. & Brown, S. D. (2019). Social cognitive career theory at 25: Empirical status of the interest, choice, and performance models. *Journal of Vocational Behavior*, *115*, 103316. https://doi.org/10.1016/j.jvb.2019.06.004

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, *45*(1), 79–122. https://doi.org/10.1006/jvbe.1994.1027

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology*, *47*(1), 36–49. https://doi.org/10.1037//0022-0167.47.1.36

Lent, R. W., Brown, S. D., & Hackett, G. (2002). Social cognitive career theory. In D. Brown (Ed), *Career choice and development* (4th ed., pp. 255–311). Jossey-Bass.

Lent, R. W., Brown, S. D., Sheu, H.-B., Schmidt, J., Brenner, B. R., Gloster, C. S., et al. (2005). Social cognitive predictors of academic interests and goals in engineering: Utility for women and students at historically Black universities. *Journal of Counseling Psychology*, *52*, 84–92. https://doi.org/10.1037/0022-0167.52.1.84

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Mathematics self-efficacy: Sources and relation to science-based career choice. *Journal of Counseling Psychology*, *38*(4), 424–430. https://doi.org/10.1037/0022-0167.38.4.424

Lent, R. W., Miller, M. J., Smith, P. E., Watford, B. A., Lim, R. H., Hui, K., et al. (2013). Social cognitive predictors of adjustment to engineering majors across gender and race/ethnicity. *Journal of Vocational Behavior*, *83*(1), 22–30. https://doi.org/10.1016/j.jvb.2013.02.006

Lent, R. W., Sheu, H. B., Singley, D., Schmidt, J. A., Schmidt, L. C., & Gloster, C. S. (2008). Longitudinal relations of self-efficacy to outcome expectations, interests, and major choice goals in engineering students. *Journal of Vocational Behavior*, *73*(2), 328–335. https://doi.org/10.1016/j.jvb.2008.07.005

Lent, R. W., Singley, D., Sheu, H. B., Schmidt, J. A., & Schmidt, L. C. (2007). Relation of social-cognitive factors to academic satisfaction in engineering students. *Journal of Career Assessment*, *15*, 87–97. https://doi.org/10.1177/1069072706294518

Lopez, F. G., Lent, R. W., Brown, S. D., & Gore, P. A. (1997). Role of social-cognitive expectations in high school students. mathematics-related interest and performance. *Journal of Counseling Psychology*, *44*, 44–52. https://doi.org/10.1037/0022-0167.44.1.44

Ma, Y., Autin, K. L., & Ezema, G. N. (2022). Validation of the Chinese decent work scale. *Journal of Career Development*, 1–15. https://doi/10.1177/08948453221080980

Mellor, S., Barclay, L. A., Bulger, C. A., & Kath, L. M. (2006). Augmenting the effect of verbal persuasion on self efficacy to serve as a steward: Gender similarity in a union environment. *Journal of Occupational and Organizational Psychology*, *79*(1), 121–129. https://doi.org/10.1348/096317905X36353

Navarro, R. L., Flores, L. Y., Lee, H. S., & Gonzalez, R. (2014). Testing a longitudinal social cognitive model of intended persistence with engineering students across gender and race/ethnicity. *Journal of Vocational Behavior*, *85*, 146–155. https://doi.org/10.1016/j.jvb.2014.05.007

Navarro, R. L., Flores, L. Y., Legerski, J.-P., Brionez, J., May, S. F., Suh, H. N., et al. (2019). Social cognitive predictors of engineering students' academic persistence intentions, satisfaction, and engagement. *Journal of Counseling Psychology*, *66*(2), 170–183. https://doi.org/10.1037/cou0000319

Pehlivanli-Kadayifci, E. (2018). Social construction of gendered engineering culture in Turkey. *International Journal of Gender, Science and Technology*, *9*(3), 221–243. http://hdl.handle.net/10536/DRO/DU:30057995

Poon, J. (2013). Blended learning: An institutional approach for enhancing students' learning experiences. *Journal of Online Learning and Teaching*, *9*(2), 271–288.

Ramos-Sandoval, R. & Ramos-Diaz, J. (2020). Barriers and supports in engineering career development: An exploration of first-year students. *Advances in Science, Technology and Engineering Systems*, *5*(6), 920–925. https://doi.org/10.25046/aj0506109

Roberts, D. (2010). Vicarious learning: A review of the literature. *Nurse Education in Practice*, *10*(1), 13–16. https://doi.org/10.1016/j.nepr.2009.01.017

Rogers, M. E. & Creed, P.A. (2011). A longitudinal examination of adolescent career planning and exploration using a social cognitive career theory framework. *Journal of Adolescence*, *34*(1), 163–172. https://doi.org/10.1016/j.adolescence.2009.12.010

Sauermann, H. (2005). Vocational choice: A decision making perspective. *Journal of Vocational Behavior*, *66*(2), 273–303. https://doi.org/10.1016/j.jvb.2004.10.001

Schaub, M. (2003). *Learning experiences questionnaire (LEQ) scoring key*. University of Akron. [Unpublished manuscript].

Schaub, M. & Tokar, D. M. (2005). The role of personality and learning experiences in social cognitive career theory. *Journal of Vocational Behavior*, *66*(2), 304–325. https://doi.org/10.1016/j.jvb.2004.09.005

Shen, D., Cho, M. H., Tsai, C. L., & Marra, R. (2013). Unpacking online learning experiences: Online learning self-efficacy and learning satisfaction. *The Internet and Higher Education*, *19*, 10–17. https://doi.org/10.1016/j.iheduc.2013.04.001

Sheu, H. B., Lent, R. W., Miller, M. J., Penn, L. T., Cusick, M. E., & Truong, N. N. (2018). Sources of self-efficacy and outcome expectations in science, technology, engineering, and mathematics domains: A meta-analysis. *Journal of Vocational Behavior*, *109*, 118–136. https://doi.org/10.1016/j.jvb.2020.103516

Smith, A. E. & Dengiz, B. (2010). Women in engineering in Turkey–a large scale quantitative and qualitative examination. *European Journal of Engineering Education*, *35*(1), 45–57. https://doi.org/10.1080/03043790903406345

Stevens, R. O', Connor, K., Garrison, L., Jocuns, A., & Amos, D. M. (2008). Becoming an engineer: Toward a three dimensional view of engineering learning. *Journal of Engineering Education*, *97*(3), 355–368. https://doi.org/10.1002/j.2168-9830.2008.tb00984.x

Tokar, D. M., Thompson, M. N., Plaufcan, M. R., & Williams, C. M. (2007). Precursors of learning experiences in social cognitive career theory. *Journal of Vocational Behavior*, *71*(3), 319–339. https://doi.org/10.1016/j.jvb.2007.08.002

Topping, K. J. (2005). Trends in peer learning. *Educational Psychology*, *25*(6), 631–645. https://doi.org/10.1080/01443410500345172

Ulaş-Kılıç, Ö (2021). A psychometric evaluation of the career transition inventory with Turkish participants. *International Journal for Educational and Vocational Guidance*, *21*(3), 631–651. https://doi.org/10.1007/s10775-021-09458-3 1 3

Usher, E. L. & Pajares, F. (2009). Sources of self-efficacy in mathematics: A validation study. *Contemporary Educational Psychology*, *34*(1), 89–101. https://doi.org/10.1016/j.cedpsych.2008.09.002

Vanasupa, L., Stolk, J., & Herter, R. J. (2009). The four-domain development diagram: A guide for holistic design of effective learning experiences for the twenty-first century engineer. *Journal of Engineering Education*, *98*(1), 67–81. https://doi.org/10.1002/j.2168-9830.2009.tb01006.x

Vandenberg, R. J. & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, *3*(1), 4–70. https://doi.org/10.1177/109442810031002

Van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology*, *9*(4), 486–492. https://doi.org/10.1080/17405629.2012.686740

Van Prooijen, J. W. & Van Der Kloot, W. A. (2001). Confirmatory analysis of exploratively obtained factor structures. *Educational and Psychological Measurement*, *61*(5), 777–792. https://doi.org/10.1177/00131640121971518

YOK (2021). *Yükseköğretim bilgi yönetim sistemi [Higher education information management center]*. Retrieved December 3, 2021from https://istatistik.yok.gov.tr/

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