

STATISTICAL EVALUATION OF EFFECTIVENESS OF LMS IN HIGHER EDUCATIONAL INSTITUTES DURING COVID-19

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ABSTRACT

The widespread impact of the COVID-19 pandemic has compelled a rapid transformation in global education, leading educational institutions to adopt Information Technology (IT) solutions, notably exemplified by the increased use of the Moodle Learning Management System (LMS). This study delves into the effectiveness and sustainability of LMS in higher education amidst the ongoing health crisis, examining both the challenges and opportunities associated with the integration of technology. Employing in-depth route analyses, the research explores the factors influencing university students' adoption of LMS and assesses its significance in facilitating educational processes. The study acknowledges the transformative role of technology in education, particularly accentuating its influence during the COVID-19 pandemic. While recognizing students' proficiency in navigating LMS features, the research also addresses intricacies related to technical skills and the need for structured guidance. Despite the effectiveness of LMS, challenges such as slow internet connectivity and material upload errors emerge as impediments to seamless e-learning. The recommendations propose strategic interventions, including the expansion of broadband infrastructure and the implementation of robust teacher support programs, aiming to address challenges and reshape the online learning landscape for more equitable access and reduced educational inequalities.

Keywords: LMS, higher education, effectiveness, COVID-19, digital learning, DeLone and McLean's model.

INTRODUCTION

After its initial appearance, the COVID-19 promptly proliferate globally, becoming a pathogen. Its high lethality has intensified concerns among the human population [1]. The contagious virus has led to widespread damage to educational systems public health, social structures, and economic frameworks. Worldwide, the infection and mortality rates stand at

approximately 768 million and 6.9 million, respectively [2].

Moreover, the COVID-19 pandemic has profoundly impacted global education systems. According to United Nations Educational, Scientific and Cultural Organization (UNESCO) documentation in 2020, repercussions of closures extend to over 1.5 billion students across 195

countries, representing 87% of the world's student population. The challenges posed by the pandemic encompass alterations in curriculum, adjustments in digital learning infrastructure, changes in teaching and learning approaches [3].

It has yielded significant insights into the transformative role of technology in education, enabling students worldwide to engage in distance learning [4]. In addition, it has markedly transformed the dynamics of interactions between educators and learners [5]. As a consequence, universities globally have undergone a comprehensive shift, transitioning all their activities to an online mode [6]. The gravity of the pandemic has yielded notably dire outcomes, with one such consequence being the closure of universities and the suspension of school activities. In response to the exigencies of such emergency situations, the imperative to incorporate technology has become unavoidable [7].

The Moodle LMS, serving as a course management system for e-learning, is alternatively referred to as a learning management system or a virtual learning environment. Functioning as a free web application, it facilitates the creation of online learning platforms. Noteworthy is its versatility and extensive array of communication tools, constituting a distinct advantage of this system [8]. LMS is pivotal, guiding students to make substantial academic progress, fostering growth and accomplishment. [9]. This online framework is designed to enhance the sustainability of learning in schools. It focuses on organizing, implementing, and continuously updating the educational system for maximum effectiveness [10].

This study employed route analyses to gain insights into the determinants influencing university students' adoption and significance of effectiveness of LMS in higher education. The closure of higher education systems in response to the imperative of limiting the spread of COVID-19 prompted a reliance on technologies to facilitate effective learning experiences, particularly through home-based learning activities[11].

While exploring the opportunities for both the utilization of technology and the challenges it

confronts [12] and understanding the transformative role of technology, study aims to assess and evaluate the statistical aspects of LMS sustainability and effectiveness within the unique context of the ongoing global health crisis. This contribution involves rigorous statistical analysis and evaluation to gauge the effectiveness, adaptability of LMS implementation in higher educational settings during the pandemic. The research chief objectives and hypotheses are as follows:

Objectives:

- Assess the effectiveness of the LMS in facilitating educational processes and outcomes.
- Explore how the socio-economic characteristics of respondents influence on the LMS effectiveness.
- Assess and evaluate the demographical factors affect the LMS effectiveness.
- Provide actionable recommendations to improve the efficiency and productivity of the Learning Management System, based on the findings from the study.

Hypothesis:

- H₁: Higher awareness drives LMS effectiveness.
- H₂: Functions shape LMS effectiveness.
- H₃: Access to digital gadgets influence the effectiveness of LMS
- H₄: Internet availability defines LMS effectiveness.

1. Literature review

In the realm of academic discourse, a LMS is a software application designed to facilitate the administration, documentation, tracking, reporting, and delivery of educational courses, training programs, or initiatives related to learning and development [13]. Its primary design objective is to pinpoint gaps in teaching and learning, utilizing automated processes for the analysis and reporting of pertinent data [14]. LMS empower students to lay out their teaching rhythm and to adapt the learning system that suit their own necessities[15].

In addition, LMS help educators to send learning materials and follow students' assessment and allow students to get close enough to learning

devices for their online training [16]. There is need likewise to analyse the issues and difficulties related with its organization, acknowledgment, use, and management[17]. The people's accepted practice, restricted admittance to digital gadgets, and frameworks accessibility to be the major challenging factors that influence LMS implementation, and these elements essentially impacted usefulness and ease of use which thus influences LMS acceptance and improvement[18]. Moreover, the accessibility of resources that work with LMS utilization, for instance, internet speed and its reliable presence, consistent power supply, admittance to digital gadgets and system accessibility were the fundamental purposes behind prompt development of LMS in affluent countries[19]. In addition, inadequate infrastructure, weak LMS policies, high teaching load, students' congestion in educational institutions, and limited access to digital devices such as PCs, laptops, smart phones and system availability are central issues contributing to the ineffectiveness of LMS in a significant portion of low income countries [20].

In this scenario, advocates the requirements for clear LMS strategies that can further develop e-learning acknowledgment, use and effectiveness in educational institution and the effective usage of LMS for sustainable development for education [21]. Similarly, the course material and frameworks characteristics have important impact on students' mentality towards effectiveness of LMS as well as on their aim to constant use[22]. In this manner, the teachers ought to develop such content that are updated and in line with the students' knowledge, capacities, and skills to expand students' satisfaction with the system which ultimately improve LMS effectiveness and usage. [23]. Within higher education institutions, the dynamics of teaching and learning, as well as the interactions between students and teachers, underwent a profound shift due to the impact of the COVID-19 pandemic. Consequently, universities found themselves compelled to transition all student teaching and learning activities to online platforms as a direct outcome of the epidemic [24].

The gravity of the pandemic has been exceedingly catastrophic, and one of its repercussions has been

the widespread closure of schools, colleges and universities. The imperative to employ technology for educational continuity during the COVID-19 pandemic is undeniable, as underscored by several recent reports addressing this concern[25]. The current context, marked by the COVID-19 pandemic, imposes constraints on face-to-face learning events, hindering the conventional delivery of teaching materials to students and underscoring the imperative for adaptive instructional approaches in the pursuit of effective learning and educational sustainability [26].

Among the technologies adopted in response, Learning Management Systems (LMS) stand out, serving as a media integration tool for instructional purposes. LMS employs a unified platform to streamline communication processes throughout instructional events amid the challenges posed by the pandemic [27]. The profound impact of technology on reshaping the educational landscape for effectivity of LMS has yielded substantial insights, fostering a global shift toward sustainable education and empowering learners worldwide through distance education [28]. The integration of effectiveness of LMS into the educational framework is a prevailing global trend, prompting a heightened focus on the cultivation of diverse skills and qualities essential for academic success among both educators and students keeping in view the environment around must be positively sustained [29].

The emphasis is rooted in the belief that sustained academic and occupational success corresponds to the enduring vitality of an educational institutions [30]. In higher education, the objective is to instil in students the capability to comprehend actions, problems, solutions, and consequences within a framework encompassing scientific, technical, and economic and environmental dimensions [31]. However, the evolving landscape demands the integration of novel concepts like social responsibility and sustainable development into virtual environment of e-learning [32].

This study addresses a critical gap in the current understanding of LMS effectiveness amidst the challenges presented by the COVID-19 pandemic. By innovatively adapting and extending the Technology Acceptance Model (TAM) as a

foundational academic framework, our objective is to construct a novel model.

In addressing COVID-19 challenges, integrating the Technology Acceptance Model (TAM) into LMS effectiveness research is a strategic move. TAM, a foundational academic framework, facilitates a structured analysis of students' engagement with LMS adoptability. This study extends TAM for a nuanced understanding of interconnections between key constructs during the pandemic. Focusing on perceived usefulness and ease of use, it assesses students' perspectives on LMS value and accessibility in remote learning. This adaptation aids in evaluating challenges and benefits associated with LMS adoption. Leveraging TAM establishes a theoretical foundation and a practical framework for policymakers and educators, enhancing LMS design for a more effective and student-centric remote learning experience.

Moreover, this model aims to comprehensively elucidate the interconnections between exogenous and endogenous constructs, providing a nuanced understanding of students' engagement with LMS adoptability. The specific challenges posed by the pandemic, such as rapid shifts to online learning and varying levels of technological access, underscore the urgency of this research. Gaining insights into these dynamics is essential for informing educational practices and policies in the face of ongoing global uncertainties.

2. Materials and methods

Data description

The research employed a systematic data collection method through a carefully designed questionnaire administered to 630 participants from universities in Islamabad and Rawalpindi. The sample size, determined through Proportionate Random sampling, ensured diverse representation for comprehensive insights. Among the participants, male were 430 (68.3%) and female were 200 (31.7%), the age distribution reveals a majority in the 20-25 (47.9%) and 26-30 (45.4%) groups, presenting an average age of 25. Initial data obtained processing involved the systematic compilation of demographic information, combining categorical and numerical

3.4 Conceptual framework

variables. Data privacy has been carefully handled and we employ codes for each participant instead of identity. Pre-processing further refined the dataset, ensuring consistency and reliability for advanced statistical analyses.

Data pre-processing

The collected dataset experienced a comprehensive data processing phase to refine and prepare it for analysis. Initial steps included addressing missing values and inconsistencies, ensuring data integrity. Categorical variables were encoded for numerical representation, and numerical variables were standardized to maintain consistency in scale. Data collection was conducted through a meticulously designed structured questionnaire, incorporating both open-ended and close-ended questions based on prior studies and literature. The entire process aimed at enhancing the dataset's quality, making it conducive for robust analysis. Common techniques employed for data pre-processing included imputation for missing values, one-hot encoding for categorical variables, standardization or normalization for numerical variables, and outlier detection methods such as Z-score Approach which is a statistical measure that quantifies how many standard deviations a data point is from the mean of the dataset. These techniques collectively contribute to a refined dataset, facilitating accurate and meaningful interpretation of the research findings.

Data Processing and Analysis

Quantitative research methods were employed in this study. A Proportionate Random sampling technique was applied, resulting in a well-balanced sample size of 630 respondents. The survey method facilitated data gathering, with the questionnaire seamlessly integrated into Google Forms for efficiency. Subsequently, the collected data underwent rigorous description and pre-processing, involving careful organization and categorization of responses. This meticulous approach ensures the dataset's readiness for analysis, contributing to the study's credibility and the reliability of its quantitative findings.

Background variable	independent Variables	Dependent Variable
Age	Internet availability	Effectiveness of LMS
Gender	Possession of digital gadgets	
Area of Residence	Knowledge of e-learning	
Marital Status	Electricity supply	
Academic Program		
Family type		
Family income		
Wi-Fi connection at home		

3.5 Analysis of the data

To acquire better results and insight into the problem, this study used two types of quantitative data analysis univariate and bivariate analysis. It

was achieved by using Statistical Package for Social Sciences (SPSS). The analysed data along with tables and explanations is presented in further headings.

4. RESULTS AND DISCUSSIONS

Table 1 Baseline characteristics of the respondents (n=630)

S.No	Age	F	%
1	20-25	302	47.9
2	26-30	286	45.4
3	>30	42	6.7
	Total	630	100.0
Mean: 25.74		Standard Deviation: 2.902	
S.No	Gender	F	%
1	Male Students	430	68.3
2	Female Students	200	31.7
	Total	630	100.0
S.No	Area of residence	F	%
1	Village	350	55.5
2	City	280	44.5
	Total	630	100.0
S.No	Academic program	F	%
1	Bachelors	368	58.4
2	Masters	194	30.7
3	Doctoral	68	10.7
	Total	630	100.0

Table 1 shows the frequency, percentage, mean and standard deviation of demographic variables. It includes age of the respondents, gender of the respondents, area of residence of the respondents, academic program of the respondents, family type of the respondents, family income of the respondents and sources that respondents used to participate in online lectures during corona pandemic.

The results depict that out of total (630), majority of the respondents (47.9 percent) were between the age group of 20-25. More than one fourth of the respondents (45.4 percent) were between the age group of 26-30. The mean score of the age

variable remained at 25 and standard deviation score remained at 2.902. The data show that out of total (630) research sample, majority of the respondents (68.3 percent) were male students; while, more than one fourth of the respondents (31.7 percent) were female students.

Concerning the area of residence, out of total (630) respondents, majority (55.5 percent) lived in rural areas. On the other hand, more than one fourth of the respondents (44.5 percent) lived in urban areas. The collected data illustrates that, out of total (630) respondents, more than half (58.4 percent) were enrolled in bachelors studies. More than one fourth (30.7 percent) of the respondents

were enrolled in masters studies; while, less than a quarter (10.7 percent) of the respondents were

enrolled in doctoral studies.

Table 1 Continued

S.No	Type of family	F	%
1	Elementary family	310	49.2
2	Joint household	300	47.6
3	Extended family	20	3.1
	Total	630	100.0
S.No	Total income of family(per month)	F	%
1	Up to 60000	68	10.8
2	60001-70000	36	5.7
3	70001-80000	80	12.7
4	> 80000	446	70.8
	Total	630	100.0
Mean: 92587		Standard Deviation: 17565.80	
S.No	Source of online class participation	F	%
1	Landline internet	230	36.5
2	Mobile Data	400	63.5
	Total	630	100.0

The results further depict that, out of total (630) respondents, majority (49.2 percent) lived in nuclear families. More than one fourth of the respondents (47.6 percent) lived in joint families. Concerning the monthly family income, the results show that majority of the respondents (70.8 percent) had the monthly family income above 80,000. Less than a quarter of the respondents (12.7 percent) had the monthly income ranging between 70,001-80,000. The

mean of the income category was 92,587.30. However, the standard deviation score remained at 17565.80. Concerning the source of online class participation, the collected data demonstrates that a considerable number of the respondents (63.5 percent) used data packages of different cellular networks to participate in online lectures. On the other hand, more than one fourth of the respondents (36.5 percent) used WIFI networks for online class participation.

Table 2 Respondent's awareness level about Learning Management System (LMS)

S.No	Statement	SA	A	NO	D	SD	Tot.	Me.	Sd.
1	I can easily operate Google classroom application	(72) 11.4	(298) 47.3	(11) 1.7	(219) 34.8	(30) 4.8	(630) 100	2.74	1.185
2	Google meet is easy to operate	(77) 12.2	(289) 45.9	(48) 7.6	(177) 28.1	(39) 6.2	(630) 100	2.70	1.179
3	Zoom application is easy to use	(56) 8.9	(202) 32.1	(156) 24.8	(185) 24.9	(31) 4.9	(630) 100	2.89	1.076
4	PDF and video tutorials about LMS are not useful	(50) 7.9	(195) 31.0	(82) 13.0	(278) 44.1	(25) 4.0	(630) 100	3.05	1.107
5	Students need guidance about the operation of LMS	(239) 37.9	(335) 53.2	(28) 4.4	(26) 4.1	(2) .3	(630) 100	1.76	.748

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

Majority of the respondents (47.3 percent) agreed to the statement that they can easily operate Google classroom application. More than one fourth of the respondents (34.8 percent) disagreed to this statement. The mean of this statement was 2.74 on the other hand the standard deviation score was 1.185. Most of the respondents (45.9 percent) strongly agreed to the statement that they can easily operate Google meet application and more than one fourth (28.1 percent) of the respondents disagreed to this statement. The mean of this statement was 2.70. The standard deviation score remained at 1.179.

Majority of the respondents (32.1 percent) agreed that Zoom application is easy to use. Less than one fourth (24.9 percent) of the respondents held

the view that Zoom is not easy to use. Very similar percentage (24.8 percent) of the respondents remained neutral in this regard. The mean score of the statement was 2.89 and the standard deviation score was 1.076. The data shows that majority (44.1 percent) of the respondents disagreed to the statement that PDF and video tutorials about LMS are not useful. More than one fourth of the respondents (31.0 percent) agreed to this statement. The mean of the statement was 3.05 and the standard deviation remained at 1.107. The data further illustrates that more than half of the respondents (53.2 percent) agreed to the statement that students need guidance about the operation of LMS. Mean score of the statement was 1.76 while the standard deviation score was .748.

Table 3 Respondents' opinion about features of LMS

S.No	Statement	SA	A	NO	D	SD	Tot.	Me.	Sd.
1	I am satisfied with the quality of graphics being displayed	(75) 11.9	(348) 55.2	(29) 4.6	(147) 23.3	(31) 4.9	(630) 100	2.54	1.118
2	Downloading the study material from subject folder is simple	(76) 12.1	(325) 51.6	(52) 8.3	(147) 23.3	(30) 4.8	(630) 100	2.57	1.114
3	I am not satisfied with the sound quality of online lectures	(61) 9.7	(177) 28.1	(80) 12.7	(297) 47.1	(15) 2.4	(630) 100	3.04	1.111
4	LMS software works fine during weak internet connectivity	(25) 4.0	(185) 29.4	(158) 25.1	(204) 32.4	(58) 9.2	(630) 100	3.13	1.062
5	LMS suite can easily be accessed on multiple devices	(54) 8.6	(387) 61.4	(96) 15.2	(71) 11.3	(22) 3.5	(630) 100	2.40	.920

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

The data shows that majority of the respondents (55.2 percent) agreed that they were satisfied with the quality of graphics. Less than one fourth (23.3 percent) of the respondents disagreed to this statement. The mean of the statement was 2.54 while the standard deviation score remained at 1.118. More than half of the respondents (51.6 percent) agreed to the statement that downloading the study material from subject folder is easy and less than one fourth (23.3 percent) of the respondents disagreed to this statement. The mean

score of the statement remained at 2.57. The standard deviation for the statement was 1.114. Majority of the respondents (47.1 percent) disagreed to the statement that they are not satisfied with the sound quality of online lectures and more than one fourth of the respondents (28.1 percent) agreed to this statement. The mean of the statement was 3.04 while the standard deviation remained at 1.111. The data shows that majority of the respondents (32.2 percent) disagreed to the statement that LMS software works fine during week internet connectivity and more than one fourth of the respondents (29.4 percent) agreed to this statement. The mean score of the statement

was 3.13. Similarly, the standard deviation score was 1.062. More than half of the respondents (61.4 percent) agreed to the statement that LMS suite can be accessed on multiple devices and a

quarter of the total respondents (15.2 percent) remained neutral to this statement. The mean score of the statement was 2.40; similarly, the standard deviation score remained at 920.

Table 4 Respondent's opinion about uploading of study material

S.No	Statement	SA	A	NO	D	SD	Tot.	Me.	Sd.
1	The uploading process of study material is easy	(60) 9.5	(298) 47.3	(20) 3.2	(218) 34.6	(34) 5.4	(630) 100	2.79	1.172
2	I do not face any error while uploading the material	(45) 7.1	(196) 31.1	(96) 15.2	(236) 37.5	(57) 9.2	(630) 100	3.10	1.151
3	Study material is also accepted through email by the teacher	(71) 11.3	(383) 60.8	(44) 7.0	(119) 18.9	(13) 2.1	(630) 100	2.40	.984
4	The uploaded material is always assessed by the teacher	(61) 9.7	(264) 41.9	(172) 27.3	(103) 16.3	(30) 4.8	(630) 100	2.65	1.018
5	It is difficult to convert assignments into PDF for uploading	(53) 8.4	(275) 43.7	(70) 11.1	(119) 31.6	(33) 5.2	(630) 100	2.82	1.125

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

Majority (47.3 percent) of the respondents agreed to the statement that the uploading process of study material is easy and more than one fourth of the respondents (34.6 percent) disagreed to this statement. The mean score of the statement was 2.79 and standard deviation score was 1.172. Majority (37.5 percent) of the respondents disagreed to the statement that they do not face any error while uploading the material and more than one fourth of the respondents (31.1 percent) agreed to this statement. The mean of the statement was 3.10 and standard deviation remained at 1.151.

A considerable number of the respondents (60.8 percent) agreed to the statement that study material is also accepted through email by the

teacher and more than a quarter of the respondents (18.9 percent) disagreed to this statement. The mean score remained at 2.40 while the standard deviation score was .984. Majority (41.9 percent) of the respondents agreed to the statement that the uploaded material is always assessed by the teacher and more than one fourth (27.3 percent) of the respondents remained neutral. Moreover, more than a quarter (16.3 percent) of the respondents strongly disagreed to the statement. The mean score of the statement remained at 2.65. The standard deviation score was 1.018. Most of the respondents (43.7 percent) agreed to the statement that it is difficult to convert data into PDF for uploading and more than one fourth (31.6 percent) of the respondents disagreed to this statement. The mean score of the statement was 2.82; similarly, the standard deviation score was 1.125.

Table 5 Respondent's views about the open book examination

S.No	Statement	SA	A	NO	D	SD	Tot.	Me.	Sd.
1	The allocated time for the paper write up is not enough	(79) 12.5	(161) 25.6	(30) 4.8	(287) 45.6	(73) 11.6	(630) 100	3.18	1.283
2	The uploading procedure of terminal exam material is lengthy	(105) 16.7	(247) 39.2	(56) 8.9	(194) 30.8	(28) 4.4	(630) 100	2.67	1.199
3	There are more chances of plagiarism	(162) 25.7	(208) 33.0	(135) 21.4	(110) 17.5	(15) 2.4	(630) 100	2.38	1.115

	in open book exams								
4	The teacher is always available for help through calls	(101) 16.0	(358) 56.8	(53) 8.4	(90) 14.3	(28) 4.4	(630) 100	2.34	1.049
5	Terminal exam paper is accepted by the teacher through email	(108) 17.1	(351) 55.7	(74) 11.7	(73) 11.6	(24) 3.8	(630) 100	2.29	1.006

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

Table illustrates that a considerable percentage (45.6 percent) of the respondents disagreed to the statement that the allocated time for the paper write up is not enough and one fourth of the respondents (25.6 percent) agreed to this statement. The mean score of the statement was 3.18 and the standard deviation score was 1.283. Majority of the respondents (39.2 percent) agreed to the statement that the uploading procedure of terminal exam material is lengthy and more than one fourth of the respondents (30.8 percent) disagreed to the statement. The mean score of this statement was 2.67. Similarly, the standard deviation score was 1.199.

The data illustrates that most of the respondents (33.0 percent) agreed to the statement that there are more chances of plagiarism in open book exams and less than one fourth (21.4 percent) of

the respondents remained neutral. The mean score of the statement was 2.38. The standard deviation score was 1.115. More than half of the respondents (56.8 percent) agreed to the statement that the teacher is always available for help through calls and less than quarter of the respondents (14.3 percent) disagreed to the statement. The mean score of the statement was 2.34. The standard deviation was 1.049. More than half of the respondents (55.7 percent) agreed to the statement that terminal exam paper is accepted by the teacher through email and less than a quarter (11.7 percent) of the respondents remained neutral. The mean of the statement was 2.29 which prove that majority of the respondents agreed to the statement. Similarly, the standard deviation score of 1.006 states that the data was normally dispersed around the mean of the given data set.

Table 6 Respondent's opinions about Internet infrastructure

S.No	Statements	SA	A	NO	D	SD	Tot.	Me.	Sd.
1	I have to go out of home to get internet	(66) 10.5	(155) 24.6	(101) 16.0	(244) 38.7	(64) 10.2	(630) 100	3.13	1.201
2	The internet speed in my locality is not satisfactory	(106) 16.8	(307) 48.7	(42) 6.7	(142) 22.5	(33) 5.2	(630) 100	2.51	1.163
3	Internet signals are not reliable at my home	(119) 18.9	(274) 43.5	(59) 9.4	(142) 22.5	(36) 5.7	(630) 100	2.53	1.193
4	I cannot easily acquire WIFI connection	(120) 19.0	(213) 33.8	(158) 25.1	(115) 18.3	(24) 3.8	(630) 100	2.54	1.107
5	Internet connectivity is disturbed by the rainy weathers	(95) 15.1	(259) 41.1	(145) 23.0	(106) 16.8	(25) 4.0	(630) 100	2.53	1.061

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

Table shows that more than one fourth (38.7 percent) of the respondents disagreed to the statement that they travel far from home to get uninterrupted internet signals and one fourth of

the respondents (24.6 percent) agreed to this statement. The mean of the statement was 3.13; however, the standard deviation score remained at 1.201. Most of the respondents (48.7 percent) agreed to the statement that they are not satisfied with the internet speed in their localities and more

than a quarter (22.5 percent) of the respondents disagreed to this statement. The mean of the statement 2.51 proved that that majority of the respondents agreed to the statement. The standard deviation score of 1.163 states that the data was normally spread around the mean of the group. Majority of the respondents (43.5 percent) agreed to the statement that they rarely catch reliable internet signals in their houses and slightly less than one fourth (22.5 percent) of the respondents disagreed to the statement. The mean of the statement remained at 2.53 which stated majority of the respondents' agreement to the statement. The standard deviation score of 1.193 highlights that the data was normally dispersed around the mean of the statement. Most of the respondents (33.8 percent) agreed to the statement that the

process to acquire a landline/WIFI connection is difficult and more than one fourth (25.1 percent) of the respondents remained neutral to this statement. In addition, less than one fourth of the respondents (18.3 percent) disagreed. The mean of the statement was 2.54, while the standard deviation remained at 1.107. Data shows that considerable number of the respondents (41.1 percent) agreed to the statement that rainy weather disrupts the internet connectivity and less than one fourth (23.0 percent) of the respondents remained neutral to this statement. Moreover, more than a quarter of the total respondents (16.8 percent) disagreed to the statement. The mean of the statement was 2.53 and the standard deviation score remained at 1.061.

Table 7 Respondent's views about use of digital devices

S.No	Statement	SA	A	NO	D	SD	Tot	Me.	Sd.
1	I participated in online lectures using laptop	(132) 21.0	(318) 50.5	(54) 8.6	(87) 13.8	(39) 6.2	(630) 100	2.34	1.137
2	I used tablet for class participation	(45) 7.1	(229) 36.3	(125) 19.8	(152) 24.1	(79) 12.5	(630) 100	2.99	1.181
3	I participated in lectures using mobile	(162) 25.7	(342) 54.3	(35) 5.6	(68) 10.8	(23) 3.7	(630) 100	2.12	1.029
4	I used desktop computer for attending lectures	(41) 6.5	(90) 14.3	(111) 17.6	(278) 44.1	(110) 17.5	(630) 100	3.60	2.340
5	Digital gadgets have an effect on e-learning	(156) 24.8	(239) 37.9	(113) 17.9	(93) 14.8	(29) 4.6	(630) 100	2.37	1.140

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

Half of the study respondents (50.5 percent) agreed to the statement that they use laptop for online class participation and less than a quarter (13.8 percent) of the respondents disagreed to the statement. The mean of the statement was 2.34 and the standard deviation score remained at 1.137. More than one fourth (36.3 percent) of the respondents agreed to the statement that they participate in online classes using tablet; similarly, one fourth (24.1 percent) of the respondents disagreed to this statement. The mean of the statement was 2.99 and standard deviation remained at 1.181.

Table shows that more than half (54.3 percent) of the respondents agreed to the statement that they

use smart phone for the online class participation and less than quarter (10.8 percent) of the respondents disagreed to the statement. The mean of statement was 2.12 and standard deviation score was 1.029. Majority of the respondents (44.1 percent) disagreed to the statement that they use PC/Desktop for online classes and more than a quarter of the respondents (17.6 percent) remained neutral against this statement. The mean of the statement was 3.60 and standard deviation score was 2.230. More than one fourth (37.9 percent) of the respondents agreed to the statement that access to digital devices influence effective e-learning and more than a quarter (17.9 percent) of the respondents gave no opinion. The mean of the statement was 2.37 while the standard deviation score remained at 1.140.

Table 8 Respondent’s opinion on importance of knowledge about e-learning

S.No	Statement	SA	A	NO	D	SD	Tot.	Me.	Sd.
1	e-learning platforms are easy to use	(105) 16.7	(218) 34.6	(69) 11.0	(153) 24.3	(85) 13.5	(630) 100	2.83	1.331
2	Prior knowledge eased the process of e-learning	(69) 11.0	(236) 37.5	(93) 14.8	(178) 28.3	(54) 8.6	(630) 100	2.86	1.192
3	Effective online learning relies on knowledge of e-learning avenues	(89) 14.1	(224) 35.6	(132) 21.0	(153) 24.3	(32) 5.1	(630) 100	2.71	1.132
4	Students need awareness about e-learning platforms	(144) 22.9	(296) 47.0	(44) 7.0	(124) 19.7	(22) 3.5	(630) 100	2.34	1.134
5	Universities lacked trainings about e-learning	(164) 26.0	(253) 40.2	(103) 16.3	(76) 12.1	(34) 5.4	(630) 100	2.31	1.140

(SA) Strongly Agree (A) Agree (NO) No Opinion (D) Disagree (SD) Strongly Disagree

Most of the respondents (34.6 percent) agreed to the statement that they felt no difficulty while operating online learning platforms and more than one fourth (24.3 percent) of the respondents disagreed to this statement. The mean score of the statement was 2.83; on the other hand, the standard deviation score remained at 1.331. More than one fourth of the respondents (37.5 percent) agreed to the statement that level of knowledge eased them during online classes similarly more than one fourth (28.3 percent) of the respondents disagreed to this statement. The mean of the statement was 2.86. Standard deviation of the statement remained at 1.192.

More than one fourth of the respondents (35.6 percent) agreed to the statement that knowledge of internet determines effective online class and

more than one fourth of the respondents (24.3 percent) disagreed to this statement. Similarly, more than a quarter of the total respondents (21.0 percent) remained neutral against this statement. The mean of this statement remained at 2.71. The standard deviation score was 1.132. Majority (47.0 percent) of the respondents agreed to the statement that students need training about functions of e-learning platforms and more than a quarter (19.7 percent) of the respondents disagreed to the statement. The mean of the statement was 2.34 and standard deviation score was 1.134. Majority (40.2 percent) of the respondents agreed to the statement that universities did not organize training sessions about e-learning and more than a quarter (16.3 percent) of the respondents remained neutral against the statement. The mean of the statement was 2.31 and standard deviation score was 1.140.

Table 9 Cross tabulation of H1

Awareness about LMS establish the effectiveness of LMS

LMS awareness	Effectiveness of LMS			Total
	1. Low	2. Medium	3. High	
i. Low	-	(37) 5.9	(1) 0.2	(38) 6.0
ii. Medium	(57) 9.0	-	(144) 22.9	(201) 31.9
iii. High	(10) 1.6	(116) 18.4	(265) 42.1	(391) 62.1
Total	(67) 10.6	(153) 24.3	(410) 65.1	(630) 100.0
Chi-Square: 248.983^a	Df: 4	Sig. level: 0.000		
Gamma: 0.169	T^b: 2.300	Sig. level: 0.021		

**Significance at 1%
5%

*significance

Table 9 shows cross tabulation of the two variables: awareness about LMS portal, which is

independent variable; and, the effectiveness of LMS which is dependent variable. Chi-square value of 248.983 and its significance level 0.000 confirm that these variables share a significant relationship. Similarly, the value of Gamma 0.169 and its significance 0.021 also point to a significant relationship between the independent

and dependent variable. The score of awareness about LMS moves from low to high, R= 0.2 to R= 22.9 and finally to R= 42.1; it show as the awareness about LMS increases from low to high the effectiveness of LMS increases with it. This confirms the study hypothesis i.e. Awareness about LMS establish the effectiveness of LMS

Table 10 Cross tabulation of H2

Functions of LMS define the effectiveness of LMS

LMS Functions	Effectiveness of LMS			Total
	1. Low	2. Medium	3. High	
i. Low	-	(65) 10.3	-	(65) 10.3
ii. Medium	(52) 8.3	(1) 0.2	(69) 11.0	(122) 19.4
iii. High	(15) 2.4	(87) 13.8	(341) 54.1	(443) 70.3
Total	(67) 10.6	(153) 24.3	(410) 65.1	(630) 100.0
Chi-Square: 384.513^a	Df: 4	Sig. level: 0.000		
Gamma: 0.587	T^b: 8.430	Sig. level: 0.000		

**Significance at 1%
5%

*significance

significance 0.000 also point towards a significant relationship between the functions of LMS and effectiveness of LMS. The score of functions of LMS moves from low to high, R= 11.0 to R= 54.1. It depicts that as the functions of LMS increase from low to high, the effectiveness of LMS increases accordingly. This confirms that Functions of LMS define the effectiveness of LMS.

Table 10 shows cross tabulation of the two variables, functions of LMS and effectiveness of LMS. Former represents independent variable, while the later represents dependent variable. The results explain that value of Chi-square 384.513 and its significance level 0.000 verify the presence of significant relationship between the two variables. The value of Gamma 0.587 and its

Table 11 Cross tabulation of H3

Access to digital devices influence the effectiveness of LMS

Digital Devices	Effectiveness of LMS			Total
	1. Low	2. Medium	3. High	
i. Low	(21) 3.3	(6) 1.0	(33) 5.2	(60) 9.5
ii. Medium	(1) 0.2	(6) 1.0	(47) 7.5	(54) 8.6
iii. High	(45) 7.1	(141) 22.4	(330) 52.4	(516) 81.9
Total	(67) 10.6	(153) 24.3	(410) 65.1	(630) 100.0
Chi-Square: 55.090^a	Df: 4	Sig. level: 0.000		
Gamma: 0.420	T^b: 4.216	Sig. level: 0.000		

**Significance at 1%
5%

*significance

relationship between the independent and dependent variable. Results show that the score of access to digital devices moves from low to high, R= 5.2 to R= 7.5 and ultimately to R= 52.4. Consequently, as the access to digital devices increases from low to high the effectiveness of LMS increases as a result. This confirms the study hypothesis i.e. Access to digital devices influence the effectiveness of LMS.

Table 11 shows cross tabulation between the independent variable access to digital devices and dependent variable effectiveness of LMS. The results explain that Chi-square value of 55.090 and its significance level 0.000 confirms that there is a significant relationship between the two variables. The value of Gamma 0.420 and its significance 0.000 further highlight a significant

Table 12 Cross tabulation of H4

Internet availability defines the effectiveness of LMS

Internet availability	Effectiveness of LMS			
	1. Low	2. Medium	3. High	Total
i. Low	(5) 0.8	(3) 0.5	(108) 17.1	(116) 18.4
ii. Medium	(39) 6.2	(76) 12.1	(121) 19.2	(236) 37.5
iii. High	(23) 3.7	(74) 11.7	(181) 28.7	(278) 44.1
Total	(67) 10.6	(153) 24.3	(410) 65.1	(630) 100.0
Chi-Square: 63.639^a	Df: 4	Sig. level: 0.000		
Gamma: 0.475	T^b: 7.970	Sig. level: 0.000		

**Significance at 1%
5%

Table 12 shows cross tabulation of the two variables. Access to internet represents independent variable, while the effectiveness of LMS is a dependent variable. The results explain that value of Chi-square 63.639 and its significance level 0.000 confirm the presence of significant relationship between the two variables. The value of Gamma 0.475 and its significance

0.000 also indicate a significant relationship between the independent and dependent variable. The score of availability of internet moves from low to high, R= 17.1 to R= 19.2 and finally to R= 28.7, show as the availability of internet increases from low to high the effectiveness of LMS increases with it. This confirms the study hypothesis i.e. Internet availability defines the effectiveness of LMS.

Table 13 Pearson Correlation table between Demographic, Independent and Dependent variables

Variables		Effectiveness of LMS
Gender	Correlation	.121**
	Sig	.002
Area of residence	Correlation	-.088*
	Sig	.027
Academic Program	Correlation	.213**
	Sig	.000
Family Income	Correlation	.143**
	Sig	.000
Source of e-lectures	Correlation	.201**
	Sig	.000
Awareness of LMS	Correlation	.818**
	Sig	.000
Functions of LMS	Correlation	.856**
	Sig	.000
Ownership of gadgets	Correlation	.276**
	Sig	.000
Internet availability	Correlation	.123**
	Sig	.002

**Correlation is highly significant at the 0.01 level

*Correlation is significant at the 0.05 level

Table 13 demonstrates the analysis of Pearson's correlation between demographic variables (Gender of the respondents, Area of residence, Family income of the respondents, Source of online class participation and the academic

program), Independent variables (Awareness of LMS, Access to digital devices, Functions of LMS and Availability of Internet) and dependent variable (Effectiveness of LMS).

The results show a highly significant relationship between the variable gender and effectiveness of LMS ($r= 0.121$ and sig. 0.000). There is a highly significant but negative relationship between the

variables area of residence and effectiveness of LMS ($r = -0.088$ and sig. 0.027). The results show a highly significant relationship between academic program and effectiveness of LMS ($r = 0.213$ and sig. 0.000). The relationship between the variable family income and effectiveness of LMS is significantly high ($r = 0.143$ and sig. 0.000). Analysed data show a highly significant relationship between source of online lectures and effectiveness of LMS remained significantly high ($r = 0.201$ and sig. 0.000). There is a highly significant relationship between the variable awareness about LMS and effectiveness of LMS remained significantly high ($r = 0.818$ and sig. 0.000). The data show a highly significant relationship between the variable functions of LMS and effectiveness of LMS remained significantly high ($r = 0.856$ and sig. 0.000). The results show a significant relationship between the variable access to digital devices and effectiveness of LMS remained significantly high ($r = 0.276$ and sig. 0.000). Similarly, the relationship between internet availability and effectiveness of LMS remained significantly high ($r = 0.123$ and sig. 0.002).

5. CONCLUSION AND RECOMMENDATIONS

The onset of the COVID-19 pandemic required a rapid transition from traditional to online learning methods, compelling educational institutions to adopt IT solutions, specifically LMS.

While holding significant promise, the shift in paradigm faced numerous challenges in successful implementation, especially in developing countries. The Learning Management System (LMS), a crucial element in this transformation, exhibits a diverse range of features. These encompass integration with social media, correspondence functions, attendance tracking, and various others.

Student feedback revealed a proficient utilization of these features, aligning with the system quality component of DeLone and McLean's 2003 information system success model. A thorough examination of the effectiveness of the Learning Management System (LMS) showcased the respondents' proficiency in utilizing platforms like Google Classroom, Google Meet, and Zoom. The

research affirmed the importance of system quality, underscoring the user-friendly and well-organized characteristics of the online platform. However, the operation and management of online systems necessitate technical skills, posing challenges for educational institutions in deploying online setups effectively.

Particularly noteworthy is that students highlighted the effectiveness of PDFs and video tutorials in navigating the Learning Management System (LMS). However, they emphasized the necessity for organized guidance through seminars and conferences, aligning with the service quality measures elucidated in DeLone and McLean's model. User satisfaction has emerged as a pivotal metric in assessing the efficacy of the learning system, as respondents expressed satisfaction with the quality of visuals and the ease of accessing study materials through the LMS. However, challenges surfaced regarding slow internet connectivity, errors during material uploads, and difficulties in converting assignments to PDF format. These issues pose potential threats to the effective implementation of e-learning.

The study delved deeper into the integration of Outcome-Based Education (OBE) as a solution during the pandemic, recognizing its potential benefits and emphasizing the necessity for improvement in terms of time allocation and addressing plagiarism risks. Despite challenges, participants expressed satisfaction with teacher cooperation and guidance during OBE, aligning with the service quality component outlined in DeLone and McLean's model.

Significantly, the analysis highlighted the persistent challenges of unreliable internet signals, especially in rural areas, underscoring the critical necessity for improved connectivity to alleviate educational inequalities. Strategic interventions, such as tackling technical challenges, promoting equitable access, and improving the overall effectiveness of online learning systems, need to be implemented.

To address these challenges, prioritizing and investing in the expansion of high-quality and reliable broadband infrastructure, especially in rural areas, is essential. Simultaneously, comprehensive teacher support programs

should be established to enhance the guidance and feedback mechanisms for students. These recommendations provide a compelling call to action for policymakers, educators, and stakeholders, urging a collective commitment to reshape the online learning landscape and mitigate educational inequalities.

REFERENCES

- A.A. (2020) Task-Technology Fit and Technology Acceptance Model Application to Structure and Evaluate the Adoption of Social Media in Academia. *IEEE Access*, 8, 78427–78440.
- Abbasi, S.; Ayoob, T.; Malik, A.; Memon, S.I. (2020) Perceptions of students regarding E-learning during Covid-19 at a private medical college. *Pak. J. Med. Sci.* 36, S57.
- Abugre, J.B. (2018) Institutional governance and management systems in Sub-Saharan Africa higher education: Developments and challenges in a Ghanaian Research University. *High. Educ.* 75, 323–339.
- Ahorsu, D.K., Lin, C.Y., Imani, V., Saffari, M., Griffiths, M.D. and Pakpour, A.H. (2020) The Fear of COVID-19 Scale: Development and Initial Validation. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-020-00270-8>
- Al-Maatouk, Q.; Othman, M.S.; Aldraiweesh, A.; Alturki, U.; Al-Rahmi, W.M.; Aljeraiwi, UNESCO Covid-19 Educational Disruption and Response. (2020) Available online: <https://en.unesco.org/covid19/educationresponse> (accessed on 11 November 2020).
- Al-Neklawy, A.F. (2017) Online embryology teaching using learning management systems appears to be a successful additional learning tool among Egyptian medical students. *Ann. Anat.* 214, 9–14.
- Bernroider, E.W. (2008), “IT governance for enterprise resource planning supported by the DeLone-McLean model of information systems success”, *Information and Management*, Vol. 45 No. 5, pp. 257-269.
- Bokhari, R.H. (2001), “User participation and user satisfaction in information systems development”, Doctoral dissertation, Brunel University, School of Information Systems, Computing and Mathematics.
- Cameron, K.S. (1981), “Domains of organizational effectiveness in colleges and universities”, *Academy of Management Journal*, Vol. 24 No. 1, pp. 25-47.
- Chang, C.-C.; Shu, K.-M.; Liang, C.; Tseng, J.-S.; Hsu, Y.-S. (2014) Is blended e-learning as measured by an achievement test and self-assessment better than traditional classroom learning for vocational high school students? *Int. Rev. Res. Open Distrib. Learn.* 15, 213–231.
- Chou, S.W. and Liu, C.H. (2005), “Learning effectiveness in a web-based virtual learning environment: a learner control perspective”, *Journal of Computer Assisted Learning*, Vol. 21 No. 1, pp. 65-76.
- Chiu, C.M., Chiu, C.S. and Chang, H.C. (2007), “Examining the integrated influence of fairness and quality on learners’ satisfaction and web-based learning continuance intention”, *Information Systems Journal*, Vol. 17 No. 3, pp. 271-287.
- Cidral, W.A.; Oliveira, T.; Felice, M.D.; Aparicio, M. (2018) E-learning success determinants: Brazilian empirical study. *Comput. Educ.* 122, 273–290.
- DeLone, W.H. and McLean, E.R. (1992), “Information systems success: the quest for the Dependent variable”, *Information Systems Research*, Vol. 3 No. 1, pp. 60-95.
- DeLone, W.H. and McLean, E.R. (2003), “The DeLone and McLean model of information Systems success: a ten-year update”, *Journal of Management*

Information Systems, Vol. 19 No. 4, pp. 9-30.

- Dias, S.B.; Hadjileontiadou, S.J.; Diniz, J.A.; Hadjileontiadis, L.J. (2017) Computer-based concept mapping combined with learning management system use: An explorative study under the self-and collaborative-mode. *Comput. Educ.* 107, 127–146.
- Dobbs, K. (2000), “Who’s in charge of e-learning?”, *Training*, Vol. 37 No. 6, pp. 54-58.
- El-Masri, M.; Tarhini, A. (2017) Factors affecting the adoption of e-learning systems in Qatar and USA: Extending the unified theory of acceptance and use of technology 2 (UTAUT2). *Educ. Technol. Res. Dev.* 65, 743–763.
- Fabianic, D. (2002), “Online instruction and site assessment”, *Journal of Criminal Justice Education*, Vol. 13 No. 1, pp. 173-186.
- García-Martínez, J.-A.; Fuentes-Abeledo, E.-J.; Rodríguez-Machado, E.-R. (2021) Attitudes towards the use of ICT in Costa Rican university students: The influence of sex, academic performance, and training in technology. *Sustainability* 13, 282.
- Ghazal, S.; Al-Samarraie, H.; Aldowah, H. (2018) “I am still learning”: Modeling LMS critical success factors for promoting students’ experience and satisfaction in a blended learning environment. *IEEE Access*, 6, 77179–77201.
- Grönroos, C. (1984), “A service quality model and its marketing implications”, *European Journal of Marketing*, Vol. 18 No. 4, pp. 36-44.
- Gudigantala, N., Song, J. and Jones, D. (2011), “User satisfaction with web-based DSS: the role of cognitive antecedents”, *International Journal of Information Management*, Vol. 31 No. 4, pp. 327-338.
- Holsapple, C.W. and Lee-Post, A. (2006), “Defining, assessing, and promoting e-learning success: an information systems perspective”, *Decision Sciences Journal of Innovative Education*, Vol. 4 No. 1, pp. 67-85.
- Kim, S.S. and Malhotra, N.K. (2005), “A longitudinal model of continued IS use: an integrative view of four mechanisms underlying postadoption phenomena”, *Management Science*, Vol. 51 No. 5, pp. 741-755.
- Klobas, J.E. and McGill, T.J. (2010), “The role of involvement in learning management system success”, *Journal of Computing in Higher Education*, Vol. 22 No. 2, pp. 114-134.
- Koohang, A. and Du Plessis, J. (2004), “Architecting usability properties in the e-learning instructional design process”, *International Journal on E-learning*, Vol. 3 No. 3, pp. 38-44.
- Lee, J.K. and Lee, W.K. (2008), “The relationship of e-learner’s self-regulatory efficacy and perception of e-learning environmental quality”, *Computers in Human Behavior*, Vol. 24 No. 1, pp. 32-47.
- Lewin, C.; Lai, K.-W.; Van Bergen, H.; Charania, A.; Ntebutse, J.G.; Quinn, B.; Sherman, R.; Smith, D. (2018) Integrating academic and everyday learning through technology: Issues and challenges for researchers, policy makers and practitioners. *Technol. Knowl. Learn.* 23, 391–407
- Mailizar, Almanthari, A., Maulina, S., & Bruce, S. (2020). Secondary School Mathematics Teachers’ Views on E-learning Implementation Barriers during the COVID-19 Pandemic: The Case of Indonesia. *Eurasia Journal of Mathematics, Science and Technology Education*, 16(7), em1860. <https://doi.org/10.29333/ejmste/8240>
- McGill, T.J. and Klobas, J.E. (2009), “A task-technology fit view of learning

- management system impact”, *Computers and Education*, Vol. 52 No. 2, pp. 496-508.
- Mtebe, J.S.; Raisamo, R. (2014) A model for assessing learning management system success in higher education in Sub-Saharan countries. *Electron. J. Inf. Systems Dev. Ctries.* 61, 1–17.
- Muchtar, F.B.; Al-Adhaileh, M.H.; Singh, P.K.; Japang, M.; Eri, Z.D.; Haron, H.; Muchtar, F. (2019) Evaluation of Students’ Performance Based on Teaching Method Using LMS. In *Proceedings of the International Conference on Computing, Communications, and Cyber-Security, Chandigarh, India*, 12–13; pp. 647–667.
- Omar, A.; Kalulu, D.; Alijani, G.S. (2011) Management of innovative e-learning environments. *Acad. Educ. Leadersh. J.* 15, 37.
- Peltier, J.W., Schibrowsky, J.A. and Drago, W. (2007), “The interdependence of the factors Influencing the perceived quality of the online learning experience: a causal model”, *Journal of Marketing Education*, Vol. 29 No. 2, pp. 140-153.
- Samarasinghe, S.M. (2012), “e-Learning systems success in an organisational context: a thesis presented in partial fulfilment of the requirements for the degree of doctor of philosophy in management information systems at Massey university, Palmerston North, New Zealand”, Doctoral dissertation, Massey University.
- Sammour, G., Schreurs, J., Al-Zoubi, A.Y. and Vanhoof, K. (2008), “The role of knowledge management and e-learning in professional development”, *International Journal of Knowledge and Learning*, Vol. 4 No. 5, pp. 465-477.
- Santos, J. (2003), “E-service quality: a model of virtual service quality dimensions”, *Managing Service Quality: An International Journal*, Vol. 13 No. 3, pp. 233-246.
- Sobaih, A.E.E.; Hasanein, A.M.; Abu Elnasr, A.E. (2020) Responses to COVID-19 in Higher Education: Social Media Usage for Sustaining Formal Academic Communication in Developing Countries. *Sustainability.* 12, 6520. <https://doi.org/10.3390/su12166520>.
- N.A.; Zainuddin, A.M. (2005) Innovation for better teaching and learning: Adopting the Learning Management System. *Malaysia. Online J. Instr. Technol.* 2, 27–40.
- Taufiqurrochman, Imam Muslimin, Imam Rofiki, Joshua Abah. (2020) Students’ Perceptions on Learning Management Systems of Arabic Learning through Blended Learning Model. *Jurnal Al Bayan: Jurnal Jurusan Pendidikan Bahasa Arab, Universitas Islam Negeri Raden Intan Lampung, Indonesia*, 12 (1), pp.22-36.
- Verdegem, P. and Verleye, G. (2009), “User-centered E-Government in practice: a comprehensive model formeasuring user satisfaction”, *Government Information Quarterly*, Vol. 26 No. 3, pp. 487-497.
- Waight, C.L. and Stewart, B.L. (2005), “Valuing the adult learner in e-learning: part one-a Conceptual model for corporate settings”, *Journal of Workplace Learning*, Vol. 17 Nos 5/6, pp. 337-345.
- Wang, Y.S., Wang, H.Y. and Shee, D.Y. (2007), “Measuring e-learning systems success in an organizational context: scale development and validation”, *Computers in Human Behavior*, Vol. 23 No. 4, pp. 1792-1808.
- Wang, C.J.; Ng, C.Y.; Brook, R.H. (2020) Response to COVID-19 in Taiwan: Big data analytics, new technology, and proactive testing. *JAMA*, 323, 1341–1342.
- WHO Coronavirus Disease (COVID-19) Dashboard. (2020) Available online: <https://covid19.who.int/> (accessed on 11 November 2020).
- Yengin, I., Karahoca, A. and Karahoca, D. (2011), “E-learning success model for instructors’ satisfactions in perspective of interaction and usability outcomes”,

