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Assessment of learner satisfaction with asynchronous electronic learning systems

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Abstract

The electronic learning (e-learning) literature has not addressed the measurement of learner satisfaction with asynchronous e-learning systems. Current models for measuring user satisfaction (US) and students' evaluation of teaching effectiveness (SETE) are perceived as inapplicable as they are targeted primarily towards either organizational information systems or classroom education environment. My study developed a comprehensive model and instrument for measuring learner satisfaction with asynchronous e-learning systems. The procedures used in conceptualizing the survey, generating items, collecting data, and validating the multiple-item scale are described. This study carefully examined evidence of reliability, content validity, criterion-related validity, convergent validity, discriminant validity, and nomological validity by analyzing data from a sample of 116 adult respondents. The norms of the instrument were then developed, and the potential applications for practitioners and researchers explored. Finally, this paper discusses limitations of the work. The empirically validated instrument should be useful to other researchers in developing and testing their e-learning theories.

Keywords: Electronic learning; User satisfaction; End-user computing satisfaction; Learner satisfaction; Measurement; Instrument development

1. Introduction

Electronic learning (e-learning) is one of the most significant recent developments in the IS industry. The growth of asynchronous e-learning systems has presented a unique challenge for both schools and industry. Methods of assessing the effectiveness of e-learning systems are a critical issue in both practice and research. However, the value of e-learning systems cannot be evaluated using a single-item scale, such as global satisfaction. The measure of e-learning systems must incorporate different aspects of electronic learner (e-learner) satisfaction to become a useful diagnostic instrument. Traditionally, both student's evaluation of teaching effectiveness (SETE) and user satisfaction (US) scales have been used to assess teaching quality or user satisfaction with IS.

There are six instruments as examples of SETE: Endeavor Instrument, Student Instructional Rating System (SIRS) Form, Instructor and Course Evaluation System (ICES), Student Description of Teaching (SDT) Questionnaire, Students' Evaluations of Educational Quality (SEEQ) Instrument, and Instructional Development and Effectiveness Assessment (IDEA) [9,13,21,33,34]. All instruments measure several teaching quality factors (from 5 to 9) with a varying number of survey items for each factor. On the other

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hand, user information satisfaction (UIS) and end-user computing satisfaction (EUCS) instruments are examples of user satisfaction scales [4,17,19,30,35,36]. However, measures of US and SETE developed for the organizational IS or classroom teaching context may no longer be appropriate for the e-learning context, because the role of an e-learner is different to that of an traditional end user or student. SETE and US instruments focus primarily on teaching quality or user information satisfaction rather than on learner satisfaction with regard to asynchronous e-learning systems. Therefore, there is a need to develop a comprehensive instrument for measuring e-learner satisfaction (ELS) with asynchronous e-learning systems.

To assess the extent and specific nature of e-learner satisfaction, different dimensions of ELS must be theoretically and operationally defined. The development of such a multidimensional instrument can:

1. capture multiple aspects of e-learner satisfaction that may be subsumed within general (single scale) measures;
2. provide insight into the nature of interrelationships among ELS dimensions;
3. provide a more accurate diagnostic tool to assess e-learning activities within organizations.

Until such an instrument is developed, the varying criteria of e-learning effectiveness among studies will inhibit the generalizability and accumulation of research findings. In addition, using a well-validated instrument, e-learning planners can better justify their activities when they devote significant portion of their organizational resources to them.

The purpose of this research is therefore to develop a theoretical and operational construct space for latent factors that may be indicative of ELS. I incorporated both classical frameworks for developing measures and contemporary statistical techniques for assessing dimensionality.

2. Domain of e-learner satisfaction

2.1. Teaching quality versus learner satisfaction

SETE is a primary method for defining and measuring teaching quality, and many established instruments exist in educational psychology. Overall, the SEEQ presents a comprehensive definition and measurement of teaching quality and has eight factors. Curiously, the quality–satisfaction relationship is seldom examined explicitly. One reason is that both concepts are often used synonymously [1]. Thus, conceptual ambiguity between quality and satisfaction that marketing is currently exploring also appears in educational psychology literature.

Marketing literature has generally treated perceived service quality and customer satisfaction as related but distinct [7]. While recent research appears to indicate that perceived service quality is an antecedent of customer satisfaction, debate on the causal direction between these two constructs continues [41]. A literature review identified a consensus on the fundamental distinction between perceived service quality and customer satisfaction constructs: namely, perceived service quality is a long-term attitude, whereas customer satisfaction is a transaction-specific judgment [6]. With perceived service quality and customer satisfaction now being two distinct constructs, they should be measured using different instruments. Researchers also suggest that the directionality of the relationships between perceived service quality and customer satisfaction should continue to be examined and that future studies should incorporate multi-item measures [44], implying that multi-item satisfaction instruments need to be developed.

2.2. Conceptualization of e-learner satisfaction (ELS)

Defining a construct's theoretical meaning and conceptual domain are necessary steps in developing appropriate measures and obtaining valid results [25]. A marketing perspective suggests that students are as the ultimate customers, since satisfaction with an educational product/service is one outcome of the exchange between instructors and students. Collectively, satisfaction research contributes to a comprehensive model [52] that explains the constructs and their interrelationships (i.e. antecedents and consequences of satisfaction). Recently, Giese and Gote [26] proposed a definitional framework for consumer satisfaction that could resolve inconsistencies in the literature. They identified the commonalities of

20 different definitions used in the past 30 years of consumer satisfaction research. As seen by their literature reviews and validated by group and personal interview data, consumer satisfaction appears to consist of three essential components: (1) summary affective response, which varies in intensity; (2) time of determination, which varies by situation but is generally limited in duration; and (3) satisfaction focus around product choice, purchase, and consumption.

Based on Giese and Gote's findings, e-learner satisfaction can be defined as

> a summary affective response of varying intensity that follows asynchronous e-learning activities, and is stimulated by several focal aspects, such as content, user interface, learning community, customization, and learning performance.

Operationally, ELS can be considered as a summation of satisfactions with various attributes or items. On the one hand, ELS, like traditional customer satisfaction, represents an exchange-specific affective response [29], an attitude-like post-consumption evaluative judgment varying along the hedonic continuum [51]. On the other hand, the ELS construct emphasizes specific aspects of the e-learning context, such as online content and user interfaces. Furthermore, ELS emphasizes the construct itself rather than the evaluative process (model) through which the response is determined. Consequently, the focus is on the response (construct) rather than the process (model), to facilitate the operationalization of e-learner satisfaction as a single construct, unencumbered by various antecedents or consequences.

2.3. The theoretical framework for assessing ELS

Measurement issues are receiving increased attention among the education research community. The primary purpose for developing ELS measures is to predict behavior, and thus the measurement of e-learner satisfaction should be more closely tied to attitude–behavior theory. ELS is an important theoretical construct because of its potential for helping us discover both forward and backward links in a causal chain (i.e. a network of cause and effect relationships) that are important to the e-learning community (see Fig. 1). Thus, e-learner satisfaction is potentially both a dependent variable (when the domain of one's research interest is upstream activities or factors that cause e-learner satisfaction) and an independent variable (when the domain is downstream behaviors affected by e-learner satisfaction). Past research in IS relating user attitudes to success bears some resemblance to the downstream research domain in the assumed direction of influence (attitudes → behavior) [37]. Likewise, e-learner satisfaction is believed to mediate student learning from prior experience and to explain key post-learning behaviors, such as complaining, word of mouth, and reuse intention.

Based on this theoretical framework, satisfaction appraisal is generally considered the central mediator of post-learning behavior, which links pre-usage system beliefs to post-usage cognitive structure, student communications, and reuse behavior. Most behavior researchers would agree that satisfaction influences future usage intention and complaining behavior. Students with high levels of satisfaction are expected to have higher levels of reuse intention and make less complaints. An instrument has *nomological* validity if it behaves as expected with respect to some other constructs to which it is theoretically related [11]. Therefore, the following two hypotheses were tested to validate this validity of the proposed ELS instrument:

H1. A positive relationship exists between ELS score and the reuse intention of the e-learning systems.

H2. A negative relationship exists between ELS score and the extent of post-usage complaint behavior.

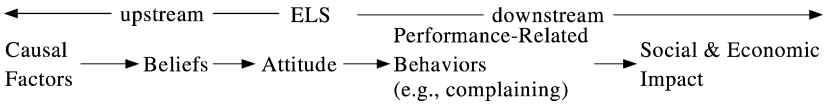

Fig. 1. The theoretical framework for assessing ELS (adapted from [18]).

3. Generation of scale items

IS research has emphasized the development of instruments for measuring both UIS and EUCS. But UIS and EUCS instruments are not appropriate for e-learning contexts. However, students in e-learning contexts are really also IS users. Accordingly, both instruments should be considered when generating initial items to develop the ELS instrument.

Various potential measures of the ELS construct exist. Reviewing the literature on user information satisfaction, end-user computing satisfaction, customer satisfaction, and student satisfaction [2,5,20,27,31,32,42,40,45] obtained 21 items representing various dimensions underlying ELS construct, and these were used these to form the initial item pool for the ELS scale. To make sure that important aspects of satisfaction were not omitted, I conducted experience surveys and personal interviews on e-learning satisfaction with 2 professionals, 4 college teachers, and 10 e-learners. They were asked to review the initial item list of the ELS scale, and recommended only adding three items. Consequently, the expanded 24-item list was considered to constitute a complete domain for the ELS measurement.

An exploratory ELS instrument involving 26 items (as shown in the Appendix A), with the two global measures *perceived overall satisfaction* and in *success of* the e-learning system as criterion, was developed using a seven-point Likert-type scale, with anchors ranging from ''strongly disagree'' to ''strongly agree.'' The global measures can be used to analyze the criterion-related validity of the instrument and to measure overall satisfaction prior to detailed analysis. Besides the performance items, the questionnaire contained demographic questions. The measure of the degree of importance for each item was not adopted because

1. adding an independent measure of degree of importance merely provides redundant information [22], and
2. the weighted and unweighted scores are highly correlated, making the additional information provided by the importance rating unnecessary.

After careful examination of the result of experience surveys and interviews, the statements were further adjusted to make their wording as precise as possible.

4. Data collection and scale purification

4.1. Sample and procedure

Sample data was collected from five international organizations: Taiwan Semiconductor Manufacturing Corporation (TSMC), United Microelectronics Corporation (UMC), Compal Electronics, Inc., MiTAC International Corporation, and Dell Taiwan. To be consistent with the exchange-specific nature of ELS conceptualization, respondents were restricted to those who had used at least one e-learning system prior to the survey. One hundred and sixteen screened and qualified respondents self-administered the 26-item questionnaire, which asked respondents to name one e-learning system that they had used in the previous 3 weeks. For each question, respondents were asked to circle the response which best described their level of agreement.

4.2. Item analysis and reliability estimates

The 24-item instrument (with the two global items excluded) was refined through analyzing the pooled data; that is, data from all five organizations was considered together. Because the primary purpose herein was to develop a general instrument capable of reliably and accurately measuring ELS in various organization sectors, the pooling of sample data was appropriate.

The first step in purifying the instrument was to calculate the coefficient alpha and item-to-total correlations that would be used to delete garbage items [14]. In addition, it seems appropriate and justified to assume that ELS is a simple construct prior to identifying its underlying dimensions using exploratory factor analysis. Thus, based on the assumption that all items in the ELS instrument share a common core, the researcher calculated the coefficient alpha and item-to-total correlations for the 24-item ELS instrument.

The 24-item ELS instrument had a reliability (Cronbach alpha) of 0.95. To avoid spurious part–whole correlation, the criterion used by the researcher to determine whether to delete an item was the item's corrected item-to-total correlation. The corrected item-to-total correlations were plotted in descending order, and items with item-to-total correlations below

0.4 or whose correlations produced a substantial or sudden drop in the plotted pattern were eliminated. The correlations with the corrected item total ($r \geq 0.4$) were significant at $P < 0.001$. Thus, the cutoff values were considered high enough to ensure that the items retained were adequate measures of the ELS construct. Because each item's corrected item-to-total correlation was above 0.4, no item was eliminated in this stage.

4.3. Identifying the factor structure of the ELS construct

The researcher conducted an exploratory factor analysis to further examine the factor structure of the 24-item instrument. Before identifying the factor structure of e-learner satisfaction construct using factor analysis, a χ^2 value of 2285 and significance level of 0.000 were obtained using Bartlett's sphericity test, which suggests that the intercorrelation matrix contains sufficient common variance to make factor analysis worthwhile. The sample data of 116 responses was examined using principal components factor analysis as the extraction technique and varimax as the orthogonal rotation method. To improve the unidimensionality/convergent validity and discriminant validity [46] of the instrument through exploratory factor analysis, four commonly employed decision rules [28,48] were applied to identify the factors underlying the ELS construct: (1) using a minimum eigenvalue of 1 as a cutoff value for extraction; (2) deleting items with factor loadings less than 0.5 on all factors or greater than 0.5 on two or more factors; (3) a simple factor structure; and (4) exclusion of single-item factors from the standpoint of parsimony.

The iterative sequence of factor analysis and item deletion was repeated, resulting in a final instrument of 17 items representing four distinct factors. These factors were interpreted as learner interface, learning community, content, and personalization, explaining 78% of the variance in the dataset. Table 1 summarizes the factor loadings for the condensed 17-item instrument. The significant loading of all the items on the single factor indicates unidimensionality, while the fact that no cross-loadings items were found supports the discriminant validity of the instrument.

In sum, end users of e-learning systems have become e-learners, thus making them emphasize several aspects of e-learning satisfaction (e.g. learning community and personalization), which seem to be omitted in the traditional framework of user information satisfaction and end-user computing satisfaction.

Table 1
Rotated factor loadings for the 17-item instrument

Item code	Learner interface	Learning community	Content	Personalization
Q5	0.839			
Q8	0.823			
Q7	0.766			
Q9	0.714			
Q6	0.672			
Q22		0.927		
Q24		0.892		
Q21		0.881		
Q23		0.874		
Q4			0.821	
Q1			0.777	
Q3			0.764	
Q2			0.739	
Q17				0.817
Q18				0.792
Q16				0.750
Q19				0.660

Suppress absolute values <0.50.

5. Assessing reliability and validity

5.1. Reliability

Reliability was evaluated by assessing the internal consistency of the items representing each factor using Cronbach alpha. The 17-item instrument had a reliability of 0.93, exceeding the minimum standard of 0.80 suggested for basic research. The reliability of each factor was as follows: learner interface = 0.90; learning community = 0.95; content = 0.89; personalization = 0.88. Furthermore, each of these 17 items had a corrected item-to-total correlation of above 0.50 (see Table 2).

5.2. Content validity

The ELS instrument meets requirements of reliability and consistent factor structure. However, while high reliability and internal consistency are necessary conditions for a scale's construct validity (the extent to

Table 2
Item-to-total correlations of ELS measures

Item code	Original item code	Item description	Corrected item-to-total correlation
I1	Q5	The e-learning system is easy to use	0.66
I2	Q8	The e-learning system is user-friendly	0.67
I3	Q7	The content provided by the e-learning system is easy to understand	0.68
I4	Q9	The operation of the e-learning system is stable	0.58
I5	Q6	The e-learning system makes it easy for you to find the content you need	0.66
L1	Q22	The e-learning system makes it easy for you to discuss questions with other students	0.58
L2	Q24	The e-learning system makes it easy for you to access the shared content from the learning community	0.56
L3	Q21	The e-learning system makes it easy for you to discuss questions with your teachers	0.64
L4	Q23	The e-learning system makes it easy for you to share what you learn with the learning community	0.65
C1	Q4	The e-learning system provides up-to-date content	0.59
C2	Q1	The e-learning system provides content that exactly fits your needs	0.58
C3	Q3	The e-learning system provides sufficient content	0.71
C4	Q2	The e-learning system provides useful content	0.66
P1	Q17	The e-learning system enables you to learn the content you need	0.68
P2	Q18	The e-learning system enables you to choose what you want to learn	0.66
P3	Q16	The e-learning system enables you to control your learning progress	0.65
P4	Q19	The e-learning system records your learning progress and performance	0.68

which a scale fully and unambiguously captures the underlying, unobservable, construct it is intended to measure) they are not sufficient [38]. The basic qualitative criterion concerning construct validity is content validity. Content validity implies that the instrument considers all aspects of the construct being measured. Churchill [10] contends that "*specifying the domain of the construct, generating items that exhaust the domain, and subsequently purifying the resulting scale should produce a measure which is content or face valid and reliable.*" Therefore, the procedures used in conceptualizing the ELS construct, generating items, and purifying the ELS measures suggest that the ELS instrument has strong content validity.

5.3. Criterion-related validity

Criterion-related validity is assessed by the correlation between the total scores on the instrument (sum for 17 items) and the measures of valid criterion (sum for two global items). Criterion-related validity refers to concurrent validity in this study where the total scores on the ELS instrument and scores on the valid criterion are measured at the same time. A positive relationship was expected between the total score and the valid criterion if the instrument is capable of measuring the ELS construct. The 17-item instrument had a criterion-related validity of 0.81 and a significant level of 0.01, representing an acceptable criterion-related validity.

5.4. Discriminant and convergent validity

The correlation matrix approach was applied to evaluate the convergent and discriminant validity of the 17-item instrument. Convergent validity tests whether the correlations between measures of the same factor are different than zero and large enough to warrant further investigation of discriminant validity. Table 3 presents the measure correlation matrix. The smallest within-factor correlations are: learner interface = 0.50; learning community = 0.75; content = 0.58; personalization = 0.58. These correlations are significantly different than zero ($P < 0.000$) and large enough to proceed with discriminant validity analysis.

Discriminant validity for each item is tested by counting the number of times that the item correlates higher with items of other factors than with items of its own theoretical factor. For discriminant validity,

Table 3
Correlation matrix of measures

	I1	I2	I3	I4	I5	L1	L2	L3	L4	C1	C2	C3	C4	P1	P2	P3	P4
I1	1.00																
I2	0.75	1.00															
I3	0.72	0.69	1.00														
I4	0.69	0.67	0.50	1.00													
I5	0.64	0.61	0.65	0.58	1.00												
L1	0.19	0.19	0.30	0.06	0.25	1.00											
L2	0.25	0.31	0.34	0.14	0.23	0.81	1.00										
L3	0.24	0.29	0.35	0.19	0.26	0.87	0.75	1.00									
L4	0.26	0.32	0.37	0.21	0.33	0.83	0.79	0.82	1.00								
C1	0.39	0.39	0.32	0.38	0.40	0.32	0.29	0.37	0.38	1.00							
C2	0.52	0.47	0.43	0.44	0.52	0.17	0.16	0.20	0.25	0.58	1.00						
C3	0.50	0.47	0.47	0.52	0.46	0.42	0.38	0.48	0.43	0.73	0.64	1.00					
C4	0.62	0.59	0.50	0.56	0.57	0.16	0.20	0.20	0.32	0.61	0.79	0.67	1.00				
P1	0.53	0.52	0.50	0.47	0.50	0.30	0.26	0.38	0.35	0.36	0.40	0.44	0.48	1.00			
P2	0.44	0.41	0.51	0.43	0.48	0.39	0.35	0.41	0.35	0.35	0.34	0.47	0.43	0.75	1.00		
P3	0.50	0.48	0.53	0.48	0.54	0.31	0.25	0.38	0.38	0.29	0.43	0.36	0.46	0.70	0.64	1.00	
P4	0.36	0.47	0.45	0.36	0.49	0.45	0.42	0.54	0.51	0.42	0.35	0.48	0.40	0.63	0.58	0.58	1.00

Campbell and Fiske [8] suggest that the count should be less than one-half the potential comparisons. However, examining the correlation matrix in Table 3 reveals only 14 violations of the discriminant validity condition from 216 comparisons.

5.5. Nomological validity

To test hypotheses H1 and H2, Westbrook's [50] two-item complaint behavior measure was adopted to represent the extent of respondents' post-learning complaint behavior. Respondents were questioned about (1) the number of complaint incidents and (2) the number of topics voiced. This instrument had a reliability (Cronbach alpha) of 0.86. Additionally, a continuous measure of reuse intention was obtained by asking respondents to indicate the likelihood that they would reuse the same e-learning system on a seven-point scale ranging from "no chance" to "certain." Using correlation analysis, hypotheses H1 and H2 are significantly supported at $P < 0.01$, thus supporting the nomological validity of the proposed ELS measures.

6. An empirically validated model for measuring e-learner satisfaction

In sum, the 17-item ELS instrument that emerged was demonstrated to produce acceptable reliability estimates, and evidence also supported its content validity, criterion-related (concurrent) validity, discriminant validity, convergent validity, and nomological validity. Based on previous analysis, an empirically validated model for measuring e-learner satisfaction is presented (see Fig. 2).

I roughly compared the underlying dimensions between UIS, EUCS, and ELS constructs (see Table 4) according to their item lists. While there was some overlap in dimensions between these three constructs, it clearly showed that ELS construct in the e-learning environment was different to the UIS construct in the traditional data processing environment and EUCS construct in the end-user computing environment. In fact, the ELS measurement model can be

Table 4
Comparison of underlying dimensions between UIS, EUCS, and ELS

UIS	EUCS	ELS
Knowledge and involvement		
EDP staff and service		
	Ease of use	Learner interface
Information product	Format	Learner interface
Information product	Content	Content
Information product	Timeliness	Content
Information product	Accuracy	
		Learning community
		Personalization

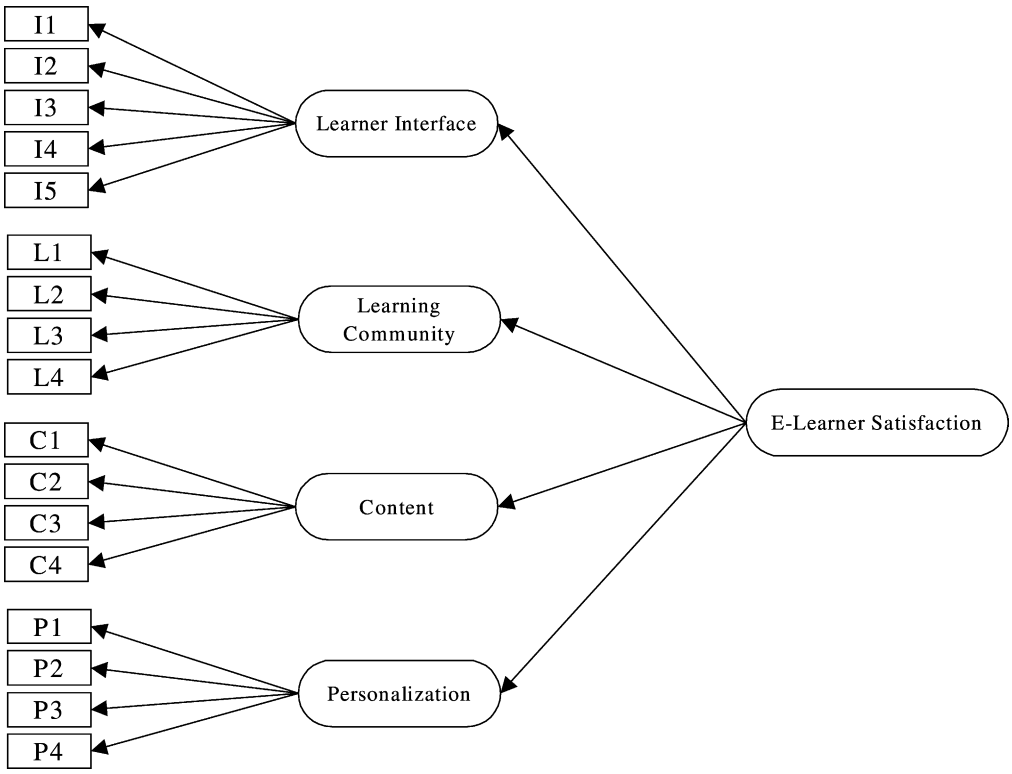

Fig. 2. A model for measuring e-learner satisfaction.

characterized as containing three distinct components, i.e. elements similar to traditional UIS construct (e.g. content), dimensions much the same as EUCS construct (e.g. learner interface), and special factors making up the ELS construct (e.g. learning community). Specifically, both UIS and EUCS exclude two factors unique to ELS, i.e. learning community and personalization.

7. Developing norms and applications for the ELS instrument

The ELS instrument can be utilized to assess student satisfaction with e-learning systems. However, a better way of assessing individual satisfaction is to compare individual satisfaction levels with norms—the total distribution of the satisfaction levels rated by other people. This cross-organizational aspect of the sample data used in this study makes it appropriate for the development of tentative standards. Table 5 lists percentile scores for the 17-item ELS instrument. Other relevant sample statistics are: minimum = 41; maximum = 110; mean = 80.59; median = 83; mode = 90; standard deviation = 14.62; and skewness = −0.423; kurtosis = −0.468. These statistics may be useful in more precisely evaluating learner satisfaction with a specific e-learning system. As the concise ELS instrument with good reliability and validity is periodically administered to a representative

Table 5
Percentile scores—seven-item instrument

Percentile	Value
10	60.7
20	66.0
30	72.0
40	77.8
50	83.0
60	88.0
70	90.0
80	93.0
90	98.0

set of students, e-learning planners can use this ELS instrument to enhance their understanding of student satisfactions and to take necessary corrective actions to improve them.

Besides making an overall assessment, the ELS instrument can be used to compare learner satisfaction for different e-learning systems with specific factors (i.e. learner interface, learning community, content, and personalization). This instrument has been designed to be applicable across a broad spectrum of asynchronous e-learning systems, and to provide a common framework for comparative analysis. The framework, when necessary, can be adapted or supplemented to fit the specific research or practical needs of a particular environment.

Conventional consumer research that focuses primarily on satisfaction can be divided into three categories:

1. Considering the satisfaction construct as antecedent to remedial behaviors (such as complaining and word-of-mouth communication [23,49]).
2. Identifying the relationships among expectation, perceived performance, disconfirmation, satisfaction, and post-purchase behaviors [12,39,47].
3. Discussing the directionality between service quality and customer satisfaction [43,15,16].

The multiple-item ELS instrument with good reliability and validity provides researchers with a basis for explaining, justifying, and comparing differences across results.

8. Limitations

The rigorous validation procedure allowed me to develop a general instrument for measuring e-learner satisfaction. Nevertheless, this work involves some limitations.

First, while the valid instrument was developed using the large sample gathered in Taiwan, a confirmatory analysis and cross-cultural validation using another large sample gathered elsewhere is required for greater generalization of the instrument. While exploratory factor analysis may be a satisfactory technique during the early stages of research on a construct, the subsequent use of confirmatory factor analysis (CFA) seems necessary in later stages. The advantages of applying CFA as compared to classical approaches to determine convergent and discriminant validity are widely recognized [3]. Additionally, the sampling method has potential bias, since a sample of willing respondents may not be generalizable. Consequently, other samples from different areas or nations should be gathered to confirm and refine, the factor structure of the ELS instrument, and to assess its reliability and validity.

Second, the nomological validity should also be validated using structural equation modeling (SEM). A limitation of the nomological validity test is that both the ELS and complaint behavior scores were computed by totaling each instrument's items.

Third, the test–retest reliability of the instrument should be evaluated. Measures of reliability include internal consistency, generally evaluated by coefficient alpha, and stability, while test–retest reliability examines the stability of an instrument over time. Galletta and Lederer [24] also contend that test–retest is necessary for establishing the reliability of an instrument. Therefore, the stability of ELS instrument, including short- and long-range stability, should be further investigated using the test–retest correlation method.

Finally, an instrument for measuring learner satisfaction with synchronous e-learning systems should be developed.

9. Conclusions

This study achieved significant progress towards developing a general instrument for measuring student satisfaction with e-learning systems. Current models for measuring user satisfaction and students' evaluation of teaching effectiveness are geared towards organizational IS or classroom education, thus the development of ELS measures in e-learning environments is necessary. This study has conceptually defined the domain of the ELS construct, operationally designed the initial ELS item list, and empirically validated the general ELS instrument. The final instrument indicates adequate reliability and validity across a variety of e-learning systems. The generality of this proposed instrument provides a common framework for the comparative analysis of results from various research.

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Appendix A. Measurement of electronic learner satisfaction—26 items used in the exploratory factor analysis

Q1. The e-learning system provides content that exactly fits your needs.

Q2. The e-learning system provides useful content.

Q3. The e-learning system provides sufficient content.

Q4. The e-learning system provides up-to-date content.

Q5. The e-learning system is easy to use.

Q6. The e-learning system makes it easy for you to find the content you need.

Q7. The content provided by the e-learning system is easy to understand.

Q8. The e-learning system is user-friendly.

Q9. The operation of the e-learning system is stable.

Q10. The e-learning system responds to your requests fast enough.

Q11. The e-learning system makes it easy for you to evaluate your learning performance.

Q12. The testing methods provided by the e-learning system are easy to understand.

Q13. The testing methods provided by the e-learning system are fair.

Q14. The e-learning system provides secure testing environments.

Q15. The e-learning system provides testing results promptly.

Q16. The e-learning system enables you to control your learning progress.

Q17. The e-learning system enables you to learn the content you need.

Q18. The e-learning system enables you to choose what you want to learn.

Q19. The e-learning system records your learning progress and performance.

Q20. The e-learning system provides the personalized learning support.

Q21. The e-learning system makes it easy for you to discuss questions with your teachers.

Q22. The e-learning system makes it easy for you to discuss questions with other students.

Q23. The e-learning system makes it easy for you to share what you learn with the learning community.

Q24. The e-learning system makes it easy for you to access the shared content from the learning community.

Q25. As a whole, you are satisfied with the e-learning system.[1]

Q26. As a whole, the e-learning system is successful.[1]

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