

Customized moodle-based learning management system for socially disadvantaged schools

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ABSTRACT

This study aims to develop Moodle-based LMS with customized learning content and modified user interface to facilitate pedagogical processes during covid-19 pandemic and investigate how teachers of socially disadvantaged schools perceived usability and technology acceptance. Co-design process was conducted with two activities: 1) need assessment phase using an online survey and interview session with the teachers and 2) the development phase of the LMS. The system was evaluated by 30 teachers from socially disadvantaged schools for relevance to their distance learning activities. We employed computer software usability questionnaire (CSUQ) to measure perceived usability and the technology acceptance model (TAM) with insertion of 3 original variables (i.e., perceived usefulness, perceived ease of use, and intention to use) and 5 external variables (i.e., attitude toward the system, perceived interaction, self-efficacy, user interface design, and course design). The average CSUQ rating exceeded 5.0 of 7 point-scale, indicated that teachers agreed that the information quality, interaction quality, and user interface quality were clear and easy to understand. TAM results concluded that the LMS design was judged to be usable, interactive, and well-developed. Teachers reported an effective user interface that allows effective teaching operations and lead to the system adoption in immediate time.

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1. INTRODUCTION

Coronavirus disease (covid-19) pandemics persisted for almost two years and spread educational disruption in terms of learning and instruction around the world [1]-[3]. Schools and educational institutions have been impacted by the virus emergence and new regulations in minimizing the pandemic's effects. To prevent society from the virus threat and negative impact, almost all schools around the world limited their physical activities and educational interactions. Offline or on-site teaching and learning activities should be transformed into online instructions to support the continuation of educational practices during covid-19 pandemics. In response to this challenging situation, many educational institutions gradually and continuously implemented new technology supporting distance learning. More and more learning technologies have been developed in relevance with the need of distance educational practices in the time of covid-19 pandemics [4], [5]. The most needed application in facilitating and managing distance learning activities is learning management system (LMS) [6]-[9]. LMS has been widely adopted by schools and institutions to facilitate the creation, design, and delivery of course content through mobile devices or

websites. In general use, the implementation of LMS aimed at different learning purposes such as conventional classroom complementary activities and classroom management. However, in a pandemic's situation, LMS can replace completely physical presence among students, teachers, and staff members in terms of learning and instructions.

LMS facilitated online meetings, content management, presentation, and assessment using electronic devices [10]. Besides LMS's advantages, according to Awad *et al.* [11], the level of LMS utilization should be investigated particularly for teachers and students from socially disadvantaged schools because they may have limited access to the LMS and may have low digital literacy. Furthermore, although they have access to digital learning and have digital literacy, some of them may perceive low engagement and benefit from their time investment with LMS [12]. They lack access to distance learning support, whereas the need for education during school closures due to covid-19 pandemics cannot be denied. According to the result of a technical paper by Liabo *et al.* [13], access to online learning for socially disadvantaged schools can be supported by companies' or institution partnerships in order to provide digital learning software and educational resources. They also stated that educational technologies should be linked to existing and new curriculum so that they will align with the school's requirements. The government also should take a part in ensuring virtual teaching presence are equally well among all schools. Teachers and students required the highest possible level of interaction via an internet connection and digital learning technology during pandemics. Students are unlikely to thrive without frequent quality teacher interaction. Furthermore, the design of learning activities and assessment process during pandemics depend on the teachers. They are responsible for monitoring the activities of each student of their school. In terms of the pedagogical process, the provision of learning opportunities both synchronous and asynchronous during pandemics also becomes challenging for teachers. Teachers should provide assistance for students who have limited access to internet connection by performing asynchronous engagement and providing electronic learning materials such as e-book or learning videos. Schools also need to ensure that distance learning and educational materials can be accessed properly by disadvantaged students.

In this situation, the use of e-learning platforms or learning management systems becomes more important to support the continuation of learning and teaching practices. Socially disadvantaged schools required learning management system as well as the technical support that were free of charge. With the rapid enhancement made by technology, the use of LMS should be enhanced considerably to upgrade the features and the capabilities. Another problem also comes from the high price tag associated with LMS development for schools that may lead to digital inequality among schools. For schools with limited technical and financial resources, it was much better to use open-source software (OSS) such as modular object-oriented dynamic learning environment (Moodle) [14]-[17]. LMS working under an open-source license like Moodle can support the implementation of online learning for socially disadvantaged schools. Due to the flexibility, security, and customization, Moodle can accommodate an online teaching environment with no extra costs [18]. The effectiveness of LMS also fully depended on technology infrastructures and usability aspect. These considerations encourage the execution of this research study. We conducted this research with three main goals: 1) to develop Moodle-based LMS to bring digital learning equality in socially disadvantaged schools so that they have access to the digital learning tools during covid-19 pandemics; 2) to investigate the usability of the proposed LMS; 3) to understand teacher's acceptance toward the Moodle-based LMS in supporting the continuation teaching and learning practices during covid-19 pandemics. Using co-design activities, we invited teachers from socially disadvantaged schools in one of the eastern areas of Indonesia to involve in the LMS development and evaluation process i.e., usability evaluation and technology acceptance evaluation. This research may have contributed in terms of a general understanding of the LMS development process and LMS adoptions in relevance to the need of teachers from socially disadvantaged schools.

2. RESEARCH METHOD

In this study, a Moodle-based LMS to support distance learning activities for teachers from socially disadvantaged schools was developed based on a co-design process [19]. In educational context, co-design process refers to the involvement of teachers in designing educational innovations such as learning technologies and learning prototypes [20]. In this study, the authors defined co-design process as collaborative activity in which educational stake holders and software developers coming together as a team to design educational innovations and learning prototypes. It consisted of two important phases, the need assessment phase and the development phase. The teacher's need assessment phase was conducted by distributing an online survey and interview session. Need assessment activity was performed to examine the general understanding of teacher's current needs, barriers, and challenges faced in relation to their use of LMS during the covid-19 pandemic. On the other hand, we also provided a brief report on the Moodle-based

LMS development phase. Co-design process in educational context facilitates teachers, educational stakeholders (i.e., administrators, students, and school staff members), and IT experts to discuss existing problems and design the appropriate solutions. After co-design process, the system was tested and reviewed by the teachers ($N=30$) in terms of usability issues and their personal acceptance toward the system. We used standard questionnaires from computer system usability questionnaire (CSUQ) version 3 as a theoretical framework to address the usability issue of the system consisting of 16 survey items with responses based on a 7-point scale. CSUQ has been widely used to measure perceived usability and has been categorized into three subscales consisting of system quality, information quality, and interface quality [21], [22]. Furthermore, to examine teacher's acceptance toward the proposed LMS, technology acceptance model (TAM) was employed with responses based on a 5-point scale. The framework consists of three original constructs comprising of perceived usefulness (PU), perceived ease of use (PEU), and behavioral intention to use (BIU) the proposed system [23], [24]. In this study, we added external variables into TAM such as attitude toward the system (ATT), perceived interaction (PI), self-efficacy (SE), user interface design (UID), and online course design (OCD) in order to gain better insight of teacher's acceptance toward our proposed LMS [25].

3. RESULTS AND DISCUSSION

3.1. Summary report of co-design process

The co-design process followed two important phases, i.e., the need assessment phase and the development phase of Moodle-based LMS. Need assessment phase resulted in a summary report on the key content and features of the learning management system suggested by a total of 112 teachers through an online survey and interview session. The report also included a brief overview of the developed system in terms of user interface design and learning content. Suggested features for the proposed learning management system can be found in Table 1.

Table 1. Key content and features of the application suggested by teachers ($N=112$)

Suggested LMS features	Status
Online homework/task assignment	Installed
Online assessment	Installed
Assignment notification to students	Installed
Automatic assignment correction	Installed
Task collaboration	Installed
Individual task completion	Installed
Collaboration task completion	Installed
Task scheduling	Installed
Reporting and class management	Installed
Learning content creation (figures, documents, audio, link, and video)	Installed
Quiz creation	Installed
Embedded external link	Installed
Incorporation of learning with Zoom meeting	Installed
Attendance record	Installed
Forum/chatting	Installed

The development process incorporated the concepts related to the development of Moodle-based LMS which consists of two stages: content development and prototype development. Content development was tailored to the existing and new curriculum of elementary schools in Indonesia and was validated by the teachers after completion. As a pilot study, we only build learning materials for the fifth and sixth grade of students consisting of three subjects i.e., natural science, social science, and mathematics. The results of content development can be found in Figure 1. On the other hand, the development stage of Moodle-based LMS included the activities such as server procurement, Moodle installation, features selection, source code editing for user interface customization, creating portal's identity, and managing the courses. We used a virtual private server (VPS) to install the Moodle because of the reliability and complete control. VPS allows users to control, manage, and configure the Moodle server completely so that it can match with the school's business needs [26]. Using VPS, Moodle can be accessed by multiple users at the same time quickly so that teachers and students can experience online learning without performance issues. After Moodle installation, the authors modified the code to customize the user interface design. Even though it provided a good framework for distance learning, Moodle is static with minimal functionalities. Authors made some modifications in HTML/CSS/PHP/Javascript file to provide aesthetic value to the proposed Moodle-based LMS. This activity contributes to the better content and user interface design of Moodle. In the final development phase, the Moodle-based LMS is hosted online and all school members can access the material

any time after completing the registration process. The results of LMS prototype development can be found in Figure 2.

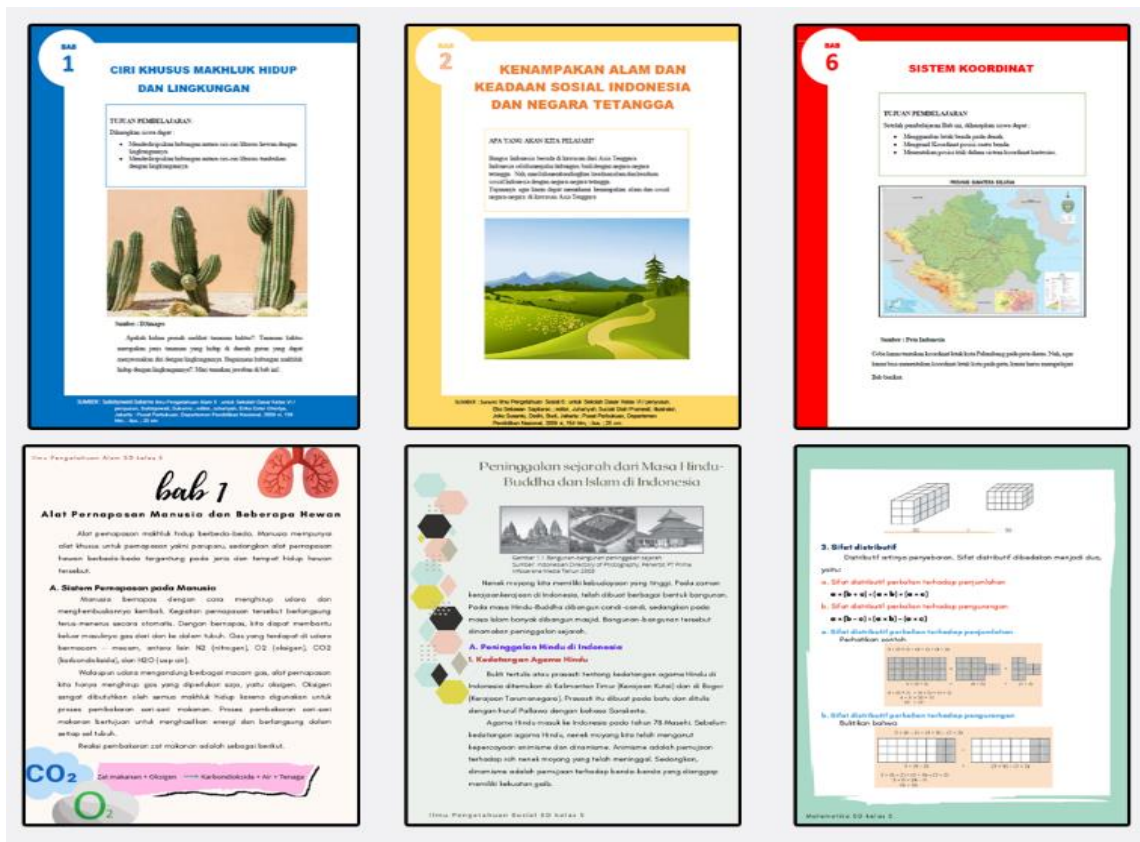


Figure 1. Content development result

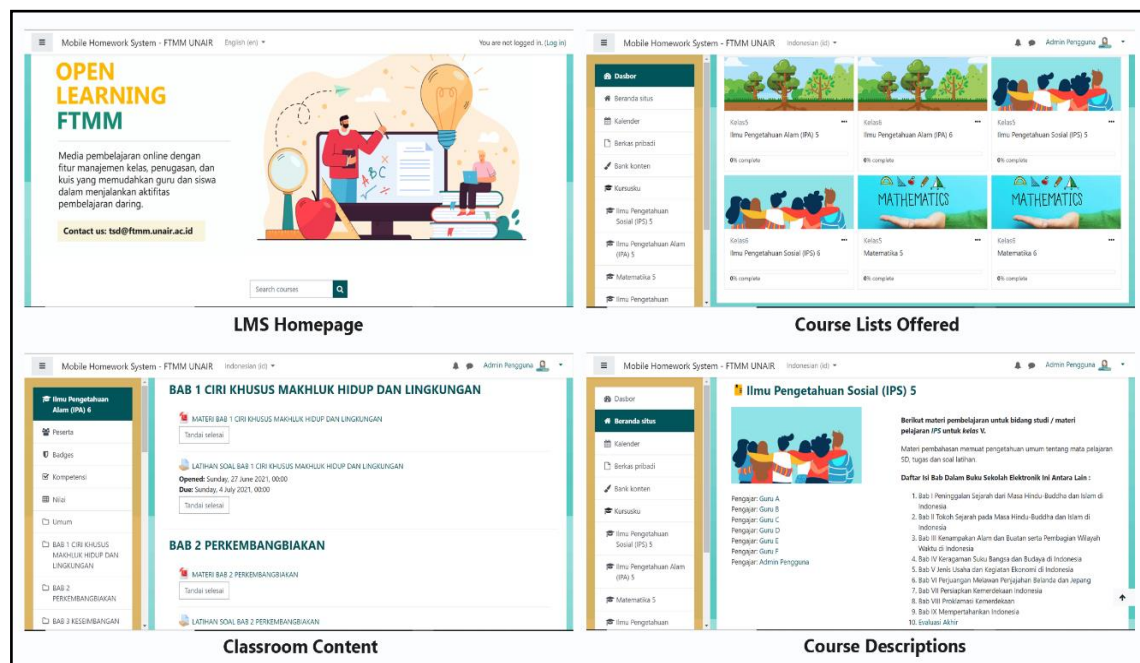


Figure 2. Prototype development result

3.2. Usability test

Before performing the system evaluation method, the participants of this research i.e., teachers from socially disadvantaged schools were asked to do some tasks with the system such as accessing the system, managing class, student's task assessment, and managing homework. Participants also signed a consent form to make clear the purposes of this study and ask them permission regarding research material shared and used. We used standard and well-established questionnaires based on computer system usability questionnaire (CSUQ) version 3, with a total of 16 items of statement and a 7-point scale. CSUQ has been widely used for measuring and exploring usability issues of software products. All CSUQ statements are positive in tone. Evaluating the usability of the proposed Moodle-based LMS involved the quality of the system, the information, and the user-interface. The results of the usability test including percentages of the CSUQ ratings and descriptive statistics of the CSUQ scores are shown in Table 2 and Table 3, respectively. The mean score of each CSUQ statement exceeded the score of 5 with the maximum value is 7 as the score for a strong agreement. The score of system quality, information quality, and interface quality ranged from 5 to 7. This result indicated positive responses perceived by the teachers in terms of system quality, information quality, and interface quality.

Table 2. Percentages of the CSUQ ratings for Moodle-based LMS prototype (N=30)

Items	Scale: Strongly Disagree to Strongly Agree						
	1	2	3	4	5	6	7
SQ1	0(0%)	0(0%)	1(3.3%)	1(3.3%)	7(23.3%)	11(36.7%)	10(33.3%)
SQ2	0(0%)	0(0%)	0(0%)	1(3.3%)	7(23.3%)	10(33.3%)	12(40%)
SQ3	0(0%)	0(0%)	1(3.3%)	2(6.7%)	8(26.7%)	10(33.3%)	9(30%)
SQ4	0(0%)	0(0%)	1(3.3%)	2(6.7%)	4(13.3%)	15(50%)	8(26.7%)
SQ5	0(0%)	0(0%)	0(0%)	2(6.7%)	7(23.3%)	10(33.3%)	11(36.7%)
SQ6	0(0%)	0(0%)	2(6.7%)	1(3.3%)	10(33.3%)	10(33.3%)	7(23.3%)
SQ7	0(0%)	0(0%)	1(3.3%)	3(10%)	7(23.3%)	15(50%)	4(13.3%)
SQ8	0(0%)	0(0%)	1(3.3%)	4(13.3%)	11(36.7%)	12(40%)	2(6.7%)
IFQ1	0(0%)	0(0%)	0(0%)	1(3.3%)	6(20%)	13(43.3%)	10(33.3%)
IFQ2	0(0%)	0(0%)	0(0%)	1(3.3%)	7(23.3%)	12(40%)	10(33.3%)
IFQ3	0(0%)	0(0%)	1(3.3%)	3(10%)	5(16.7%)	14(46.7%)	7(23.3%)
IFQ4	0(0%)	0(0%)	0(0%)	2(6.7%)	5(16.7%)	13(43.3%)	10(33.3%)
INQ1	0(0%)	0(0%)	1(3.3%)	2(6.7%)	10(33.3%)	11(36.7%)	6(20%)
INQ2	0(0%)	0(0%)	1(3.3%)	1(3.3%)	9(30%)	12(40%)	7(23.3%)
INQ3	0(0%)	0(0%)	0(0%)	2(6.7%)	10(33.3%)	15(50%)	3(10%)
INQ4	0(0%)	0(0%)	0(0%)	3(10%)	6(20%)	14(46.7%)	7(23.3%)

Table 3. Descriptive statistics of the CSUQ scores (N=30)

Aspect	Items	Mean	Std. Deviation
System quality (SQ)	SQ1	5.93	1.015
	SQ2	6.10	0.885
	SQ3	5.80	1.064
	SQ4	5.90	0.995
	SQ5	6.00	0.947
	SQ6	5.63	1.098
	SQ7	5.60	0.968
	SQ8	5.33	0.922
Information quality (IFQ)	IFQ1	6.07	0.828
	IFQ2	6.03	0.850
	IFQ3	5.77	1.040
	IFQ4	6.03	0.890
Interface quality (INQ)	INQ1	5.63	0.999
	INQ2	5.77	0.971
	INQ3	5.63	0.765
	INQ4	5.83	0.913

3.3. Moodle-based LMS acceptance

In this study, we employed technology acceptance model (TAM) as a theoretical framework to describe factors determining the use of Moodle-based LMS by teachers from socially disadvantaged schools and their intention to use the system. Three TAM original variables comprising of perceived usefulness (PU), perceived ease of use (PEU), and behavioral intention to use (BIU) are used in this study [27], [28]. The results of survey responses for the TAM original construct are presented in Table 4. The mean score of all TAM internal or original constructs exceeded the value of 4.1667, with the maximum score is 5. This result indicated that the use of the proposed Moodle-based LMS by teachers would be free of effort. It also

indicated that the system is not difficult to use by the teachers although they come from socially disadvantaged schools. Besides, all teachers also perceived that using the proposed LMS would enhance their job performance in terms of learning and instruction. In addition, we noted that all items of BIU exceed 4.2667 indicating teachers' positive intention to adopt and use the system for distance learning during covid-19 pandemics. Furthermore, Table 5 showed survey responses for TAM external variables including 1) Attitude (ATT), which refers to teacher's belief that it is a good idea to use the Moodle-based LMS; 2) self-efficacy (SE), refers to teacher's self-confidence in their capability to seek for information and their skill with the use of learning technologies [29]; 3) online course design (OCD), describes teacher's important role in designing of online courses; 4) perceived interaction (PI), defines human-system interaction and interpersonal interaction; and last; 5) user interface design (UID), defines user-centered aspect and critical factors for software development. The entire TAM external constructs i.e., ATT, SE, OCD, PI, and UID obtained a mean value of more than 4.1 which concluded teacher's positive acceptance toward the proposed LMS.

Table 4. Survey responses for TAM original construct (N=30)

Construct	Survey items	Mean	SD
Perceived Usefulness (PU)	PU1	4.333	0.60648
	PU2	4.3667	0.61495
	PU3	4.3667	0.61495
	PU4	4.5000	0.57235
Perceived Ease of Use (PEU)	PEU1	4.3000	0.70221
	PEU2	4.1667	0.69893
	PEU3	4.2000	0.76112
	PEU4	4.4333	0.67891
Behavioral Intention to Use (BIU)	BIU1	4.4000	0.67466
	BIU2	4.2667	0.73968
	BIU3	4.2667	0.73968
	BIU4	4.3667	0.71840

Table 5. Survey responses for TAM external construct (N=30)

Construct	Survey items	Mean	SD
Attitude toward the system (ATT)	ATT1	4.5667	0.67891
	ATT2	4.7000	0.53498
	ATT3	4.4000	0.67466
Online Course Design (OCD)	OCD1	4.2333	0.77385
	OCD2	4.2667	0.78492
	OCD3	4.3000	0.74971
	OCD4	4.4000	0.72397
User Interface Design (UID)	UID1	4.2000	0.71438
	UID2	4.4000	0.56324
	UID3	4.3333	0.66089
	UID4	4.4333	0.56832
Perceived Interaction (PI)	PI1	4.1333	0.81931
	PI2	4.0667	0.78492
	PI3	4.3000	0.70221
Self-efficacy (SE)	SE1	4.2667	0.58329
	SE2	4.3333	0.71116
	SE3	4.2333	0.72793

4. CONCLUSION

The goals of conducting this research using co-design process, CSUQ and TAM model as a theoretical frameworks are: 1) to develop Moodle-based LMS in order to bring digital equality in socially disadvantaged schools so that they can have access to the digital learning tools during covid-19 pandemics; 2) to investigate the system quality, interface quality, and interaction quality of the proposed LMS; 3) to understand teacher's acceptance toward the Moodle-based LMS in supporting the continuation of educational activities during the pandemic of covid-19. With regard to the CSUQ survey responses by the teacher of socially disadvantaged schools, we found that our proposed system has good system quality, interface quality, and interaction quality to facilitate distance learning during covid-19 pandemics. This result provides evidence that Moodle-based LMS can be used by the teachers of socially disadvantaged schools to provide a good learning environment for students. Moodle-based LMS provided appropriate facilities and a good environment for teaching and learning practices. In addition, strengthening this finding, we also conducted an evaluation of teacher's acceptance toward the proposed LMS and the results confirmed that the system is

easy to use and more useful for facilitating the pedagogical process in the distance learning environment. Teachers from socially advantaged schools also perceived that they can attain significant benefit through interaction with the system and gain a positive attitude toward the system. Their intention to use the proposed LMS would be stronger as they did not face any difficulties while using the system. User interface design and online course design also were considered as motivational factors for the teachers to use the system. Overall implications of the results should be used for developing countries to provide equity of education facilities, proper learning environment, and opportunities so that teachers from socially disadvantaged schools can attain better performance in pedagogical process during covid-19 pandemics.

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