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Preliminary development and validation of online distance education satisfaction scale (ODESS)

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ABSTRACT

This study outlines the development and validation of a new scale measuring undergraduate students' satisfaction with online distance education. Employing a survey model, the study included item generation, data collection, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA). An initial 72-item pool was created through a literature review and expert consultation. Content validity was ensured through evaluations by 12 academics, resulting in a refined set of 65 items. These items were reviewed by 15 students for further clarity. Data were collected via an online survey from undergraduate students at three universities. A total of 407 students participated in the EFA phase and 333 in the CFA phase. Reliability and validity were assessed using various statistical tests. The final ODESS scale comprises 39 items across seven factors: Instructor Support, Self-satisfaction and Needs, Course Materials, Self-expression, Student-student Interaction, Exam Security, and Facilitative Roles of Instructors. The model explains 68% of the total variance. This study presents a valid and reliable multidimensional instrument that comprehensively assesses key dimensions of the online learning experience, supporting efforts to improve quality and responsiveness in distance education.

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Distance education; satisfaction scale; scale development and validation; undergraduate students; higher education

Introduction

The rapid advancement and accessibility of information and communication technologies (ICTs) have bolstered the popularity and reach of online distance education, making it a viable mode of learning, regardless of the circumstances. This has been highlighted through methods such as online, blended, or hybrid learning (Durak et al., 2017; Masalimova et al., 2022) as well as through emergent needs, for instance, during the COVID-19 pandemic. Online distance education is crucial in a time of crisis as it ensures the sustainability and accessibility of education for learners who are affected by the crisis

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(Durak et al., 2020). Drilling down into more specific scenarios, during the COVID-19 pandemic, many schools and universities had to close their physical institutions and switch to online learning to prevent the spread of the pandemic and protect the health and safety of instructors, students and staff (Durak & Çankaya, 2020; Lockee, 2021; Masalimova et al., 2022). Beyond these advantages, online distance education can also offer flexibility and diversity for learners who have different needs and preferences in terms of time, pace, place, and mode of learning (Ng, 2021; Veletsianos & Houlden, 2019).

Online distance education is also reported to have some positive effects on learning outcomes and skills development (Min & Yu, 2023; Yu, 2021). Certain studies indicate that online distance education aided some students to become more proactive, independent, motivated, and IT literate in their learning (Ulum, 2022; Zhou & Zhang, 2023). Moreover, it also enable new forms of learning, such as collaborative, project-based, or inquiry-based learning, which can foster creativity, critical thinking, and problem-solving skills among learners (Dos Santos Caparróz Carvalho et al., 2008; Neroni et al., 2019).

Despite its numerous benefits, online distance education also poses several challenges and difficulties for both learners and instructors, such as lack of interaction, social isolation, feedback, motivation, and support (Chiu et al., 2021; Croft et al., 2010; Pelikan et al., 2021). These challenges can negatively impact the overall learning experience and lead to lower levels of engagement and satisfaction, which in turn affect critical outcomes such as academic achievement, retention, and dropout rates (Rajabalee & Santally, 2021). Measuring and evaluating the satisfaction level of online distance education participants provides valuable insights into how these challenges can be addressed effectively. For example, understanding satisfaction levels can help identify areas that need improvement, such as enhancing interaction or providing better feedback mechanisms, ultimately contributing to the quality and effectiveness of online learning experiences. Additionally, one primary indicator of the quality of online learning is students' satisfaction with their online education, as it reflects the extent to which educational objectives and students' expectations are being met (Ilgaz & Gülbahar, 2015; Parahoo et al., 2016; Yukselturk & Yildirim, 2008). By systematically assessing satisfaction, institutions can make data-driven decisions to improve both student outcomes and instructional practices.

Satisfaction is characterized as the degree to which learners perceive that their expectations have been met or exceeded (Liaw & Huang, 2013; Sun et al., 2008). It is a multidimensional construct that can be influenced by various factors, such as instructor support, learner interaction, course structure, course quality, computer/internet self-efficacy, learning materials, technical support, assessment and feedback, and overall satisfaction (Harsasi & Sutawijaya, 2018; Kirtman, 2009; Turhangil Erenler, 2020; Uusiautti et al., 2017; Young & Norgard, 2006).

According to Gil (2008), there are four categories that affect online learning satisfaction: administration, functionality, instruction, and interaction Researchers have found a number of factors that support student motivation and satisfaction in online learning. These factors include challenging and encouraging academic activities (Chen, 2007; Lister, 2014; Tibi, 2015; An et al., 2008), prompt and clear feedback (Britto & Rush, 2013; Sebastianelli et al., 2015; Wallace, 2003), routine contact with the teacher (Lister, 2014; Roper, 2007; Uusiautti et al., 2017), and constructive relationships with classmates (Kurucay & Inan, 2017; Liaw & Huang, 2013; Lister, 2014; Wallace, 2003).

The landscape of online distance education is in constant flux due to the rapid evolution of technology and innovation (Lavicza et al., 2022). Therefore, scales that are developed to measure the level of satisfaction in online distance education environments should reflect the current state of the art in technologies, theories, and practices.

Developing an up-to-date scale for online distance education can enable that the scale items to be more accurate and consistent with the current state of art in online distance education. Such an approach can help to avoid potential biases or errors that may arise from using outdated or irrelevant scales that do not reflect the reality of online distance education. Moreover, developing up-to-date scales can also enhance the credibility and trustworthiness of online distance education research and practice, as it shows that the researchers and practitioners are aware of and responsive to the latest trends and developments in online distance education. Given these considerations, it is important to develop up-to-date scales for online distance education to measure and evaluate the attitudes and perceptions of online distance education participants. This can help to improve the quality and effectiveness of online distance education experiences and outcomes.

Literature review

There are various scales that have been developed and validated about online distance education satisfaction. Some of these scales are listed in Table 1. Among the listed scales, while some are unidimensional (e.g., Bayrak et al., 2020; Yavuzalp & Bahçivan, 2020), others are multidimensional (e.g., Hwang & Kim, 2022; Torrado & Blanca, 2022; Walker & Fraser, 2005). Common attitudes and perceptions measured across these scales include satisfaction, interaction, course content, instructor support, and technological readiness. Reviewing these diverse aspects is important because online learning satisfaction is a multidimensional construct influenced by various factors, such as interactions, learning environments, and self-efficacy.

These scales are examples of existing online learning scales that can be utilized to quantify and assess the attitudes and perceptions of online learners. However, it is important to note that these scales may not fully cover all aspects of online learning or may not be applicable to every learning context. For instance, the scales by Bayrak et al. (2020) and Hamutoğlu et al. (2020) focus primarily on overall satisfaction, without addressing key dimensions such as exam security or self-expression, which are increasingly significant in contemporary online learning environments. Hence, it is crucial to create new scales that align with specific needs and attributes of online learners and instructors. The aim of this study is to address the existing gap in the literature by developing the Online Distance Education Satisfaction Scale (ODESS).

Many studies have developed scales to assess different aspects of the learner's experience in the field of online education and satisfaction. These scales can be categorized according to their specific areas of focus: learner satisfaction, learning environment, and readiness and self-efficacy. Reviewing these diverse aspects is important because online learning satisfaction is a multidimensional construct influenced by various factors, such as interactions, learning environments, and self-efficacy. Understanding these dimensions helps create a more comprehensive framework for measuring satisfaction, as it ensures that the scales address the full range of student experiences and expectations in online education.

Table 1. Online distance education satisfaction scales.

Study	Scale Name	Target	Number of Items	Factors
Bayrak et al. (2020)	Online Course Satisfaction Scale	Undergraduate students	10	Satisfaction
Torrado and Blanca (2022)	Learner Satisfaction Survey (LSS-S) with Online Courses	Undergraduate and graduate students	25	Learner–content interaction, Learner–instructor interaction, Learner–learner interaction, Learner–technology interaction, General satisfaction
Toraman et al. (2022)	Distance Education Satisfaction Scale (DESS).	Undergraduate students	20	Satisfaction with Distance Education, Satisfaction with the Council of Higher Education Approach in Distance Education, Satisfaction with Instructors in Distance Education
Walker and Fraser (2005)	Distance Education Learning Environments Survey (DELES)	Undergraduate students	34	Instructor Support, Student Interaction and Collaboration, Personal Relevance, Authentic Learning, Active Learning, Student Autonomy
Hwang and Kim (2022)	Development and validation of the e-learning satisfaction scale (eLSS)	Adult learners	17	Content, Interface, Communication
Hamutoglu et al. (2020)	Virtual Learning Environment Satisfaction	Undergraduate students	13	Contribution, Satisfaction, Communication
Yurdugül and Sarikaya (2013)	Çevrimiçi Öğrenme Hazır Bulunuşluk Ölçeği [Online Learning Readiness Scale (OLRS)]	Undergraduate students	18	Self-directed learning, Motivation for learning, Computer/Internet self-efficacy, Learner control, Online communication self-efficacy
Ramazanoğlu et al. (2022)	Online Learning Readiness Scale (OLRS)	High School Students	16	Computer self-efficacy, Internet self-efficacy, Self-learning
Yavuzalp and Bahçivan (2020)	Cevrimici Ogrenme Oz-Yeterlik Olcegi [Online Learning Self-Efficacy Scale]*	Undergraduate students	21	Single dimension
Zimmerman and Kulikowich (2016)	Online Learning Self-Efficacy Scale (OLSES)	Postsecondary Students	22	Learning in the online environment, Time management, Technology use

Exam security and the facilitative roles of instructors were emerged as dimensions in ODESS due to their growing significance in online learning environments. Exam security has become a critical concern in online education due to the challenges of maintaining academic integrity in remote assessment settings (Bertiz & Hebebci, 2021; Kaiiali et al., 2016). Ensuring that online exams are conducted fairly and securely is directly linked to students' perceptions of the credibility and quality of the education they receive. Similarly, the facilitative roles of instructors emphasize the importance of instructor behaviors that actively support and engage students in the learning process. Studies have shown that instructor facilitation, such as timely feedback, personalized support, and the promotion of collaborative activities, significantly enhances student satisfaction (Arghode et al., 2018).

Learner Satisfaction: A basic theme in these studies is assessing learner satisfaction in online courses. For instance, Bayrak et al. (2020) developed a scale called the Online Course Satisfaction Scale specifically for undergraduate students. This scale measures overall satisfaction and consists of 10 items. In a different study, Torrado and Blanca (2022)

developed the Learner Satisfaction Survey (LSS-S), consisting of 25 items, to assess the satisfaction of both undergraduate and graduate students. This scale is more detailed, evaluating various interactions such as learner – content, learner – instructor, learner – learner, and learner – technology, in addition to overall satisfaction. Moreover, Toraman et al. (2022) made a significant contribution by developing the Distance Education Satisfaction Scale (DESS) specifically for undergraduate students. This scale consists of 20 items that assess satisfaction in distance education, the approach of higher education authorities, and instructor effectiveness.

Learning Environment: Walker and Fraser (2005) developed the Distance Education Learning Environments Survey (DELES), which is a comprehensive scale consisting of 34 items, specifically designed for undergraduate students to assess their learning environment in distance education. The psychosocial learning environment is assessed using six dimensions, which include Instructor Support, Student Interaction and Collaboration, and Student Autonomy. This scale emphasizes the significance of the different psychosocial aspects of the learning environment in distance education.

Readiness and Self-Efficacy: Several studies concentrate on the readiness and self-efficacy of students in terms of online learning. In one of these studies, The Online Learning Readiness Scale (OLRS) developed by Yurdugül and Sarikaya (2013) and further developed by Ramazanoğlu et al. (2022) is specifically designed to assess the readiness of undergraduate and high school students in online learning. Readiness is assessed by evaluating factors such as self-directed learning and computer self-efficacy. In another study, The Online Learning Self-Efficacy Scale (OLSES) by Zimmerman and Kulikowich (2016) assesses postsecondary students' confidence in managing learning in the online environment, time management, and technology use.

Each study listed above offers unique insights into the diverse aspects of online learning, from satisfaction and the quality of the learning environment to readiness and self-efficacy. These scales collectively contribute to a deeper understanding of what makes for a successful and satisfying online learning experience.

The need for the scale

The development of the Online Distance Education Satisfaction Scale (ODESS) is an important advance in the field of online learning, especially with regard to addressing certain challenges and dynamics of modern online learning environments. There's an increasing need for up-to-date measurement tools as the field of online distance education develops quickly due to major improvements in information and communication technologies (Lavicza et al., 2022). ODESS is a relevant and accurate tool for evaluating student satisfaction in today's online learning environments since it is made to reflect contemporary educational methods and technologies.

Even though they are thorough, the present scales may not cover for all the factors relevant to the situation of online distance learning today. In order to close this gap, ODESS incorporates factors that other scales may not have sufficiently addressed, such as exam security and the facilitative roles of instructors (Bayrak et al., 2020; Toraman et al., 2022; Torrado & Blanca, 2022). Through the integration of these factors, ODESS offers a more holistic evaluation of student satisfaction, ensuring a broader and more relevant assessment. The scale explicitly includes seven dimensions: instructor support, self-

satisfaction and needs, course materials, self-expression, student-student interaction, exam security, and facilitative roles of instructors. These dimensions were operationally defined based on a detailed review of the literature and expert consultation to ensure comprehensive coverage of factors influencing satisfaction.

Numerous factors, such as course materials, student interactions, self-expression, and instructor support, affect how satisfied students are with their online learning (Harsasi & Sutawijaya, 2018; Kirtman, 2009). These many factors are thoroughly covered by ODESS, which provides a thorough grasp of the variables influencing student satisfaction. This multidimensional perspective is essential for accurately capturing the complex nature of student experiences in online education.

The COVID-19 pandemic has emphasized the need for robust online educational frameworks (Durak et al., 2020). ODESS was developed in response to this paradigm shift, where traditional educational methods rapidly transitioned to online formats. This situation highlights the importance of having a tailored scale like ODESS that can effectively measure student satisfaction during such unprecedented times.

Understanding and measuring student satisfaction is directly related to learning outcomes such as retention, academic success, and dropout rates (Rajabalee & Santally, 2021). Online distance education can be improved overall by using ODESS, which offers a comprehensive evaluation of satisfaction levels and assists educators and institutions in identifying areas that require improvement.

Online learning accommodates a wide range of learner preferences and needs due to its flexibility and diversity (Ng, 2021; Veletsianos & Houlden, 2019). Because of its extensive structure, ODESS is ideally suited to evaluate student satisfaction in a variety of learning environments and demographics, helping that a wide range of needs and preferences are adequately addressed.

In the ever-changing field of online distance education, the ODESS emerges as a vital instrument. ODESS fits in well with the fast changes and unique challenges of contemporary online education by filling in the gaps left by the shortcomings of current assessment tools and taking into account the complex nature of student satisfaction. In order to ensure that student satisfaction is measured in a way that is both comprehensive and reflective of the state of online educational practices and technologies today, its development is not only an addition to the array of tools already in place but also an essential evolution.

Method

In the present study, the survey model was used to develop a scale for determining undergraduate students' satisfaction levels towards online distance education.

Item generation

The purpose of the scale was defined as measuring online distance education students' satisfaction. Before constructing the preliminary version of the scale, studies on online learning satisfaction were examined to identify key dimensions and items commonly used in existing scales (Alshare et al., 2011; Arbaugh, 2018; Bolliger & Halupa, 2012; Gunawardena et al., 2010; Kolburan Geçer & Deveci Topal, 2015). Based on this review, the researchers initially drafted a set of items to capture the key aspects of online learning

satisfaction. These draft items served as the foundation for the item pool, culminating in a pool of 72 items.

To affirm content validity, the researchers asked 12 academics who have expertise in online distance education to examine each item and indicate if it was necessary, relevant in terms of content, and easy to understand. The experts were selected based on their extensive experience in online education, and all held a PhD degree. Additionally, they were asked to specify the dimensions under which each item should be evaluated. During this stage, an assessment form was created with spaces under each item for the experts to write their evaluations. The following rating scale was given to the experts to rate each item as follows: (1) Item is appropriate, (2) Item should be revised, (3) Item should be attentively revised, and (4) Item is not appropriate. Items receiving a majority rating of (1) or (2) were retained, while items receiving a majority rating of (3) or (4) were removed or revised according to the comments of the experts. Each expert was instructed not only to evaluate the clarity and appropriateness of each item but also to specify whether the item adequately represented the intended subscale. This dual-level evaluation ensured that every item was reviewed for both general relevance and its alignment with the specific construct it was intended to measure. Among the 72 items, the items considered inappropriate by the experts were removed. Of the initial 72 items, those deemed inappropriate by the experts were discarded, leaving a pool of 65 items. The items in the draft version were randomized and converted into a five-point Likert-type scale. Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree were the ratings on this scale. Lastly, 15 students were asked to read each item and identify any unclear or redundant wording and those identified as unclear or redundant were revised to improve clarity and precision based on their feedback. The 65 items were preliminarily grouped according to the proposed dimensions: 9 items were drafted for Instructor Support, 9 for Self-satisfaction and Needs, 6 for Course Materials, 6 for Self-expression, 6 for Student – Student Interaction, 5 for Exam Security, and 8 for Facilitative Roles of Instructors. These distributions were shaped through theoretical background and expert consultation.

Data collection

The participants of sample were undergraduate students from three universities in Türkiye. The research utilized a convenience sampling technique to choose participants for the study. In total, 407 undergraduate students participated in the exploratory factor analysis phase, which comprised 215 females and 192 males. In the subsequent phase involving confirmatory factor analysis, the study included a distinct group of 333 undergraduate students – 209 females and 124 males – none of whom were part of the earlier research sample. The responses from the participants were collected through online Google Form. On the data collected during the initial implementation, exploratory factor analysis and other validity and reliability tests were carried out. The data collected with the second implementation was subjected to a confirmatory factor analysis. All participating students had ample experience in online distance education. This was confirmed by the fact that all students were enrolled in higher education during the COVID-19 pandemic, when all courses were delivered exclusively online as a necessity. Additionally, in Turkey, all universities provide certain compulsory courses, such as Introduction to Information

Technologies and Atatürk's Principles and History of Turkish Revolution, through online platforms, ensuring that every student gains experience in online learning environments.

Data analysis

An exploratory factor analysis (EFA) was carried out using SPSS 24.0 software to discern the number of factors present in the observable variables of the ODESS. The number of factors was determined based on eigenvalues. Items that were not working, meaning those with factor loadings below the threshold of 0.30 or those that cross-loaded onto multiple factors with similar weights, were eliminated to ensure the clarity and reliability of the factor structure. The finalized tool incorporated seven subscales, comprising a total of 39 items. After the EFA, the confirmatory factor analysis (CFA) was carried out to validate the suggested ODESS instrument and assess the DES theoretical structure. CFA was carried out on the seven-factor model based on the seven-factor structure with 39 items collected by exploratory factor analysis. AMOS 21 was used to create and test a structural equation model (SEM) in the current investigation.

Findings

EFA

EFA was completed with 39 items using principal components and Direct Oblimin rotation. Direct Oblimin rotation was chosen because the factors were assumed to be correlated, a common assumption in social science research (Büyüköztürk, 2002; Çokluk et al., 2014). The KMO value was 0.942 and the Bartlett's test of sphericity resulted in a value of 11,275.512 and a p-value of.000, indicating that the data were suitable for factor analysis (Baser et al., 2016). Furthermore, 68% of the overall variation in the model was explained by the seven-factorial structure. Correlations among the factors were calculated as part of the analysis, and the results showed moderate to high correlations, which supported the use of an oblique rotation method like Direct Oblimin. Alternative factor solutions were also explored by examining the scree plot and eigenvalues greater than 1.0. A seven-factor solution was determined to be the most appropriate, as additional factors did not meet the theoretical or statistical criteria for inclusion.

Table 2 displays the cumulative variance, total variances explained, and eigenvalues for each of the seven factors identified via factor analysis. According to Netemeyer et al. (2003), the value of variance between 40% and 60% is adequate for social science studies. Therefore, the total variance explained in this study (67.88%), which was over 60%, more than satisfactory. The factor analysis revealed that the ODESS scale is comprised of a seven-factor structure. In accordance with the academic literature, these factors have been named as follows:

Table 2. Total variance explained after rotation.

Factor	Eigenvalues	Percentage of Variance	Percentage of Total Variance
1	15.353	39.366	39.366
2	3.316	8.504	47.869
3	2.083	5.342	53.211
4	1.851	4.746	57.957
5	1.532	3.928	61.885
6	1.256	3.221	65.106
7	1.082	2.773	67.879

- Instructor Support: This factor measures the level of support provided by the instructor, including the frequency and quality of feedback, one-on-one engagement with students, and guidance related to course objectives and materials.
- Self-satisfaction and needs: This factor assesses students' satisfaction with their online learning experiences, their ability to meet learning needs, and their motivation to achieve personal goals within the learning environment.
- Course materials: This factor evaluates the alignment of course materials with learning objectives, their contribution to students' learning, and their effectiveness in maintaining student engagement.
- Self-expression: This factor reflects students' ability to express themselves, share opinions and concerns, participate actively in discussions, and communicate ideas and emotions during online classes.
- Student – student interaction: This factor measures the quality of interactions among students, the exchange of feedback, and how these interactions enhance their learning experience and foster a sense of community.
- Exam security: This factor assesses the perceived fairness and integrity of online examinations, including measures to prevent cheating and the organization of exam processes.
- Facilitative roles of instructors: This factor evaluates the instructor's ability to foster collaboration, design activities that meet learning needs, and increase student motivation through effective facilitation techniques.

According to these findings, seven factors are formed. The dimensions covered in this study were identified through a comprehensive review of the literature and consultation with field experts. The scale is not solely based on the subjective interpretation of satisfaction in online learning by the experts but rather integrates empirical evidence and theoretical foundations. The scree plot used to calculate the final factor number is seen in Figure 1. The value flattens out after the seventh item, as seen in Figure 1, and falls below one. Therefore, it may be said that the scree plot indicated that the scale's factor number was seven.

Each factor's eigenvalue is more than one, as shown in Table 2, and the values are parallel according to the scree plot. Values less than 0.3 were screened and omitted (Büyüköztürk, 2002; Çokluk et al., 2014; Pallant, 2016). This approach was adopted to provide for a more accurate interpretation of the data and a more detailed assessment of the items' suitability for the factors.

The statistics related to the factors of the scale are presented in Table 3. The total Cronbach's alpha of the scale was .957, indicating a very high reliability for the scale. Each of the seven subscales, with Cronbach's alphas ranging from .790 to .925, can be considered reliable.

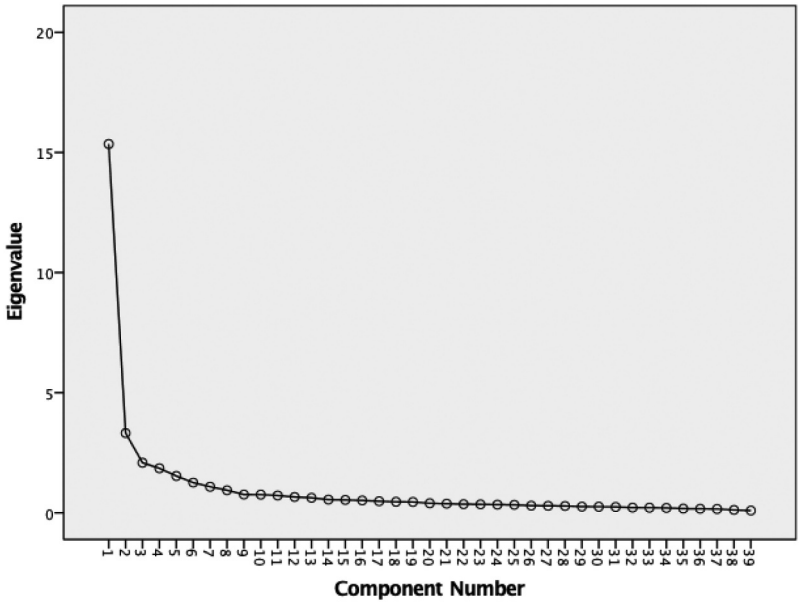

Figure 1. Scree plot.

CFA

The CFA research included 333 undergraduate students, of which 209 were females and 124 males. Although CMIN/DF is the fit index that is employed the most frequently, there are disparate views on the usage of alternative fit indexes. Brown (2006) proposes reporting RMSEA (the Root Mean Square Error of Approximation), SRMR (the Standardized Root Mean Square Residual), CFI (the Comparative Fit Index) and NNFI (the non-normed fit index-TLI); Lacobucci (2010) proposes reporting CFI and SRMR fit indexes. For this reason, CMIN/DF, RMSEA, RMR, SRMR, NNFI, CFI, GFI, AGFI, NFI, and IFI fit indexes are given in this study.

Researchers used modification indices to find covariance routes between the errors of items 64 and 65, 24 and 25, 31 and 34, and then rerun the model because the first model did not satisfy the requirements. CMIN/DF = 1.849, RMSEA = .05, RMR = .59, SRMR = .071, NNFI = .90, CFI = .91, GFI = .83, AGFI = .81, NFI = .82, and IFI = .91 were the outcomes of the seven-factor structural model fit produced in this investigation (Table 4). The model fit indices indicate a good fit between the model and the observed data (Brown, 2006; Lacobucci, 2010).

The model fit metrics in Table 4 showed a good fit for the structural equation model, demonstrating the construct validity of the ODESS measurements. Figure 2 shows the correlations between each latent variable, the loadings of each item onto their construct, and the correlated residuals. The results of the SEM investigation are shown in Figure 2.

As seen in Figure 2, the factor loadings in the CFA model vary between .39 and .89. All these values are above .30, which is accepted as the cut-off point (Kline, 2016). The factor loadings in the Instructor Support (F1) dimension were between .39 and .72, in the Self

Table 3. Scale item statistics.

	M	SD	
F1 - Instructor Support			**.905**
F1_26 Assignments are compatible with the course objectives	3.98	.93	
F1_27 Homework contributes to my learning	3.94	1.01	
F1_28 The evaluation criteria of the course are clearly stated at the beginning of the semester	4.06	.86	
F1_29 Sufficient time is given to complete assignments.	3.85	.96	
F1_30 The instructor gives appropriate feedback on assignments	3.85	.99	
F1_31 The instructor gives timely feedback on assignments	3.78	.99	
F1_32 The lecturer deals with the students one-to-one	3.55	1.08	
F1_33 The difficulty level of the lessons is appropriate for me	3.79	.91	
F2 - Self Satisfaction & Needs			**.925**
F2_11 I believe that live online courses create an intimate learning environment	3.13	1.29	
F2_36 I think distance education meets my learning needs	3.23	1.37	
F2_37 I think distance education gives me many opportunities to learn	3.37	1.33	
F2_63 I enjoy working in distance education environments	3.29	1.38	
F2_64 I set realistic learning goals to meet my needs in distance education	3.59	1.13	
F2_65 I plan in detail the steps to achieve my goals in distance education	3.60	1.10	
F3 - Self Expression			**.882**
F3_15 I can easily share my questions/concerns with my friends during the lessons	3.73	1.03	
F3_17 I actively participate in live online classes	3.79	1.11	
F3_19 I can easily express my ideas in classes	3.83	.98	
F3_20 I can express my opinions when I have a difference of opinion in class discussions	3.83	.90	
F3_21 I can express my emotions in various ways (written/verbal or video) in lessons	3.91	.89	
F3_22 I can easily ask the instructor about the subjects I do not understand in the lessons	3.92	.89	
F4 - Course Materials			**.893**
F4_24 Course materials (presentations, documents, etc.) are compatible with the course objectives	4.19	.68	
F4_25 Course materials (presentations, documents, etc.) contribute to my learning	4.24	.69	
F4_41 I think that the feedback from the instructor is useful for me	4.20	.76	
F4_43 I would be pleased to have the opportunity to practice what I have learned	4.18	.81	
F4_44 Course materials keep my interest in the course alive	4.14	.77	
F4_45 Online resources provided for the course support my learning	4.15	.77	
F5 - Exam Security			**.790**
F5_48 I think that the organization of online exams at the University is carried out successfully	3.65	1.06	
F5_56 Measures are taken to prevent cheating in online exams	3.57	1.13	
F5_57 I think that the scores obtained in online exams are fair	3.34	1.23	
F6 – Facilitative Roles of Instructors			**.847**
F6_04 The instructor is willing to communicate with students	3.88	.89	
F6_05 The instructor treats me well in terms of style and attitude	4.12	.80	
F6_06 Learning activities in the course are at a level to meet my learning needs	3.69	.99	
F6_07 Learning activities in the course increase my motivation	3.75	1.02	
F6_08 The instructor provides opportunities for collaborative work	3.83	.88	
F7 - Student - Student Interaction			**.832**
F7_35 I feel that my classmates care about each other	3.43	1.09	
F7_38 The feedback I receive from my classmates about the course contributes to me	3.90	.82	
F7_39 Communication with my classmates helps me benefit more from the lesson	3.84	.93	
F7_40 I enjoy talking about concepts and ideas with my classmates	3.88	.90	
F7_62 I feel that my classmates value my suggestions and opinions in online courses.	3.71	.95	
Total			**.957**

Satisfaction & Needs dimension (F2) between .59 and .89, in the Self Expression dimension (F3) between .57 and .86, in the Course materials dimension (F4) between .58 and .73, in the Exam security dimension (F5) between .71 and .84, in the Facilitative roles of instructors dimension (F6) between .52 and .67, and in the Student – Student Interaction dimension (F7) between .66 and .79. In addition, the path diagram in Figure 2 shows that the model is appropriate and the correlation between the items is at a satisfactorily good level.

Table 4. Fit statistics of the CFA.

Fit Indexes	ODESS Fit Values	Perfect Fit	Acceptable Fit Values	Interpretation
CMIN/DF	1.849	0 < CMIN/DF < 2	2 < CMIN/DF < 5	Perfect
RMSEA	.05	0 < RMSEA < .05	.05 < RMSEA < 0.8	Perfect
RMR	.059		RMR < 0.08	Acceptable
SRMR	.071	0 < SRMR < .05	.05 < SRMR < .1	Acceptable
NNFI	.90	.95 < NNFI < 1.00	.90 < NNFI < .95	Acceptable
CFI	.91	.95 < CFI < 1.00	.90 < CFI < .95	Acceptable
GFI	.83	0.95 < GFI < 1	0.9 < GFI < 0.95	–
AGFI	.81		AGFI > 0.9	–
NFI	.82		NFI > 0.8	Acceptable
IFI	.91	0.95 < IFI < 1	0.9 < IFI < 0.95	Acceptable

Conclusion and implications

The aim of this study was to develop a reliable, valid, and practical instrument to measure online distance education students' satisfaction. The scale is intended to be a general-purpose tool that can be used to assess satisfaction across various online distance education settings and populations. However, further research is needed to confirm its generalizability to other populations. The instrument was tested for its structure and reliability based on responses from 407 students through EFA and was further validated by CFA with data from 303 students. The results confirmed the reliability and validity of the scale. The satisfaction scale's seven-factor proved that it is appropriate for usage in a variety of settings. However, this study represents the preliminary development and validation phase of the ODESS, and further studies are required to establish its criterion validity by administering it alongside other established scales. In addition, examining the convergent and divergent validity of the dimensions and subscales would provide stronger evidence for the scale's construct validity.

The ODESS developed in this study provides a comprehensive measure of student satisfaction in online distance education. The seven identified factors, including instructor support, self-satisfaction and needs, course materials, self-expression, student-student interaction, exam security, and facilitative roles of instructors, represent important components of the online learning experience. The ODESS scale has drawn parallels with existing scales. For example, the "instructor support" factor in the ODESS scale is also included as a factor in the scale developed by Walker and Fraser (2005). Although this factor is not directly included in Toraman et al. (2022), it can be said to be related to the "satisfaction with instructors in [online] distance education" factor. "Student-student interaction" factor is also included in Walker and Fraser's (2005) and Torrado and Blanca's (2022) scales. It can be concluded that the "course materials" factor is also related to the "content" factor inHwang and Kim's (2022) scale. The "self-expression" factor can be related to the "student autonomy" factor in Walker and Fraser's (2005) scales, and the "self-satisfaction and needs" factor can be related to the "authentic learning" factor. The "exam security" factor, which is not included among the factors of the scales in the literature, was developed to explain the situation of taking exams online. Lastly, the items under the "facilitative roles of instructors" factor can be considered to overlap with the items under different factors in other scales in the literature.

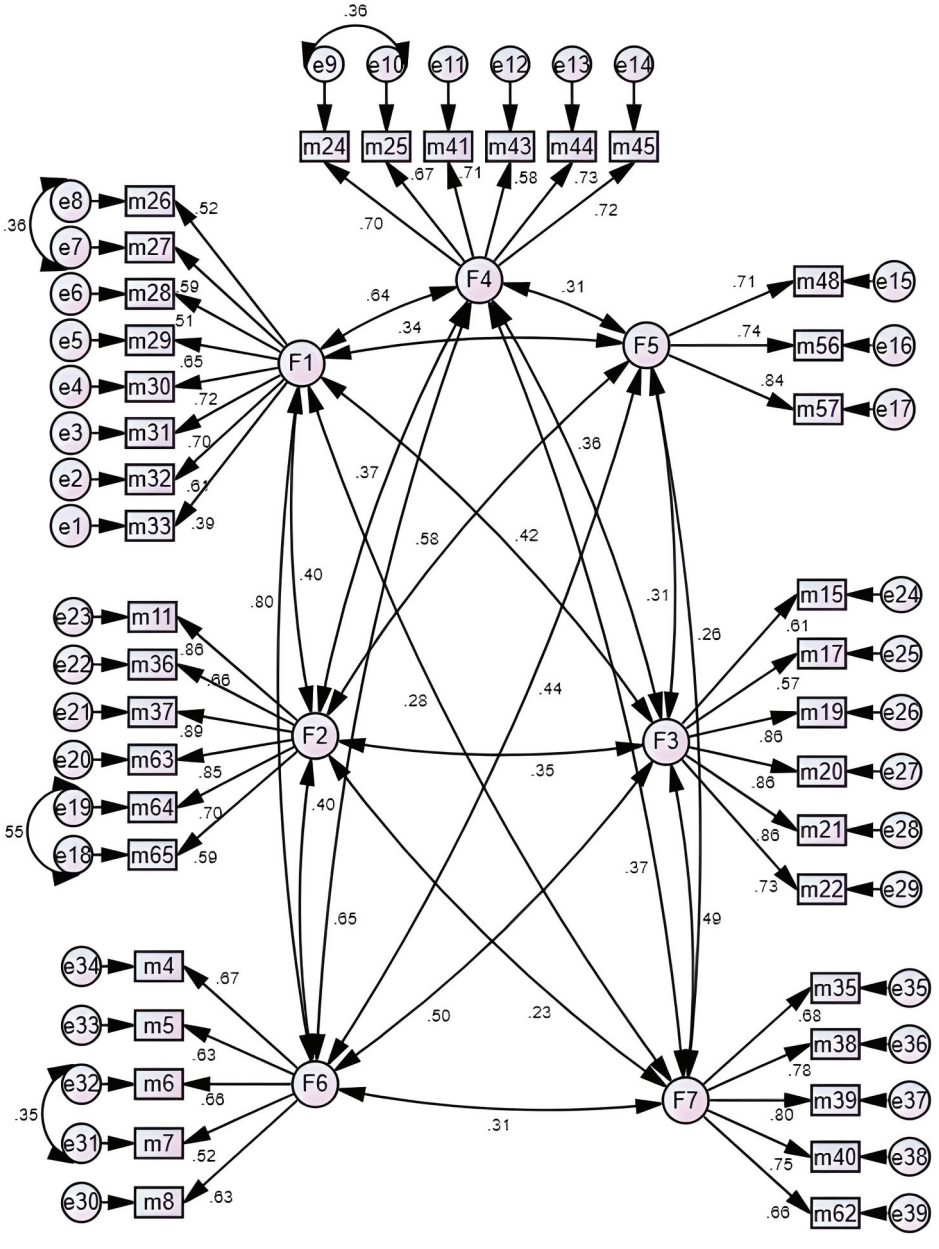

Figure 2. Confirmatory factor analysis for ODESS.

While the ODESS scale is designed to measure satisfaction across various settings, it is important to acknowledge that students' experiences in online distance education may vary significantly between different courses. This variability should be considered as a limitation of the study. Future research could explore how the scale performs across different course types and disciplines to further validate its generalizability.

For instructors and online distance education institutions, the ODESS's development has significant implications. Through the assessment of student satisfaction across these

seven dimensions, educational institutions are able to identify areas that need to be improved and devise plans to enhance the online learning experience. Institutions can, for example, try to enhance instructor support by giving instructors more resources and training, or by making sure they are accessible and responsive to students' needs. Furthermore, the study's findings imply that students value their interactions with instructors and fellow students highly. Institutions could include features like discussion boards, group projects, and other cooperative activities in their online courses to facilitate these interactions. Additionally, the scale will have a big impact on future studies in the area of online distance learning. This scale can be used by researchers to investigate the connections between other variables, like academic success, retention rates, etc. Overall, ODESS can serve to create a more engaging, effective, and satisfying online learning environment.

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References

Alshare, K. A., Freeze, R. D., Lane, P. L., & Wen, H. J. (2011). The impacts of system and human factors on online learning systems use and learner satisfaction. *Decision Sciences Journal of Innovative Education*, *9*(3), 437–461. https://doi.org/10.1111/j.1540-4609.2011.00321.x

An, H., Kim, S., & Kim, B. (2008). Teacher perspectives on online collaborative learning: Factors perceived as facilitating and impeding successful online group work. *Contemporary Issues in Technology and Teacher Education*, *8*(1), 65–83.

Arbaugh, J. B. (2018). Republication of "virtual classroom characteristics and student satisfaction with internet-based MBA courses". *Journal of Management Education*, *42*(4), 533–556. https://doi.org/10.1177/1052562918770400

Arghode, V., Brieger, E., & Wang, J. (2018). Engaging instructional design and instructor role in online learning environment. *European Journal of Training & Development*, *42*(7–8), 366–380. https://doi.org/10.1108/EJTD-12-2017-0110

Baser, D., Kopcha, T. J., & Ozden, M. Y. (2016). Developing a technological pedagogical content knowledge (TPACK) assessment for preservice teachers learning to teach English as a foreign language. *Computer Assisted Language Learning*, *29*(4), 749–764. https://doi.org/10.1080/09588221.2015.1047456

Bayrak, F., Tibi, M. H., & Altun, A. (2020). Development of online course satisfaction scale. *Turkish Online Journal of Distance Education*, *21*(4), 110–122. https://doi.org/10.17718/TOJDE.803378

Bertiz, Y., & Hebebci, M. T. (2021). Security for online exams: Digital proctoring. In S. Jackowicz & I. Sahin (Eds). *Proceedings of IHSES 2021- International Conference on Humanities, Social and Education Sciences* (pp. 369–374). ISTES Organization, New York, USA.

Bolliger, D. U., & Halupa, C. (2012). Student perceptions of satisfaction and anxiety in an online doctoral program. *Distance Education*, *33*(1), 81–98. https://doi.org/10.1080/01587919.2012.667961

Britto, M., & Rush, S. (2013). Developing and implementing comprehensive student support services for online students. *Journal of Asynchronous Learning Network*, *17*(1), 29–42. https://doi.org/10.24059/olj.v17i1.313

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. The Guilford Press.

Büyüköztürk, Ş. (2002). Faktör analizi: Temel kavramlar ve ölçek geliştirmede kullanımı. *Kuram ve Uygulamada Eğitim Yönetimi*, *32*(32), 470–483.

Chen, S. J. (2007). Instructional design strategies for intensive online courses: An objectivist-constructivist blended approach. *Journal of Interactive Online Learning*, *6*(1), 72–86.

Chiu, T. K. F., Lin, T. J., & Lonka, K. (2021). Motivating online learning: The challenges of COVID-19 and beyond. *The Asia-Pacific Education Researcher*, *30*(3), 187–190. https://doi.org/10.1007/s40299-021-00566-w

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2014). *Sosyal bilimler için çok değişkenli istatistik: Spss ve Lisrel uygulamaları* (3. Baskı). Pegem Akademi.

Croft, N., Dalton, A., & Grant, M. (2010). Overcoming isolation in distance learning: Building a learning community through time and space. *Journal for Education in the Built Environment*, *5*(1), 27–64. https://doi.org/10.11120/jebe.2010.05010027

Dos Santos Caparróz Carvalho, A., Lima Paniago Lopes, M. C., & Santos, R. (2008). Distance education and its different forms of learning - New learners? *Revista Brasileira de Aprendizagem Aberta e a Distância*, *6*. https://doi.org/10.17143/rbaad.v6i0.188

Durak, G., & Çankaya, S. (2020). Is there a change? Distance education studies in COVID-19 pandemic. *Asian Journal of Education and e-Learning*, *8*(3), 31–42. https://doi.org/10.24203/ajeel.v8i3.6458

Durak, G., Çankaya, S., & İzmirli, S. (2020). Examining the Turkish universities' distance education systems during the COVID-19 pandemic. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, *14*(1), 787–810. https://doi.org/10.17522/balikesirnef.743080

Durak, G., Çankaya, S., Yunkul, E., Urfa, M., Topraklikliоğlu, K., Arda, Y., & İnam, N. (2017). Trends in distance education: A content analysis of master's thesis. *The Turkish Online Journal of Educational Technology*, *16*(1), 203–218.

Gil, H. T. (2008). The challenge of the transition from online delivery to online teaching and learning. *Proceedings of Society for Information Technology and Teacher Education International Conference* Las Vegas (pp. 2589–2594.

Gunawardena, C. N., Linder vanberschot, J. A., LaPointe, D. K., & Rao, L. (2010). Predictors of learner satisfaction and transfer of learning in a corporate online education program. *American Journal of Distance Education*, *24*(4), 207–226. https://doi.org/10.1080/08923647.2010.522919

Hamutoglu, N. B., Gemikonakli, O., Duman, I., Kirksekiz, A., & Kiyici, M. (2020). Evaluating students experiences using a virtual learning environment: Satisfaction and preferences. *Educational Technology Research & Development*, *68*(1), 437–462.

Harsasi, M., & Sutawijaya, A. (2018). Determinants of student satisfaction in online tutorial: A study of a distance education institution. *Turkish Online Journal of Distance Education*, *19*(1), 89–99. https://doi.org/10.17718/tojde.382732

Hwang, S., & Kim, H. K. (2022). Development and validation of the e-learning satisfaction scale (eLSS). *Teaching and Learning in Nursing*, *17*(4), 403–409. https://doi.org/10.1016/j.teln.2022.02.004

Ilgaz, H., & Gülbahar, Y. (2015). A snapshot of online learners: E-readiness, e-satisfaction and expectations. *International Review of Research in Open and Distance Learning*, *16*(2), 171–187. https://doi.org/10.19173/irrodl.v16i2.2117

Kaiiali, M., Ozkaya, A., Altun, H., Haddad, H., & Alier, M. (2016). Designing a secure exam management system (SEMS) for m-learning environments. *IEEE Transactions on Learning Technologies*, *9*(3), 258–271. https://doi.org/10.1109/TLT.2016.2524570

Kirtman, L. (2009). An examination of differences in learning outcomes. *Issue in Teacher Education*, *18*(2), 103–116.

Kline, R. B. (2016). *Principles and practice of structural equation modeling*. The Guilford Press. https://doi.org/10.15353/cgjsc.v1i1.3787

Kolburan Geçer, A., & Deveci Topal, A. (2015). E-derslere yönelik memnuniyet ölçeğinin geliştirilmesi: Geçerlik ve güvenirlik çalışması. *Eğitimde Kuram ve Uygulama*, *11*(4), 1272–1287. https://doi.org/10.17860/efd.55137

Kurucay, M., & Inan, F. A. (2017). Examining the effects of learner-learner interactions on satisfaction and learning in an online undergraduate course. *Computers and Education*, *115*, 20–37. https://doi.org/10.1016/j.compedu.2017.06.010

Lacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology*, *20*(1), 90–98. https://doi.org/10.1016/j.jcps.2009.09.003

Lavicza, Z., Weinhandl, R., Prodromou, T., Anđić, B., Lieban, D., Hohenwarter, M., Fenyvesi, K., Brownell, C., & Diego-Mantecón, J. M. (2022). Developing and evaluating educational innovations for STEAM education in rapidly changing digital technology environments. *Sustainability*, *14*(12), 1–15. https://doi.org/10.3390/su14127237

Liaw, S. S., & Huang, H. M. (2013). Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Computers and Education*, *60*(1), 14–24. https://doi.org/10.1016/j.compedu.2012.07.015

Lister, M. (2014). Trends in the design of e-learning and online learning. *Journal of Online Learning and Teaching*, *10*(4), 671–680.

Lockee, B. B. (2021). Online education in the post-COVID era. *Nature Electronics*, *4*(1), 5–6. https://doi.org/10.1038/s41928-020-00534-0

Masalimova, A. R., Khvatova, M. A., Chikileva, L. S., Zvyagintseva, E. P., Stepanova, V. V., & Melnik, M. V. (2022). Distance learning in higher education during covid-19. *Frontiers in Education*, *7*, 1–6. https://doi.org/10.3389/feduc.2022.822958

Min, W., & Yu, Z. (2023). A systematic review of critical success factors in blended learning. *Education Sciences*, *13*(5), 1–15. https://doi.org/10.3390/educsci13050469

Neroni, J., Meijs, C., Gijselaers, H. J. M., Kirschner, P. A., & de Groot, R. H. M. (2019). Learning strategies and academic performance in distance education. *Learning and Individual Differences*, *73*(April), 1–7. https://doi.org/10.1016/j.lindif.2019.04.007

Netemeyer, R. G., Bearden, W. O., & Sharma, S. (2003). *Scaling procedures: Issues and applications*. Sage.

Ng, C. F. (2021). The physical learning environment of online distance learners in higher education - a conceptual model. *Frontiers in Psychology*, *12*, 1–13. https://doi.org/10.3389/fpsyg.2021.635117

Pallant, J. (2016). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. Open University Press.

Parahoo, S. K., Santally, M. I., Rajabalee, Y., & Harvey, H. L. (2016). Designing a predictive model of student satisfaction in online learning. *Journal of Marketing for Higher Education*, *26*(1), 1–19. https://doi.org/10.1080/08841241.2015.1083511

Pelikan, E. R., Korlat, S., Reiter, J., Holzer, J., Mayerhofer, M., Schober, B., Spiel, C., Hamzallari, O., Uka, A., Chen, J., Välimäki, M., Puharić, Z., Anusionwu, K. E., Okocha, A. N., Zabrodskaja, A., Salmela-Aro, K., Käser, U., Schultze-Krumbholz, A. … Wright, M. F. (2021). Distance learning in higher education during COVID-19: The role of basic psychological needs and intrinsic motivation for persistence and procrastination-a multi-country study. *PLoS One*, *16*(10), 1–23. https://doi.org/10.1371/journal.pone.0257346

Rajabalee, Y. B., & Santally, M. I. (2021). Learner satisfaction, engagement and performances in an online module: Implications for institutional e-learning policy. *Education and Information Technologies*, *26*(3), 2623–2656. https://doi.org/10.1007/s10639-020-10375-1

Ramazanoğlu, M., Gürel, S., & Çetin, A. (2022). The development of an online learning readiness scale for high school students. *International Journal of Assessment Tools in Education*, *9*, 126–145. https://doi.org/10.21449/ijate.1125823

Roper, A. R. (2007). How students develop online learning skills. *Educause Quarterly*, *1*(1), 62–65.

Sebastianelli, R., Swift, C., & Tamimi, N. (2015). Factors affecting perceived learning, satisfaction, and quality in the online MBA: A structural equation modeling approach. *Journal of Education for Business*, *90*(6), 296–305. https://doi.org/10.1080/08832323.2015.1038979

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers and Education*, *50*(4), 1183–1202. https://doi.org/10.1016/j.compedu.2006.11.007

Tibi, M. H. (2015). Improving collaborative skills by computer science students through structured discussion forums. *Journal of Technologies in Education*, *10*(3–4), 27–41. https://doi.org/10.18848/2381-9243/CGP/v10i3-4/56460

Toraman, Ç., Karadağ, E., & Polat, M. (2022). Validity and reliability evidence for the scale of distance education satisfaction of medical students based on item response theory (IRT). *BMC Medical Education*, *22*(1), 1–13. https://doi.org/10.1186/s12909-022-03153-9

Torrado, M., & Blanca, M. J. (2022). Assessing satisfaction with online courses: Spanish version of the learner satisfaction survey. *Frontiers in Psychology*, *13*, 1–11. https://doi.org/10.3389/fpsyg.2022.875929

Turhangil Erenler, H. H. (2020). A structural equation model to evaluate students' learning and satisfaction. *Computer Applications in Engineering Education*, *28*(2), 254–267. https://doi.org/10.1002/cae.22189

Ulum, H. (2022). The effects of online education on academic success: A meta-analysis study. *Education and Information Technologies*, *27*(1), 429–450. https://doi.org/10.1007/s10639-021-10740-8

Uusiautti, S., Määttä, K., & Leskisenoja, E. (2017). Succeeding alone and together - University students' perceptions of caring online teaching. *Journal of Studies in Education*, *7*(2), 48–66. https://doi.org/10.5296/jse.v7i2.11162

Veletsianos, G., & Houlden, S. (2019). An analysis of flexible learning and flexibility over the last 40 years of distance education. *Distance Education*, *40*(4), 454–468. https://doi.org/10.1080/01587919.2019.1681893

Walker, S. L., & Fraser, B. J. (2005). Development and validation of an instrument for assessing distance education learning environments in higher education: The distance education learning environments survey (DELES). *Phenomenology and the Cognitive Sciences*, *4*(3), 289–308. https://doi.org/10.1007/s10984-005-1568-3

Wallace, R. M. (2003). Online learning in higher education: A review of research on interactions among teachers and students. *Education, Communication & Information*, *3*(2), 241–280. https://doi.org/10.1080/14636310303143

Yavuzalp, N., & Bahçivan, E. (2020). The online learning self-efficacy scale: Its adaptation into Turkish and interpretation according to various variables. *Turkish Online Journal of Distance Education*, *21*(1), 31–44. https://doi.org/10.17718/tojde.674388

Young, A., & Norgard, C. (2006). Assessing the quality of online courses from the students' perspective. *Internet and Higher Education*, *9*(2), 107–115. https://doi.org/10.1016/j.iheduc.2006.03.001

Yu, Z. (2021). The effects of gender, educational level, and personality on online learning outcomes during the COVID-19 pandemic. *International Journal of Educational Technology in Higher Education*, *18*(1). https://doi.org/10.1186/s41239-021-00252-3

Yukselturk, E., & Yildirim, Z. (2008). Investigation of interaction, online support, course structure and flexibility as the contributing factors to students' satisfaction in an online certificate program. *Educational Technology and Society*, *11*(4), 51–65.

Yurdugül, H., & Sarikaya, D. A. (2013). The scale of online learning readiness: A study of validity and reliability. *Egitim ve Bilim*, *38*(169).

Zhou, Z., & Zhang, Y. (2023). Intrinsic and extrinsic motivation in distance education: A self-determination perspective. *American Journal of Distance Education*, *38*(1), 1–14. https://doi.org/10.1080/08923647.2023.2177032

Zimmerman, W. A., & Kulikowich, J. M. (2016). Online learning self-efficacy in students with and without online learning experience. *The American Journal of Distance Education*, *30*(3), 180–191. https://doi.org/10.1080/08923647.2016.1193801