




# An Assessment of Learning Management System Use in Higher Education: Perspectives from a Comprehensive Sample of Teachers and Students

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## Abstract

Learning Management Systems (LMSs) are underutilized in universities despite them being standard components of higher education. Given this, there is a need to gather the perspectives of students and teachers to examine how these key end-users engage with LMS and utilize its various features and functions. Such an endeavor could aid in addressing the barriers and in promoting the use of LMSs in online teaching and learning. As studies about LMS use with both teacher and student samples are limited, we simultaneously gathered both students' and teachers' perceptions of Moodle from all academic faculties at a public university in Hong Kong. Structured qualitative interviews were conducted with eighty-two participants (41 teachers, 41 students) via Zoom. Results suggest that Moodle, while previously viewed as merely a repository of course materials, transitioned from being a supplementary tool to a key information dissemination tool during the pandemic. Despite the availability of collaboration tools, majority of interactions still occur in alternative communication channels. Findings point to students' and teachers' need for familiarity, training, and a visually and functionally improved interface to enhance their experience in the LMS. We also found how content and pedagogy influenced how LMS was integrated into teaching, with frequency and manner of LMS use varying between faculties and departments. Given this, tailor-made information and support for each department are needed to maximize LMS use in classes. We suggest the conduct of dialogues involving multiple stakeholders (i.e., teachers, students, administrators, and technical support staff) so that higher education institutions can share best practices on how to improve LMS utilization to enhance the quality of teaching and learning in universities.

**Keywords** Learning management systems · Student and teacher perspectives · Higher education · TPACK · TAM · LMS usage framework

## 1 Introduction

Learning Management Systems (LMSs) refer to online technologies for the creation, management, and delivery of course materials (Al-Busaidi & Al-Shihi, 2012; Turnbull et al., 2022). They play an important role both in face-to-face and virtual teaching and learning especially in the higher education context (Torres-Martín et al., 2022). LMSs provide instructors with platforms for information dissemination and classroom management (Philippo & Krongard, 2018). LMSs are used for making announcements, giving assignments, providing feedback, and conversing with students outside class sessions through discussion forums (Wong et al., 2021). Despite the accessibility and availability of LMSs in higher education institutions (HEIs), they tend to be underutilized (Azhar & Iqbal, 2018; Dahlstrom et al., 2014; Kite et al., 2020). A number of studies noted resistance as a barrier to successful LMS implementation in HEIs (Sakala & Chigona, 2020). This points to the need to obtain the perspectives of key end-users of the platform. Gathering data on students' and teachers' knowledge, experiences, and on how they engage with LMS and utilize its various features and functions could help in acquiring useful insights and in providing direction on how to address the barriers and promote the use of LMSs in online teaching and learning.

In Asia alone, e-learning is growing at an annual rate of 17.3% (Wadhvani & Gankar, 2020). In Europe, LMS adoption increased at a compound annual growth rate (CAGR) of almost 27% in 2020 as more European higher education institutions have started offering online degrees to both local and international students (Clark, 2020). Demand for e-learning is likely to continue to grow along with increased access to LMS platforms of countries across the globe in the coming years (Huang, 2022). The role of LMS as a valuable and indispensable learning resource for distance learning and asynchronous education was further emphasized during the COVID-19 pandemic where more than 1.5 billion students globally were affected by lockdowns and school closures (UNESCO, 2022). Educators were compelled to adapt their in-person teaching methodologies to conform to the predominantly online format, while students had to familiarize themselves with attending online classes (Anastasakis et al., 2023; Cavanaugh et al., 2022; Hickling et al., 2021; Octaberlina & Muslimin, 2020). Prior to the pandemic, a study surveyed Hong Kong higher education students' acceptance of Moodle and found that perceived ease of use, perceived usefulness, attitude towards behavior and subjective norm are significantly related to behavioral intention to use and actual LMS use (Luk et al., 2018). During the pandemic, Hong Kong higher education students reported the challenges they encountered such as difficulties accessing equipment, quality of feedback and clarity of course arrangement (Yeung & Yau, 2022). The challenges came with the realization of the importance of technology in learning. In another research conducted during the COVID-19 pandemic, students from a Southern European university reported positive experiences about learning through LMSs, indicating an intent to continuously use learning technologies in the post COVID-19 era (Camilleri & Camilleri, 2022). As these studies were focused on students and were conducted before and during the pandemic, we also deemed it important to examine whether there had been a shift in both students' and teachers' perceptions of LMS as a consequence of the COVID-19 pandemic.

There are different types of LMSs on the market, the most common of which are Moodle, Blackboard, Brightspace, Canvas, Docebo, Google Classroom, Schoology, and Edmodo (TeachThought Staff, 2023). Modular Object-Oriented Dynamic Learning Environment (Moodle), an open-source software launched in 2002, was the LMS evaluated

in this study. By the end of 2019, Moodle has a record of having 11,289,190 members (Hill, 2019). It was found to be the most widespread and most preferred open-source LMS according to a recent systematic review (Altinpulluk & Kesim, 2021). It is also the official LMS used by teachers and students at the public university in Hong Kong where the current study was conducted.

Studies that examined experiences and perspectives on LMS use have been conducted among undergraduate students (Alhosban & Ismaile, 2018), postgraduate students (Mpungose & Khoza, 2022), and teachers (Al Meajel & Sharadgah, 2018; Almarashdeh, 2016), with the LMS literature dominated by studies with undergraduate students relative to teacher samples (Al-Nuaimi & Al-Emran, 2021). Furthermore, studies that have simultaneously examined LMS use in both teacher and student samples in higher education are scarce (Anthony et al., 2022; Kite et al., 2020; Simon et al., 2023). This is a critical gap because students and teachers could have different perspectives and experiences with LMSs. Thus, in the present study, we employed purposive sampling in recruiting teacher and student respondents from all faculties of a public university in Hong Kong. This ensured equal representation across faculties. The sampling technique also allowed us to comprehensively and simultaneously capture both student and teacher perspectives in the use of LMSs. Having both student and teacher samples enabled us to identify similarities and differences in how students and teachers are using various levels and functions of the LMS, and to ascertain how LMS use impacts teaching and learning.

In the interviews, respondents were asked about their knowledge, experience, and perceptions of LMS as a tool for teaching and learning. We examined how students and teachers engage with LMS and utilize its various features and functions. We also asked respondents about the challenges they encountered in using LMS. Through these questions, we aimed to obtain insights on how to address the barriers and maximize the benefits of using LMS, given its history of underutilization. As an additional aim, we also examined whether perceptions of students and teachers regarding their LMS and other educational technology tools changed because of the pandemic.

The current research was guided by the following research questions:

1. How knowledgeable and experienced students and teachers are in using Moodle?
2. How do students and teachers perceive Moodle as a tool for teaching and learning?
3. What are the challenges encountered by teachers and students in the use of Moodle?
4. Did teachers' and students' perceptions of Moodle and other educational technology tools change as a consequence of the pandemic?
5. What would make learning management systems (e.g., Moodle) a more effective tool for teaching and learning?

## 2 Literature Review

In this section, we reviewed existing literature on LMSs from both students' and teachers' point of view.

### 2.1 Students' and Teachers' Perceptions of LMS

A study that examined Hong Kong higher education students' acceptance of using Moodle found that perceived usefulness, perceived ease of use, attitude towards behavior and

subjective norms influence behavioral intention to use and actual use of the platform (Luk et al., 2018). Another study also demonstrated that higher education students' perceived usefulness had a strong influence on their continued intention to use LMSs (Goh & Yang, 2021). During the COVID-19 pandemic, the sudden shift to online learning made Hong Kong higher education students reflect on the critical role of technology to make learning accessible despite the challenges (Yeung & Yau, 2022). Additionally, students from a Southern European university reported positive experiences about learning through LMSs, indicating an intent to continuously use learning technologies in the post COVID-19 era (Camilleri & Camilleri, 2022).

However, it has been noted that more than 90% of students use LMSs only as a data repository and as a platform for taking online tests (Al-Shaikhli et al., 2022). A very small percentage of learners utilize LMS for online collaboration or forum discussion (Awad et al., 2019). The average use of an LMS is said to fall between 19 and 36% of the total number of students enrolled in a course (Medved, 2017). Thus, despite huge investments made by higher education institutions to make LMSs highly accessible and available, it is apparent that they remain to be underutilized (Azhar & Iqbal, 2018; Dahlstrom et al., 2014; Kite et al., 2020). This problem could be partly attributed to technical difficulties encountered by students while using LMS, prompting them and the teachers to raise the issue of needing training on basic and advanced LMS features (Dahlstrom et al., 2014).

In a study that explored higher education teachers' perception of Google Classroom as a tool for teaching, they perceived LMS merely as a platform for document management and basic classroom management (Azhar & Iqbal, 2018). This is echoed by findings from interviews with lecturers and postgraduate public health students suggesting that LMS is merely perceived as a repository for course materials (Kite et al., 2020). There was no indication in these studies that teachers found the LMS especially useful in improving their pedagogy. Findings that showed how perceived usefulness and low perceived ease of use are associated with higher education teachers' low intention to use an LMS (Schoonenboom, 2014) can perhaps explain why LMSs are underutilized. Teachers reported that system glitches, design problems, and complicated interfaces made LMS difficult to use (Azhar & Iqbal, 2018; Kite et al., 2020). On the other hand, teachers in one study scored high in intentions to use LMS, motivation to continue to use LMS, perceived importance of use and perceived ease of use (Huang, 2022). Teachers also expressed belief that technology will aid them in accomplishing their tasks effectively (Sharma & Srivastava, 2019). Attending a professional development course appeared to have made Hong Kong higher education teachers use the features and functions of their LMS in blended learning more extensively (Evans et al., 2020). The training the teachers received gave them an authentic student perspective and helped them use LMS better in teaching. Lastly, in-service teachers enrolled as students in an instructional technology program reported varying levels of subjective satisfaction, ease of use, and functionality based on the type of LMS they used (Demir et al., 2022), affirming how examining specific features of LMSs and their functionality is needed to determine what characteristics appeal to users the most.

While both students' and teachers' perceptions of LMS have already been explored in the literature, a systematic review noted the lack of simultaneous examination of perspectives from multiple stakeholders such as students and teachers (Anthony et al., 2022). This is a gap that this study aimed to fill. In the next section of the paper, we further note important gaps that the current study aimed to address.

### 3 Research Gaps

The review of literature presented highlights critical gaps that the current study aimed to address. First, a gap remains in terms of describing how specific features and functions of LMS are perceived by its users and how these features and functions are being used by both students and teachers (Demir et al., 2022). Second, even though teaching and learning are closely linked with each other, most LMS studies focus on students (Al-Nuaimi & Al-Emran, 2021; Camilleri & Camilleri, 2022, 2023; Luk & Lam, 2018; Mpungose & Khoza, 2022; Şahin & Yurdugül, 2022; Yeung & Yau, 2022), and seldom do studies simultaneously obtain the perspectives of both students and teachers (Anthony et al., 2022; Simon et al., 2023). Third, purely quantitative studies on LMS are at times conducted with no sufficient contextualization (Al-Nuaimi & Al-Emran, 2021; Luk & Lam, 2018). Lastly, studies tend to focus on specific departments (Al-Nuaimi & Al-Emran, 2021), but we aimed to be more comprehensive by recruiting from all faculties at a university, acknowledging that the content knowledge, pedagogy, and even the technological capability of teachers from each faculty could differ.

The identified gaps in the literature reinforce the value of obtaining the perspectives of both students and teachers about LMSs as key end-users of the platform. As there are limited studies conducted on both student and teacher samples (Anthony et al., 2022; Kite et al., 2020), we aimed to fill an important gap that enables comparisons between two distinct perspectives. In the subsequent section, we describe in detail the theoretical framework that guided the present study in light of previous research findings.

### 4 Theoretical Framework

In this study, we employed a combination of the Technological Pedagogical Content Knowledge framework (TPACK; Mishra & Koehler, 2006), the Technology Acceptance Model (TAM; Davis, 1989), and the LMS Usage Framework (Rankine et al., 2009).

#### 4.1 TPACK Framework

The TPACK framework is a model that accounts for the types of knowledge necessary for instructors to teach their courses successfully with technology (Mishra & Koehler, 2006). In this framework, efficient technology integration in courses is assumed to be impacted by teacher's technological knowledge, pedagogical knowledge, content knowledge and intersections among these three. In this study, we employed the TPACK by asking the teachers about their knowledge, experience and background in using LMS, and exploring how the course content and the manner they teach the course (pedagogy) influence how they are engaging with the LMS as a teaching tool. Likewise, students were asked about their experiences of using LMS as a tool for learning and their perceptions of how their teachers are using the technology.

## 4.2 Perceived Ease of Use and Perceived Usefulness

As perceived ease of use and perceived usefulness were identified as factors that impact people's behavioral intention and their actual use of a system (Cigdem & Topcu, 2015; Luk et al., 2018; Teo et al., 2019; Watty et al., 2016), we tied these two constructs from the TAM with the TPACK framework to guide our data analyses. Perceived ease of use is defined as the extent to which a person believes that using a specific system would be free from effort. Perceived usefulness denotes the extent to which a person believes that a specific system would enhance their performance of a task. With the assumption that previous knowledge and experience with the LMS shape not only students' and teachers' use of the tool but also their perceptions of it, we integrated these two frameworks to describe how teachers and students are currently utilizing the platform for online teaching and learning. Also, given the evidence for perceived ease of use and perceived usefulness's explanatory power (Al-Nuaimi & Al-Emran, 2021; Cigdem & Topcu, 2015; Teo et al., 2019; Watty et al., 2016), we deemed them as useful in organizing the present study's findings.

## 4.3 LMS Usage Framework

One of the major challenges identified by researchers is the variations in the level of LMS use (Al-Shaikhli et al., 2022). In a study among in-service teachers, users of different LMSs (Canvas, Blackboard, Moodle) had varying levels of subjective satisfaction, ease of use and perceived functionality (Demir et al., 2022). Some functions were used more in Moodle such as the assignment and announcement functions, due to ease of use and accessibility. Another study on postgraduate students' experiences in using Moodle and Canvas LMSs revealed that students mainly used their LMS for downloading readings and for participating in discussion forums (Mpungose & Khoza, 2022). Depending on the type of learner using the LMS, they might expect affordances that could potentially improve their motivation to use the technology for learning such as gamification, notifications about assessment tasks, and functions that enable self-monitoring (Şahin & Yurdugül, 2022). These studies highlight the importance of LMS functionality and of having specific features that appeal to users and that meet their expectations of a learning environment.

To make assessing what and how the various LMS features and functions are used, we employed the LMS Usage Framework in this study. The LMS Usage Framework was developed previously to enable comparison of LMS usage across different institutions (Rankine et al., 2009). The framework was applied in the current study to capture various levels of pedagogical content types and tools common to online courses, and what particular features and functions in the LMS are used: Content and Communication, Assessment, Collaboration and Advanced Learner Support. Content and communication tools are functions involved in the provision of instructional materials to students (e.g. File Upload, News Announcements). Assessment tools are functions employed in assessing students' performance and in providing feedback (e.g. Assignment, Turnitin, Quiz). Features that were intended to promote collaboration among users and other forms of support (e.g. Forum, Chat, Scheduler) were classified under collaboration and advanced learner support.

**Table 1** Students' sample breakdown by gender, year and faculty (N = 41)

<i>Gender</i>										
Female	Male									
19	22									
<i>Year</i>										
1	2	3	4							
9	10	9	12							
<i>Faculty</i>										
Architecture	Arts	Business	Dentistry	Education	Engineering	Law	Medicine	Science	Social Sciences	
4	4	5	4	4	4	4	4	4	4	4

**Table 2** Teachers' sample breakdown by gender, teaching experience and faculty (N=41)

<i>Gender</i>											
Female	Male										
15	26										
<i>Teaching experience (including outside the current university)</i>											
1–10 years	11–20 years			21–30 years			31–40 years				
20	15			5			1				
<i>Number of students taught in one academic year</i>											
Not specified	Less than 100 students		101–300 students		301–500 students		501–700 students		701–900 students		More than 900 students
3	5		17		12		2		4		1
<i>Faculty</i>											
Architecture	Arts	Business	Dentistry	Education	Engineering	Law	Medicine	Science	Science	Social Sciences	
5	4	4	4	4	4	4	4	4	4	4	



## 4.4 Integration

The current study extends previous research through applying the LMS Usage Framework in examining students' and teachers' perceived ease of use and perceived usefulness of each of the three levels identified in the framework. To date, there are no existing studies that integrated the TPACK framework with perceived ease of use and perceived usefulness from TAM, and assessed the different levels of LMS pedagogical content types and tools in terms of students' and teachers' perceived ease of use and perceived usefulness of these various LMS features and functions. In conducting structured interviews with students and teachers across all 10 faculties, we aimed to foreground the entangled nature of teaching and learning and to find ways to address the problem of LMS underutilization by gathering users' perspectives. Employing the LMS Usage Framework in combination with TAM's core variables—perceived ease of use and perceived usefulness—is one way to portray LMS usage in a specific higher education context with a representative sample of teachers responding with varying levels of technological, pedagogical, and content knowledge. The merging of three frameworks aimed to provide a lens by which we can come up with useful recommendations on how to make LMSs more effective tools for teaching and learning.

## 5 Methods

### 5.1 Sampling

Structured qualitative interviews were conducted with a total of eighty-two participants (41 teachers, 41 students) from all 10 colleges of the university where the study took place. Tables 1 and 2 present sample distribution by gender, year (student sample), teaching experience (teacher sample), number of students taught in one academic year (teacher sample), and faculty (student and teacher samples).

Purposive sampling was employed to ensure that a representative sample of students and teachers were recruited. It is a non-probability sampling method in which participants are selected because they possess the characteristics required in the sample. Four students and four teachers in each of the 10 faculties (i.e., Architecture, Arts, Business, Dentistry, Education, Engineering, Law, Medicine, Science, and Social Sciences) were recruited for the interviews. Administrative staff were approached to request help in nominating teacher and student participants for the interviews, with endorsement from the deans and associate deans. Collecting data from multiple sources was one way of ensuring that the data are comprehensive and representative of a diverse set of perspectives on the phenomenon under study (Neuman, 2014).

The public university in Hong Kong where the study was conducted has around 2957 faculty staff and its undergraduate student body consists of around 19,958 students at the time of the study. Ethical clearance was obtained from the university's ethical review board [IRB number removed for anonymous peer review] prior to data collection. Based on the university's Information Technology Services, the current version being used in the institution is Moodle version 3.11.

## 5.2 Interview Settings

The selected respondents were contacted via email. The email contained information about the study's purpose and a request for an appointment based on their convenience. Once a schedule was agreed on, a Zoom link was sent to the student/teacher interviewee along with the informed consent form for their review. Interviews were conducted online through Zoom between July 2022 to January 2023, for participants' convenience and for more flexibility in scheduling (as some respondents had been overseas at the time of data gathering). Videoconferencing can mimic the natural back-and-forth of face-to-face communication, including verbal and nonverbal signals (Salmons, 2012). This made it a viable alternative to in-person interviews.

All participants gave their consent to voice record the interviews. The duration of each interview varied between 15 and 30 min. The study was approved by the university ethics board.

## 6 Research Instrument

Data were collected through structured interviews with a mix of close ended and open ended questions. Adhering to Bolarinwa's recommendation (2015), the research instrument was composed and reviewed by a panel consisting of three experienced researchers and teachers who have all used LMS in their work. After a thorough review and an exchange of feedback and suggestions among the panel, the tool was finalized and utilized in the study.

### 6.1 Data Coding and Analysis

The automatically generated transcripts and the notes taken down during the interviews were reviewed to check their alignment with the video recordings. A content analysis of the interviews was conducted by two postdoctoral fellows who both have PhD degrees in Psychology. Both also had prior experience in using LMS to teach. A qualitative data analysis software (QDA Miner Lite) was utilized for coding responses. Quantitative descriptive analysis was performed on quantifiable answers, while key points from the qualitative answers were highlighted, guided by the study's frameworks.

## 7 Findings and Discussion

Data were coded and organized based on the research questions that were also guided by the theoretical framework. At the beginning of this section, we provided information about participants' knowledge and experience in using Moodle and other LMSs. Subsequently, we presented students' and teachers' perceptions of ease of use and usefulness of the various functions and features of Moodle based on the LMS Usage Framework—Content and Communication, Assessment, Collaboration and Advanced Learner Support. Additionally, we noted the challenges the students and teachers encountered in the use of Moodle and how their perceptions of Moodle and other educational technology tools changed as a consequence of the COVID-19 pandemic. We ended with recommendations on how

to make Moodle a more effective tool for teaching and learning. We presented the findings on teachers and students separately and noted similarities and differences between the responses when applicable.

## 7.1 Knowledge and Experience of Teachers in Using Moodle and other LMSs

Almost half (41.5%) of the teachers interviewed received no training in LMS functions. This is consistent with findings from a previous study where majority of the lecturers shared their perception of lack of support from their institutions in terms of integrating ICTs in teaching and learning (Mwalongo & Mkonongwa, 2023). Others attended a brief in-house training when Moodle was first introduced in the university more than a decade ago, taught themselves as they used it in their classes, or learned from colleagues, IT staff, or through a guidebook provided by the university's teaching and learning center. Most teachers (44%) have been using Moodle for between more than a year to five years, with average years of Moodle use at seven years.

Apart from the official LMS used by the university, teachers found other tools to supplement their teaching. While Moodle had features similar to other platforms that they used, they often picked a tool that suited their technological and pedagogical needs better. When asked about other LMS tools used, 11 teachers claimed they used Mentimeter, 11 used Blackboard, three used Open edX, three used Panopto, three used Google Classroom, and three used Slack. Other platforms used by at least one teacher included Adobe Connect, WebCT, Canvas, InLearn, PETAL, Curious, iClass, and ELearn. Some of these tools were homegrown tools that teachers developed themselves based on course needs.

## 7.2 Knowledge and Experience of Students in Using Moodle and other LMSs

Students have used Moodle for an average of 2.77 years. The majority of students (80.5%) reported that they received no training on the use of Moodle and had to learn it by themselves. Only three students said they received some basic level of training, and three students reported that they had some training experience in LMS but not in Moodle. One student mentioned that some teachers taught their class how to use Moodle at the beginning of the course.

Among the 41 student interviewees, 18 of them had also used LMSs other than Moodle such as Google Classroom (29.3%). Other LMSs that have been used by more than one student were Blackboard (9.8%), Panopto (7.3%), and Kahoot! (4.9%). Students' experience in Moodle (i.e., how many years they have been using Moodle) was not necessarily equal to how many years they have been studying in the university. Some of the students reported that they have been using Moodle since before they entered the university, and some students reported that the university and their teachers did not promote Moodle at all, so that they only heard it from other senior students:

“Can I say that I know the existence of Moodle because of my friend? Because they are [institution removed for anonymous review] students and they got in [institution removed for anonymous review] earlier than me, so that I know Moodle and this year I am the ambassador, a mentor for year one students. And I just tell them Moodle and they have no idea what that is. They don't even know that exists. And I just tell them that you need to read, I basically tell them that thing exists and how to use and what it is for. No one tells them anything.”

### 7.3 Perception of Moodle as a Tool for Teaching and Learning

Twenty-nine percent of the teachers view Moodle as a centralized platform and as a one-stop shop for course materials and information. As one teacher noted:

“My understanding at least the way I use it, is that it’s a central platform for courses that I teach. So it is a central repository where students can come and everybody can have access to all the needed information for the course as well as all of the other resources such as links to readings and, you know, assessment guidelines and submission portal. So it’s like a one stop shop for completing the class basically.”

A good percentage of teachers (41.5%) also saw Moodle as a tool that facilitated communication between students and teachers (although communication in the platform tended to be one-way). This is in line with a previous study that found how three different types of LMSs were frequently used by teachers only for posting announcements, posting assignments, posting syllabus, conducting tests and quizzes, and posting grades through grade book (Demir et al., 2022). While Moodle was viewed as a helpful tool to assist teaching, 31.7% of teachers did not perceive it as helpful in motivating students to learn since they perceived it as “just a platform.” As one teacher stated:

“I’m not sure it’s the tool. I mean, if you, if you expect to motivate your students only with Moodle, I think you are wrong. I think motivation has to do with the activities you do and everything. But of course, you can use Moodle, maybe to support some of your activities. But Moodle in itself is mostly I think, to share information and to offer some tools to like collect information or deliver information but is it very motivational in itself? I wouldn’t say that.”

Seventeen percent of teachers claimed that students’ motivation to learn in Moodle depends on how teachers design the activities and structure the courses in the platform. Past literature noted how learners prefer entertaining, competitive, and self-monitoring learning environments (Şahin & Yurdugül, 2022). As one teacher noted:

“Moodle is just a vehicle or a blank canvas, but not a source of inspiration or motivation. It’s what you put on it that will motivate students.”

As for students’ perception of the purpose of Moodle, most students (92.7%) perceived Moodle as a platform to manage learning materials. Many students also thought of Moodle as a tool that teachers used to give assignments (63.4%). Some students mentioned that Moodle could be used to facilitate communication between students and teachers, and also among students (43.9%). Over half of the students (55.7%) thought that Moodle was merely a learning tool and not relevant to students’ motivation towards learning. On the other hand, some students reported that Moodle can be used for motivating students to learn because it allows them to collaborate or have discussions (12.2%). Students also noted that the information in Moodle is well organized so it makes their learning more efficient (19.5%).

Below, we outlined teachers’ and students’ perception of Moodle based on two variables drawn from the TAM (perceived ease of use and perceived usefulness). We also presented their responses based on the three levels identified in the LMS Usage Framework.

**Table 3** Teachers' perceptions of ease of use according to functions

Level (LMS usage framework)	Cases	Percent of cases (%)
Level 1	11	26.8
Level 2	8	19.5
Level 3	6	14.6

Level 1 = Content and Communication; Level 2 = Assessment; Level 3 = Collaboration and Advanced Learner Support

**Table 4** Students' perceptions of ease of use according to functions

Level (LMS Usage Framework)	Cases	Percent of cases
Level 1	31	75.6%
Level 2	30	73.2%
Level 3	20	48.8%

Level 1 = Content and Communication; Level 2 = Assessment; Level 3 = Collaboration and Advanced Learner Support

### 7.3.1 Perceived Ease of Use from Teachers' Perspectives

Table 3 displays the number and percentage of teachers who perceived the functions and features of Moodle as user-friendly.

More teachers found content and communication tools easy to use, relative to functions in other levels. This could be due to teachers' using level one functions more than they used other features, which is what past research suggests (Demir et al., 2022). However, teachers also noted that there was a learning curve to be overcome, and using Moodle simply gets easier over time the more one uses it:

“There is a learning curve when first exposed to Moodle. It's not it's not that intuitive. But I don't, I don't think that it's impenetrable. I think it can be learned. And I've learned that my colleagues have learned it.”

Despite a number of teachers finding Moodle user-friendly enough, perception of ease of use did not always translate into perception of usefulness. This finding is inconsistent with TAM's proposition that perceived ease of use predicts perceived usefulness (Davis, 1989).

### 7.3.2 Perceived Ease of Use from Students' Perspectives

As presented in Table 4, majority of the students perceived the different functions of Moodle as user-friendly. It appears that compared to teachers, students had fewer difficulties when using Moodle. This difference in perception could be attributed to the effect of age as in other information and communication technologies applied in the education field (Cattaneo et al., 2022; Lucas et al., 2021). Alternatively, it could also be because understanding and actively utilizing the different functions of Moodle cost more time and effort for

the teachers who need to prepare for classes compared to the students. Thus, teachers perceived the platform as less user-friendly than students.

Similar to teachers' perceptions on the ease of use of the different functions of Moodle, less students perceived the level three functions (collaboration and advanced learner support) as user-friendly compared to the other two levels. This potentially explains why previous research found a very small percentage of learners utilized LMS for online collaboration or forum discussion (Awad et al., 2019), and why in-service teachers enrolled as students in an instructional technology program only used their LMSs for posting and not for collaborating (Demir et al., 2022). Some students complained that it was difficult to raise questions or have discussions using a function like Forum in Moodle, because it did not allow students to leave comments anonymously. As one student noted:

“People are just shy and whenever you post a message in the Forum, they will record your name. I think people tend to cover their names when asking questions.”

Some students even reported that the Forum was only utilized when teachers gave credit for using it:

“People just discuss in Forum when it contains mark, otherwise students don't care.”

The statement above is supported by a previous finding of how students' valuation of e-learning appeared to be limited to what could be interpreted as a type of internalized extrinsic motivation (Fryer et al., 2014). Students' Moodle use seemed to be largely driven by the desire to obtain good grades.

### 7.3.3 Perceived Usefulness from Teachers' Perspectives

**7.3.3.1 Level 1: Content and Communication** Among all content and communication tools, File Upload (68.3%) and News Announcements (58.5%) were most commonly employed. Among three levels in the LMS Usage Framework, Moodle was mostly utilized as a content and communication tool that can be used to disseminate course content (e.g. video recording of lectures) and information to a large number of students (39%). Moodle aids teachers in organizing course materials (36.6%), and saves students time in locating materials by making the materials accessible, as noted by 31.7% of the teachers sampled.

**7.3.3.2 Level 2: Assessment** Teachers noted how the usefulness of assessment tools were course-dependent. For instance, engineering assessments are usually in the format of multiple-choice questions and calculations, while assessments in most law courses are case-based and thus are in no need for extensive technology. In marking multiple choice questions, auto-grading is useful as it saves teachers' time. However, some teachers noted that the assessment tools in Moodle are not very useful for projects without a written component. Furthermore, 34.1% of teachers still gave their feedback outside of the LMS. Teachers marked the submitted assignments offline and used the platform to upload grades and feedback.

Among all assessment functions, assignment (70.7%) and Turnitin (63.4%) were the most utilized. Assessment tools, particularly Turnitin, were perceived to be useful in promoting academic integrity by 51.2% of teacher respondents. According to teachers, Turnitin was useful in detecting plagiarism and in assessing students' performance in written work. On the contrary, other teachers believed that Turnitin was not an effective tool for assessment. While they recognized its usefulness for checking plagiarism, they perceived

it very easy for students to get around the system, especially since some classes allowed resubmission of assignments. Some teachers believed that the use of Turnitin encourages the wrong idea about academic integrity:

“So in my experience, there are plenty of students who have a poor understanding of what is academic integrity. And I think Turn It In can support some misunderstandings. Students feel academic integrity is about paraphrasing other people’s ideas into their own words. I think this is incorrect understanding of academic integrity. Yeah, I think academic integrity is about giving credit to other people’s ideas when you use them. So students seem to feel like there’s some level of turning in similarity score. And if they’re above that level, they cheated. If they’re below that level, they didn’t cheat.”

**7.3.3.3 Level 3: Collaboration and Advanced Learner Support** Eight (19.5%) of the teachers noted that collaboration tools are not effective in facilitating collaboration among students. Teachers claimed that students did not check Moodle often, and that they preferred to send individual emails rather than discussing in the Forum. Teachers attributed the unwillingness of students to participate in online discussions to the lack of anonymity when posting answers in the platform. Another reason for the low use of collaboration functions was the nature of some courses that did not require much collaboration among students.

Overall, Moodle was seen as not useful for social connection and group discussions. Despite this, Forum was still the most often used function among all the other functions under level three, with 53.7% of teachers reporting its use in their courses. Forum was identified to be most useful for teachers giving group feedback and for teachers communicating with their classes, but communication tends to be only in one direction (from teacher to student). This is concerning since teaching quality is in part influenced by the quality of interaction between teachers and students (Xie et al., 2023).

### 7.3.4 Perceived Usefulness from Students’ Perspectives

**7.3.4.1 Level 1: Content and Communication** For level one functions, over half of the student sampled used URL (90.2%), File Upload (87.8%), Folders (85.4%), News Announcement (80.5%), and Deadline Reminder (65.9%). Majority of the students (75.6%) perceived these functions as useful. These findings are consistent with their perception of the purpose of Moodle as a platform for managing learning materials. Students’ perceived usefulness of the news announcement and deadline reminder features also confirmed previous findings about learners preferring to receive notifications and reminders about assessment tasks, especially the learners who have procrastination behavior (Şahin & Yurdugül, 2022).

**7.3.4.2 Level 2: Assessment** As for level two functions, Turnitin (82.9%), Assignment (61%), and Quiz (58.5%) were the functions that over half of the student interviewees have used before. Majority of the students (68.3%) agreed that using Turnitin could be useful in promoting students’ academic integrity because it is useful for checking plagiarism. However, a student expressed that it is difficult to promote academic integrity for numerical assignments:

“I think it is difficult to promote academic integrity for numerical assignments because it is very difficult to track and verify whether students have actually done the calculation themselves.”

A substantial percentage of the students (39%) also thought that Moodle is useful for receiving feedback from teachers. However, they reported that feedback in Moodle tended to be short and simple, and most of the teachers preferred to provide feedback through email (41.5%).

**7.3.4.3 Level 3: Collaboration and Advanced Learner Support** Regarding level three functions, majority of the students have used Forum before (82.9%), but only less than 20% of the students have used other level three functions. This was expected, as a previous study found participation in discussion forums as one of the activities that students engage in most when using LMS, apart from downloading readings (Mpungose & Khoza, 2022). Students reported that the Forum function was quite useful because it allowed students to share ideas, and teachers could even pin the important threads and make sure the most useful information is on top of the Forum. Forum can be a platform for facilitating asynchronous online discussions and for fostering social interactions in online and blended learning environments (Rolim et al., 2019). But in the current study, while we found that the Forum function is perceived to be useful, and the most used by students among level three functions, students expressed wanting an option for anonymity when posting answers and used Forum more for responding to questions rather than collaborating with their peers.

In the subsequent sections, we present the challenges reported by both teachers and students in the use of Moodle.

## 7.4 Challenges Encountered in the Use of Moodle from Teachers' Perspectives

Twenty percent of the teachers shared how Moodle is slow and how some of its functions take a while to load (e.g. assignment, Turnitin, grading feature). They also noted the file size limit, which made it hard for both teachers and students to upload videos. One of the main challenges teachers also shared was Moodle's complicated interface, and they reported being confused about having too many buttons, functions, and information that they personally did not find useful or relevant. As one teacher shared,

"It's dazzling to have too many buttons and content, dazzling and confusing. Yeah, and many functions that I don't use...I mean, I know some teachers will find those functions useful. But to me, I may only find about 1/3 of them useful to me."

Teachers also described using Moodle as "step-heavy." For example, teachers shared about having to manually search for their classes and add to their page. For more senior students, it becomes difficult as time progresses as the Moodle page becomes quite long, the more courses they accumulate. As one teacher noted,

"And then there's a long list and then you have to scroll down."

Teachers recognized that most of the challenges they encountered stemmed from their lack of training and unfamiliarity with the full functions of Moodle. This finding is consistent with evidence for teachers' self-assessment of their low or medium-low digital competencies, pointing to the need for more practical and personalized training programs responsive to teachers' needs (Basilotta-Gómez-Pablos et al., 2022; Sáiz-Manzanares et al., 2021). The latter is important since a previous study found that teachers made more extensive use of features/tools in their LMS after attending a professional development course (Evans et al., 2020).



Furthermore, teachers from the current study noted how the use of Moodle was not relevant for all pedagogies, and this led other teachers to prefer using other platforms or systems that suited their teaching needs. As one teacher noted:

“It’s just one of many choices. Because I do a lot of flipped classrooms. I do a lot at a studio based teaching thesis in small seminar groups, I have different pedagogies different needs for each of those courses, some of which Moodle is very good for some of which is not.”

## 7.5 Challenges Encountered in the Use of Moodle from Students’ Perspectives

With regard to the challenges and difficulties encountered by students in Moodle, over half of the students reported difficulty finding the information they wanted (53.7%). It appears that the current version of Moodle in the institution did not contain a search function. Since every course they have taken before remained in their home page, they needed to scroll down the page from the top to the end whenever they had to find any content from a course, a process that they found time consuming and frustrating.

Another challenge that many students shared was teachers’ lack of knowledge and skills in using Moodle (26.8%). For instance, one student complained about the teacher’s disorganized manner of handling the learning materials, causing confusion for students:

*“Lecturer posts a lot of materials that are not well-named and tend to be in a mess, and sometimes when it’s compressed, I have to download the compressed folder, I cannot open, rename or uncompress it because file name is too long, error comes up.”*

And because some teachers were not familiar with Moodle, they often had to ask for help from the admin staff, as noted by one student:

“Some teachers do not know how to use Moodle, so they rely on the admin staff. The admin staffs are busy so for some courses it’s not very efficient.”

In the next section, we present findings about COVID-19 pandemic’s impact on teachers’ and students’ perceptions of Moodle and other educational technology tools.

## 7.6 COVID-19 Pandemic’s Influence on Teachers’ and Students’ Perceptions of Moodle and other Educational Technology Tools

A substantial percentage of teachers (36.6%) did not perceive Moodle differently from how they perceived it prior to the pandemic. However, they reported an increase in usage of Moodle and other educational technology tools (e.g., Zoom) among teachers during the global health crisis. Despite this, teachers still expressed preference for face-to-face learning over the use of online tools.

Teachers believed that the integration between Moodle and other online learning tools was a good thing, particularly with Zoom. Despite teachers’ reluctance in using the LMS, the pandemic made teachers understand better the importance of online interactions and made them appreciate the importance of other technologies in education. As two teachers noted:

“I think the significance of Moodle was further recognized during the COVID pandemic, especially when we had the lectures recorded.”

“The action of recording videos and sharing them online has become crucial for online teaching & learning for both teachers/students.”

Ten students (24.4%) reported that the COVID-19 pandemic had no impact at all on their perception of Moodle and other educational technologies. Since some of the students entered the university after the pandemic broke out, they had no experience in learning in a university before the pandemic to compare with. However, a large proportion of the student sample (87.8%) also reported that after the start of the pandemic, the use and the value of Moodle and other software like Zoom significantly increased. Findings confirmed that perceived usefulness of online technologies during the global health crisis had a positive effect on students' attitudes toward remote learning (Camilleri & Camilleri, 2022). As one student noted:

“I think because of the pandemic, the perception I have towards Moodle was quite positive perception. For the online learning, I think Moodle plays a very important role because the teachers need to upload everything on Moodle and students can just check the Moodle to know what the teachers need to say. I think maybe the COVID-19 pandemic has strengthened the positive perception of Moodle. In my case, it is really useful, especially during online learning, as I mentioned it organized things well.”

## **7.7 Teachers' Recommendations on How to Make Moodle a More Effective Tool for Teaching and Learning**

Teachers recommended having constant technical support that is tailor-made for each faculty. As stated by one teacher:

“If they could be specific, tailor-made information that's available to law faculty, to, to social sciences and to different faculties. And I think that that that might incentivize teachers to make better use of them.”

Given their packed schedule, having short tutorial videos they can access in their own time would be helpful. As one teacher noted:

“If you just do a document, no one's going to read it. I think short video recording, highlighting how to use it is the best.”

This is a good solution for teachers who expressed preference for workshops with flexible schedule. One teacher also expressed the desire to see more showcases of Moodle usage from fellow teachers:

“I think it will be very helpful if I know how other faculties or other universities are making use of Moodle's features, because I haven't seen how those features might impact my teaching.”

This finding reflects people's tendency to perform a behavior more due to the influence of important others, or what is labeled as subjective norms in the TAM (Schepers & Wetzels, 2007). Following the above recommendation can also be anticipated to increase users'

behavioral intention to use and actual LMS use as shown in a previous survey conducted in Hong Kong (Luk et al., 2018).

A cleaner interface with fewer and streamlined functions was also suggested by the teachers to make Moodle more user-friendly. According to one teacher:

“There’s a lot of content on Moodle that is, for me, very unnecessary. I’m not sure specifically, but they’re just a lot of you can hide and delete a lot of them once you have a course page. But again, for me, less is more.”

Some teachers noted their preference to customize Moodle’s design for their courses. Even though the current version already allowed for adding external plug-ins, a few teachers recommended embedding and integrating other programs into Moodle. Teachers also preferred to have more learning analytics functions to monitor student engagement (e.g. to see if students read feedback or participate in group projects). The value of this recommendation is supported by findings from studies that employed digital trace data from LMS to monitor students’ behavior patterns and topic-based social interactions in an online learning environment (Wong et al., 2021; Ye & Pennisi, 2022). In the latter study, learning analytics was found to be a more powerful predictor of student academic performance compared to self-reported self-regulated learning. As one teacher noted:

“It would be good to have students’ overall activity report— more specific reports such as showing outliers like those who have visited the Moodle course page less than five times in the semester and allowing teachers to download the report with students’ names to follow up.”

A few teachers suggested having a Moodle app that can be accessed through mobile phones so that students can receive notifications for announcements easier. The feasibility of this recommendation is supported by findings from a study that revealed how students are well-acquainted and habituated with the use of mobile devices and their applications in learning (Camilleri & Camilleri, 2022).

As teachers identified lack of anonymity as one of the major reasons for lack of student participation in online discussions, teachers also suggested having an option for anonymizing responses in the Forum. As stated by one teacher,

“If the Forum is anonymous, students are more willing to speak and will be more active.”

## **7.8 Students’ Recommendations on How to Make Moodle a More Effective Tool for Teaching and Learning**

As mentioned earlier, one challenge that many students shared was the difficulty in finding the information they wanted in Moodle. Thus, almost half of the students (48.8%) reported that they wished they could customize their home page so that the content would be more organized. They also suggested adding a search function to help them locate the course they were looking for:

“I wish I could arrange the courses according in the order of the year, or the code or the name, so I can find the information I need easier.”

There were also some students who recommended having a workshop or tutorial that can teach them how to use Moodle:

“I think it is not about the (functions of) the app but how to use it. Students need to be taught how to use Moodle.”

“I think Moodle will be more useful to me if I learnt more functions of it.”

Considering that workshops or tutorials might not be convenient for students to join due to scheduling conflicts, students brought up the need for recorded training videos. Like teachers, they recommended the videos be tailor-made for each faculty or department so users could modify Moodle based on their needs.

## 8 Conclusion

The bulk of LMS research had respondents from very specific departments (Al-Nuaimi & Al-Emran, 2021) which limited insights that could have been derived from having more diverse samples from other fields. The current study contributes to the literature by applying purposive sampling in recruiting a comprehensive sample of teachers and students from all 10 faculties of [institution removed for anonymous review], allowing us to glimpse the different contexts where LMS is used.

Furthermore, as most studies have simply examined LMS use as a whole (Al-Nuaimi & Al-Emran, 2021), assessing the adoption of specific tools and features of LMS across all colleges can be considered a major strength of the current study. The present study is a rich source of insight, since LMS research has predominantly employed quantitative self-report survey instruments, often without sufficient contextualization (Al-Nuaimi & Al-Emran, 2021).

Most studies using TPACK previously neglected to account for context in their research (Rosenberg & Koehler, 2015). Through large-scale qualitative interviews, the current study showed the importance of context in determining how a particular technology will be used in teaching and learning. Consistent with the TPACK framework, this study provided evidence that technological knowledge, teachers' content knowledge and pedagogical knowledge individually and in interaction with each other influence how LMS is integrated into teaching, with frequency and manner of Moodle use varying between colleges and departments. The general resistance in LMS use previously observed (Sakala & Chigona, 2020) still exists among teachers despite pandemic-induced adjustments. Findings suggest that the LMS is still not systematically used throughout [institution removed for anonymous review], as some teachers reverted to previous practices with minimal LMS use after shifting back to face-to-face learning. Furthermore, the perception of Moodle as merely a centralized platform for organizing and accessing course materials was shared by majority of the respondents. This particular finding is aligned with results of past research (Al-Shaikhli et al., 2022; Azhar & Iqbal, 2018; Kite et al., 2020). As most teachers lacked the necessary training on the use of Moodle, students expressed their desire for their teachers to be more adept at using the tool. However, we also found that increasing motivation to use and actual use of LMS goes beyond increasing ease of use, as teachers have noted how they found the tool user-friendly enough, but not useful in teaching their courses. Similarly, most students found the functions of Moodle easy to use. However, how students used the LMS largely depended on how their teachers were using it in their courses. Therefore, there is much to learn from studies that demonstrated how helpful attending professional development courses is for higher education teachers, especially trainings that enable

teachers to approach teaching with technology from students' perspectives (Evans et al., 2020). This is aligned with the theory of constructivist learning, where teachers are viewed as facilitators that adapt their lessons to accommodate their students' level of understanding (Kurt, 2021). Lecturers' attitude, teaching style, level of responsiveness and communication are all essential elements that motivate students in online learning environments (Anthony et al., 2022). Overall, findings point to students' and teachers' need for familiarity, training, sufficient technical support, and a visually and functionally improved interface to enhance their experience in the LMS.

Communication should be a primary function of LMSs, and to some extent it is good for one-way communication and mass announcements, but not for collaborations and private or formative feedback processes (Demir et al., 2022). Despite the availability of collaboration tools and tools for providing feedback on submitted requirements, we found that majority of interactions still occur in alternative communication channels. This is consistent with a past study that found few students utilize LMS for online collaboration or forum discussion (Awad et al., 2019), and even teachers used communication and collaboration tools the least across different LMSs (Demir et al., 2022). Constructivism forwards the idea of learning as an active process and as a social activity where interactions are deemed essential for knowledge construction (Kang et al., 2007; Kurt, 2021). Thus, the limited use of more interactive features of LMSs contradicts the essence of effective teaching and learning that hinges on student–teacher interaction. This could partly explain why a number of teachers in the present study, similar to what past literature has indicated, believe that learning happens more in person than online (Kite et al., 2020). This implies a need to promote LMSs as learning communities (Kwon et al., 2021) and as avenues for collaboration (Sáiz-Manzanares et al., 2021) and not just course material repositories. This would entail strong institutional support in endorsing the interactive and relational features of online learning and teaching through LMSs and other educational technology tools.

In the literature, there is very limited LMS research that had both student and teacher samples (Simon et al., 2023), and studies have been skewed towards students relative to teacher samples (Al-Nuaimi & Al-Emran, 2021). We addressed this issue by obtaining the perspectives of both students and teachers regarding LMS use. This comes with the acknowledgement that teaching and learning go hand in hand. Taken together, our findings highlight the important role that teachers play in the success of e-learning environments (Al-Busaidi & Al-Shihi, 2012; Fryer & Bovee, 2016, 2018). Both students and teachers attested that the value and relevance of LMS as a learning tool are heavily dependent on teachers' proficiency with the medium, on the course content and on how teachers design the activities and lessons in the platform. Digital technologies continue to bring challenges to teacher education, especially in the area of developing new competences to keep up with evolving learning environments (Kaminskienė et al., 2022). Given this, tailor-made information, training, and support for teachers are needed to maximize the use of LMSs in teaching and learning.

## 8.1 Practical Implications

This study was conducted to examine students' and teachers' perception of LMS and how they engage with the educational platform. This was aimed at finding ways to address LMSs' reported underutilization despite their availability in higher education institutions. Based on our findings, we note some practical implications that could aid in the

improvement of LMS as a tool for teaching and learning and consequently, in the promotion of its use.

Results imply that the problem of lack of training identified in previous studies has persisted. Thus, higher education institutions must prioritize investing in good LMS training opportunities that are responsive to the unique needs of both students and teachers. As teachers were found to be the main drivers of LMS adoption, there should be readily accessible training and technical support for them to maximize the various features and functions available in LMSs. This is important as a recent systematic review noted that teachers tend to report low or medium–low digital competencies (Basilotta-Gómez-Pablos et al., 2022). As suggested by the respondents, one good approach is to create and make available brief but informative training videos for each program or department that demonstrate how to use the various LMS functions. Instructional designers could customize the videos, considering the diversity of pedagogies employed by higher education teachers from different programs. More knowledgeable and experienced teachers who are adept at using LMSs can also be tapped as trainers and content creators as part of technical support teams.

Respondents expressed their preference for a cleaner interface with fewer and streamlined functions. They also noted some limitations of the platform such as the lack of a search function that would enable quick access to relevant information. This shows the need for information technology teams to conduct constant and frequent updates of institutional LMSs for overall system improvement. As online educational technology tools such as LMSs continue to evolve, resources should also be directed at a continuous and systematic evaluation of the LMS used in institutions. Finally, dialogues that involve multiple stakeholders (i.e., teachers, students, administrators, and technical support staff) can be held so that higher education institutions can share best practices on how to improve LMS utilization to enhance the quality of teaching and learning in universities.

## 8.2 Limitations and Future Directions

It is important to note the current study's limitations to guide future research. First, the present study was conducted at one public university in Hong Kong within the context of one type of LMS. While most of the findings can be generalized to other LMSs, it would be interesting to conduct a similar study in other universities (both public and private) to allow for meaningful comparisons across various contexts. Second, given the qualitative approach employed in this research, generalizability might be improved by executing well-designed, large-scale surveys using instruments with good psychometric properties. Third, future research can also consider utilizing mixed method research designs to combine detailed insights from qualitative inquiry with easily replicable quantitative evidence. Fourth, to avoid overreliance on self-report data from surveys and interviews, other means of capturing LMS usage (e.g. social network analysis, log data) such as those used in previous studies should be explored (Norz et al., 2023). Lastly, given that the current study's focus was on the perspectives of teachers and students, researchers are encouraged to extend investigations on LMS use to include perceptions of other stakeholders in higher education institutions such as technical support teams, instructional designers, and administrators.

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## Declarations

**Competing interests** The authors declare no conflict of interest.

**Ethical Approval** The study has been reviewed and approved by the Human Research Ethics Committee (HREC) of The University of Hong Kong (HKU) with Reference Number [EA220016].

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