EXAMINATION OF THE FACTORS AFFECTING THE PREFERENCE OF OPEN EDUCATION AND E-LEARNING WITH THE STRUCTURAL EQUATION MODEL

EXAME DOS FATORES QUE AFETAM A PREFERÊNCIA DE EDUCAÇÃO ABERTA E E-LEARNING COM O MODELO DE EQUAÇÕES ESTRUTURAIS

EXAMEN DE LOS FACTORES QUE AFECTAN LA PREFERENCIA DE LA EDUCACIÓN ABIERTA Y E-LEARNING CON EL MODELO DE ECUACIÓN ESTRUCTURAL

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ABSTRACT: The aim of this study is to investigate the factors that affect the preference of e-learning systems used as a basic or supportive tool in both open education and formal education. The data set used in this study was obtained from a questionnaire applied to randomly selected university students who took courses with the e-learning system. The questionnaire was applied to 561 people and descriptive statistics were calculated based on the obtained data. For modeling and analyzing the relationships of the factors that directly and indirectly affect the preference of e-learning systems, Structural Equation Modeling was established. As a result of the analysis, the variables that directly or indirectly affect the preferability of the e-learning systems were determined. In addition to the positive effect of the information system infrastructure on other variables in the model, the mediation effect of the learning management system on the information system infrastructure and preferability was revealed.

KEYWORDS: E-learning. Learning management system. Information systems. Preferability.

RESUMO*: O objetivo deste estudo é investigar os fatores que afetam a preferência por sistemas de e-learning usados como ferramenta básica ou de apoio tanto na educação aberta quanto na educação formal. O conjunto de dados utilizado neste estudo foi obtido a partir de um questionário aplicado a estudantes universitários selecionados aleatoriamente que fizeram cursos com o sistema de e-learning. O questionário foi aplicado a 561 pessoas e estatísticas descritivas foram calculadas com base nos dados obtidos. Para modelar e analisar as relações dos fatores que afetam direta e indiretamente a preferência dos sistemas de e-learning, foi estabelecida a Modelagem de Equações Estruturais. Como resultado da análise, foram determinadas as variáveis que afetam direta ou indiretamente a preferibilidade dos sistemas de e-learning. Além do efeito positivo da infraestrutura do sistema de informação sobre outras variáveis do modelo, foi revelado o efeito de mediação do sistema de gestão da aprendizagem sobre a infraestrutura do sistema de informação e a preferência.*

PALAVRAS-CHAVE*: E-learning. Sistema de gerenciamento de aprendizado. Sistemas de informação. Preferência.*

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RESUMEN: *El objetivo de este estudio es investigar los factores que inciden en la preferencia de los sistemas de e-learning utilizados como herramienta básica o de apoyo tanto en la educación abierta como en la educación formal. El conjunto de datos utilizado en este estudio se obtuvo de un cuestionario aplicado a estudiantes universitarios seleccionados al azar que tomaron cursos con el sistema e-learning. El cuestionario se aplicó a 561 personas y se calcularon estadísticas descriptivas a partir de los datos obtenidos. Para modelar y analizar las relaciones de los factores que afectan directa e indirectamente la preferencia de los sistemas de e-learning, se estableció el Modelado de Ecuaciones Estructurales. Como resultado del análisis se determinaron las variables que directa o indirectamente inciden en la preferencia de los sistemas e-learning. Además del efecto positivo de la infraestructura del sistema de información sobre otras variables del modelo, se reveló el efecto de mediación del sistema de gestión del aprendizaje sobre la infraestructura del sistema de información y la preferencia.*

PALABRAS CLAVE: *E-learning. Sistema para el manejo del aprendimiento. Sistemas de información. Preferibilidad.*

Introduction

Computer technologies affect and transform every aspect of life. It is inevitable to see important effects in education. New technologies are also being developed and used in education. Holmgren *et al.* (2017) stated that digitalization is a complex process that requires large-scale changes. Digital transformation in education started with the digitalization of course materials and continued with the interaction and virtualization of educational processes. The most prominent concepts are distance education and e-learning. Changes in educational technologies, teaching methods and education systems have led to the emergence of alternative educational institutions to traditional education models. The adoption and sustainability of e-learning depends on its preference over traditional methods. The most important factor in preferability is that learning processes are being student-oriented. Compared to traditional face-to-face classroom learning, which focuses on instructors who have control over the classroom content and learning process, e-learning offers a learner-centered, self-paced learning environment (FALLAH *et al.*, 2000; HILTZ; TUROFF, 2002; MORALES *et al.*, 2001; PICCOLI *et al.*, 2001).

E-learning has no time and place restrictions or is very flexible. Other advantages of distance education and e-learning are that it provides repetitive and unrestricted access to information and is more cost-effective (ZHANG *et al.*, 2004). These advantages are the result of the use of information technologies in distance education. For success in using technology, users must first accept the technology and be convinced that it will support their learning. Being easy to learn and use, and user satisfaction are other important factors in the preference of information technologies (HARA; KLING, 2000; MAKI *et al.*, 2000). For preferability, e-learning systems should offer quality course materials. Digital materials need to positively support learning processes and achieve learning goals. Course materials and complementary training tools increases the preference of e-learning in terms of user success and user satisfaction. Another dimension of distance education and e-learning is the learning management system, which constitutes the software part of the information system. The main task of the LMS is to provide interaction between users, tutorials and course materials. The success of these systems and the way they achieve their goals are important factors in their preference. The primary purpose of using the tools mentioned above is student success. This concept, which is defined as academic success, includes both learning success and passing a course. Which success goal is more important depends on users' perceptions.

In this study, the effects of information system infrastructure on learning management system, academic success, quality of course materials, and preferability are investigated. A comprehensive literature review was also conducted on this subject. In the first part, these issues were discussed and these approaches were tested with hypotheses. The emphasis of the study is that the mediating effect of academic achievement on the positive effect of information systems infrastructure on preferability is not mentioned in the literature. In this study, mediator variable analysis was performed to further enrich and clarify the relationship between information system infrastructure and preferability.

Theory

Information System Infrastructure

Basic components of information systems are hardware, software, database, data communication networks, data processing models, users, etc. Among these components, computer hardware and computer networks are infrastructure elements. In addition, data transmission technologies and data security systems are important elements that make up the information processing infrastructure. The most important criteria used in evaluating the total success of the information systems are physical success and user satisfaction. Physical achievement is achieved using standard scales (bandwidth, number of signals etc.). Rockart (1982) defined success as the actual implementation of a system that focuses on the technical aspects of technology. Since the total success is determined by the weakest element of the system, the success of the information system infrastructure is as important as all the elements in the model. User satisfaction is another method used to evaluate the total success of the information system. User satisfaction is an evaluation method in which the degree of meeting the expectations of the users is more significant than the physical success measures. Therefore, the success of the system can be measured by the user satisfaction achieved as a result of efficient use (RAYMOND, 1990; DELONE, 1988; IGBARIA *et al.*, 1998; RAYMOND, 1985; YAP *et al.*, 1992).

Ives and Olson (1984) examine system success in terms of system quality, system usage, user behavior and user satisfaction. DeLone and McLean (2003), DeLone (1988) and Seddon *et al.* (1999) suggested using system quality, information quality, service quality, user satisfaction, and perceived user benefits to measure system success. There are many other behavioral models developed to measure system success. The basic theory on which these models are based on the theory of planned behavior (AJZEN, 1991). According to this theory, which models how attitudes and behaviors affect intention, the quality of information is measured by the completeness, timeliness, accuracy, relevance, and continuity of the information output (DELONE, 1988; DELONE; MCALEAN, 2003; PETTER *et al.*, 2008). The frequency of use of an information system is measured by the actual number of accesses to the systems during a given period of time (DAVIS, 1989; DELONE; MCLEAN, 2003; URBACH *et al.*, 2010).

Another widely used model discusses the success of the system as two parts: system quality and service quality. System quality is measured by variables such as functionality, ease of use, reliability, data quality, portability, integration, usability, reliability, adaptability, and response time (DELONE; MCLEAN, 2003; PETTER *et al.*, 2012). Information systems success theory states that one of the success criteria is the satisfaction of individuals from using a system. Service quality focuses on the effect of user satisfaction on improving the quality of future interactions (PITT *et al.*, 1995). When users rate the quality of service, they compare their expectations and the actual effects of their use of the system (CONRATH; MIGNEN, 1990). Service quality can be measured by concreteness, reliability, sensitivity, and empathy. The support given to the user is an important indicator of the quality of the system (DELONE; MCLEAN, 2003).

Course Materials Quality

Quality of information is the ability of a system to distribute useful information (APARICIO *et al.*, 2016). Information quality depends on the quality of the system output, that is, the quality of the information the system produces primarily in the form of reports. In e-learning systems, information is collected in the form of course materials and distributed to students. The quality of course materials is related to the accuracy, precision, completeness, comprehensibility, significance, relevance, adequacy, comparability, timeliness, and reliability of existing content (DELONE; MCLEAN, 1992; PETTER *et al.*, 2008; RAI *et al.*, 2002; SWAID; WIGAND 2009). Teaching techniques and information technologies used for preparing course materials also affect the quality. The content that students will use in classroom activities or individual learning (videos, slides, guides, forums, links etc.) should be understandable and appropriate to their needs. Digital materials and media provide valuable support in the learning process (PICCOLI *et al.*, 2001; SUN *et al.*, 2008). Therefore, the current study assumes that:

H1: The quality of information system infrastructure positively affects the quality of course materials.

Learning Management System

While evaluating the system quality of learning management systems, it is very important that both course materials and information system users are volunteers. If the student uses the system out of necessity, criteria such as the continuity and frequency of use will be insufficient to measure satisfaction. In this case, the relationship between frequency of use and satisfaction cannot be considered, since increased use is not as a result of student satisfaction, but because it is required by the course content (BAROUDI *et al.*, 1986; CHENEY; DICKSON, 1982; SRINIVASAN, 1985; LAWRENCE; LOW, 1993).

The quality of learning management systems is related to how the function and performance of the system in learning processes are perceived (SAKAGUCHI; FROLICK, 1997). Although some remarkable features such as scalability, standardization, and security, which are valid for other systems, are mentioned, the success of Learning Management System is most descriptively evaluated by learning activity (SAKAGUCHI; FROLICK, 1997). In order to contribute to the purposes of the learning activity, it is important that the information and methodology provided by the course materials, as well as the hardware and network elements that provide access to information, meet the needs. The user-friendliness of the system and its effectiveness in providing useful feedback to students are features that support user satisfaction and system quality. In this study, the following assumptions about the success of learning management systems will be tested: The relationship between system quality and user satisfaction is widely used when measuring system success (RAI *et al.*, 2002; GUIMARAES *et* *al.*, 2003; GUIMARAES *et al.*, 2006). System quality is evaluated as a function of the user's perception of using information technology (DELONE and MCLEAN 2003). User satisfaction is the result of successful interaction between an information system and its users. At the same time, it is evaluated that students are satisfied to the extent that they believe that their information needs are met by the system (IVES *et al.*, 1983).

In this study, the following assumption regarding the success of learning management systems will be tested:

H2: The quality of information systems positively affects the quality of the learning management system.

Academic Success

Learning outputs explain the main objectives of the course, and the success of both the course and the students is measured by whether these outcomes have been achieved. The most widely used model to explain the success of information systems in the context of e-learning is the Information System success model developed by DeLone and McLean. This model takes net benefits into account while measuring learning quality, and the elements that make up quality are defined as system quality, information quality, and service quality (DELONE; MCLEAN 1992; APARICIO *et al.*, 2016; HEO; HAN, 2003; MOHAMMADI, 2015; WANG *et al.*, 2007).

When the literature is examined, it is seen that studies on learning achievement focus on course management systems, and the effect of teachers on learning is at the forefront. The main application area of such studies is technology classes equipped with digital tools instead of the web. These studies have very strong commonalities with the Open education and Distance learning. These are academic success, advanced learning, and empowering students. In terms of e-learning success, in addition to the planning of teaching processes and the performance of trainers, the methods and tools offered to the user are important factors that determine satisfaction (PAYNE *et al.*, 2011; BUZZARD *et al.*, 2011; HOLLENBECK *et al.*, 2011).

While measuring academic success, it is not sufficient alone that to evaluate the efficiency in learning. The success of the student in passing the course is also an important factor that increases satisfaction and supports the frequency of use of e-learning technologies. System quality and the quality of course materials have an impact on success. The success of students in exams is an important variable that measures whether e-learning systems can achieve their goals. Exam success is considered as a common result of student's material usage, system usage, and learning success. The fact that students realize that e-learning systems provide easy access to content, the platform is well-structured, and it supports them in passing the course, may be an incentive factor for the use of the e-learning system (RAI *et al.* 2002; PETTER *et al.,* 2008). Success in passing courses can be measured and evaluated more easily than other effects of e-learning processes. Since the success of passing the course can clearly show the net result, it is an effective scale for the benefit-cost evaluation of e-learning processes. It can give important clues to measure satisfaction, especially in cases where participation in the system is mandatory. Therefore, the following assumptions will be used in this study:

H3: The quality of course materials positively affect academic success

H4: The quality of the learning management system positively affects academic success.

H5: The quality of the information system infrastructure positively affects academic success.

Preferability

There are two dimensions to preference of open or distance education systems: Preferability over other education systems and preferability over other open education systems. In both dimensions, system quality, satisfaction, and compliance with the needs come to the fore among the reasons for preference. The use of digital media is inevitable when the instructor and the student cannot come together in the same place and/or at the same time. The user must first know how to use digital technology (literacy) in learning processes and be persuaded (adopt and accept) to use it (DAVIS, 1989). When the studies in the literature are examined, it is seen that the strong indicators of perceived satisfaction by the user are system quality, system usage, users' behaviors and attitudes, and there is a very strong relationship between satisfaction and system success (IVES; OLSON, 1984). Students' satisfaction is based on their positive experience of using the system. Positive experiences of students can have a positive effect on perceived individual outcomes in terms of matching students' needs with their self-efficacy (PICCOLI *et al.*, 2001). Although the relationship between satisfaction and system use is seen as controversial in cases where system use is mandatory, this does not negatively affect the relationship between student satisfaction and the preference of the e-learning system. When open or e-learning systems are evaluated in terms of their suitability for their intended use, it can be argued that both the learning achievement and the benefit of the acquired knowledge and competencies are effective in satisfaction and choice. In this study, it is aimed to analyze the effect of factors other than satisfaction on preferability. The effect of Information System Infrastructure on Academic success was tested with the H5 hypothesis. The effect of academic achievement on preferability was tested with H6. In this case, it would be appropriate to investigate whether academic success has a mediation variable effect between the information system infrastructure and preferability. Therefore, the following assumptions will be used for preferability:

H6: Academic success positively affects preference.

H7: Information system infrastructure has a positive effect on preferability.

H8: Academic success has a mediation effect between information system infrastructure and preferability.

Method

The population of the study is composed of higher education students enrolled in a higher education program and taking courses through the E-learning system. In the period 2019-2020 undergraduate education in higher education institutions in Turkey, there are approximately 4.5 million students. During the pandemic period, almost all of these students started to receive an education with the e-learning system. A pre-test of 45 units was conducted to determine whether the scale created was understandable. As a result of this test, 3 statements were excluded because they did not show the appropriate factor load. Cronbach Alpha for the whole scale was found to be 0.903. After the scale was prepared, a survey form was sent to 700 randomly selected enrolled in different universities students from the registered students, and data analysis was made using the answers. The data of 568 students who answered the questionnaire were subjected to data cleaning and noise reduction processes. According to Yazıcıoğlu and Erdoğan (2004), a sample of 384 students at the 5% significance level is sufficient if the population size is 10 million. The scale was included in data analysis with the data of 561 participants. Participation in the survey was done on a voluntary basis and the information of the participants has collected anonymously. Participants, who were given enough time to prevent the Common Method Bias problem from occurring, were asked to respond to the demographic and 1-5 Likert (Strictly Disagree-Strongly Agree) statements of the questionnaire. In determining whether there is a CMB problem in the Smart PLS program, Inner Model VIF value values were checked. If these values are less than 3.3, it can be decided that there is no CMB problem. For current data, Inner VIF Value values are less than 3.3. First, demographic information is given in the application part. In accordance with the research model given in Figure 1 variables were included in the SmartPLS 3.2 program. After the reliability and validity information of the scale and factor loads were given, path analysis was performed to test the hypotheses.

Measures

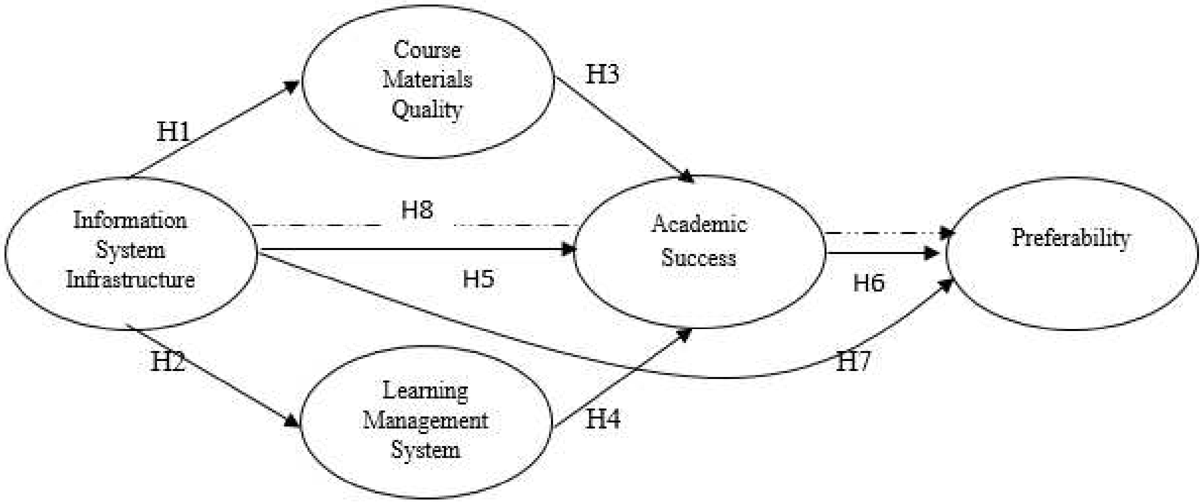
When measuring user approaches regarding the Course Materials Quality used in the e-learning system, the scale questions in the Mtebe and Raisamo (2014; Cronbach Alpha: 0.937) study were used. For measuring user approaches regarding Learning Management Systems used in e-learning Kim *et al.* (2012; Cronbach Alpha: 0.930) and Cidral *et al.* (2018; Cronbach Alpha: 0.939) used the scales. While measuring user approaches regarding Academic Success systems used in e-learning Cidral *et al.* (2018), Mtebe and Raisamo (2014) used the scales. In the study, scales used by Freeze *et al.* (2010), Cidral *et al.* (2018) were used to measure the preferability. For measuring user approaches regarding Information System Infrastructure used in e-learning Freeze *et al.* (2010; Cronbach Alpha: 0.950) used the scales.

Since the study was conducted on university students, the age range of the participants was between 18-25. 217 (38.6%) of the students who answered the survey are Female and 344 (61.4%) are Male. All of the participants are studying at university. 70% of these students are enrolled in formal education and 30% distance education. Since the changes in class hours may affect the decisions, firstly, whether there is a difference between the mean scores given by the formal and distance education students to the scale was tested with the independent sample t-test. Sig. Calculated based on the result obtained. (0.000 <0.05), it was decided that there was no difference between the mean scores given at the 5% significance level. Likewise, the effect of gender on the given scores was also examined. The result of the independent sample t-test, Since Sig. value is (0.000 <0.05), it has been determined that there is no difference between the mean scores given by gender. For these reasons, there was no harm in collectively analyzing the data.

Research Framework

The research model given in Figure1 was established according to the scale expressions and hypotheses obtained as a result of the literature research. In this model, the positive effects of the independent variable on the dependent variable were tested in the hypotheses between H1 and H7. H8 Hypothesis is established for mediation effect analysis.

Figure 1 – Research Model



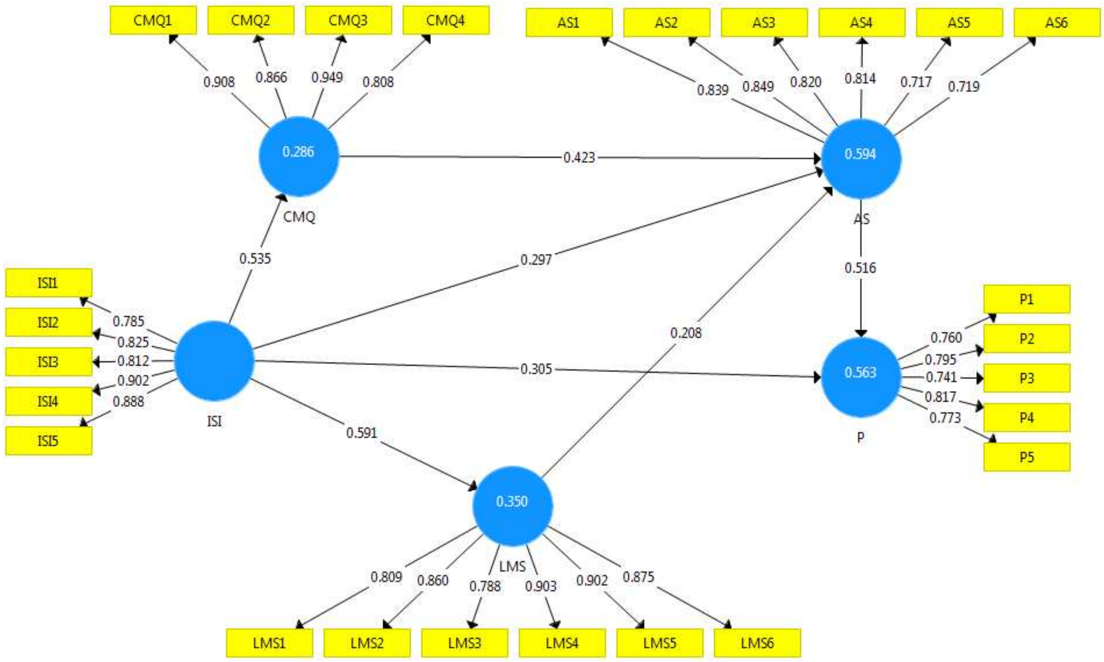
Source: Devised by the authors

Findings

The relationships of Information System Infrastructure (ISI), Course Materials Quality (CMQ), Learning Management System (LMS), Academic Success (AS), Preferability (P) variables given in Figure 1 were tested. Besides, the mediation effect values between Information System Infrastructure and Preferability variables of the Academic Success variable were also examined.

Kaiser Mayer Olkin test result in SPSS program was 0.895 and Bartlett Test result p value was obtained as 0.000. These results showed that the data are suitable for factor analysis. After these processes, the SmartPLS program was used to obtain factor weights and measuring the reliability and validity of the model. The results of the Confirmatory Factor Analysis performed to reveal the relationship between expressions and variables are given in Figure 2. The research model given in Figure 1 has been expressed differently so that the variables and expressions are not confused. The values inscribed in the circles show the R square values. The arrow between the two circles shows the direction of the relationship and the value written on it is the Path Coefficient value between the two variables. The arrow between each circle and the boxes around it indicates the expressions of the variable and the values above these arrows give the factor loading values. For SmartPLS, factor loading values are preferred to be above 0.70. Details of the values given in Figure 2 are shown in Table 1.

Figure 2 – Factor Analysis Result



Source: Devised by the authors

Table 1 – Factor Loadings (FL), Factor Weights (FW), t Values and Variance Inflation Factor (VIF) Values

Items	**FL**	**FW**	**R Square**	**T Value**	**VIF**
IS1: The system provides high speed information access.	0.785	0.247		18.841	1.891
IS2: I have no problem viewing or downloading course materials.	0.825	0.261		24.267	2.285
IS3: I think the system is safe.	0.812	0.202		17.436	3.466
IS4: I can easily access the system from any device.	0.902	0.233		39.001	4.555
IS5: I can easily access the system from any application.	0.888	0.243		33.305	3.241
CM1: Digital materials in the system content are useful.	0.908	0.261	0.286	37.053	3.414
CM2: Digital materials in the system content are up-to-date.	0.866	0.301		28.605	2.845
CM3: Digital materials in the system content are sufficient for the learning process.	0.949	0.334		87.232	4.223
CM4: Digital materials in the system content are supportive in terms of learning techniques.	0.808	0.229		13.210	2.403
LM1: The system is well configured.	0.809	0.173	0.350	12.029	2.405
LM2: The system is easy to use.	0.860	0.203		26.072	2.890
LM3: The system supports communication with tutors and other students.	0.788	0.192		13.266	2.121
LM4: The system actively participates in the learning process	0.903	0.222		36.314	4.467
LM5: The system helps me keep track of learning processes.	0.902	0.196		31.204	4.463
AS1: If I learn lesson subjects, the success of passing the lesson comes automatically.	0.839	0.207	0.594	21.734	2.764

AS2: I prefer to work with evaluation questions and trial tests while preparing for the exam.	0.849	0.199		24.704	3.653
AS3: If the course content interests me, I can study more regularly and effectively and I will be successful.	0.820	0.196		21.189	3.342
AS4: Course success is a goal that can be achieved with study rather than intelligence and talent.	0.814	0.216		15.751	2.841
AS5: The digital environment has a positive effect on my learning performance.	0.717	0.225		12.838	2.558
AS6: I enjoy the digital learning experience.	0.719	0.222		13.024	2.557
P1: I prefer distance or e-learning system as educational subjects meet my needs.	0.760	0.266		14.545	1.908
P2: I prefer distance or e-learning systems as they give me new and useful knowledge / skills.	0.795	0.261		16.242	1.800
P3: I would prefer distance or e-learning systems as they will help in developing my career.	0.741	0.198	0.563	12.725	1.971
P4: I have a positive attitude and evaluation of the functioning of distance or e-learning systems	0.817	0.277		15.899	2.207
P5: I would like to study in other fields with distance or e-learning systems.	0.773	0.281		13.375	1.818

Source: Devised by the authors

The values of these variables and their measurement expressions are given in Table 1. Factor loadings show the relationship of expressions with the factors while performing factor analysis. Factor Weights shows the weights of expressions in variables. Factor weights indicate whether there is a multicollinearity problem between expressions, and factor weights should not be negative whether the model is reflective or formative (HAIR *et al.*, 2017; ADIGÜZEL *et al.*, 2020). When Table 1 is examined, it can be seen that all factor weight values are positive. Factor loadings for all five variables were found over 0.70. R Square shows how much of the argument explains the change in the dependent variable. The part explained between the variables is defined as follows for certain coefficients. R square values greater than 0.75 are interpreted as high, between 0.75 and 0.50 as medium, and between 0.50 and 0.25 as weak correlation (HENSELER *et al.*, 2009; ÖZDEMIR *et al.*, 2022). Since all R square values in the table are between 0.50 and 0.25 values, it means there is a medium relationship between variables. T values indicate expressions' suitability for the latent variable. These values are required to be greater than 1.96, which is the t table value at the 5% significance level. Values greater than 1.96 indicate that expressions are meaningful for the latent variable. All calculated t values are greater than 1.96. Variance Inflation Factor (VIF) values were examined to see if there are multicollinearity problems. If the VIF value obtained as a result of the analysis is greater than 10, there is definitely a Multicollinearity problem. When VIF values are not above 3, there is no multiple linearity problem (DIAMANTOPOULOS; SIGUAW, 2006). If VIF values are below 5, there is no multiple linearity problem (HAIR *et al.*, 2017). For SmartPLS, this value is limited to 3. When the VIF column is examined, it can be seen that there is no multicollinearity problem in the model. In the factor analysis stages, all model variables and expressions gave appropriate results (ADIGÜZEL *et al.*, 2020).

Table 2 – Construct Reliability and Validity

	Number of Items	Cronbach's Alpha	Rho_A	Composite Reliability (CR)	Average Variance Extracted (AVE)
AS	**6**	**0.882**	**0.881**	**0.911**	**0.632**
CMQ	**4**	**0.907**	**0.927**	**0.935**	**0.782**
ISI	**5**	**0.898**	**0.901**	**0.925**	**0.712**
LMS	**5**	**0.927**	**0.932**	**0.943**	**0.735**
P	**5**	**0.837**	**0.843**	**0.884**	**0.605**

Source: Devised by the authors

Cronbach alpha coefficient is the most widely used estimator of the reliability of tests and scales (HOGAN *et al.*, 2013). Cronbach's Alpha values were all over 0.81. It is interpreted as "High" between 0.81 <α<1.00. Rho_A; The coefficient is a coefficient that indicates whether the data is consistent and shows the reliability level of the resulting factor items (DIJKSTRA; HENSELER, 2015). If this coefficient is above 0.70, it indicates reliable measurement and data is consistent (RATZMANN *et al.*, 2016). All calculated Rho_A values are greater than 0.70. In other words, it can be said that the data for this scale are consistent and reliable. Composite Reliability (CR)values, one of the values showing model reliability, are above 0.70 for each variable. AVE values must be 0.50 or higher in order to be able to properly adhere to the validity of the model, and all values obtained are both above 0.50 and less than the CR of the relevant variable. The Rho_A coefficient indicates whether factor items are reliable. Average Variance Extracted (AVE) value gives the Convergent Validity of the scale. In order to ensure Convergent Validity, the AVE value must be greater than 0.50 and the CR value must be greater than 0.70 (HAIR *et al.*, 2019; ADIGUZEL *et al.*, 2020). AVE and CR values show again that the scale is reliable and valid.

Table 3 – Latent Variables Correlation, Discriminant Validity and Fit Index

		Correlation Values and Discriminant Validity (Fornell Larcker Criterion)				Heterotrait-Monotrait (HTMT) Ratios			
	AS	CMQ	ISI	LMS	P	AS	CMQ	ISI	LMS
AS	0.795*								
CMQ	0.672	0.884*				0.747			
ISI	0.646	0.535	0.844*			0.703	0.580		
LMS	0.567	0.432	0.591	0.857*		0.619	0.477	0.640	
P	0.713	0.609	0.638	0.569	0.778*	0.819	0.690	0.721	0.624

Source: Devised by the authors

According to Fornell Larcker (1981) criterion, when a latent variable is compared with itself, the validity value obtained should be greater than all values in the same column and same row of the table (FORNELL, LARCKER, 1981). Another discriminant validity control value is the HTMT ratio and this value should be less than 0.85 (CLARK; WATSON, 1995; KLINE, 2011; ADIGÜZEL *et al.*, 2020) or 0.90 (GOLD *et al.*, 2001), Discriminant Validity could not be achieved. Table 3 shows the correlations between latent variables and Fornell-Larcker Criterion results and Heterotrait-Monotrait (HTMT) ratios for Discriminant Validity. There is an appropriate level of correlation between the variables. In the Discriminant Validity columns, those shown with bold and an asterisk are the coefficients given according to Fornell-Larcker criteria. The values below give the correlation coefficients between variables. Values shown in bold in the table for Fornell-Larcker Criteria are greater than all row and column values in the section reserved for this criterion. At the same time, all HTMT values are less than 0.85 as reference. Both results show that the model provides separation validity.

When the path model results given in Table 4 are examined, it can be seen that the t values of all path coefficients are greater than 1.96 and the p values are less than 0.05. This result indicates that all hypotheses are supported and the paths are significant. There is a significant positive relationship between the variables.

Table 4 – Path coefficients and test results for hypotheses

Hip.	Paths	Path Coefficients	T Statistics	P Values	Conclusion
H1	ISI→CMQ	0.535	7.661	0.000	Accepted
H2	ISI→LMS	0.591	8.463	0.000	Accepted
H3	CMQ→AS	0.431	5.140	0.000	Accepted
H4	LMS→AS	0.211	2.148	0.032	Accepted
H5	ISI→AS	0.281	2.739	0.000	Accepted
H6	AS→P	0.516	6.016	0.000	Accepted
H7	ISI→P	0.309	3.777	0.000	Accepted

Source: Devised by the authors

The acceptance of the hypotheses also shows that the data collected support the literature. The hypotheses between H1-H7, which were established with their justifications in the literature section, were accepted. The effects of the E-learning system infrastructure, which is the focus point of the study, are revealed in each hypothesis test. The mediation effect of Academic Success variable between ISI and P variables constitutes the other focus of the study. Path analysis results are given in the Table 5. below.

Table 5 – Path coefficients and test results for hypotheses

Hip.	Paths	Path Coefficients	T Statistics	P Values	Conclusion
H8	ISI→AS→P	0.145	2.721	0.007	Accepted

Source: Devised by the authors

Path analysis for ISI→AS→P gives positive results. Accordingly, while going from ISI variable to P variable, variable AS is a suitable variable. H8 hypothesis was accepted. To determine the extent of this effect, VAF values were examined. The results are given in Table 6.

Table 6 – Mediator Effect Results

Hip.	Paths	Path Coef. (a)	Path Coef. (b)	Path Coef. (c)	VAF	Conclusion
H8	ISI→AS→P	0.281	0.516	0.309	0.319	Admission/Partial

Source: Devised by the authors

In the last part of the application, the mediator effect of AS has been investigated. In the mediator impact study for testing of the H8 hypothesis, the VAF value suggested by Nitzl and Hirsch (2016) was used. While calculating the VAF value; VAF = a*b/(a*b+c) equation is used. If VAF values are below 20%, zero mediator effect is mentioned, while 20-80% of VAF value means partial and more than 80% means full mediator effect (HAIR *et al.*, 2017). When Table 6. is examined, it can be seen that AS variable has a mediation variable effect for the H8 hypothesis. AS variable for H8 hypothesis has a partial mediator effect.

Discussions and conclusion

The use of e-learning systems instead of formal education depending on today's environmental conditions is important for the effective execution of the pandemic process. In this period, the adoption and sustainability of e-learning systems, whose use has become widespread all over the world, depends on their preference over traditional methods. An application that is not adopted cannot be expected to be sustainable. For this reason, it is inevitable to return to formal education when the pandemic conditions disappear. A preferred e-learning model compared to traditional education systems can continue to be implemented under normal conditions. Since e-learning requires the extensive use of computing technologies, for the model to be successful, users must accept technology and be convinced that it will support their learning. Easy learning, use, and user satisfaction of systems based on information technologies are important factors for preferability. At the same time, the quality of course materials and auxiliary training tools also support preferability in terms of user success and satisfaction. The digital materials used are also an important factor for the success and preferability of the e-learning system, and the success of learning management systems has an important role in ensuring the active use of this factor. The mentioned systems can be made stronger in terms of preferability by ensuring academic success.

This article presents a theoretical background that includes the effects of the Information System Infrastructure variable on the Learning Management System, Academic Success, Course Materials Quality, and Preferability. Based upon theory, a model was proposed and validated empirically in Turkish universities. This study shows that the publications given in the research model in Figure1 are confirmed, all hypotheses are supported and accepted. Information System Infrastructure has a positive effect on all other variables. The highlight of the study. Academic success had a mediation effect on the positive effect of Information System Infrastructure on Preferability. In the analysis, it was found that the AS variable had a partial mediator effect in the interaction of Information System Infrastructure and Preferability. This result contributed to the literature for the analysis of similar relationships.

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