

# Using a User Experience Evaluation to Improve a Learning Management System Created in Response to COVID-19

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## Abstract

User-experience (UX) evaluation is one approach to design a high-quality user experience for a product. UX evaluation aims to examine the effectiveness of a product and what end-users expect to do with the product to complete intended tasks. In education, adopting a learning management system (LMS) is critical for institutions. Thus, it is important to understand the users' needs and requirements in order to design a comprehensive LMS that provides the desired features in ways that are easy to use. The purpose of this study was to describe the process of a UX evaluation of a K-12 educational organization's LMS that was developed in-house in response to COVID-19. Data for this study was collected using a triangulation of methods: interviews, survey questionnaires, thinking-aloud, and focus-group discussions. The result of UX evaluation lists 19 problems that users had with their current LMS and 17 areas of the LMS where users wanted improvement.

## Keywords

Affordances, Usability Evaluation, Learning Management System, User Experience Design

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## 1. Introduction

Technological advancement over decades has led to evolution in the education sector. One of the manifestations of advanced technology is a learning management system (LMS). An LMS is technology software that offers services to support teachers in managing their curriculum instructions (Ouadoud & Chkouri, 2021). It provides services in areas such as management of content and sharing of educational resources. In addition, an LMS offers other kinds of tools: synchronous and asynchronous communication tools; and collaborative tools to support online instruction and students' success (Gomez, 2020).

Several studies have been conducted to examine the reasons behind non-adoption and user dissatisfaction with the use of an LMS (Al-Khalifa, 2010; Iqbal & Qureshi, 2011; Orfanou, Tselios, & Katsanos, 2015). The common issue of these non-adoptions was the complexity of using the LMS. End-users need simple, learnable, and easy-of-use systems. As a result, it is necessary to conduct a usability test examining the functions and available features in an LMS to determine the areas of improvement. In addition, Iqbal and Qureshi (2011) described the main barriers encountered by faculty in using an LMS and the functions they desire to have across public and private universities in Islamabad. A total of 98 responses outlined three major impediments: lack of training on using the LMS; lack of time for development of lessons; and lack of technical support from the university. In addition, these were the faculty responses regarding the functionalities they wanted in the LMS: promoting the creation of groups for collaborative activities among stu-

dents; sharing of files; adding discussion forums, announcements, quizzes, and exams; submitting of assignments; tracking of student performance; and grading features, including providing feedback on students' work.

According to Nakamura, Oliveira, and Conte (2017), user experience (UX) evaluation is an effective method to improve the quality of an LMS. User experience design is a thorough process of designing a product with the inclusion of usability, usefulness, accessibility, and the emotional and social impact of the interaction that occurs in the context of the usage (Hartson & Pyla, 2012). UX principles have shifted the UX design process from design centered on user performance to design centered on user experience, including everything that affects a user's interaction with the products: systems, services, and devices. Therefore, a UX researcher can define the constraints, performance problems, and essential requirements at an early stage of the UX design process, based on what people need; how they want it; and how they will use and interact with it.

Recently, several studies have examined the utility and usability of LMSs. Phongphaew and Jiamsanguanwong (2018) stated that usability evaluation would provide recommendations to developers to enhance the functional affordances of an LMS. In the end, users like to have an intuitive human-centric navigation experience without user-experience problems. For instance, Orfanou, Tselios, and Katsanos (2015) conducted a study to evaluate the usability of two learning management systems, Moodle and eClass. A number of (N=769) students from eight universities in Greek participated in this study. The study used the System Usability Scale (SUS) that was developed by Brooke (1996). The result of this study showed that the perceived usability of the LMSs was at a satisfactory level, and the analysis of this SUS data provided designers with insights into areas for improvement. Ghilay (2019) examined the effectiveness of the Moodle LMS in higher education based on the real experience of faculty members (n=45) who were using the Moodle LMS in teaching their courses. The study showed that the Moodle LMS needed to be enhanced in several areas: promoting interactions among students and faculty; promoting the features of posting video tutorials and computer-assisted assessments; and providing discussion forums and peer interaction.

Phongphaew and Jiamsanguanwong (2018) evaluated the usability of an LMS called myCourseVille that was launched in 2011 and implemented in many universities across Thailand. The myCourseVille LMS was developed to support instructors and students in higher education. Specifically, this study examined the usability of myCourseVille regarding user interface issues. Five undergraduate students and five instructors participated in this study. This study used the usability test developed by Nielsen (1993) that is based on five attributes: learnability, efficiency, memorability, effectiveness, and satisfaction. Phongphaew and Jiamsanguanwong (2018) conducted three rounds: The first round aimed to evaluate the learnability and effectiveness of the system by each participant, using scenario questionnaires without instructions or help information. The second round sought to complete the questionnaire of the usability test. The third round was conducted to evaluate the memorability. The results of this study showed that the students' interface problems resided in the inappropriate size and location of icons and texts throughout the system. In addition, there were difficulties in understanding the purpose and meaning of some icons in the interface. On the other hand, the instructors' interface issues were found on the layout of the interface, which increased the complexity of use. For example, instructors encountered difficulties in locating the registration function in the interface because it was located at the end of the page. Furthermore, some ambiguous terminologies needed revision.

## 1.1 Problem Statement

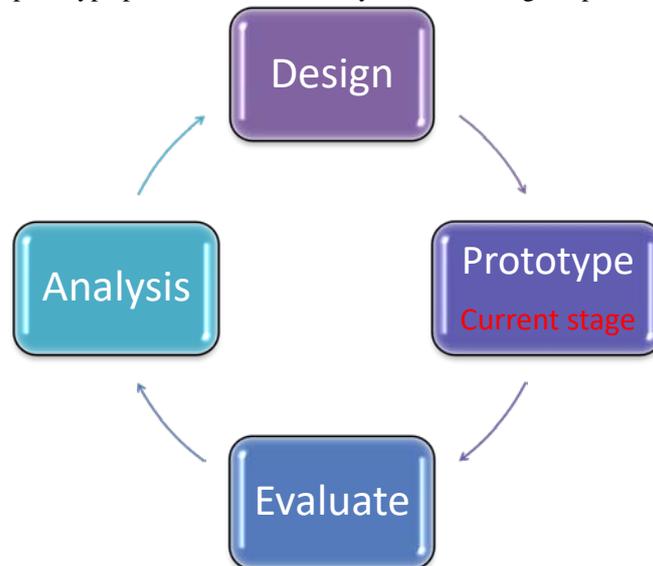
As COVID-19 spread out the world and affected education, some educational institutions were not adopting an LMS yet in their educational system. Consequently, the pandemic forced these institutions to adopt an LMS in a short period without passing the iterative process of analysis, design, prototype, and evaluation. Several organizations have adopted the Google Classroom due to the free version of the web-service applications. Other organizations preferred to build their own LMSs that were not aligned with the UX process and principles. The purpose of this study was to conduct a UX evaluation of a K-12 educational organization's LMS that was developed in-house in response to the emergent shifting to online learning in the academic year 2020/2021 during the COVID-19 pandemic. Teachers faced many issues in the use of this LMS in terms of its complexity, functionality, and effectiveness. Thus, we considered the current stage of the existing LMS as a first prototype that needed to be moved to the next step of testing and evaluation.

The current platform was designed for grades 1-4 to deliver blended learning through virtual classrooms and online learning. It was designed to enable teachers to submit resources and materials for their syllabus and to communicate, interact, and chat with their students. In addition, it helps teachers to assign tests and other tasks to students and follow their progress.

## 2. Methodology

This UX study took place in the academic year 2020/2021. The model used in this study is the Hartson and Pyla life-

cycle (2012), shown in Figure 1. The UX lifecycle begins in the design phase with understanding users' work and needs. Then, the users' requirements are translated into interaction design concepts that are subsequently used to produce a practical design called the prototype phase. The prototype phase uses iterative evaluation and testing with users until the desired results are reached. Finally, the product is distributed with continued evaluation for further refinement. In this study, the UX began with the prototype phase as it was used by schools during the pandemic.



**Figure 1.** UX lifecycle based on Hartson and Pyla (2012).

Overall, the UX evaluation was carried out in two rounds (Table 1). The first round was prototype testing using two methods: (1) Analyze the main features of the current LMS, based on the major components across LMS platforms. (2) Analyze the affordances of the current LMS in terms of look and feel. The second round evaluated the usability of the current LMS with two methods: first, evaluation based on teachers' experiences, using a standardized scale. The second round involved collaborating with schoolteachers and other key stakeholders in the organization, to determine their requirements for improvements in the current LMS. Each method is discussed below.

**Table 1.** Two Rounds of UX Evaluation in this Study

Round	Method	Outcome
First round	<ul style="list-style-type: none"> <li>• Analysis of the main features of the current LMS, based on the major components of LMS platforms</li> <li>• Analysis of affordances of the current LMS</li> </ul>	<ul style="list-style-type: none"> <li>• Determine the obstacles in the current LMS and the areas needing improvement</li> </ul>
Second round	<ul style="list-style-type: none"> <li>• Evaluation of usability of the current LMS: Standardized questionnaires</li> <li>• Evaluation of usability of the current LMS: Thinking-aloud focus-group discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Determine the users' requirements</li> </ul>

## 2.1 Research Questions

Q1. To what extent is the LMS implemented in the organization compatible with the major components across LMS platforms?

Q2. To what extent is the LMS implemented in the organization easy to use?

Q3. What are the areas needing development from the users' perspectives?

## 2.2 Participants

Specific participants were involved in each round of this UX study. In the first round, the participants of the study were a selected group of elementary teachers (grades 1-4) from seven regions across the country. The office management in each region was contacted to select two teachers who were sufficiently skilled at using the LMS. These teachers

(N=14) were classroom teachers of various subjects such as English or information technology. In addition, 150 elementary teachers were randomly selected to respond to a survey remotely.

In the second round, the elementary teachers (N=14) from the first round participated in a focus-group discussion about the improvements they wanted in the current LMS. The focus-group discussion also included key stakeholders (N=10) from areas of the organization such as the assessment center, supervision, information technology, the training center, and educational technology. These additional stakeholders were aware of the issues that had occurred in using the current LMS and had a vision for improvements based on the actual practices of the organization.

### 2.3 Measures

**First Round: Analysis of major components.** This analysis aimed to map the major components of the current LMS in the organization to the essential components that are known across LMS platforms. The seven categories used for this analysis were developed by Gomez (2020), as shown in Figure 2: navigation, content creation, communication, collaboration tools, assessments, grading, and user management.

**Navigation:** Navigation refers to the system interface that helps users to navigate from the dashboard through the different components of the system, including content area, assignments, and grading.

**Content creation:** The content area is where the instructional materials are created, curated, shared, and published through a rich-text editor. The materials include the syllabus, discussions, and assignments.

**Communication:** Communication refers to the reciprocal interactions between student and between the teacher and students, using a variety of tools such as email, discussion forums, chat rooms, and announcements.

**Collaboration tools:** The LMS has affordances that promote collaborative learning through group sites, Wiki pages, blogs, and conference tools.

**Assessments:** The assessments in the LMS are provided through assignments, discussion forums, and quizzes.

**Grading:** Grading in the LMS refers to grading students' work through features such as rubrics and grade books.

**User management:** User management is a part of the LMS administration. It refers to the LMS capability that allows each user in the system to be assigned a role as student, teacher, parent, or administrator.

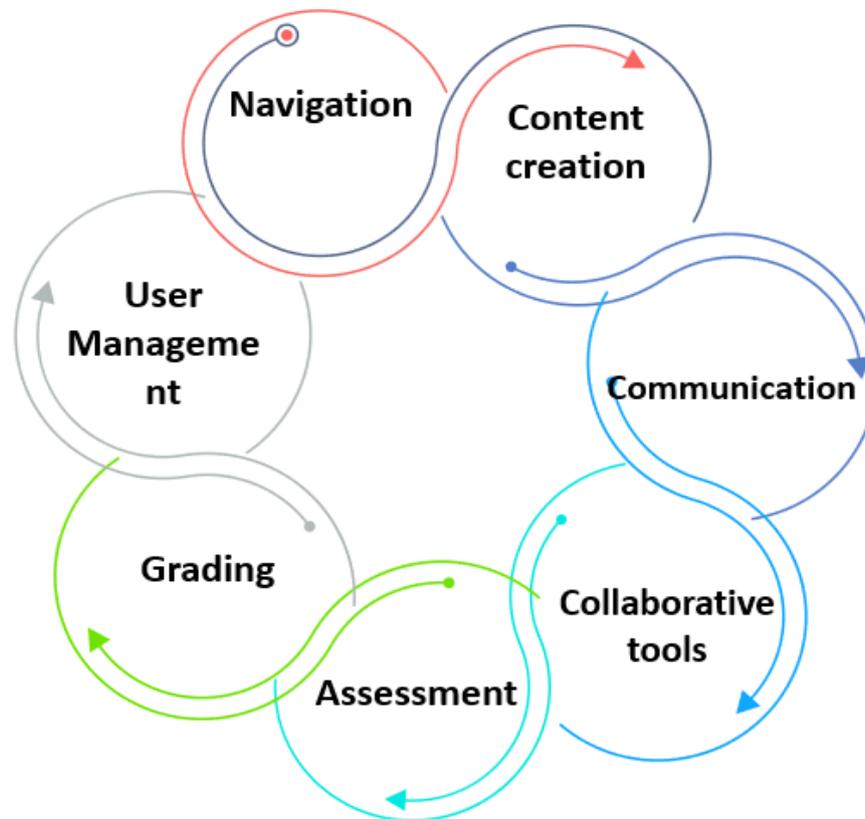
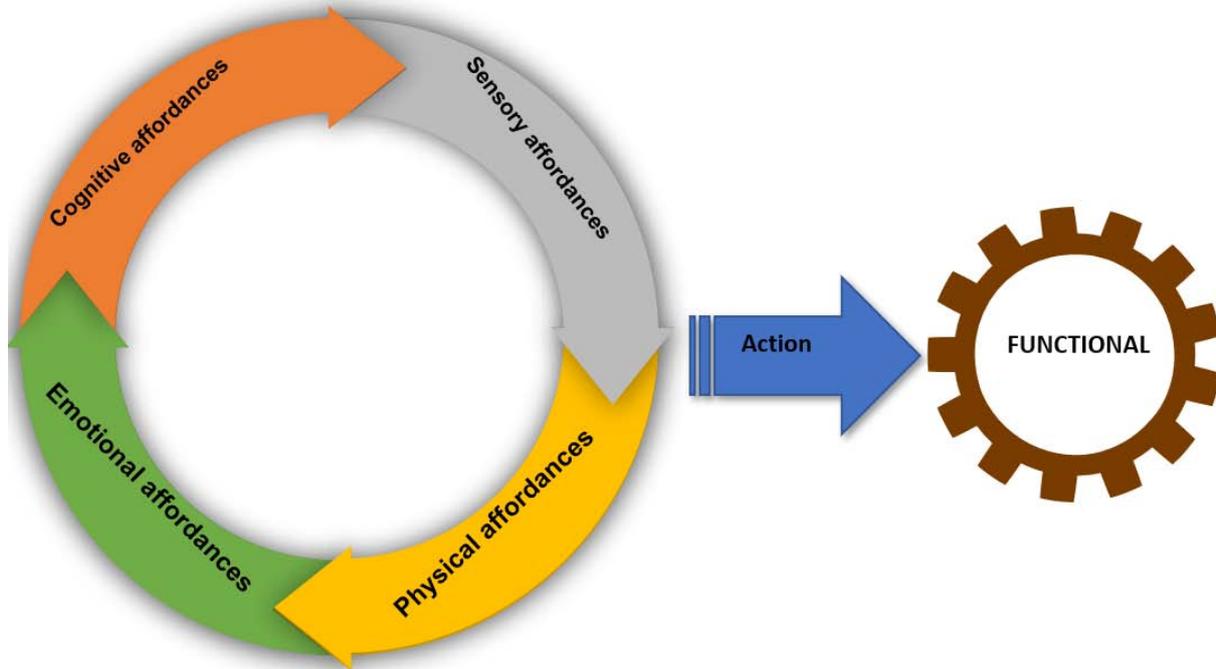


Figure 2. Major Components of an LMS, developed by Gomez (2020).

**First Round: Analysis of affordances of the current LMS.** The analysis process of the affordances of the current LMS was informed by Hartson and Pyla's (2012) four types of affordances, as shown in Figure 3: Cognitive affordances refer to the user's thinking about and remembering the LMS features; Physical affordances refer to the user's understanding to perform an action in the LMS such as touching or clicking. Sensory affordances refer to what they see and hear when they using the LMS. Emotional affordances refer to the user's feelings and attitudes about getting things done in the LMS. All these types of affordances help users to do actions to complete intended tasks in the system.



**Figure 3. Hartson and Pyla affordances (2012).**

**Second Round: Evaluation of usability.** Usability evaluation is a popular user-experience research methodology (Rohrer, 2014). It aims to improve the design of an LMS by studying realistic users of the service. Fourteen elementary school teachers were interviewed via Microsoft Teams, and 150 additional elementary school teachers responded to the questionnaires online. The purpose of this usability test was to understand the difficulties teachers faced and the issues they encountered that hindered them from delivering learning seamlessly. This determined the improvements to implement in the next phase of refining the functionality of the LMS to fulfill user needs. Two instruments were used in this usability test: standardized questionnaires, and thinking-aloud focus-group discussions.

**Second round evaluation of usability: Standardized questionnaires.** The researchers explained the standardized questionnaires and ensured the participants of the confidentiality of their responses to the items, in order to minimize the researcher's influence on the responses. The standardized questionnaire used for this usability testing was adapted from the LMS Usability Questionnaire (LMSUQ) (Al-Khalifa, 2008). The LMSUQ was constructed based on two questionnaires: the User Satisfaction Questionnaire and the Web-Based Learning Environment Instrument (Chang, 1999; Zins, Bauernfeind, Del Missier, Venturini, & Rumetshofer, 2004). The LMSUS consisted of 31 items in the following categories: design layout, functionality, ease of use, learnability, satisfaction, outcome/future use, errors/system reliability, emancipatory activities, co-participatory activities, and quality. A five-point Likert scale ranging from strongly agree (5) to strongly disagree (0) was used to rate the students' responses toward the statements in the LMSUQ questionnaire.

**Second round evaluation of usability: Thinking-aloud and focus-group discussions.** These methods were carried out virtually through Microsoft Teams. Three meetings were held with teachers and stakeholders to carefully understand the needs for improvements and determine how the problem areas will be improved and how they will look in the new LMS. Open-ended and probing questions were used to understand teachers' desires for improvement based on their experience with the current LMS throughout the academic year. In addition, these teachers were struggling from using this LMS, so their feedback was critical for improvement. As a result, the thinking-aloud and focus-group discussion were used to direct teachers toward testing particular tasks in the LMS and explaining the ways of improvement.

## 2.4 Procedures and Analysis

First, the LMS was analyzed based on the major components across known LMSs. Then, the affordances of existing LMS were analyzed based on Hartson and Pyla's (2012) four types of affordances. After that, to further understand and determine the pitfalls of the LMS, usability evaluation was conducted remotely with elementary teachers. The researchers sought the participants' consent for their participation in the study. The researchers explained that the main purpose of this usability evaluation was to explore the challenges and issues the participants faced in the use of the LMS, in order to improve its functionality. They explained that the participants' insight was critical for improving the design and features of the LMS. In addition, the researchers explained that the information would be confidential and would be used only for the study's purpose. The results of the first round were analyzed immediately step-by-step, then merged to determine the areas of improvement as presented in the results section.

Then, the focus-group discussions were used in three online meetings. The duration of each focus-group discussion was approximately one hour. In the thinking-aloud method, the facilitators/researchers asked the participants to provide their thoughts as they tested the system's functionality. In addition, the researchers demonstrated examples of open-source LMSs such as CANVAS. Over the course of the three online meetings, the documentation of the participants' requirements was developed in detail, along with the wireframes and paths of tasks in the intended LMS.

## 3. Results

### 3.1 Analysis of major components of the current LMS

The first round of this study aimed to compare the major components found across different LMSs with the current LMS (Table 1), using the categories of Gomez (2020). The results of the analysis showed that many components are unavailable, such as file management, communication tools (emails, Wiki, and Blogs), assessment options (projects, and final exams), grading options (descriptive reports, gradebook, and performance analytics), and user management privileges. In addition, several components that are available needed improvements: interface elements such as announcements and dashboard; content creation (rich-text editor); communication (discussion forums), and assessments features (assignments and short questions). The only components that were functioning well were the video conference and quizzes creation. The video conferences were linked to Microsoft Teams. The quiz features enabled teachers to create multiple types of questions (e.g., multiple choice, matching, fill-in-the-blank).

**Table 2. Comparison of the Major Components across LMS Platforms with the Current LMS**

LMS Major Components				
Component	Features	Available	Available and need improvement	Unavailable
Interface	Navigation/dashboard		☑	
Content creation	Rich-text editor		☑	
	File management			☑
Communication	Announcements		☑	
	Email communication options			☑
	Discussion forums		☑	

<b>Collaboration tools</b>	Video conferences	☑		
	Wiki pages			☑
	Group sites			☑
	Blog			☑
<b>Assessment</b>	Assignments		☑	
	quizzes	☑		
	Short questions		☑	
	Projects			☑
	Final exams			☑
<b>Grading</b>	Reports			☑
	Gradebook			☑
	Performance analytics			☑
<b>User management</b>	User privileges			☑

### 3.2 Analysis of affordances of the current LMS

Hartson and Pyla (2012) referred the user's experience of technology to the term *usability*, which measures aspects such as ease-of-use, satisfaction, effectiveness, efficiency, productivity, retain-ability, and learnability. Performing tasks in the LMS shows that there are barriers and difficulties in performing tasks seamlessly. Users need to consistently use the LMS in order to be able to recognize and remember how to perform tasks in the system. As a result, the analysis of the affordances in the current LMS shows its usability based on the four types of affordances: cognitive, physical, sensory, and emotional. Table 3 provides examples of the analysis.

### 3.3 The Usability of the LMS from the Teachers' Perspectives

Conducting a usability evaluation based on users' experiences provides data about the utility and ease to use of the LMS. A five-scale Likert scale (Strongly Agree {5}, Strongly Disagree {0}) was used to rate the teachers' responses toward the statements in the LMSUQ questionnaire. The midpoint of combining the data obtained from all teachers

(N=164) was (2.18), as shown in Figure 4. The data showed that the average responses were between disagree and strongly disagree. For example, participants' responses to statements 1 and 4 imply that the interface design was unpleasant for participants and the organization of information was confusing. Regarding participants' responses to the learnability statement, the data showed that there was too much information to read before they could understand how to use the system.

In addition, participants' responses to other statements found that teachers suffered from the inconsistency and the complexity in system functionalities. For example, participants reported that the information retrieved by the existing LMS was ineffective. It did not help them to complete the tasks as they had expected, and they felt uncomfortable using it because of the complexity. Regarding the statement outcome and qualia, participants' responses showed that they were unable to complete tasks quickly using this system (e.g., submit assignments, or post new content), and they felt it was a time-consuming task, unenjoyable, and they were unable to access materials quickly and readily.

**Table 3. Affordances Analysis of the LMS based on Hartson and Plya model (2012)**

Affordances Analysis of Existing LMS		
Cognitive Affordances	<ul style="list-style-type: none"> <li>- Difficulty understanding elements and links from the first time of use, as they do not suggest to the user what he/ she is supposed to accomplish.</li> <li>- The member's icon was not performing its intended purpose. When users click on the member's icon, it's expected that all student data including activities, duties, and student's status in attendance will be displayed.</li> <li>- Having more than one link for the same event.</li> <li>- Users can locate the calendar of synchronous classes through the system easily.</li> <li>- Different features are available on a single page, such as question bank, my library, new folder, new template, and new assignments. This confuse users about the purpose of the page and where to start first.</li> </ul>	
Physical Affordances	<ul style="list-style-type: none"> <li>- There is a drop-down menu in the top bar related to the organization's portal that distracts users from controlling the menu of the system.</li> <li>- The tabs of the system are not organized and are not clear in terms of their contents and the way to access them (for example, the forum).</li> <li>- The calendar is organized and synchronized to Microsoft Teams, so users do not face any difficulty.</li> <li>- Adding synchronous classes through the same page is easy and simple.</li> <li>- Discussion forums are designed for each subject without classification, which confused users about knowing where they should participate.</li> </ul>	
Sensory Affordances	<ul style="list-style-type: none"> <li>- There are no dedicated dashboards for different users. The dashboard is unified for all users, even for users with different roles.</li> <li>- There are no consistent terminologies for terms throughout the system.</li> <li>- Users need to do no less than 31 steps to perform some tasks, especially in creating assignments.</li> </ul>	
Emotional Affordances	<ul style="list-style-type: none"> <li>- Uncomfortable look and unsuitable for the age group (grades 1-4) in terms of colors, movement, organization of pages, links, and fonts.</li> <li>- There is an overlap between elements.</li> <li>- Office files such as Word and PowerPoint cannot be opened, and the student cannot download them.</li> <li>- There is no consistency between background colors and font colors.</li> <li>- Difficulty in getting tasks done quickly, which gives users a feeling of dissatisfaction from using the system.</li> </ul>	

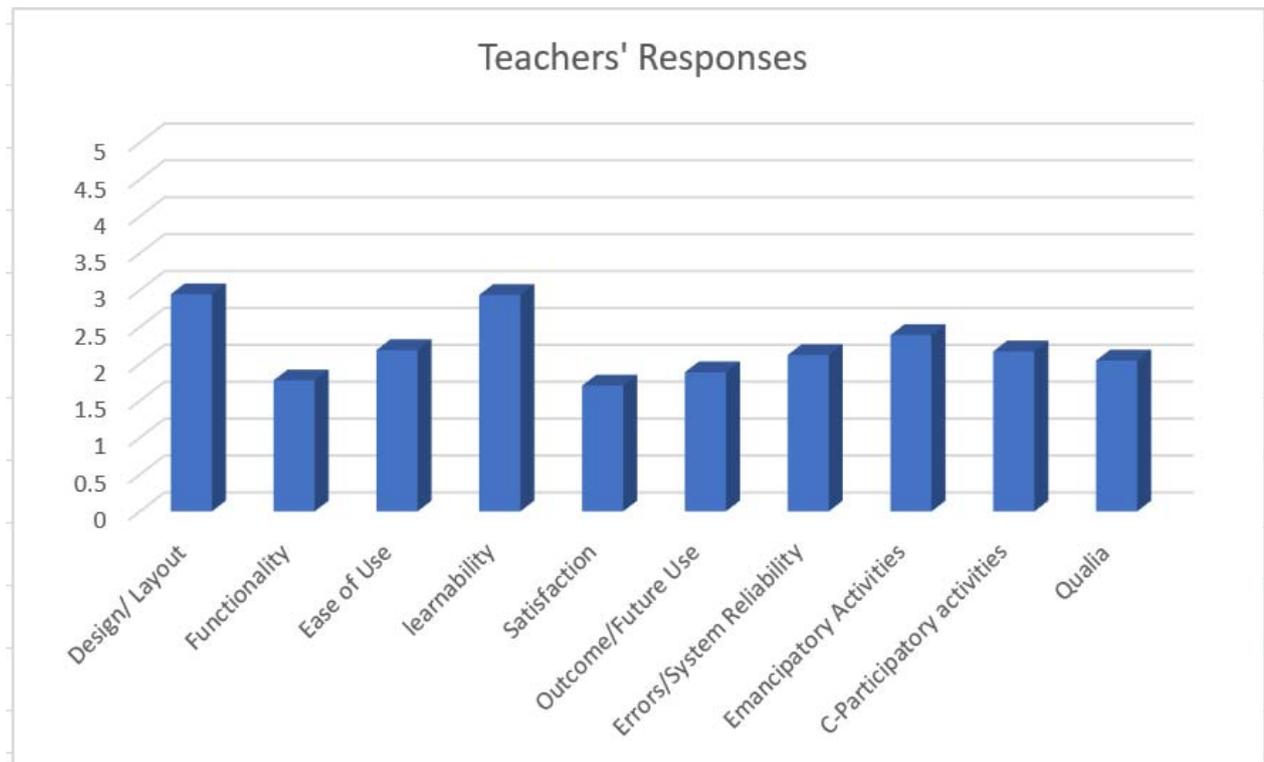


Figure 4. Teachers' responses on the LMSUQ developed by Al Khalifa (2019).

### 3.4 Problems with the Current LMS

Analyzing data from the focus-group discussions in the second round revealed 19 problems that teachers encountered in using the current LMS. The problems in each category are described below.

#### Problems in the LMS interface:

- 1) The interface design does not fit the characteristics of the students' age group.
- 2) Some tabs need re-organization based on their importance. They should be organized in a logical order (e.g., learning content should be first, before the forum).
- 3) The interface lacks notification features to inform students and teachers about particular tasks to complete, newly posted resources, and upcoming assignments.
- 4) There is a fixed discussion forum that appears on the teachers' interface that makes the page crowded.

#### Problems in using the LMS discussion forums:

- 5) The interface of the discussion forum is crowded and limited; only five threads showed up.
- 6) Teachers were unable to reschedule a discussion forum and link it to a specific lesson.
- 7) In the chats, teachers were unable to send a message to a particular student.

#### Problems in using the LMS content area:

- 8) The contents are scattered, unorganized, and unclassified. They must be classified according to units and lessons.
- 9) The system does not update the date of adding new content/ resources; the old materials remained.
- 10) The system does not support multiple formats of content. It only supports pdf files, hyperlinks, and PowerPoint files. For example, the system doesn't support images and video formats.
- 11) The platform is not compatible with different browsers and devices.

#### Problems in the LMS assignments:

- 12) There are too many steps (30 steps) to insert content into the system, making it a workload task for teachers.
- 13) Teachers were unable to link questions to a particular lesson.
- 14) The purpose of the question bank is not explained, so it is not clear how a teacher can benefit from the question bank.
- 15) *My library* in the system needs clarification. It is a duplication of the question bank.

- 16) There are no features to add audio to essay questions.
- 17) There is no feature to preview students' work; a teacher must download students' work to the teacher's device to review the students' work.
- 18) The system does not support notification features such as alerting teachers to the receipt of assignments by students.
- 19) Teachers were unable to assign tasks or assignments to particular students.

### 3.5 Areas of the Current LMS Needing Improvement

The data of this study shed light on the requirements for an LMS and 17 areas in the current LMS needing improvement:

- 1) There should be a different dashboard for each role: student, teacher, supervisor, school principal, and parent.
- 2) The navigation among functions in the system should be re-designed to be more user-friendly.
- 3) The LMS needs additional features of emails, notifications, profile files, discussion forums, and collaboration and communication tools.
- 4) There is a need for a student portfolio for each student, so that the teacher can follow the student's progress and plan accordingly.
- 5) There is a need for a user manual (system aid) that guides and supports users on using the platform readily.
- 6) The LMS needs to allow a discussion to be scheduled so that it is linked to a specific lesson and not be general. Each lesson must have its own discussion, so teachers can easily refer to and review all comments.
- 7) In each LMS instructional unit, the topics should be linked to related activities and the associated assignments.
- 8) The LMS needs to provide a variety of assessment tools such as multiple choice, fill-in-the-blank, yes/no, and projects.
- 9) The LMS needs to provide a variety of activities with the possibility of adding them as hyperlinks in the tasks.
- 10) To allow organizing the syllabus of a subject, the LMS needs to provide for classifying tasks as activities, assignments, exercises, or tests.
- 11) The LMS needs to allow for creating questions and linking them to the lessons, and the LMS should provide the capability to edit the questions and keep them in a library that can be reused.
- 12) The LMS should provide the capability to preview materials and download materials.
- 13) The LMS should provide supervisors and school principals with features for mentoring teachers and following students' performance through the system.
- 14) The LMS should provide parents with features such as notifications and communication channels, so they can follow up on their children's learning progress.
- 15) The LMS platform should support collaborative work and enable teachers to assign students to groups. As a result, teachers would be able to make assignments to specific groups of students.
- 16) The LMS platform should support cooperative work among teachers to share activities, assignments, and resources, both at the school level for a specific subject and at the regional level.
- 17) The LMS should make alerts available for both students and teachers in all aspects of the platform, including alerts to classes, assignments, tests, and results.

## 4. Conclusion

This UX evaluation study contributed to improving the affordances of the current LMS based on end-user perspectives. The results showed that teachers favored adopting an LMS to help manage the learning process, but the current LMS lacks many essential features. As a result of this UX evaluation, this study determined the areas needing improvements such as redesigning the interface to make it easy to use, adding features such as notifications, adding student portfolios (achievement files), enhancing the assessment tools, and adding tools for communication and collaboration. This study suggests that customizing a well-known LMS according to these intended requirements would be more effective in cost and time than improving the current LMS to meet these requirements. This study has a limitation in targeting only teachers in grades 1-4: these teachers had experience with the current LMS, and they contributed to the UX evaluation by explaining the barriers they faced and the improvements they desired. After a prospective LMS is selected to meet the requirements for teachers in grades 1-4, teachers in grades 5-12 will participate in customizing the prospective LMS for their grades.

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