
Learning management system success: the role of student experience explored

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Abstract: Learning management system (LMS) is a widely used learning environment in academia. As such, LMS success should be of concern for educators and administrators in institutions of higher education. This research study explores whether students' LMS experience, in terms of the time elapsed since first use, affects their perception of the LMS. Following the replacement of an old LMS platform with a new one, student perceptions about system quality, and net benefit in terms of contribution to learning and student satisfaction with the system, were explored. The results indicate with respect to the new system, that the quality ratings and student satisfactions were lower for relatively shorter experience of use for one year but did elevate for more extended experience of use for two or three years. These results suggest that student experience should be taken into consideration by administrators when deploying a new key IS platform.

Keywords: learning management system; LMS; system experience; DeLone and McLean information system success model; student satisfaction; system quality; contribution to learning.

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1 Introduction

A learning management system (LMS) is an information system (IS) designed to facilitate interaction among instructors and students. LMS use has been widespread in higher education (Klobas and McGill, 2010) and spiralled under the Covid-19 pandemic. The massive resource investment in integration of LMS platforms and the extent of their use in academia have motivated a thorough exploration of LMS success where, most frequently, the perception of instructors was the focus (Malm and Defranco, 2012). However, positive student perceptions are crucial for prolonged LMS use and benefit (Al-Busaidi, 2012). Acknowledging the importance of LMS adoption, this research study explores the impact on LMS success of student experience in terms of the time elapsed since first LMS use. As LMS becomes a chief communication channel between instructors and students and an integral part of the learning process in higher education, it is of interest to explore all relevant factors that might affect students' perceptions.

This work assesses the success of LMS according to the IS success model of DeLone and McLean (2003). The model classifies IS success measures into six categories: system quality, information quality, service quality, use (and intention to use), user satisfaction, and net benefit. This comprehensive and widely used model has been tested and validated in hundreds of studies, including some about LMS success (Hassanzadeh et al., 2012), showing that relationships exist among the six categories.

The present study explores a unique factor not examined in the context of LMS in higher education where a well-established LMS platform in institutions was replaced, exploring student perceptions of the old and new LMS platforms at three different points in time. The goal of the study is to explore the relation between student experience, in terms of the time elapsed since usage of the replaced system began, and LMS success. As platform replacement is most frequently considered to be a technical and business issue, with end-user perspective often marginalised (e.g., Bisbal et al., 1999; Furneaux and Wade, 2017), this research aims to fill some of this gap in the context of higher education teaching, through exploration of the impact of platform replacement on students' perception. Based on the DeLone and McLean (2003) IS success model, this research examines the effect of student experience on perceived system quality, user satisfaction, and perceived net benefit of using the LMS as a complementary medium for face-to-face teaching. Additionally, this study explores the relationship among three categories of the DeLone and McLean model: system quality, user satisfaction, and net benefit.

Following the next section, which presents previous work relevant to this research, the research model of this study is presented in Section 3. The research methodology used in this study follows in Section 4, and the results are presented in Section 5. The paper concludes with discussion of its implications for practice, recommendations for future research, limitations, and conclusions.

2 Related work

DeLone and McLean (2003) argue that IS success may be determined using various measurements that fall under six categories. The first category, system quality, refers to technical aspects of the system, such as flexibility, response time, and accessibility. The second category, information quality, deals with the quality of the system's output, such as accuracy, timeliness, and understandability. The third category, service quality, refers to dimensions such as tangibles, reliability, responsiveness, assurance, and empathy of the service provided by the organisation in which the system is functioning. The fourth category, use and intention to use, may be measured by objective data (system log files) or as perceived by the user, and may be represented by the number of times the user accessed the system, the duration of use, and similar metrics. The fifth category, user satisfaction, reflects the appreciation of users of the system. The sixth category, net benefit, is focused on the system's impact on the individual, the organisations, and even the industry. The DeLone and McLean model suggests that the first three categories (system, information, and service quality) affect the other three categories, which in turn, affect each other.

The model was used in some studies to explore the adoption of IS in the context of teaching in general and LMS in particular. Most studies supported the relevance of this model to some extent. For example, Ramírez-Correa et al. (2017) explored the moderating effect of the student's learning style in the relationship between five of the six categories of the model (system quality, information quality, use, user satisfaction, and net benefit) in the context of LMS. They found that all the examined relationships between categories were statistically significant, in line with the DeLone and McLean model. Similarly, Kim et al. (2012) replaced service quality with instructional quality to adjust the DeLone and McLean model to the LMS setting and found that all relationships suggested by the model between categories were supported.

Some studies found mixed results. For instance, Mtebe and Raisamo (2014) analysed the relationships among the six categories of the DeLone and McLean model, for an LMS deployed at a Tanzanian University. Based on a sample of 200 students, they did not find statistically significant correlations between student satisfaction and either service quality or system quality. They did, however, find all other correlations explored to be statistically significant. Likewise, Al-Busaidi (2012) examined, among other factors, the impact of system quality, information quality, and service quality on system use and user satisfaction, and found that system quality was correlated to use and information quality was correlated to user satisfaction. However, the other correlations between these factors were found to be not statistically significant.

The first category in the DeLone and McLean model explored in this research is system quality. System quality of the LMS refers to the technical factors of the e-learning system and may be assessed by ease of use, functionality, and reliability (Kim et al., 2012). Several researchers examined LMS quality as an independent variable and

explored its effect on student satisfaction with the LMS. For example, Islam (2014), relying on the expectation-confirmation theory (Oliver, 1980), the two-factor theory (Herzberg et al., 1993) and the satisfaction model (Kano, 1984), found that ease of use and usability as well as other system characteristics impacted student satisfaction. Similarly, D'Ambra et al. (2018), extending the expectation-confirmation theory (Oliver, 1980), found LMS quality, among other characteristics, to be a determinant of student satisfaction. Although system quality is an independent variable used in research about IS success, studies examining perceived LMS quality determinants, other than the perceived characteristics of the system itself, were not found.

The second category in the DeLone and McLean model examined in this study is user satisfaction, which is considered especially appropriate for evaluating a specific IS (DeLone and McLean, 1992) and have been used in numerous studies as a dependent variable to measure LMS success (e.g., D'Ambra et al., 2018; Islam, 2014).

Net benefit, the third and last category in the DeLone and McLean model explored in this study, is concerned, in the context of LMS, with the contribution of the system to learning, because it represents the expected impact of the system on the user. McGill and Klobas (2009), noting the great diversity in the LMS success studies, recommend that further research be focused on the effect of LMS on learning, i.e., on the core activity that LMS is designed to support. The contribution of learning technologies to learning has been examined in previous research in two main approaches – objectively, by examining students' grades and performances, and subjectively, that is, by asking students for their perception of their learning. For example, Kintu et al. (2017) examined, among others, the impact of the technology quality on student grade performance but found no correlation between them. Ramírez-Correa et al. (2017), on the other hand, analysed the perceptions of approximately 250 engineering students of an LMS using partial least squares structural equation modeling and found use and user satisfaction to explain perceived net benefit following the DeLone and McLean model. Similarly, Mtebe and Raisamo (2014) explored the relationship between use and user satisfaction and net benefit of LMS as perceived by students in a Sub-Saharan country, finding them, as well, to be statistically significant.

Although not explicitly included in the above DeLone and McLean model, user experience is another interesting factor in the context of IS success. Experience with using a system, the explanatory variable in the model developed in this study and presented in the next section, is most frequently operationalised in research as the time elapsed since the first use of a system (Venkatesh et al., 2012).

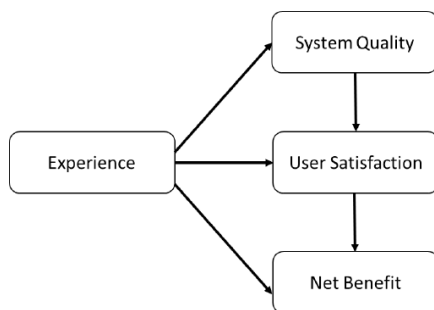
Some researchers explored the effect of experience on system perception. For example, Venkatesh (2000) examined the change in user perception at three points in time: first, after an hour of training, again after one month of system use, and then again after three months. He found ease of use to be more correlated with system enjoyment after three months than after one month. Kim et al. (2005) considered experience as a control variable, along with internet experience, age, and gender, while considering the effect of hedonic, social, and utilitarian values on usage intention, and the effect of usage intention on actual usage. They found target system experience was correlated to usage intention. Similarly, Venkatesh et al. (2012) suggested an extension to the unified theory of acceptance and use of technology model (Venkatesh et al., 2003) considered experience as a moderating variable and found experience to be correlated, among other things, to behavioural intention (i.e., the intention to use).

Experience should not be confused with habit – the degree of which use is automatic (Kim et al., 2005), nor with past use – previous use of information technology and IS (e.g., Tan et al. 2012). Experience, habit, and past use are thus different and interconnected in their effect on system perception and use (Kim et al., 2005), supporting the attending in this work to the effect of experience on LMS success. Unlike prior research, which measured user perceptions over relatively short periods of a few months, this study examines one year of LMS experience and three years of LMS experience as an explanatory variable in the research model elaborated upon next.

3 Research model

Based on the DeLone and McLean model, this research examines the effect of experience on three categories of success – system quality, user satisfaction, and net benefit, as well as the relationship among them, as presented in Figure 1.

Figure 1 Research model



The first category in the DeLone and McLean model explored in this study is system quality as perceived by the user, because this is the aspect most directly influenced by platform replacement. System quality was measured in previous research using various technical aspects of the IS. In this research, multiple aspects of the system quality were explored, covering user interface, organisation, navigation, accessibility, and errors. The second explored category of success is user satisfaction with the system, which is the most commonly used category in IS success research (DeLone and McLean, 2003), and extremely relevant when exploring IS widely used in higher education (e.g., Ramírez-Correa et al., 2017; Kim et al., 2012). In this study, the respondents provided information that indicated how successful the system was and the degree to which they were satisfied. The last category of success examined in the study is net benefit. Because net benefit is focused on the impact of the system on its users (DeLone and McLean, 2003), considering the purpose of an LMS as an IS that supports learning, net benefit in the context of this study focused on measuring the contribution of the system to the users' learning. Learning is a complex process impacted by numerous factors and performed in a highly uncontrolled environment. Exploring the contribution of the LMS to learning as perceived by the students is, therefore, more suitable in the research context (an IS used in all courses by all instructors) than examining students' performances. Additionally, the effect of system quality on user satisfaction and the effect of user satisfaction on

perceived net benefit are also examined in the study, following the DeLone and McLean model.

The explanatory variable in the study is student experience, measured as the time elapsed since the first use of the IS (Venkatesh et al., 2012). In addition, the institution that the student attends and her/his year of study are accounted for in the study. Details about the methodology employed to examine the relationships in Figure 1 is provided in the next section.

4 Methodology

4.1 Participants

This research was conducted in Israel, where most academic institutions implemented in the early 2000s an LMS developed by Britannica Knowledge Systems (<https://www.britannica-ks.com>). The LMS soon became a standard (Soffer et al., 2010) and was used mostly for posting papers, presentations, and messages (Naveh et al., 2006; Bonk and Graham, 2012). After ten years, most universities and colleges looked for an alternative LMS and opted for the open-sourced Moodle (<https://moodle.org>). Like the replaced LMS, the Moodle offered functionalities in all categories suggested by Malikowski et al. (2007), from transmitting course content to creating computer-based instruction.

The two institutions whose students participated in this study switched to Moodle in the same academic year. Ben-Gurion University (BGU) is one of nine universities in Israel, with nearly 900 undergraduate students in its Industrial Engineering and Management (IEM) Department. Shamoon College of Engineering (SCE) is an engineering college with over five hundred undergraduate students in its IEM department. Both institutions operate their principal campuses in the same city.

Although each institution deployed the new LMS with its own unique 'skin' (theme) to set the look and feel of the website, each used the system similarly as a medium to complement face-to-face teaching, mainly for posting material and announcements, submission of assignments, and maintaining discussion forums. The transition from the old LMS to the new one in both institutions was conducted in a very similar manner, leaving unchanged in both institutions factors such as technology, supporting staff, or requirements from academic staff. Subsequent to the initial transition to the new LMS, no further technological and user interface changes were made. Notification of system replacement was not sent to the students. The instructors were invited to a short training session but only a few attended. Examining the impact of the LMS replacement was thus possible without the effect of other potential factors on explored variables, allowing attribution of variation in the success measures under study to student experience with the system and, possibly, to the institution and the year of study.

Respondents were juniors and seniors in the IEM departments of their respective institutions. Juniors and seniors were chosen for their experience and knowledge of the LMS and their skills in learning strategies and meeting course requirements. These selection criteria aimed to reduce 'noise' in the collected data that might stem from the adjustment process of freshmen to the academic world. The instrument used to collect the data is detailed next.

4.2 Data collection

The survey instrument employed in this study, whose eighteen items are detailed in the Appendix, was used to explore whether LMS experience affected the relevant success measurement categories of the DeLone and McLean model, focusing on participant perception, as suggested by Al-Busaidi (2012). Specifically, respondents were asked to indicate their perception of system quality, satisfaction with the system, and perceived net benefit of the system, using a seven-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree’.

Based on past research (Wang, 2003; Ozkan and Koseler, 2009), perceived system quality was measured with items 1 to 12 of the instrument, which focused on use efficiency, ease of use, organisation and navigation, user interface, and reliability. Based on Palvia (1996), who developed a comprehensive model for examining the satisfaction of users covering a wide range of use forms of IS, user satisfaction was measured with Items 15 to 18 of the instrument, which focused on general satisfaction and system success as perceived by the respondents. Based on Ozkan and Koseler (2009), net benefit was measured with two items 13 to 14 of the instrument, which focused on the perception of how much the LMS contributed to learning. Students’ perception of learning, which may differ from actual learning, was explored in this study for two main reasons. First, due to the research setting – the exploration of a system that is used campus-wide, by hundreds of instructors and teaching assistants in very different courses and learning settings, suggests that there are many elements influencing students’ performances; attributing change observed to a single factor would be incautious. The second reason for using perceived learning rather than actual learning (i.e., students’ performances) is the focus of the study. The study aims to capture the impact of experience on students’ apprehension of the system. Thus, explores their perception about the contribution to learning.

The paper-and-pencil survey instrument detailed in the previous subsection was administered in class at the beginning of the academic years 2015 (year 1), 2016 (year 2), and 2018 (year 3) to junior and senior IEM students in both institutions, by the researchers who entered a face-to-face lecture of a mandatory course. All students present in the classroom when the survey was administered completed it, a total of 463 responses, as detailed in the results section. In year 1, participants were asked about the old LMS after two or three years of use (long-term experience with the old LMS). In year 2, they were asked about the new system after using it for a full year, to capture their perceptions after passage of a substantial, yet relatively short, period of time (short-term experience with the new LMS). In year 3, participants were asked to fill out the same questionnaire after two or three years of use of the new LMS system (long-term experience with the new system). The research protocol anticipated that by this time the new LMS system would be considered as the standard rather than new since, some of them used only the new system for two years and the rest used the new system longer (two years) than the old one (one year). Some of the respondents filled out more than one survey (since all surveys were administered in the same department), but keeping the answers anonymous prevented analysis of longitudinal data. Procedural details are provided in Naveh and Shelef (2018).

4.3 Data analysis

The IBM SPSS® 25 software platform was used to perform the reliability analysis and calculate descriptive statistics; R 4.0.1 programming language was used for the regression analysis. The Cronbach's α scores calculated before actual data analysis were above 0.7, confirming the reliability of the questionnaire (Hisham et al., 2004). The Cronbach's α score for the 12 statements dealing with system quality was 0.93, the Cronbach's α score for the four statements dealing with user satisfaction was 0.86, and the Cronbach's α score for the two statements dealing with net benefit was 0.89. The values of perceived system quality, user satisfaction, and net benefit for each respondent were calculated as the average of its respective items.

Analysis of the collected data was two-phased. The first phase was devoted to calculating descriptive statistics: the frequency of participants regarding the institution, gender, year of study (junior and senior), and the number of responses in each of the three occasions the questionnaires was filled in years 1, 2, and 3. The averages and standard deviations of their responses in each category (system quality, satisfaction, and net benefit) were calculated.

The second phase of data analysis was devoted to performing regression investigations to evaluate the effect of both participant experience with the LMS as well as their year of study (junior and senior) and the institution of study (BGU and SCE), on their perception of system quality, satisfaction, and net benefit in terms of contribution to learning.

For the assumptions of the regression analysis and the parametric tests to hold, a Box-Cox power transformation (Box and Cox, 1964) was applied to system quality, user satisfaction, and net benefit. For perceived system quality, a Box-Cox power transformation with an exponent (power) λ equals 1.5 was used; for user satisfaction, λ equals 1.8 and for net benefit, λ equals 1.4. In the following three regression analyses, the transformed variables were used.

The first regression model was conducted to determine whether experience (long-term experience of two or three years versus a short-term experience of one year), the institution (BGU and SCE), and the year of study (junior and senior) affect perceived system quality. The formulation of the linear regression model is defined as follows:

$$SQ_i = \beta_0 + \beta_1 P_{2i} + \beta_2 P_{3i} + \beta_3 I_i + \beta_4 Y_i + \varepsilon_i, \quad (1)$$

where SQ_i is the (transformed) perceived system quality for the respondent i ; β_0 is the intercept in the model; β_1 is the coefficient for the short-term experience (year 2); P_{2i} is a dummy variable that equals 1 for a short-term period (year 2) or 0 otherwise; β_2 is the coefficient for the long-term experience with the new system (year 3); P_{3i} is a dummy variable that equals 1 for the long-term experience with the new system (year 3) or 0 otherwise; β_3 is the coefficient for the institution (I_i is a dummy variable that equals 1 if the institution is BGU and 0 otherwise); β_4 is the coefficient for the year of study (Y_i is a dummy variable that equals 1 for senior students and 0 for junior students); and ε_i is the error term.

The second regression model was conducted to determine whether system quality, experience, institution, and the year of study affect user satisfaction. The formulation of the linear regression model is defined as follows:

$$S_i = \beta_0 + \beta_1 SQ_i + \beta_2 P_{2i} + \beta_3 P_{3i} + \beta_4 I_i + \beta_5 Y_i + \varepsilon_i, \quad (2)$$

where S_i is the (transformed) user satisfaction for respondent i ; β_0 is the intercept in the model; β_1 is the coefficient for the (transformed) perceived system quality (SQ_i); β_2 is the coefficient for the short-term experience (P_{2i}); β_3 is the coefficient for the long-term experience with the new system (P_{3i}); β_4 is the coefficient for the institution (I_i); and β_5 is the coefficient for the year of study (Y_i). SQ_i , P_{2i} , P_{3i} , I_i , Y_i and ε_i are defined in equation (1).

The third regression analysis was conducted to determine whether experience, user satisfaction, institution, and the year of study affect perceived net benefit in terms of contribution to learning. The formulation of the linear regression model is defined as follows:

$$NB_i = \beta_0 + \beta_1 S_i + \beta_2 P_{2i} + \beta_3 P_{3i} + \beta_4 I_i + \beta_5 Y_i + \varepsilon_i, \quad (3)$$

where NB_i is the (transformed) net benefit for respondent i ; β_0 is the intercept in the model; β_1 is the coefficient for the (transformed) user satisfaction (S_i); β_2 is the coefficient for the short-term experience (P_{2i}); β_3 is the coefficient for the long-term experience with the new system (P_{3i}); β_4 is the coefficient for the institution (I_i); and β_5 is the coefficient for the year of study (Y_i). S_i is defined in equation (2); P_{2i} , P_{3i} , I_i , Y_i and ε_i are defined in equation (1). The results of these analyses are presented in the next section.

5 Results

As mentioned in the previous section, descriptive statistics were first calculated on the raw collected data prior to transformation. These calculations were followed by three regression analyses on the transformed variables, as detailed in Section 4.3. The regression analyses explored the effect of the explanatory variable experience and the additional variables year of study and institution on the dependent variables system quality, user satisfaction, and net benefit, as well as the relationships between the dependent variables according to the DeLone and McLean model.

5.1 Descriptive statistics

The descriptive statistics of the respondents and their responses is presented in Table 1. As expected, and reflecting the size differences between the investigated institutions, the majority of the respondents studied in BGU and the minority in SCE.

The changes in the average evaluation by respondents over time are illustrated in Figure 2, showing that the averages of perceived system quality, user satisfaction, and net benefit are higher after prolonged use of the system for two or three years, for both the old and the new systems, and lower otherwise for one year. Perceived system quality was lower for respondents with short-term experience of one-year, compared to respondents with long-term experience of two or three years, both for the old LMS, and for the new LMS. Also, perceived system quality was higher for junior students, compared to senior students. Respondent satisfaction with short-term experience of one year was lower than respondent satisfaction with long-term experience of two or three years, for both the old LMS and the new LMS. Additionally, the respondent satisfaction was higher for junior students than for senior students. Perceived net benefit was lower with short-term

experience and higher for long-term experience with the old system and the new one. The net benefit that junior students perceived was higher compared to senior students.

Table 1 Descriptive statistics

		Freq.	Percent	System quality		User satisfaction		Net benefit	
				Avg.	St. dev.	Avg.	St. dev.	Avg.	St. dev.
Experience	Long-term, old system (Year 1)	190	41.0%	5.152	1.120	5.378	1.301	4.539	1.546
	Short-term, new system (Year 2)	173	37.4%	4.467	1.057	4.523	1.262	4.000	1.422
	Long-term, old system (Year 3)	100	21.6%	5.096	0.986	5.253	1.176	4.310	1.368
Institution	BGU	334	72.1%	4.853	1.116	5.010	1.352	4.199	1.505
	SCE	129	27.9%	4.966	1.110	5.087	1.231	4.519	1.390
Gender	Female	263	56.8%	5.071	1.027	5.248	1.216	4.337	1.509
	Male	200	43.2%	4.638	1.178	4.747	1.394	4.225	1.441
Year of study	Junior	284	61.3%	5.028	1.104	5.234	1.296	4.472	1.398
	Senior	179	38.7%	4.655	1.095	4.710	1.292	3.997	1.560
Total		463	100.0%	4.8842	1.1145	5.0315	1.3184	4.2883	1.4795

Next, the statistical significance of the differences in the averaged perception of the system with long-term versus short-term experience regarding the three dependent variables (system quality, user satisfaction, and net benefit) was examined. Due to the large sample sizes, independent t-tests are appropriate. T-tests verified that the averages were significantly higher after prolonged use of the system (two or three years) and lower otherwise (one year) for all averaged perceptions: system quality (t-statistic = 6.52, p-value < 0.001), user satisfaction (t-statistic = 6.70, p-value < 0.001) and net benefit (t-statistic = 3.31, p-value < 0.001).

Figure 2 Experience versus averages of system quality, user satisfaction, and net benefit perceptions

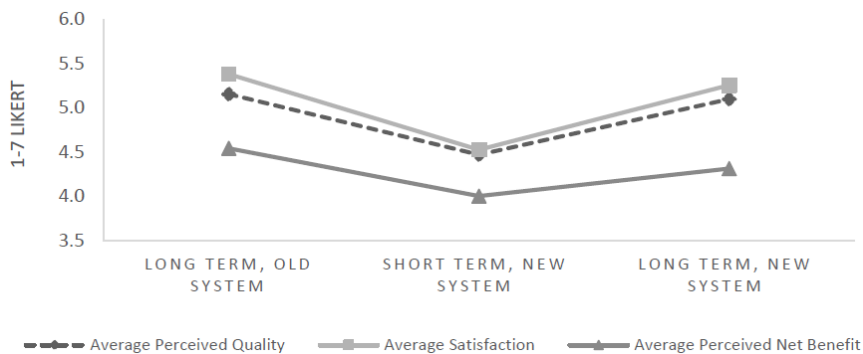


Table 2 Regressions for system quality, user satisfaction, and net benefit

<i>Dependent variable</i>	<i>Model</i>	<i>Explanatory variables</i>	<i>Coefficient</i>	<i>t-statistic</i>	<i>p-value</i>	<i>R²</i>	<i>Adj. R²</i>	<i>F-statistic</i>	<i>p-value</i>
System quality [Equation (1)]	Initial model	Intercept (β_0)	8.008	17.329	< 0.001	***			***
		Short-term, new system (Year 2, β_1)	-1.498	-6.262	< 0.001	***			***
		Long-term, new system (Year 3, β_2)	-0.283	-0.994	0.321				
	Final model (backward)	Institution (β_3)	-0.246	-1.034	0.302				
		Year of study (β_4)	-0.750	-3.435	0.001	***			***
		Model summary				0.111	0.104	14.353	< 0.001
User satisfaction [Equation (2)]	Initial model	Intercept (β_0)	7.481	48.252	< 0.001	***			***
		Short-term, new system (Year 2, β_1)	-1.409	-6.436	< 0.001	***			***
		Year of study (β_4)	-0.726	-3.340	0.001	***			***
	Initial model	Intercept (β_0)	-0.481	-0.884	0.377				
		System quality (β_1)	1.621	37.925	< 0.001	***			***
		Short-term, new system (Year 2, β_2)	-0.621	-2.724	0.007	**			**
		Long-term, new system (Year 3, β_3)	-0.341	-1.309	0.191				
		Institution (β_4)	0.183	0.838	0.402				
		Year of study (β_5)	-0.545	-2.694	0.007	**			**
		Model summary				0.791	0.789	346.243	< 0.001

Notes: *p-value < 0.05; **p-value < 0.01; ***p-value < 0.001

Table 2 Regressions for system quality, user satisfaction, and net benefit (continued)

Dependent variable	Model	Explanatory variables	Coefficient	t-statistic	p-value	R ²	Adj. R ²	F-statistic	p-value
User satisfaction [Equation (2)]	Final model (backward)	Intercept (β_0)	-0.298	-0.853	0.394				
		System quality (β_1)	1.622	37.986	<0.001				***
		Short-term, new system (Year 2, β_2)	-0.498	-2.380	0.018				*
		Year of study (β_3)	-0.526	-2.611	0.009				**
		Model summary				0.790	0.789	575.204	<0.001
Net benefit [Equation (3)]	Initial model	Intercept (β_0)	3.151	5.855	<0.001				***
		User satisfaction (β_1)	0.292	12.064	<0.001				***
		Short-term, new system (Year 2, β_2)	-0.084	-0.348	0.728				
		Long-term, new system (Year 3, β_3)	-0.403	-1.465	0.144				*
		Institution (β_4)	-0.536	-2.335	0.020				
		Year of study (β_5)	-0.279	-1.297	0.195				
		Model summary				0.287	0.279	36.817	<0.001
	Final model (backward)	Intercept (β_0)	2.773	5.927	<0.001				***
		User satisfaction (β_1)	0.298	13.218	<0.001				***
		Institution (β_4)	-0.483	-2.124	0.034				*
		Model summary				0.282	0.278	90.159	<0.001

Notes: *p-value < 0.05; **p-value < 0.01; ***p-value < 0.001

5.2 Regression analysis

The results of the three regression analyses are detailed in Table 2. For each of the three dependent variables, the results for two models are detailed in both initial and final models, where the final model was obtained by backward regression.

The first regression analysis was conducted to determine whether experience, as well as the institution and the year of study, affect perceived system quality [following equation (1)]. The perception of system quality was significantly lower for respondents with a short-term experience, compared to the respondents with long-term experience of two or three years ($p\text{-value} < 0.001$). In addition, perceived system quality was higher for junior students versus senior students. The final model explains 10.8% of the variance in respondent perceptions of system quality. As also indicated from the regression, there was no significant difference between perception of system quality for long-term experience with the old LMS (year 1) and the new LMS (year 3). Furthermore, the perception of system quality was not significantly affected by whether the institution of studies was BGU or SCE.

The second regression analysis was conducted to determine whether experience, system quality, institution, and year of study affect user satisfaction [following equation (2)]. Respondent satisfaction was positively and significantly affected by perceived system quality ($p\text{-value} < 0.001$). Respondent satisfaction with the short one-year LMS experience was significantly lower than respondent satisfaction after the longer two or three years of LMS experience, for both the old LMS and the new LMS ($p\text{-value} = 0.018$). In addition, the respondent satisfaction of junior students was significantly higher than that of senior students ($p\text{-value} = 0.009$). Note that the differences in perception between juniors and seniors seem consistent regarding system quality and user satisfaction. Significant differences were not found between the satisfaction averages for long-term experience with the old LMS (year 1) and the new LMS (year 3), nor were significant differences found between the satisfaction averages for BGU and SCE. The final model explains 79% of the satisfaction's variance.

The third regression analysis was conducted to determine whether experience, year of study, institution, and user satisfaction affect perceived net benefit [following equation (3)]. The perceived net benefit was positively and significantly affected by user satisfaction ($p\text{-value} < 0.001$) and was also affected by whether the institution was BGU or SCE ($p\text{-value} = 0.034$). Note that the institution's contribution to the explanation of perceived net benefit is statistically significant ($p\text{-value} = 0.034$), but it has minor explanatory contribution ($R^2 = 0.009$). Net benefit was not significantly affected by experience or by the year of study (senior versus junior). The final model explains 28.2% of the variance in perceived net benefit ($p\text{-value} < 0.001$).

6 Discussion and conclusions

In response to the absence of prior research focused relating user experience, in terms of the time elapsed since initial use, to IS success, this study explores this relation in the context of LMS using the DeLone and McLean (2003) IS success model based on the proposed research model (Section 3). Statistical analysis of responses to identical questionnaires, collected at the beginning of three academic years in two institutions, indicated that experience affected perceived system quality and user satisfaction. A

relatively short experience of one year was associated with lower perceived system quality and lower user satisfaction, which improved with a more extended experience period of two or three years. However, experience was not found to significantly affect perceived net benefit in terms of contribution to learning. In addition, data analysis showed significant correlations between system quality and user satisfaction, as well as satisfaction and net benefit, in line with the IS success model of DeLone and McLean (2003).

The effects of experience were examined under unique circumstances in which a system changed while the pedagogical and administrative circumstances remained essentially unchanged. Lower perceived system quality and user satisfaction were observed after one full year of use, a period after which both instructors and students were expected to reach a satisfactory level of familiarity with functionality and interface of the new system. Furthermore, there was no significant difference between the responses received from participants in both institutions, despite considerable differences in population and the user interfaces of the LMSs. Thus, it is safe to attribute the shift in perceived system quality and user satisfaction to the experience with the system itself.

In the following sections, the implications for practitioners are presented, followed by limitations of the study, recommendations for future research, and conclusions.

6.1 Implications of the results for practice

The results of the study suggest that system replacement and its entailed shorter experience may affect student perception of both the system quality and the satisfaction with it for a full year. The importance of these results might increase in a pandemic and post-pandemic era in which learning technology takes a more integral and dominant part in higher education learning, thus a positive students' perception of these learning technologies is respectively important. These conclusions suggest that administrators and instructors in higher education should expect a period of decreased student satisfaction with a replaced LMS, and consider implementing organisational processes known to support IS deployment, shortening and mitigating the effect of system replacement on user satisfaction. Organisational processes such as these may include user and management involvement in the early stages of the implementation (Azis and Salleh, 2011), training programs (Bikson et al., 1981), or engagement of champion users (Kwon and Zmud, 1987).

6.2 Limitations

The study took place in a complex, uncontrolled environment with numerous unexamined factors, as the research focused on user experience alone as an explanatory variable. The unique circumstances of the system replacement while the surroundings remained unchanged, and the insignificant difference between the results in the two institutions, lend support to such focus of this study on one factor, yet further examination of other factors would be worthwhile. Another limitation is that despite exploring populations from two different institutions, the respondents were all engineering students since, perhaps, the perception of the IS would be different for students studying in less (or more) technology-oriented disciplines. An additional limitation concerns the last group of participants who responded to the questionnaire in year 3, since a minority of this group

(seniors) had used the old system for one year, while the rest (juniors) did not use the old system at all and only used the new one. This limitation remains even though the differences between seniors and juniors were found to be consistent in all surveys responses, including year 1 and year 2, in which all respondents had an identical use of the systems, and seniors in year 3 used the new system for two years and the old system for one year.

6.3 Recommendations for future research

Two of the findings of this research are of particular interest. First, the system replacement was expected to affect user perception of its quality, as this factor was examined by various questions regarding the interaction of the user with the LMS. These questions, among others, focused on system organisation and navigation and on look and feel of the user interface, which had naturally changed dramatically with the switch between the systems, yet explained less than 11% of user shifts in system quality perception. The second intriguing result is the effect of experience on perceived system quality and user satisfaction, but not on the perceived contribution to learning. Both results require further exploration in order to obtain a better understanding of these findings by, for example, using qualitative data obtained in interviews. Further research may also examine the applicability of the results to various settings such as different types of organisations, like healthcare and banking, or other types of systems, like enterprise resource planning and customer relationship management. Additionally, exploring the relationships between experience and other time-related factors as past use and habit, may facilitate more in-depth understanding of the role of time in regard to user perception of the system, or other known determinants of LMS success as perceived ease of use and perceived usefulness, would further the exploration of experience in the context of user perceptions of IS.

6.4 Conclusions

This research identifies an IS success factor that was not explored in previous research as such, specifically in the research of LMS in higher education, highlighting the complexity of IS success and shedding light on unexpected elements that might affect user perception of IS. As the adoption of IS remains a complex process that often ends with incomplete success or even implementation failure, identifying all relevant success factors is essential to both researchers and practitioners. The findings of this study also highlight the importance of the process of IS implementation that could mitigate the undesirable side effect of IS replacement. This is especially important for institutions of higher education, given that students behave differently than employees of business organisations, where most implementation processes are researched, planned, and ultimately, conducted.

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Appendix

Survey instrument

- 1 The system is an efficient educational tool.
- 2 The system helps me manage my learning more systematically.
- 3 The system is easy to use.
- 4 The system is user-friendly.
- 5 The content organisation in the system is easy to understand.
- 6 The system makes it easy to find the content I need.
- 7 The system's graphical user interface is good.
- 8 The system's fonts (style, colour) are easy to read.
- 9 I have not faced any system errors.
- 10 The system is easily accessible.
- 11 The navigation in the system is easy.
- 12 I can find required information easily in the system.
- 13 The system improves my success in school.
- 14 The system improves my learning.
- 15 Overall, the system is successful.
- 16 Overall, I am satisfied with the system.
- 17 Overall, the system has met my expectations.
- 18 Overall, I am satisfied with the use that has been made with the system.