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Exploring Thai Medical Students' Perceptions of a Novel Online Learning Management System

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ABSTRACT

During the COVID-19 pandemic, medical schools in low- and middle-income countries (LMICs) have faced numerous challenges in adopting online learning management systems (LMS). To address this, our medical school designed and implemented a tailored LMS for its students. This study aims to evaluate how medical students accept and benefit from the LMS, as well as to explore the factors that influence their engagement with online learning. This study employed a mixed-methods design, combining an online questionnaire with semi-structured interviews conducted virtually among first-year medical students at a Thai medical school. Data from the platform's monitoring system and the questionnaire were analyzed using descriptive statistics and binary logistic regression. Out of 283 students, 157 responded, resulting in a 55.5% response rate. Most respondents highlighted the benefits of the LMS and reported a high level of satisfaction with their learning experience. Analysis using logistic regression revealed that both the quality of the course content (adjusted odds ratio [AOR] = 2.43; 95% CI: 1.11–5.31) and the perceived usefulness of the platform (AOR = 2.75; 95% CI: 1.02–7.39) were significant predictors of students' acceptance of online learning. In contrast, no correlation was observed between test performance and the amount of time students spent engaging with the course. Although evidence on the effectiveness of learning management systems (LMS) in medical schools within low- and middle-income countries (LMICs) remains limited, our findings suggest that a customized LMS was well-received by students, perceived as useful, user-friendly, and effective. Acceptance of online learning was influenced by both the perceived usefulness of the platform and the quality of its content. These results indicate that medical schools in LMICs can successfully develop tailored LMS solutions to address the specific needs of their students and faculty. As this study was conducted at a single institution, further research on a larger scale is necessary to confirm the generalizability of these findings.

Keywords: Educational activity, Medical students, Online education, Online learning

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Introduction

Over the past decade, online learning has rapidly evolved and become increasingly integrated into medical education [1]. The COVID-19 pandemic has further accelerated this trend, positioning online education as the primary mode of teaching and learning for undergraduate medical students. Beyond its impact on health, the pandemic has disrupted traditional medical education [2], prompting many institutions to implement tailored online learning management systems (LMS) to maintain effective learning during this period [2].

Previous research has examined the effectiveness of online learning in medical education [3–7]. Its impact is often evaluated using Kirkpatrick's four levels of effectiveness—or modified versions adapted to medical education—assessing satisfaction, knowledge acquisition, performance, and patient or health outcomes [6, 8, 9]. While online learning has been shown to enhance knowledge and skills [7], meta-analyses indicate that its overall effectiveness is comparable to traditional teaching methods [5, 7].

Despite its comparable effectiveness, online learning offers distinct advantages such as flexibility, convenience, and accessibility, particularly under pandemic conditions [3, 6]. Nevertheless, uptake remains suboptimal [10]. Commonly reported barriers can be grouped into four categories: infrastructure, learners, instructors, and instructional design [11]. Specific challenges include limited computer skills [12, 13], reduced social interaction [14], difficulties in maintaining self-discipline [13], the loss of personal interaction inherent in traditional learning [15], technological complexity [13], and inadequate feedback [13]. Research suggests that factors promoting adoption include ease of use [16], perceived usefulness [17], alignment with learning preferences [16], active learning communities [16, 18], robust user support [19], reliable technological infrastructure [19], and integration within the curriculum [16].

Addressing these barriers is crucial for the successful implementation and adoption of online learning. One effective approach is the development of LMS platforms that are closely aligned with students' learning objectives and needs. Although online learning has expanded globally [1], medical schools in low- and middle-income countries (LMICs) continue to face obstacles [20], including financial and technological constraints [20], insufficient faculty support, time-intensive module development [21], limited learner monitoring, poorly matched instructional designs, and a lack of customization options in existing LMS platforms. Moreover, systematic reviews indicate that evidence on the effectiveness and evaluation of online learning in LMIC medical schools remains limited [20], and most online interventions in these settings have been temporary or small-scale [20].

Despite the critical role of LMS in facilitating online medical education, there is still a lack of data on the effectiveness of LMS implemented in LMICs and on factors influencing medical students' adoption of online learning. In response to the COVID-19 pandemic, our institution developed a web-based LMS to support online learning. This study aimed to evaluate the impact of the LMS on students' usage, satisfaction, and learning outcomes, while exploring students' perceptions and factors affecting their adoption of the system. The findings are intended to guide medical schools—particularly in LMICs—in developing customized LMS platforms that effectively address the needs of both students and faculty, thereby promoting more effective online education tailored to local medical education contexts.

Materials and Methods

Study design and setting

A mixed-methods study, combining a cross-sectional survey with semi-structured online interviews, was carried out at the Faculty of Medicine, Khon Kaen University. The undergraduate medical program spans six years, equally divided between preclinical and clinical phases, and enrolls approximately 1,680 students.

Development and organisation of KKUMEDX

The Faculty of Medicine developed a customized web-based LMS, KKUMEDX, to address the limitations of existing online platforms, such as cost, student monitoring capabilities, and limited customization options. While some commercial platforms offer basic functional or visual adjustments, they were insufficient to meet the faculty's specific requirements.

KKUMEDX was designed to support both degree and non-degree courses, with all resources freely accessible to faculty and students. The platform's features were developed by the project team based on literature review and collective experience, with programming implemented using PHP, HTML, JavaScript, and CSS, and MySQL for database management.

The LMS instructional design followed Sargeant's framework, incorporating three levels: content presentation only, interaction with content, and interpersonal interaction [22], supplemented with online assessments and a learner monitoring system. The monitoring system captured personal information, login counts and durations, time spent on individual topics and the overall course, course progress (started, completed, passed), and test scores. Although KKUMEDX was not initially designed for specialized medical education, it was structured to accommodate diverse and effective online learning formats.

Participants

The study included all 283 first-year students, as KKUMEDX was initially introduced to this cohort starting their academic year in July 2020. No exclusion criteria were applied. For the semi-structured online interviews, a total of 15 students were selected for convenience sampling. Five students were recruited from each attendance

category: regular, partial, and infrequent or non-attendance in the online course. Informed consent was obtained from all interview participants.

Sample size

The sample size was initially estimated using OpenEpi version 3, referencing a previous study reporting that 73% of medical students accepted e-learning [23]. With a total population of 283 students, a design effect of 1, and a 5% significance level, at least 147 participants were required. To reduce the risk of selection bias, however, the study included the entire cohort of 283 students.

Data sources, questionnaires, and assessment

An online self-administered questionnaire was developed based on prior literature on online learning in health professional education [23–26], as well as evaluations of online learning and LMS platforms [27–29]. The questionnaire aimed to assess multiple constructs related to online learning effectiveness and attitudes toward LMS use, including individual learner characteristics, perceived satisfaction, technological infrastructure, perceived usefulness, perceived ease of use, learning context, pedagogy, and interactivity. Responses were measured using a three-point Likert scale ranging from disagreement to agreement.

To ensure face and content validity, three independent experts in medical education reviewed each item for relevance, clarity, understandability, and necessity. The average content validity index across items was 0.98, indicating excellent validity.

Participants, first-year medical students, completed a 20-hour human behavior course on KKUMEDX, which comprised 18 topics within the human development and behavior module. The course included twenty 1-hour asynchronous learning sessions and two 1-hour interactive discussion sessions with instructors. A total of 77 videos were used, ranging from 0.22 to 49.01 minutes in length, with total video time per topic ranging from 8.48 to 70.33 minutes. Students were considered to have completed a topic if they accessed at least 50% of the total topic time. Based on completion rates, students were categorized into three groups: regular learners (70–100% of topics accessed), partial learners (30–69%), and rare or non-learners (<30%). Upon course completion, students took a multiple-choice test; a passing score was set at 56% or higher, consistent with the module's minimum passing standard.

After course completion, the online questionnaire was distributed via Google Forms in August 2020. Survey responses were exported from Google Sheets, and LMS monitoring data were exported to Microsoft Excel 2019. The combined dataset was reviewed for completeness before being imported into SPSS for analysis.

Semi-structured interview questions were developed based on the literature review, survey findings, and LMS monitoring data. Interviews were conducted online in January 2021 via Google Meet, with recordings and written notes taken by the interviewer (IT). Each interview lasted approximately 10 minutes. Audio recordings were repeatedly reviewed, transcribed, and saved in Microsoft Word. Transcripts were returned to participants for verification and clarification of unclear statements. Interview data were manually analyzed by the first author (IT), who coded transcripts directly from printed copies. Codes were grouped into themes, which were iteratively refined and abstracted into broader thematic categories.

Statistical analysis

Statistical analyses were conducted using IBM SPSS version 26. To manage missing data, a pairwise deletion approach was applied. Descriptive statistics summarized participant demographics. For the three-point Likert scale, responses were converted into dichotomous variables based on mean scores, with values above 2.5 considered indicative of agreement. Chi-square tests with continuity correction and calculation of odds ratios were used to assess relationships between categorical variables. Multicollinearity was evaluated using Pearson correlation coefficients, tolerance, and variance inflation factors (VIF), with thresholds of tolerance <0.1, VIF >10, and correlation coefficients ≥0.7 signaling potential multicollinearity. Variables found to be statistically significant were subsequently included in a binary logistic regression model to explore factors associated with the adoption of online learning. Statistical significance was defined as $p < 0.05$.

Qualitative interview data were analyzed manually by a single coder. Codes were applied to the transcripts, then systematically grouped into themes, which were refined and synthesized to capture overarching patterns in the data.

Ethics approval

The study protocol received approval from the Human Research Ethics Committee of Khon Kaen University (Project ID: HE631031).

Results and Discussion

Demographic data

A total of 157 of the 283 first-year medical students (55.5%) completed the study questionnaire. Participant characteristics are summarized in **Table 1**.

Table 1. Characteristics of the participants (N = 157).

Item	Total	Having attitudes towards the adoption of online learning	Not having attitudes towards the adoption of online learning	p-value
Demographics; no. (%) of students				
Age, mean (SD), years	18.37 (0.52)	18.33 (0.51)	18.39 (0.53)	0.48
Gender				
Males	72 (45.9)	30 (47.6)	42 (44.7)	0.84
Females	85 (54.1)	33 (52.4)	52 (55.3)	-
Computer literacy				
Upper level	141 (89.8)	59	82	0.30
Lower level	16 (10.2)	4	12	-
Device usage				
Computers	18 (11.5)	10 (15.9)	8 (8.5)	0.50
Laptops	35 (22.3)	14 (22.2)	21 (22.3)	-
Mobile phones	4 (2.5)	2 (3.2)	2 (2.1)	-
Tablets	100 (63.7)	37 (58.7)	63 (67)	-
Internet connection				
University internet	74 (47.1)	28 (44.4)	46 (48.9)	0.64
Personal internet	53 (33.8)	24 (38.1)	29 (30.9)	-
Cellular data	30 (19.1)	11 (17.5)	19 (20.2)	-

An independent samples t-test was used to compare age, while Chi-square tests with continuity correction were applied for gender and computer literacy. Standard Chi-square tests were performed for device usage and type of internet connection.

*Statistical significance was defined at $\alpha = 0.05$.

Factors associated with the adoption of online learning

Participants reported the extent to which various features of online learning influenced their adoption of the LMS **(Table 2)**. The majority indicated positive perceptions of KKUMEDX, with 71.3% expressing high satisfaction with their learning experience **(Table 3)**. Regarding potential barriers, approximately half of the students preferred in-person learning (mean = 2.45, SD = 0.68); however, no significant obstacles were identified in engaging with online learning through this platform.

Table 2. Student evaluations of the impact of online learning features on their engagement and adoption of the LMS (N = 157)

Item	Degree of influence on undertaking the online learning			Mean*	SD
	No influence (%)	Some influence (%)	Major influence (%)		
Domain 1. Content quality					
Content quality	10 (6.4)	36 (22.9)	111 (70.7)	2.64	0.60
Domain 2. Class interaction					

Interaction	18 (11.5)	68 (43.3)	71 (45.2)	2.34	0.68
Case discussion	12 (7.6)	53 (33.8)	92 (58.6)	2.51	0.64
Frequent interaction	17 (10.8)	58 (36.9)	82 (52.2)	2.41	0.68
Domain 3. Perceived usefulness					
Convenience	3 (1.9)	15 (9.6)	139 (88.5)	2.87	0.39
Flexibility	5 (3.2)	23 (14.6)	129 (82.2)	2.79	0.48
Prompt result	7 (4.5)	50 (31.8)	100 (63.7)	2.59	0.58
Domain 4. User-friendliness					
Ease of completion	4 (2.5)	38 (24.2)	115 (73.2)	2.71	0.51
Ease of access	0	40 (25.5)	117 (74.5)	2.75	0.44
Ease of use	0	25 (15.9)	132 (84.1)	2.84	0.37
Domain 5. Platform infrastructure					
Technical support	2 (1.3)	50 (31.8)	105 (66.9)	2.66	0.50
Online platform quality	0	35 (22.3)	122 (77.7)	2.78	0.42
Ease of the language use of the platform	2 (1.3)	31 (19.7)	124 (79)	2.78	0.45

*Mean values were derived from a three-point Likert scale, where 1 = no influence, 2 = some influence, and 3 = major influence.

Table 3. Medical students' perceptions of their learning experience using KKUMEDX (N = 157)

Domain / Item	Disagree (%)	Neutral (%)	Agree (%)	Mean*	SD
Domain 1: Perceived Usefulness					
Convenient location	3 (1.9)	13 (8.3)	141 (89.8)	2.88	0.38
Prompt feedback	6 (3.8)	101 (64.3)	50 (31.8)	2.28	0.53
Learning objectives met	3 (1.9)	39 (24.8)	115 (73.2)	2.71	0.49
Comfortable discussion	41 (26.1)	42 (26.8)	74 (47.1)	2.21	0.83
Easier to study	10 (6.4)	40 (25.5)	107 (68.2)	2.62	0.61
Faster study	5 (3.2)	29 (18.5)	123 (78.3)	2.75	0.50
Domain 2: Platform Infrastructure (Positive)					
Stimulates learning motivation	15 (9.6)	54 (34.4)	88 (56.1)	2.46	0.67
Supportive learning environment	20 (12.7)	43 (27.4)	94 (59.9)	2.47	0.71
Content meets objectives	0	27 (17.2)	130 (82.8)	2.83	0.38
Adequate platform instruction	3 (1.9)	43 (27.4)	111 (70.7)	2.69	0.51
Platform attractiveness	4 (2.5)	42 (26.8)	111 (70.7)	2.68	0.52
Adequate technical support	1 (0.6)	10 (23.8)	31 (73.8)	2.71	0.51
Domain 3: Platform Infrastructure (Negative)					
Inadequate computer skills	113 (72)	16 (10.2)	28 (17.8)	1.46	0.78
Repetitive content	94 (59.9)	39 (24.8)	24 (15.3)	1.55	0.75
Slow access time	105 (66.9)	30 (19.1)	22 (14.0)	1.47	0.73
Long learning time	82 (52.2)	28 (17.8)	47 (29.9)	1.78	0.88
Slow connection	83 (52.9)	47 (29.9)	27 (17.2)	1.64	0.76
Long download time	105 (66.9)	31 (19.7)	21 (13.4)	1.46	0.72
Domain 4: User-Friendliness					
Information readability	1 (0.6)	34 (21.7)	122 (77.7)	2.77	0.44
Ease of use	0	22 (14.0)	135 (86.0)	2.86	0.35
Ease of navigation	1 (0.6)	26 (16.6)	130 (82.8)	2.82	0.40
Proper language use	0	17 (10.8)	140 (89.2)	2.89	0.31
Domain 5: User Satisfaction					
Overall satisfaction	1 (0.6) unsatisfied	44 (28.0) satisfied	112 (71.3) very satisfied	2.71	0.47
Domain 6: Acceptance					

Intention to continue using LMS	25 (15.9)	57 (36.3)	75 (47.8)	2.32	0.06
Recommend LMS to others	18 (11.5)	53 (33.8)	86 (54.8)	2.43	0.06
Online learning can replace traditional learning	48 (30.6)	51 (32.5)	58 (36.9)	2.06	0.07

*Mean values were derived from a three-point Likert scale, where 1 = disagree, 2 = neutral, and 3 = agree.

Crude odds ratio analyses **(Table 4)** suggested that students were more likely to accept online learning when the content was of high quality and perceived as useful. Other factors, including interaction during classes, platform usability, and technical infrastructure, showed no significant relationship with acceptance. The subsequent binary logistic regression **(Table 5)** reinforced these findings, indicating that content quality and perceived usefulness were the main factors—showing borderline significance—associated with first-year students' adoption of the LMS.

Table 4. Relationship between participants' characteristics, attitudes toward online learning adoption, and acceptance of the LMS (N = 157)

Variables	Exposed	Agree	Disagree	Total	Crude odds ratios	95% CI
Characteristics						
Gender (males)	Yes	30	42	72	1.13	0.59–2.14
	No	33	52	85	-	-
Computer literacy (upper level)	Yes	59	82	141	2.16	0.66–7.03
	No	4	12	16	-	-
The domains of attitudes towards the adoption of online learning						
Content quality	Influence	51	60	111	2.41	1.13–5.13
	No influence	12	34	46	-	-
Class interaction	Influence	28	49	77	0.74	0.39–1.40
	No influence	35	45	80	-	-
Perceived usefulness	Influence	57	72	129	2.90	1.10–7.64
	No influence	6	22	28	-	-
User-friendliness	Influence	52	71	123	1.53	0.69–3.42
	No influence	11	23	34	-	-
Platform infrastructure	Influence	50	71	121	1.25	0.58–2.69
	No influence	13	23	36	-	-

Table 5. Factors influencing students' acceptance of online learning: adjusted odds ratios and 95% confidence intervals from multivariable logistic regression (N = 157)

Variables	Adjusted odds ratio	95% CI	p-value
Gender (males)	1.22	0.62–2.40	0.56
Computer literacy (upper level)	2.55	0.76–8.56	0.13
Content quality	2.43	1.11–5.31	0.03∗
Perceived usefulness	2.75	1.02–7.39	0.05∗

Logistic regression (Enter); N = 157(100%); Cox & Snell R2 = 0.78; Nagelkerke R2 = 0.11.
∗Statistically significant at an alpha level of 0.05.

Data from the LMS monitoring system (N = 283)

The students completed between 0 and 18 learning topics, with a mean of 8.77 (SD = 5.28). Total time spent on the course ranged from 0 to 6,848 minutes, with an average of 908.13 minutes (SD = 933.24). Regarding learning behavior, 134 students (47.35%) spent 10 hours or less on the course, with the highest login activity occurring in the morning (2,780 logins, 45.3%) and evening (1,678 logins, 27.3%). Although the majority of students achieved good scores in the course (N = 249, 88.6%), no significant associations were observed between achieving a good

score and course attendance (COR = 0.84; 95% CI: 0.40–1.75), total time spent on the course (COR = 1.55; 95% CI: 0.61–3.91), or login frequency (COR = 1.51; 95% CI: 0.73–3.13).

Semi-structured interviews (N = 15)

Of the participants, 60% were male, and 26.7% reported prior experience with online learning. The mean test score following course completion was 64.2%. The experiences and perceptions of the interviewees regarding learning through the LMS are summarized in **Table 6.** Irrespective of their preferred learning methods or level of course engagement, all participants expressed positive attitudes toward online learning. Those who rarely participated or did not engage with the course attributed this not to barriers in the LMS but to challenges with self-directed learning skills.

Table 6. Interviewees' experiences with and perceptions of learning using KKUMEDX

Theme	Findings / Comments
Previous online learning experience	Four students had prior experience with structured online learning; one reported no difficulties, while the others described challenges such as delayed teacher responses and system disconnections. "I posted my questions to the teacher, but it took ages to get the response" – A1 "The system was disconnected, and the videos stopped very often" – B2
Perceptions of KKUMEDX	All interviewees expressed positive attitudes toward KKUMEDX, highlighting its ease of use, well-organized content, convenience, flexibility in learning pace, location, and adjustable video speed. "The program is user-friendly; the numbers of tabs are suitable, covering all needed functions" – B4 "Contents are well arranged and easy to follow" – B5
Reasons for limited participation	Students who rarely engaged cited a preference for in-person learning and difficulty with self-directed learning rather than LMS barriers. "I need some pushes to be able to learn; coming to class is a push for me" – C3 "Some topics have many new terms which I can't understand, so I read short notes from seniors" – B4
Preferred learning methods	About half preferred face-to-face learning for its structured motivation, while the other half preferred online learning for flexibility and self-paced study. "I prefer face-to-face learning since it forces me to go to class and stay focused" – C4 "I prefer online learning as I can study anytime, review topics repeatedly, and manage my own pace" – B2
Difficulties with KKUMEDX	Less than half reported issues, mainly incomplete video downloads causing audio-video desynchronization; problems were resolved by re-downloading. "The sounds and pictures in the video clips were not synchronised" – A3
Preferred LMS features	Favorite features included adjustable video speed, progress bars, and color-coded tabs indicating completed topics. Least liked feature: inability to skip topics or jump ahead. "The change of video speed is great; I can go faster and watch at my own pace" – B3 "I like the color tab indicating completed and pending topics" – C4
Suggestions for improvement	Students suggested adding pre- and post-tests, a Q&A feature (including anonymous posting), lower video quality options for slow internet, video resuming function, and a calendar for tracking important dates. "Pre- and post-tests for all topics would help summarize key points" – C4 "A calendar would remind us of important events and assignment deadlines" – C1

This study examined the effectiveness, acceptance, adoption, and potential barriers of online learning from the perspective of medical students using a customised LMS developed at a public medical school in Thailand. The findings contribute to the limited international evidence on LMS development in low- and middle-income countries (LMICs), where funding and resources are often constrained [20]. The study also provides insights into LMS infrastructure, an area with scarce data in LMIC contexts [20].

Given that this was the students' first experience with self-directed, asynchronous online learning in medical school, the results indicate that KKUMEDX was effective in supporting satisfaction, acceptance, and learning outcomes. Although pre- and post-tests to measure knowledge gain were not conducted, summative test scores at the end of the course showed that most students performed well. Analysis of LMS monitoring data revealed no significant relationship between test scores and time spent in the course, login frequency, or course attendance. These findings were further explored through student interviews.

Despite overall satisfaction with and acceptance of online learning, approximately half of the students preferred face-to-face instruction. This preference was not due to interaction with instructors or peers but rather reflected a need for external motivation and guidance, highlighting challenges with self-directed learning, personal discipline, and intrinsic motivation [13, 30–32]. Previous studies have suggested that online learning can improve self-directed learning readiness [33]. Some students who achieved good scores without regular participation reported relying on alternative learning strategies, such as consulting summary notes from peers or seniors. These findings underscore the importance of offering diverse educational approaches that accommodate different learning styles, similar to the multifaceted learning strategies recommended for physicians [34, 35].

The lack of correlation between time spent in the course and test scores may also reflect students' ability to adjust their learning pace, such as using the video speed adjustment feature of the LMS. Regarding overall acceptance, students' attitudes toward KKUMEDX were slightly above neutral **(Table 3)**, consistent with findings from studies of Polish medical students who embraced e-learning during the COVID-19 pandemic [23]. However, these results contrast with reports from Iran and Pakistan, where medical students were less ready to adopt online learning [25, 26]. This suggests that while online learning can be accepted during emergencies, it may not suit all learners' preferences and may lack practical, hands-on components [26]. These findings emphasize the need to balance online and face-to-face learning while aligning instructional methods with students' needs and learning objectives.

KKUMEDX facilitated smooth content delivery and enhanced students' learning experiences. The study highlighted that perceived usefulness, user-friendliness, and technological infrastructure significantly influenced students' experiences **(Table 3)**, aligning with previous research [16-19]. Consistent with the Technology Acceptance Model, perceived usefulness plays a critical role in technology adoption in medical education contexts [17]. Likewise, infrastructure remains a key determinant in adopting e-learning interventions [19].

Analysis of factors associated with adoption revealed that content quality and perceived usefulness were marginally significant predictors of students' acceptance of online learning **(Table 4)**, supporting the emphasis on perceived utility in the Technology Acceptance Model [17]. Interestingly, ease of use was not a significant factor, suggesting that medical students, like physicians, prioritize usefulness over usability when engaging with educational technology [17].

Most students did not report experiencing common barriers to online learning previously identified in the literature [13, 14], likely because the LMS was designed to address these obstacles. These results suggest that medical schools in developing countries can enhance online learning adoption by focusing on content quality and perceived usefulness. Even students who were less accepting of online learning reported positive attitudes toward their experience using KKUMEDX.

This study has several limitations. First, as KKUMEDX was only introduced to first-year preclinical students, satisfaction and acceptance may differ among clinical-year students. Second, being a single-institution study limits generalizability; multi-institutional research is needed to validate these findings across diverse medical education settings. Third, the observational design and partial participation rate introduce potential selection bias. Fourth, online questionnaire respondents may have had greater familiarity with technology than the broader student population, which could influence results. Finally, although content quality and perceived usefulness were statistically associated with online learning adoption, the confidence intervals approached the null value, potentially due to the relatively small sample size. Larger-scale studies are therefore needed to strengthen the evidence base.

Conclusion

In conclusion, despite the disruption caused by COVID-19, the transition to online learning via the newly developed LMS was perceived as useful, user-friendly, and generally well-accepted by medical students. Satisfaction with the learning experience was high, and content quality and perceived usefulness were key factors influencing adoption. However, some students preferred in-class learning, indicating that online learning may not fully meet all learners' needs. Given the study's limitations, findings should be interpreted with caution, and further large-scale, multi-institutional studies are required to confirm generalizability.

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