A Review of Cross-Cultural Design to Improve User Engagement for Learning Management System

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Abstract

Online learning has become a widespread practice for students and teachers in acquiring and delivering knowledge. Education platforms have become prominent in the 21st century with the evolution of technology and the accessibility to online learning. As a result, various learning management systems (LMSs) have been introduced to facilitate online interaction between users. For instance, communication between students and teachers at school. However, there is a need to emphasise user engagement in LMS to enhance the online learning experience amongst students since the design of LMS affects user engagement. This study utilised a systematic literature review (SLR) that examined 74 articles published between 2014 and 2023, focusing on cross-cultural design (CCD), user-centred design (UCD), and usability in LMS design. This study aimed to review CCD and its association with UCD, user interfaces (UI), and user experience (UX) in the context of LMS. CCD has been introduced as an approach to design that embraces different cultures, languages, and social contexts, while UCD plays a significant role in defining user engagement for LMS. All elements in CCD and UCD help create a better user experience for LMS. Besides, this study reviewed the usability of selected LMS to give insights to developers in creating a positive user engagement. An insight into cultural factors that influence the usability of LMS has revealed their value for LMS design, such as the UI/UX elements. Initially, this study may guide future researchers in improving education quality by emphasising CCD and LMS usability, which can enhance user engagement.

Keywords: cross-cultural design, user-centred design, user interface, user experience, learning management system

1. Introduction

Culture encompasses a wide range of human behaviours and practices, as noted by [1]. Culture can be both straightforward and challenging to comprehend. It is easy to understand due to its different meanings, but its ambiguity and complexity make it difficult to grasp [2]. According to [1], culture shapes how people act, perceive the world, express themselves, and think. Historical events, values, beliefs, and surroundings shape it. Hofstede similarly defined culture as the combination of one group's beliefs, values, and attitudes of another [3]. In the context of human-computer interaction (HCI), culture is defined as aligning with the goals and preferences of end-users [3]. To design a successful interface, it is crucial to understand the end-user's characteristics thoroughly. The design must ensure services and functionalities are easily accessible and understandable.

Due to diverse perspectives, ways of thinking, and values reflecting how users interact on the interface, users have culturally different characteristics, such as religion, language, and habits. To address this, cross-cultural design (CCD) has been introduced to form a design approach that embraces different cultures, languages, and social contexts. In the era of globalisation, CCD primarily aims to improve communication and understanding across cultures and to appeal to an international audience with diverse cultural backgrounds [2]. CCD bridges the knowledge gap between designers and their target users due to different perceptions and cultural backgrounds that impact user experience (UX) and user interfaces (UI).

UI/UX is a part of user-centred design (UCD) [4]. UCD aims to achieve optimal usability and user experience in online learning settings. It is a popular method for generating initial designs, followed by iterative improvements to refine the design further. UCD was developed in the 1980s to expand usability engineering by incorporating user involvement in pre-design activities to comprehend their needs. It also involves users in evaluating early design prototypes [5]. Since UCD influences UI, Marcus and Gould [1] believed that UI should be designed based on cultural dimensions, which can be applied to various components, such as metaphors, navigation, mental models, appearance, and interactions.

This approach aimed to cater to the needs of international users by providing multi-language support and the option to switch icons for a culturally appropriate interface. Besides, the study by [6] stated that interface design is an intrinsic force of learning motivation that guides students towards successfully attaining their learning goals. It is a critical factor in determining the engagement, accomplishment, and satisfaction learners experience during online learning. A study by [7] stated that the online learning process would be more flexible and engageable by using learning management system (LMS).

LMS has helped to create an online learning environment in the education field. Besides, LMS offers time and location flexibility and secure study options for students with various lifestyles and collaboration tools within LMS that have opportunities to enhance student interaction [7]. As the learning process shifted from teacher-centred to student-centred, various LMS software offered students a new and customisable experience that met their individual needs. In the age of online learning, LMS such as Moodle, Blackboard, MOOC, Schoology, Google Classroom, and others have become popular educational platforms for teaching and learning. A review by [8] reported that LMS had been widely adopted in Asian and Gulf Cooperation countries. Thus, it is crucial to focus on the usability of the LMS to enhance user engagement.

LMS provides educational planning through an integrated learning management system, fostering partnerships between students, teachers, and parents. Therefore, this study aimed to

give insights into CCD and the association between UCD, UI and UX, specifically for LMS. The scope of this study revealed user engagement in using LMS at institutional levels, including schools and universities. The user engagement aspect involves the elements of UCD, which are related to UI and UX. The main contribution of this study is to provide insights into the CCD and UCD, which can improve user engagement when using LMS. Conducting a usability review for selected LMSs will assist future research in developing guidelines for designing LMSs that incorporate CCD and UCD principles to enhance user engagement and improve education quality.

This paper is organised as follows: In Section 2, the methodology has been conducted for this study. Next, in Section 3, the study presented the importance of CCD and cultural dimensions incorporated into UI design, as gathered from previous studies. Section 4 concentrated on the UI/UX for LMS to gain insights into LMS design and how it affects user engagement. In Section 5, the study provided a comparative analysis of selected LMS based on the insights from the previous study, focusing on the usability of LMS. Section 6 reviewed the usability of selected LMS by stating the strengths and weaknesses of each LMS. Finally, in Section 7, the study summarised the entire paper and outlined potential future work in the conclusion.

2. Methodology

The number of LMS is growing annually as education shifts to online settings. However, the abundance of effective LMS has faced barriers, with inconsistent user engagement, as noted by [7], [9]. Additionally, cultural factors have been identified as influencing user engagement [10]. Therefore, this study utilised a systematic literature review (SLR) to explore cross-cultural design (CCD) to improve user engagement for LMS. SLR was chosen for its ability to minimise subjectivity, selectivity, and bias, providing explicit inclusion and exclusion criteria [11]. This method was adapted from a previous study by [12], who successfully examined the factors related to user engagement in LMS. The research methodology structure is illustrated in **Fig. 1**.
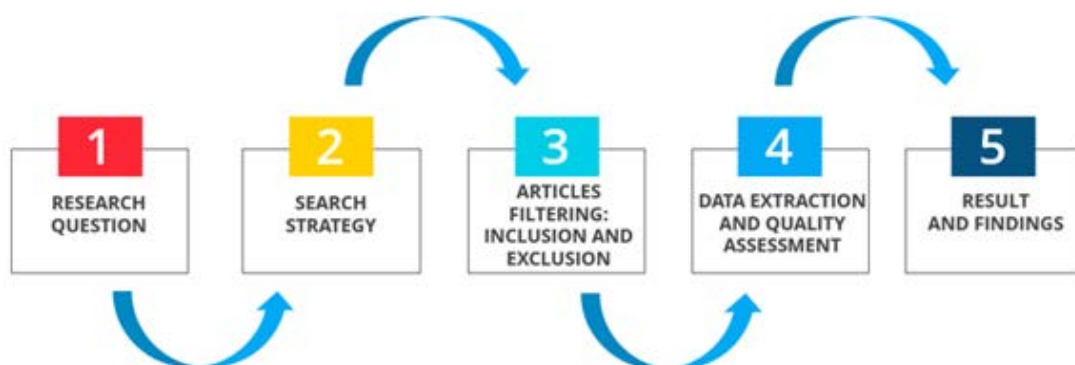

Fig. 1. The structure of the research methodology

Firstly, in this study, the research question has been developed to address issues related to user engagement with LMS, aiming to understand how CCD influences user engagement by using LMS. Two research questions have been developed as follows:

1. What are the elements in cross-cultural design (CCD) that can improve user engagement for LMS?

2. How do cross-cultural design (CCD) and user-centred design (UCD) influence user engagement in the context of learning management system (LMS)?

This study focused on exploring insights into CCD and examining the correlation between UCD, UI, and UX, which become a factor in improving user engagement. Three types of LMS have been selected for this study, such as Google Classroom, Moodle, and Schoology, to delve into the CCD element within LMS.

Secondly, the search strategy for the SLR included database selection, keyword searches, and the establishment of inclusion and exclusion criteria. Articles were chosen based on several criteria, including their relevance to the topic, research quality, and the availability of full-text access. The search strategy involved using specific keywords related to topics, such as LMS, CCD, and user engagement from reputable academic databases such as ACM, IEEE, Springer and Elsevier, besides allowing defining filters such as document type, language, and knowledge area [13].

Next, based on the findings, articles were filtered and classified by using inclusion and exclusion criteria. The inclusion criteria for this study involved selecting articles that described the utilisation of culture, CCD, and LMSs. These articles should be written in English, peer-reviewed, and published in academic journals. Besides, the selection criteria included published articles from no more than ten years ago to ensure the information remains relevant [14]. Exclusion criteria were applied to remove articles not pertinent to the research questions and those not in English.

After screening the articles, data extraction and quality assessment were conducted. The selected articles underwent data extraction to address the research question [15]. The extracted data focused on the significance of CCD, LMS, and user engagement to determine the relationship between UCD, UI/UX, usability and user engagement for LMS. As a result, 74 relevant articles were selected from 137, covering the years from 2014 to 2023, using specific keywords related to the research questions. Based on the findings from the selected articles, an evaluation will be presented in a subsequent section, revealing a thorough insight into CCD in improving user engagement for LMS.

3. Cross-Cultural Design (CCD) approach for Learning Management System (LMS)

CCD thoroughly comprehends various cultural characteristics during the design process to effectively engage with the user [5]. A study by [2] stated that the CCD approach is a subset of the UCD methodology and was developed based on cross-cultural interface design research. The CCD approach assists in gaining insights into the cultural background of the target audience in designing UI for a particular application. Thus, culture plays a vital role in UI design, which acts as a medium for users to interact with the system [1]. UI design focuses on creating a user-centred interface that is easy to understand and meets the user's needs and preferences. In this context, cultural dimensions can be used to design UI by identifying user preferences and cultural backgrounds. In this study, Hofstede's cultural dimensions analysed user engagement for LMS. Multiple researchers have utilised and examined it to examine their impact on user interface and application. Furthermore, Hofstede's cultural dimensions appear more holistic than others [16]. According to [17], Hofstede's cultural dimensions have been divided into five dimensions: power distance, uncertainty avoidance, individualism or collectivism, masculinity or femininity, and a long-term orientation, as described in **Table 1**.

Table 1. Hofstede cultural dimension

Hofstede Dimension	Description	Source/ Years
Power distance	Beliefs about the appropriate distribution of power in society	[1], 2018 [3], 2021 [18], 2019
Uncertainty avoidance	The extent to which people feel threatened by uncertain or unknown situations	
Masculinity–femininity	Assertiveness vs. passivity; material possessions vs. quality of life	
Time orientation	Long-term vs. short-term outlook on work, life, and relationships	
Individualism–collectivism	The relative importance of individual vs. group interests in society	

Based on **Table 1**, Hofstede's dimension stated that each dimension has a value that can be measured to determine the most suitable approach for specific products in different cultures. A study by [18] showed that the Hofstede's dimension helps create an application with a UI that adapts to the user's cultural background. This makes Hofstede's dimension essential in designing the UI/UX for a particular application. According to [1] cultural aspects are crucial in designing the UI. Thus, **Table 2** has been created based on a previous study by [3] to incorporate Hofstede's dimension into UI design. The review of each cultural dimension related to UI design has been examined to gain insight and stress the importance of culture in creating a more engaging UI.

Table 2. Hofstede Cultural Dimension in UI design

Hofstede Dimension	Description	Hofstede Dimension in UI design	Source/ Years
Power distance	Beliefs about the appropriate distribution of power in society	The use of images, labels, and messages	[2], 2017 [3], 2021 [20], 2022
Uncertainty avoidance	The extent to which people feel threatened by uncertain or unknown situations	The use of messages and labels	
Masculinity–femininity	Assertiveness vs. passivity; material possessions vs. quality of life	The use of images	
Time orientation	Long-term vs. short-term outlook on work, life, and relationships	The use of navigation, images	
Individualism–collectivism	The relative importance of individual vs. group interests in society	The use of colour, language, layout, icons, symbols, fonts, and image	

Table 2 describes each Hofstede's cultural dimension in UI design. The first cultural dimension is power distance. The power distance index measures the power distribution between people and cultures, affecting how they react to their environment. Countries with high power distance index in education, such as Latin, East Europe, Africa and Asia, tend to

have more formal and hierarchical communication between students and teachers [17]. In the context of UI, the design of images, labels, and messages in the power distance context represents the head of power.

For example, the user interface, such as shared icons, is unfamiliar to Syrians, who do not know the meaning. While the share-icon design could be a common feature in Sweden, it may not be intuitive for end-users with different cultural backgrounds [2], in exploring methods for improving the website's user interface.

Next, the cultural dimensions of uncertainty avoidance, masculinity versus femininity, time orientation, and individualism versus collectivism play an essential role in the design of a usable user interface. These dimensions can impact the use of language, symbols, images, layout in the design, and the user's perception of the interface.

Uncertainty avoidance refers to an individual's fear of the unknown and reaction to ambiguity. [3] explained that to incorporate Hofstede's dimension into UI design, a designer needs to consider using a straightforward design approach to prevent confusion for the user rather than implementing multiple complex menus and screens.

The cultural dimension of masculinity versus femininity refers to the differentiated emotional gender roles between men and women in a society [19], [20] categorised it into values, such as desire, achievement, and gender. When it comes to designing the user interface of a website or application, it is essential to use images that promote gender equality and fairness [20].

Time orientation refers to a culture's acceptance of new material and can be long-term or short-term. This dimension affects images in UI design, with long-term-oriented cultures preferring group images and national symbols, while short-term-oriented cultures prefer a more minimal focus [21]. For example, cultures with a long-term orientation prefer group images, national flags, and colours appearing on the website. However, for cultures with a short-term orientation, a minimal and focused image is sufficient [22], [23].

The concepts of individualism and collectivism are linked to the way individuals blend into larger groups. In an individualistic society, people prioritise their own needs and interests, whereas, in a collectivist society, the group's needs take precedence over the individual's. In the context of user interface design, six elements are associated with this dimension: colour, language, layout, icons, symbols, fonts, and images. A study by [3] found that language is the foundation of communication in interfaces that directly impacts the user's usability. [3] also found that colour has cultural significance, such as using green, blue, and black to represent Arab culture and Islamic history.

These cultural dimensions help create a user-friendly UI design, as demonstrated in a study on the design of university websites across various countries. For example, in Malaysia, a country with a high-power distance, white, purple, or blue were commonly used colours, while in Sweden, a feminine country, a white background was frequently employed in the design of their university websites [3].

Many studies have concluded that cultural dimensions are individual characteristics demonstrating how a culture prefers to deal with problems that all cultures endure. According to [24] Hofstede's cultural dimensions inspire individuals to develop a system, website, or product prototype for the targeted audience and group. A similar opinion by [10] suggested that design features connected to the cultural dimension could make interface design more attractive.

Besides, a study by [20] showed that the UI component related to Hofstede's cultural dimension could affect the UI/UX of the application. In preparing the future of LMS to be used in the 21st century, Hofstede's dimension could design an appropriate LMS for all

stakeholders (students, parents, teachers) to use as the central communication at school. Hofstede's dimensions are also part of the CCD elements that influence the design of LMS. Thus, the CCD approach in LMS should consider user preferences to enhance user engagement in online learning, as suggested by [25]. The study also revealed that users' cultural backgrounds significantly impact how they utilise LMS for their learning preferences.

LMS can also be designed to align with user preferences, considering their cultural background based on the cultural dimensions introduced by Hofstede [16]. For instance, the value of UAI significantly impacts user attention when using notifications as a message, as explained by [25]. Emphasising the importance of the CCD approach for LMS is valuable in creating a more meaningful LMS that encourages users to engage with it constantly. Currently, the CCD approach has continuously evolved due to the influence of user preferences on LMS engagement. The study by [25] also highlighted the significance of considering culture when designing LMS interface, further demonstrating the value of CCD in determining the UI/UX for LMS.

However, a study by [4] claimed that the understanding of UCD must be considered since UCD is the most popular practice for designing interfaces and creating engaging and efficient UI for online learning. Therefore, to create an effective design for an educational purpose, UCD must be stressed and examined to support the development of practical UI and UX guidelines in educational settings.

4. User-Centered Design (UCD) for Learning Management System (LMS)

UCD, as defined by [26], is an iterative design process that improves the usability of the interactive application by incorporating human factors and ergonomics knowledge. As described by [4], this approach focuses on end-user needs and has become a key concept in the design process. Practising UCD in the design process can enhance the UI design and increase user engagement [26]. UCD is an iterative design process involving users in designing application interfaces [27]. The iterative process has three phases: understanding the user, defining interaction and user interface design [28].
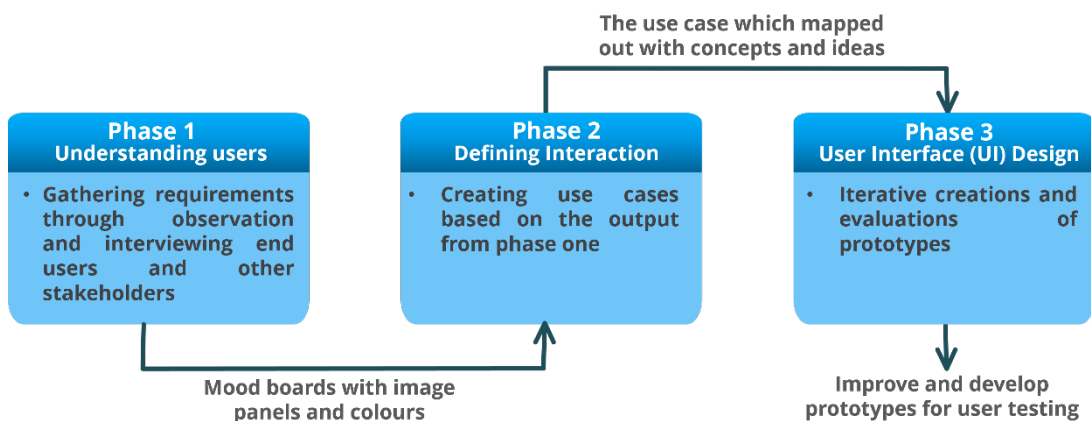
Fig. 2. UCD Iterative design process
Source:[29]

A study by [30] interpreted the phases of the iterative interface design process as illustrated in **Fig. 2**. In Phase 1, requirements are gathered from the user through observation and

interview sessions. These requirements inform the design of the interface, which is created by using mood boards with image panels and colours to understand the user persona and needs. In Phase 2, interaction is defined through a user profile analysis of factors, such as personality, interests, culture, beliefs, gender, social group, and behaviour. The user case is mapped out with concepts and ideas. In Phase 3, user feedback allows for improving ideas and elements before developing prototypes and conducting user testing. The process is iterative, so designers can return to earlier stages to make revisions and incorporate previous information. A similar approach is described by [29], which uses an iterative technique to design an educational platform, beginning with planning and progressing through design, production, and evaluation for system delivery and maintenance.

The iterative process and approach of UCD facilitate the creation of a user-friendly interface. For example, a study by [31] claimed that UCD must include essential elements that interact with the user, such as navigational links, small images, thumbnails, short text, and buttons when designing applications. A case study conducted by [1] about the cultural impact on website interface design showed that interface design for international websites must have multiple languages and let them switch icons to make a more personalised interface that fits their culture. Therefore, UCD is essential for understanding the user's requirements and creating a positive UX.

UX describes a person's emotional response and perception when using an application like LMS. The study by [29] stated that UCD is an essential component of UX, as it helps to design UI with exceptional usability. UX has objective and subjective aspects, including functionality, reliability, usability, usefulness, efficiency (objective), attractiveness, appeal, pleasure, and satisfaction (personal). These two aspects lead to user engagement when using the application.

UX focuses on emotional factors and aims to provide a positive experience and increase trust in the object. It includes considering user preferences, expectations, needs, motivation, mood, and the system's features, such as complexity, purpose, and usability. A review by [32] highlighted the importance of UX in creating a successful application.

The usability and effectiveness of UI and UX depend on the quality of the application design, which combines these two tasks, usability and effectiveness, into a single process of creating an educational [32]. An analysis by [33] emphasised that UX is vital to LMS design and development quality, as it motivates students and teachers to use the system. Hence, the significance of UCD, UX, and UI in developing applications necessitates a comprehensive review of UI/UX, considering user preferences, to guarantee the application's usability, especially for LMS.

5. User Interface (UI)/User Experience (UX) in Learning Management System (LMS)

The use of LMS has become increasingly popular in schools and universities, leading to several studies examining its efficiency in the learning process [34]. The practice of using LMS has a positive impact on the learning process between students and teachers. A study reported that many researchers had discussed students' positive experiences using LMS in the classroom [34], [35]. For instance, effective interaction between students and teachers makes learning more comprehensible. In this study, three (3) types of LMS have been selected based on user statistics and the most widely used application in recent years [36]–[38]. Google Classroom, Moodle, and Schoology are the three platforms analysed for their UI/UX design.

Google Classroom is one of the most widely used educational platforms, known for its innovation in bringing teachers and learners together in a virtual classroom [39]. It has become

increasingly popular during the COVID-19 pandemic for its ease of use in overcoming the challenges of online learning. Moodle, a free and open-source LMS, is the most commonly used amongst educational institutions for its versatility in conducting learning activities. Meanwhile, Schoology has gained popularity for its interactive features and ability to facilitate communication between students and teachers. Furthermore, all three LMSs (Google Classroom, Moodle, Schoology) have similar functionality, are easily accessible, have ease of use, and offer user-friendly interfaces, along with collaboration tools that facilitate connections between students and teachers within a single platform [40]–[42]. This section examined all selected LMS platforms' UI/UX designs and components to increase student engagement and involvement during online learning.

5.1 Google Classroom

Google Classroom is a component of the Google Apps for Education (GAFE) suite, which provides productivity applications for teachers and students in online learning [43]. In a rapidly digitalising world, Google Classroom facilitates online learning for today's digital students. Similar to many new applications, it has a unique look and feel. Google Classroom helps to aid online learning experiences for students, promoting pedagogical methods and improving a positive attitude towards the use of technology beyond the classroom. Teachers can use Google Classroom to manage, coordinate, monitor, and analyse students' work with features such as Google Docs and Google Drive, allowing for a greater focus on the students and fostering an environment of collaborative learning, including open inquiry, dialogue, and creative thinking [44].

A review by [45] noted that Google Classroom has a standard design interface that engages users. A study by [46] stated that elements of UI/UX, such as text, images, audio, video, and animation, must be considered to make the learning process more enjoyable. Besides, a study by [47] concluded that the UI design of Google Classroom, including colour, symbol, layout, and typography, effectively integrates all four elements. Analysing the UI design of Google Classroom based on these four elements reveals how Hofstede's cultural dimensions impact UI design in LMS.

[47] stated that the use of colour in Google Classroom is neutral and contrasting. Referring to Hofstede's cultural dimensions listed in **Table 2**, which explains the relationship between UI design and culture in creating meaningful designs. It inferred that using neutral and contrasting colours in Google Classroom aligns with the culture of high individualism, which prefers only one- or two-colour combinations. On the other hand, highly collectivist cultures, such as Arabic society, are more concerned with reputation, dignity, shame, and pessimism. Therefore, they use brighter colours, such as green, blue, and black, to represent their culture [3]. According to [10], colour has different meanings to users from different cultures. For example, in China, red is considered lucky and brings happiness, while in Japan, it is regarded as an unpleasant colour that symbolises danger to the United States.

Furthermore, as reviewed in previous studies, culture influences the design elements like symbols and icons in the main menu [47]. Therefore, designers must consider cultural factors when designing symbols and icons. For instance, cultures with high uncertainty avoidance must avoid uncommon icons, complex screens and menus, vague language, and inconsistent grouping functions. According to [3], Korean users with high uncertainty avoidance tend to recognise more standard icons than American users, while American users tend to recognise abstract icons more than Koreans. [48] conducted a similar study and found that users from high-context cultures, such as Japan, prefer to use culturally specific icons for navigation.

Besides, the standardised icons in Google Classroom fit the needs of cultures with high uncertainty avoidance, making the learning process more efficient. It has been supported by a study [17] that showed that uncertainty avoidance tends to be higher in East Asia, and it was similar to [49] point of view that Google Classroom is among the most used LMS in Southeast Asia.

Another critical design element in Google Classroom is the layout, which refers to the arrangement and placement of information, such as images, symbols, the navigation bar, and the logo. [10] noted that the layout of online learning must be simple, organised, balanced, clear, and neat to facilitate students. However, the layout differs between cultures. For example, the layout for Arab readers displays information from right to left, which is mainly influenced by their religious beliefs [3].

Typography is another essential design element for LMS, and it must be easy to read and understand [10]. The font is closely related to the interface's design; for instance, Arabic cultures with high individualism prefer to use Arabic font. However, designing Arabic fonts is challenging because the characters in the Arabic language have overhanging and looping features, and few typographers have a native understanding of the script. Therefore, the font used in Google Classroom is San Serif and Dynamic, making it easier and more transparent for students to use the application. **Fig. 3** illustrates the UI of Google Classroom, which has been reviewed in a previous study that mentioned the UI elements of Google Classroom [26].
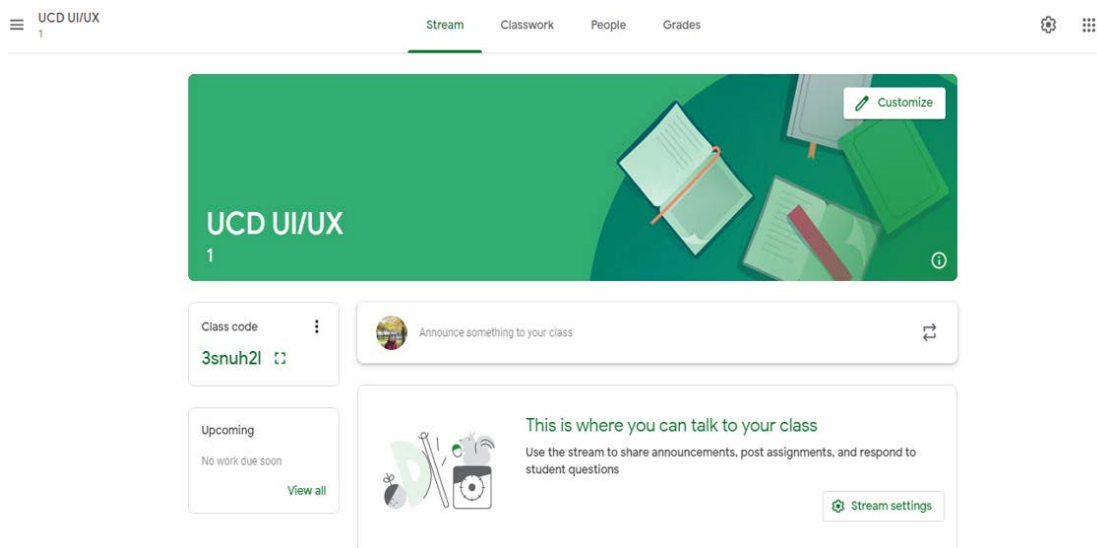
Fig. 3. UI of Google Classroom
Source: [50]

As a result, the UI of Google Classroom has proven to be efficient for online learning amongst students [44]. The analysis of students' perceptions of using Google Classroom by [44] concluded that most students have a positive experience and feedback towards the application. The students find it attractive because it is easy to use and understand and has exciting features for collaborative learning. However, students, especially beginners, struggle to get familiar with the interface for the first time. Some are unaware of the features offered by the web-based application that would benefit them, so additional time is needed to discover and become familiar with the interface [35].

Google Classroom is more beneficial than other LMS because it is accessible as a free mobile app, easy to use, reliable, and provides a platform for a network community with a slight resemblance to the Facebook user interface [51]. However, [51] asserted that not all learning courses are suitable for use with Google Classroom. It is because it has complex account management, limited integration options, no automated updates, difficult learner sharing, editing problems, and no computerised quizzes and tests. As a result, a study by [52] reviewed Moodle as an LMS with more features, such as automated quizzes and tests, which create better student engagement.

5.2 Moodle

The usability of a LMS plays a crucial role in enhancing the learning experience for students. A previous study by [33] has established a relationship between LMS use and student's satisfaction. Incorporating technology into the learning process, LMSs can increase student engagement and self-directed learning and improve learning outcomes [33]. One such LMS that is particularly effective in promoting student engagement is Moodle. Moodle, a widely used open-source platform designed to create dynamic online courses, stands for Modular Object-Oriented Dynamic Learning Environment. Its popularity is mainly due to its foundation in social constructivist pedagogy, reflected in its features supporting student learning [53]. Moodle provides an ideal environment for learning and promotes optimal learning outcomes. Besides, Moodle is also valuable for evaluating student's knowledge, skills, and disciplinary practices [44].

Moodle is known for its simple, responsive interface that is accessible to users. It has been translated into over 120 languages and can be tailored to meet the specific needs of its users [36]. Furthermore, Moodle is continuously updated to ensure its usability and user-friendliness. A study comparing Moodle and Sakai as LMSs conducted by [55] found that Moodle had a better UX, resulting in better user engagement. The success of LMS in the learning process depends on student engagement, which requires active participation and interaction with the application. To ensure the functionality and usability of the LMS, it is essential to consider both UI/UX elements [19].

[56] discovered that Moodle has features that foster student engagement, such as notifications for submissions, reminders for upcoming tasks, and automated marks for online tests and quizzes. These features provide instant feedback to students and serve as a motivator for continued engagement and participation. According to a review by [54], Moodle's features, such as task deadlines and percentage of course completion, have helped to increase engagement between students and teachers, as illustrated in **Fig. 4**. It shows that LMS can improve students' grades and academic engagement. A study by [56] evaluated the UX for students by using Moodle as their LMS. The study found that engagement is one of the critical characteristics contributing to the usability and learnability of LMS's UI/UX.
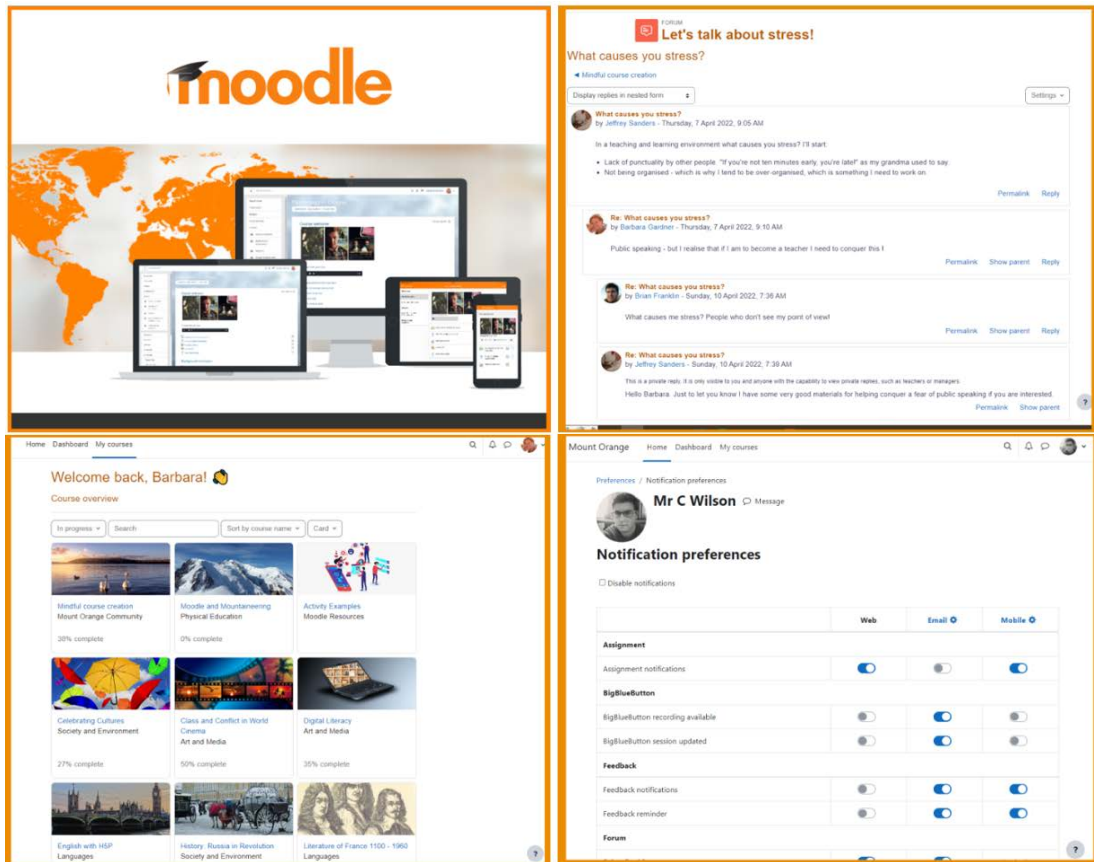
Fig. 4. UI of Moodle
Source:[57]

[58] conducted a study by using a questionnaire and the system usability scale (SUS) to evaluate the functionality and interface of Moodle. The results showed that Moodle is a well-functioning and reliable LMS for the educational sector with a quick response time that makes it easy for students to adapt to online learning. Most students agreed that the UI and UX of Moodle are useful for their learning process [58]. Moodle's user-friendly interface and whiteboard feature helps to present learning content. The application also provides communication and collaboration features, such as real-time chat, discussion forums, and file sharing, for both students and teachers [29].

However, some issues related to the UI/UX of Moodle impact user engagement during the learning process. [36] identified these issues, including unclear instructions, inconsistent language, inappropriate colour options, and difficulties logging into the system. [36] also emphasised the importance of consistency in the language, fonts, and colours used in the Moodle interface. A study by [29] also found that navigating different courses can be challenging for some students. To address these issues, teachers can be trained to structure course content engagingly and to serve as facilitators in LMS discussions. Additionally, promoting communities of practice amongst teachers can also improve student and teacher engagement in online learning environments. The institution's administration can play a role in organising training programmes and promoting these initiatives.

5.3 Schoology

Another LMS that has gained recognition amongst scholars for enhancing student engagement in online learning is Schoology. Schoology provides the necessary features for the learning process as a LMS application is used by over 7 million users from more than 60,000 K-12 schools and higher education institutions worldwide [59]. Schoology seamlessly transfers the traditional face-to-face learning experience to an online setting without sacrificing its essence and goals. The application facilitates engagement with features, such as a chat option for students to communicate with each other. Teachers can use Schoology to plan their lessons, discuss with students, evaluate their performance, and even track assessments as grades are automatically calculated and recorded.

Besides, it does not require subscription fees and facilitates communication between teachers and students and student collaboration. Lessons and coursework can be easily created, shared, and managed through a social networking interface like Facebook [60]. A study by [37] found Schoology, particularly efficient for language students, providing various learning tools to help them organise their lessons and pace their learning.

According to [37], the Schoology interface was inspired by Facebook. Schoology is an innovative application with a user-friendly interface similar to Facebook, as illustrated in **Fig. 5**. The interface is simple and easy to navigate, allowing teachers to monitor student activity. The design of Schoology mirrors that of Facebook, enabling conversations, messaging, status updates, and media sharing within class networks [60]. Schoology provides a more engaging and interactive learning environment and has the potential to revolutionise education through its flexible, feature-rich, and fun application **Fig. 5**.
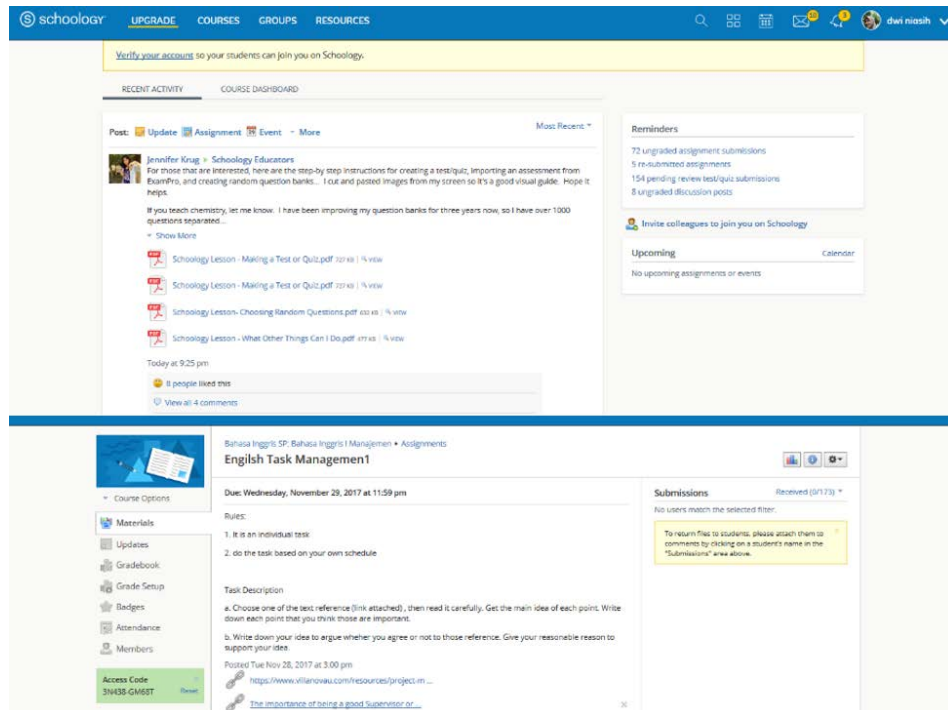

Fig. 5. UI of Schoology
Source: [60]

Schoology also offers collaborative learning opportunities, tailoring the learning experience to each student. The application includes tools for writing questions with symbols and equations and features an online assessment book, an attendance list, and user reminders [61]. Using symbols and relevant layout enhances user engagement [10], who noted that symbols serve as visual elements to attract users, and the layout focuses on ease of navigation. It makes it easier for students and other users to utilise the LMS in an online learning setting. As a result, Schoology has been identified as creating engagement for all users using it during online learning.

This section revealed the UI/UX of the selected LMS for this study, giving insights into creating a better communication environment and user engagement. Each LMS showed the importance of UI/UX, which benefits the user in navigating their learning process and improving their understanding when collaborating with the tools in the LMS. UI elements, such as colours, symbols, layout, and typography provide an insightful meaning and experience for the user to use the application. It also reveals the relationship between UI and Hofstede's cultural dimensions. However, the Hofstede's cultural dimensions were only outlined for Google Classroom, as there are few studies on Moodle and Schoology. Despite focusing only on CCD, UCD and UI/UX for LMS, the usability of the LMS must be reviewed to ensure the design quality of the LMS, which may increase user engagement [5].

6. A Review of Usability for Learning Management System (LMS)

Usability is an essential quality attribute that evaluates the ease of use of user interfaces [62]. According to Nielsen [4], usability consists of five attributes: learnability, efficiency, memorability, effectiveness, and satisfaction. These attributes contribute to creating pleasant interfaces and interactions. Previous researchers have used usability attributes to evaluate LMS usability [13], [63]. These attributes measure the user experience, specifically regarding user engagement when interacting with the application. However, usability problems for applications may arise due to variations in behaviour and cultural differences [3], [64]. Users from different cultures may interpret the same application differently, which could lead to confusion, misunderstanding, or even offence. Some metaphors, navigation, interaction, or application appearance may be misunderstood. Hence, it is crucial to evaluate the usability attributes appropriately. The descriptions of all usability attributes are outlined in **Table 3**.

Table 3. Descriptions of usability attributes

Usability Attributes	Description	Source/ Years
Learnability	Easy to learn. Users can start and complete the task quickly.	[13], 2017 [62], 2019 [64], 2017
Efficiency	Efficient to use and increase work productivity	
Memorability	Easy to remember. It is unnecessary to learn the system again after not using it for a long hiatus.	
Satisfaction	Pleasant to use. It makes users subjectively satisfied when using it	
Errors	Low error rate. The error is easy to recover by the user when they make a mistake. Catastrophic errors should not occur.	

Based on **Table 3**, the usability attributes introduced by Nielsen [4] are beneficial in creating a meaningful LMS design for an online learning environment. Usability attributes are critical factors that impact user's satisfaction and productivity as they engage users in acquiring knowledge and providing feedback [65]. In the context of LMS, usability is essential for teachers and students to facilitate the learning and teaching processes. In this study, a review of usability attributes has been conducted for selected LMSs (Google Classroom, Moodle, Schoology). This review is essential due to their usefulness and ease of use for both students and teachers, as they facilitate the learning and teaching process by using LMS. The results of the usability review for these selected LMSs are illustrated in **Table 4**.

Table 4. A review of usability for Google Classroom, Moodle and Schoology

Usability Attributes	Google Classroom	Moodle	Schoology	Source/ Years
Learnability	Layout & Focal Point, Closure	Easy and intuitive study-related tool	-	[29], 2021 [34], 2020 [41], 2020 [47], 2022 [67], 2018 [69], 2021 [72], 2020 [73], 2018 [74], 2020
Efficiency	Typography & Font Sen Serif, Dynamic Symbol Icon, Main Menu	Notification and reminders Additional features (quizzes, tests, task deadlines)	-	
Memorability	Symbol Icon, Main Menu	Symbol Icon	-	
Satisfaction	Colour Neutral and Contrast	Layout	-	
Strength	Clear design elements	Easy navigation	User Friendly	
Weakness	Lack of features for visual engagement	Inconsistency of button and colour	Fixed Icon and Font	

Based on **Table 4**, the analysis conducted by [47] reported on the usability attributes related to the UI and design elements for Google Classroom. Based on the previous analysis [47], **Table 4** was developed to review the usability attributes of Google Classroom, Moodle and Schoology in providing insights into the usability criteria that could examine user engagement with LMS.

As described in **Table 3**, the first attribute is learnability, which is particularly important in the usability quality of LMS. Google Classroom has recorded high learnability criteria due to its design that promotes learnability. According to [34], it has good learnability due to its easy navigation and convenient facilities for submitting and grading assignments. In addition, [41] found that undergraduates have positive intentions towards Google applications as a personal learning environment that makes it easy to learn with Google Classroom. It is because it has a simple interface that facilitates interaction. [47] concluded that the layout of Google Classroom is well-structured, has a focal point and closure, and has learnability criteria that makes it easier for students to navigate the content. Thus, it has become one of the most rapidly adopted online learning applications [34].

Learnability is an essential aspect of Moodle that has been evaluated in several studies [29]. For instance, a study by [29] found that students consider Moodle an easy and intuitive study-related tool that facilitates learning. The features in Moodle contribute to learnability attributes, such as deadlines and course completion percentages, which were identified as helpful for engaging students in the online learning experience. Besides, it has been supported by [66], who confirmed the positive experience of using the existing features in Moodle. Similarly, the

experiment by [67] showed that the learnability percentage in Moodle was calculated by determining the percentage difference between the completion time of the first round and its standard time, confirming the learnability attribute in Moodle. A shorter average task time in the first round indicates better learnability.

The efficiency attribute has also been demonstrated in Google Classroom [41]. The study claimed the easy adaptation to Google Classroom and familiarity with other Google applications. The study observed that the value of usefulness and ease of use were interlinked and can be traced to activities about assignment submission, notification and reminders, and accessibility. Regarding assignment submission, the study found the submission function to be the most valuable and effortless yet requiring time to master. Using symbols and typography also contributes to the efficiency of Google Classroom. It creates a better commitment for students to be more responsible with their assignments. The efficiency of Moodle has been demonstrated in its assignment section, which is one of the most essential and integral parts of an effective LMS. Assignments in Moodle involve online and offline tasks, such as quizzes, and students must submit their work online. Besides, additional features in Moodle, such as quizzes, tests, and task deadlines, improve student engagement and support teachers in using LMS for marks and grading [68]–[67].

Next are the attributes of memorability in Google Classroom UI design, whereby symbols and icons teach users how to interact with LMS repeatedly without learning it again. Next, several studies have evaluated the satisfaction of Google Classroom. According to the experiment by [41], all respondents expressed satisfaction with Google Classroom as a LMS and intended to use it in the future. [69] also reported similar findings, noting satisfaction based on the number of respondents who agreed with the advantages of the learning experience using Google Classroom.

The memorability attributes for Moodle have also been reported by [65], whereby the login icon is easy to remember, making it easier for users to memorise the steps to log into the LMS. The results showed that memorability in Moodle assessment is high, making Moodle user-friendly, which is also consistent with the study by [62], [68]. Finally, user satisfaction is crucial to usability, measuring how content users are with the LMS [65].

The study by [41] also found that usefulness, ease of use, and satisfaction were three interdependent factors influencing students to use Google Classroom. This was supported by [44], who mentioned that the satisfaction of using Google Classroom facilitated the basic needs of a LMS, including being user-friendly, systematic, and easy to learn. The satisfaction can also be observed by using neutral and contrasting colours in Google Classroom. Furthermore, [68] stated that satisfaction with Moodle can be evaluated by obtaining ratings from students regarding Moodle's usability, such as average ratings of usability properties, mean, and standard deviation. As a result, most students agreed with the satisfaction of Moodle. For example, students were satisfied with the layout, which allowed them to instantly see related events and ask for help by emailing to the system administrator. Similarly, a study by [56] demonstrated that the overall satisfaction level in Moodle is good. This was supported by [67], whereby the satisfaction survey recorded a higher average score, indicating a greater user satisfaction.

Reviewing usability attributes applicable to Google Classroom and Moodle, as few resources discussed Schoology's usability attributes, strengths and weaknesses in terms of UI/UX have been identified for all three LMS. The strength of Google Classroom lies in its clear design elements, such as colours, symbols, layout, and typography, which encourage users to engage with it effectively. However, it also lacks aesthetic appeal, which may lead to user boredom during the learning process, highlighting the need for improved features and

visual engagement, especially for primary school students [44], [70].

Next, Moodle exhibits strength in its easy navigation, a crucial factor influencing learning and teaching processes. Users expressed satisfaction with Moodle's navigation design, finding it efficient for task performance. However, Moodle's weaknesses include inconsistencies in button colour and placement across different pages, the presence or absence of back page buttons, a lack of a clear strategy for distinguishing visited and unvisited links, and unintuitive icons without supporting text to clarify their meanings [36], [71]. However, the improvement can be achieved by following the UCD principle, which focuses on user preferences to increase user engagement.

For Schoology, the primary strength is that it is a user-friendly platform [72], [73]. It is easy for teachers and students to find their courses and materials online, which makes it easy to navigate [74]. However, a weakness of Schoology is that the icons and profile images may not be appropriate for older learners, and the fixed font can make it difficult for students with disabilities. According to [29], in terms of UX, Moodle is better than Schoology in terms of attractiveness, dependability, and novelty. At the same time, Google Classroom remains with its clear UI design elements, leading to a more understandable navigation for the user.

Overall, the review of the usability attribute introduced by Nielsen is beneficial in creating a profound LMS design for an online learning environment. The learnability attribute is critical in achieving usability quality. Google Classroom is highly rated for its learnability due to its easy navigation and convenient facilities for submitting and grading assignments. Moodle also scores well in learnability, with its intuitive study-related tools and helpful features, such as deadlines and course completion percentages. Efficiency and satisfaction have been demonstrated in both Google Classroom and Moodle, with Google Classroom's easy adaptation and familiarity with other Google applications and Moodle's effective assignment section. The attributes of memorability for both Google Classroom and Moodle have been identified, which makes it the top LMS used by students and teachers in both schools and universities, as mentioned by [35], [65]. However, Schoology needs more attention on usability to reach the same levels as Google Classroom and Moodle, by addressing specific usability attributes for better user engagement. To this end, usability attributes in designing an LMS are essential to improve user engagement when using the LMS.

7. Conclusion

In conclusion, the importance of considering both CCD and UCD in the design of LMS has been highlighted in this study. Incorporating cultural dimensions into the UI design can improve the quality of the LMS design. At the same time, it is crucial to stress the understanding of CCD and UCD to support the development of practical UI/UX guidelines for LMS. Besides, integrating cultural dimensions and UCD principles can help design a more appropriate and engaging LMS for all users in the education sector in the 21st century. Comparing the findings and significance of UI/UX for LMS between various applications, such as Google Classroom, Moodle, and Schoology creates a deeper understanding of UI/UX in LMS. For example, it uses a suitable colour and font for a specific country. Based on the findings, the UI in Google Classroom eases the learning and collaborating process with its user-friendly look and clear symbols. It creates a better engagement with the user for online interaction by using a suitable layout, symbol, colour, and typography for LMS. As a result, appropriate LMS design by considering CCD, UCD, and UI/UX can enhance user engagement during the online learning process.

This study also reviewed the usability criteria for selected LMS, including learnability, efficiency, memorability, and satisfaction. It provides insight into considering usability attributes while designing the LMS to increase user engagement, especially when users interact with the LMS. The satisfaction attributes have been evaluated with both Google Classroom and Moodle. The respondents expressed satisfaction with Google Classroom as a LMS and intent to use it in the future. Besides, students are satisfied with the layout of Moodle, which allows them to see related events and ask for help. In general, Google Classroom and Moodle have been shown to facilitate the basic needs of being user-friendly, systematic, and easy to learn, and users have reported high satisfaction levels. However, more studies and reviews must be done on the memorability attributes of popular LMS, such as Google Classroom, Moodle, and Schoology, to ensure the quality of the LMS. While Google Classroom and Moodle have been evaluated for their usability attributes, Schoology as a LMS requires more attention, as a few studies in the existing literature.

As for the future, the study can be expanded by exploring usability attributes for other LMS, such as Schoology and Blackboard, since other researchers have extensively reviewed the number of studies on Google Classroom and Moodle. Moreover, it is worth looking into the cultural aspects of a particular country that are intertwined with UCD to improve user engagement with LMS. The guidelines incorporating CCD and UCD will be beneficial in assisting designers in creating LMS platforms that can enhance user engagement through effective interaction. For instance, the highlights of cultural factors that influence the usability, UI, and UX in this study provide insights into the usefulness of LMS design. Future studies can also be broadened by focusing on various stakeholders, including students, teachers, and parents, to gather their UI/UX experiences by using LMS as a communication channel. The study's outcomes may guide designers in improving LMS design and enhancing engagement for all stakeholders, ultimately providing a better-quality education experience in school.

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