

Optimizing Learning Management Systems for Elderly Teachers in Indonesia Using a User Experience-Based Design Thinking Approach: A Case Study at SMAN 77 Jakarta

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Abstract- Learning Management Systems (LMS) have become essential tools in educational institutions for delivering online learning experiences. Despite their widespread adoption, many elderly teachers face considerable challenges in navigating and operating these platforms, which can hinder the effectiveness of the teaching and learning process. Recognizing this issue, the present study focused on developing a more user-friendly LMS tailored specifically for elderly teachers by employing a design thinking approach. This approach, known for its human-centered and iterative nature, involves five key stages: empathy, problem definition, ideation, prototyping, and testing. The study involved 30 participants, including senior teachers, younger teachers, and LMS administrators, to ensure a comprehensive understanding of user needs and to foster collaborative development. During the empathy stage, the specific difficulties faced by elderly teachers were identified, and these insights guided the formulation of the core problems. Ideas for improving the LMS interface and functionality were generated and transformed into prototypes, which were subsequently tested and refined based on user feedback. Evaluation of the final LMS design involved expert validation in UI/UX, as well as the use of two established usability instruments: the User Experience Questionnaire (UEQ) and the System Usability Scale (SUS). Results showed significant improvements in user satisfaction and usability. The UEQ scores reached the “excellent” category, with the lowest score being 1.815, indicating high user experience across various dimensions. Additionally, the SUS score improved markedly from 50 to 76, highlighting a substantial increase in perceived usability. These findings suggest that the design thinking approach is highly effective in addressing usability issues and can lead to the development of more accessible and comfortable LMS platforms for elderly educators.

Keywords: Learning Management System, Design Thinking, User Experience, User Experience Questionnaire, System Usability Scale

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1. Introduction

Learning Management System (LMS) is a web-based application that can provide access to materials to students at any time online [1]. LMS plays a role in managing all aspects of the learning process, such as class administration, ability analysis, monitoring, and reporting, and has developed along with the development of learning models [2]. One of the LMSs that is often used is Moodle. Moodle is an open-source LMS that has a variety of features, is flexible and can be easily customized, and is available in various languages [3].

In Indonesia, the use of technology in education is part of the digital transformation promoted by the government through the *Merdeka Belajar* (Freedom to Learn) policy and the school digitalization initiative [4]. One way to implement this is through the utilization of online learning systems such as Learning

Management Systems (LMS) to support technology-based learning. However, the adoption of LMS has not been fully inclusive, particularly for older teachers, who make up a significant portion of the teaching workforce in various regions. This group often experiences difficulties in using LMS due to limited digital skills and a lack of training tailored to their specific needs [5]. It has been emphasized that many teachers, particularly those over 40 years old, struggle to adapt to educational technology due to low digital literacy and a lack of motivation [6]. National reports also indicate that educational technology infrastructure across regions remains uneven, further exacerbating the challenges of adaptation for teachers who are not yet familiar with the digital ecosystem [7]. Similar challenges are also found in primary schools, where older teachers face internal and external barriers in using digital media. Uneven infrastructure across regions further complicates adaptation for those unfamiliar with the digital ecosystem [8].

The COVID-19 pandemic has led to a change in learning methods to online and has an impact on the use of LMS, which is increasingly widespread in formal school environments [9]. The use of LMS as an online learning tool enables blended learning methods even when the pandemic is over because it is perceived as a better learning alternative [10]. This makes teachers, regardless of age or educational background to at least have the ability to use basic LMS technology in order to adapt to the times and provide good teaching for students.

Although teachers in general do not mind using LMS as a new learning medium, this does not seem to apply to older teachers. Older teachers are not interested in using LMS because they do not have the technical knowledge of using the technology and find it difficult to adapt [11]. Older teachers are still required to master the LMS despite all the difficulties faced; therefore, support is needed to help teachers in this age group so that they are not left behind with the times.

The elderly category in the Regulation of the Minister of Health of the Republic of Indonesia concerning the National Action Plan for Elderly Health is people aged 45 to 49 years are called pre-elderly, ages 60 to 69 are called elderly, and above 70 years are referred to as high-risk elderly [12]. Following these regulations, this study has a definition of a range of ages for the older teachers as people aged above 45 years.

This research focuses on creating an LMS that has a high User Experience (UX) value, especially for older teachers. A high UX value ensures that the use of a product or service provides a positive experience to the user, which impacts the comfort of using the product or service [13]. UX can be assessed using the User Experience Questionnaire (UEQ). In addition to UX testing, the resulting prototype will also be tested using the System Usability Scale (SUS) to assess the level of usability of the prototype. Usability testing aims to evaluate whether a product can be used easily and well and how the user experience is when using the product [14].

The method used to design this LMS is Design Thinking (DT). DT is a design process that makes empathy the focus of design. DT has five phases, namely empathize, define, ideate, prototype, and test. The five phases are not always sequential and can be done repeatedly [15]. The use of this method is expected to help create a design that has good UX value, especially helping teachers who are elderly.

2. Methods

The design of the LMS prototype is based on the Design Thinking method, visualized in Figure 1. The design has five stages, namely the analysis, design, development, implementation, and evaluation stages. The initial stage begins with identifying existing problems and then formulating the problem and conducting a literature study as a reference material in overcoming the problem.

The development of the prototype software is using the Design Thinking method combined with the Software Development Life Cycle (SDLC) Prototyping method (Figure 2). SDLC Prototyping allows a software to be developed continuously until it meets the needs of the software requirement [16].

Data was collected using interviews and observation methods. The testing of the software is done using UEQ and SUS, which are also used to test the LMS that had previously been used as a comparison with the prototype to be made.

UEQ is a tool to get a user experience assessment consisting of 26 questions divided into 6 scales [17]. The UEQ calculation results will be processed using a data analysis tool that will compare

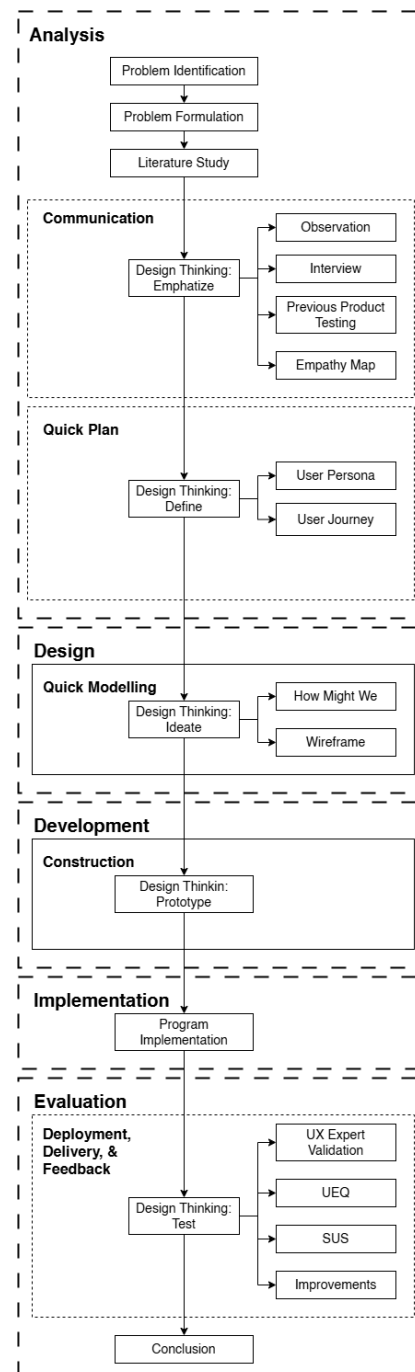


Figure 1. Research Stages

the value with the average value of the results of 468 studies that have been collected previously by the UEQ team.

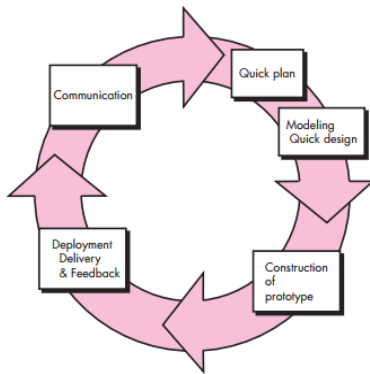


Figure 2. SDLC Prototyping

Table 1. Benchmark for UEQ Scale

	Att.	Eff.	Per.	Dep.	Sti.	Nov.
Excellent	≥ 1.72	≥ 1.64	≥ 1.82	≥ 1.6	≥ 1.50	≥ 1.34
Good	≥ 1.50 < 1.72	≥ 1.31 < 1.64	≥ 1.37 < 1.82	≥ 1.4 < 1.6	≥ 1.31 < 1.50	≥ 0.96 < 1.34
Above average	≥ 1.09 < 1.50	≥ 0.84 < 1.31	≥ 0.90 < 1.37	≥ 1.06 < 1.40	≥ 1.00 < 1.31	≥ 0.63 < 0.96
Below average	≥ 0.65 < 1.09	≥ 0.50 < 0.84	≥ 0.53 < 0.90	≥ 0.70 < 1.06	≥ 0.52 < 1.00	≥ 0.24 < 0.63
Bad	< 0.65	< 0.50	< 0.53	< 0.70	< 0.52	< 0.24

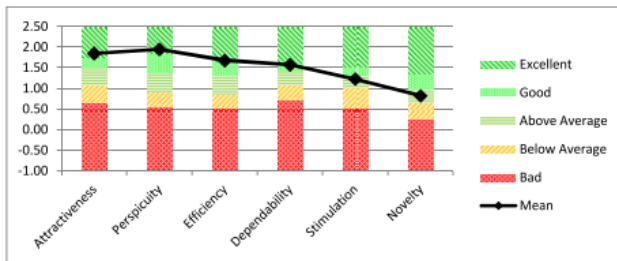


Figure 3. Graph of Benchmarks in the UEQ Data Analysis

The existence of benchmarks makes user experience assessment easier. A good product at least reaches the good limit in each aspect of its UEQ [17]. The aspects calculated in UEQ are Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty.

In addition to using UEQ, SUS is also used as a tool to test product usability. SUS is a standardized questionnaire that emerged because of the need for a method to test the usability of a product. SUS has the advantage of flexibility because it is not affected even if there are small changes in the wording of the questionnaire. In addition, SUS has also been translated into several languages so that it can be easily implemented. SUS consists of ten questions that have answers on a scale between 1 and 5 [18].

Table 2. SUS Question

No	Question
1	I think that I would like to use this system.
2	I found the system unnecessarily complex
3	I found the system unnecessarily complex
4	I think that I would need the support of a technical person to be able to use this system
5	I found the various functions in the system were well integrated.
6	I thought there was too much inconsistency in this system
7	I would imagine that most people would learn to use this system very quickly
8	I found the system very cumbersome to use.
9	I felt very confident using the system
10	I needed to learn a lot of things before I could get going with this system

The data collected through SUS is then calculated into a final score by looking at the number of questions, whether odd or even. Odd question numbers will be reduced by 1 scale, while even question numbers will get a deduction value of 5. The total SUS final score is divided into three intervals, namely Not acceptable, Marginal, and Acceptable [19] (see Figure 4).

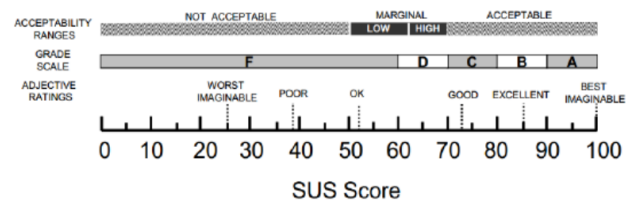


Figure 4. SUS Score

3. Result and Discussion

This study employed the Design Thinking approach as the primary framework for designing and developing a user-centered Learning Management System (LMS). The Design Thinking process consists of five phases—empathize, define, ideate, prototype, and test—which are iterative and not necessarily linear. Each phase of this approach was used to explore user needs, define problems, generate ideas, create prototypes, and test solutions directly.

In this study, the implementation of Design Thinking was carried out step-by-step and combined with various evaluation methods, such as expert validation, usability testing using the User Experience Questionnaire (UEQ), and user stability testing. The outcomes of each phase are explained in detail in the following sections, along with an analysis of findings based on user feedback and data collected throughout the development process.

1. Empathize

This stage is where researchers try to empathize with users. This stage is combined with the communication stage in

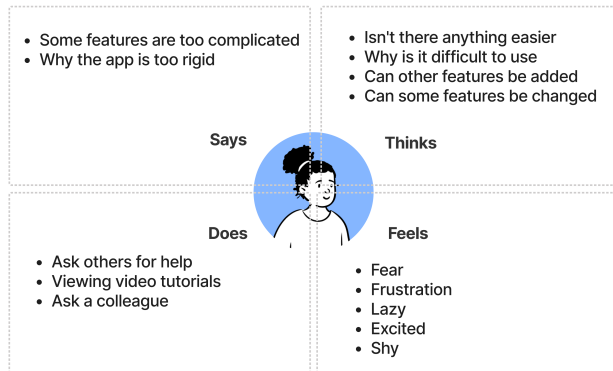


Figure 6. Empathy Map

prototyping, which involves interviews and observations with 30 elderly teachers, LMS admins, and teachers of young ages. The results of these interviews and observations are described as an empathy map. The empathy map was created to gain a deeper understanding of the teachers and help the researcher to see the LMS from the view of the teachers, especially the older ones. The Empathy Map divides user characteristics into four aspects as follows,

- Says, teachers say that the current LMS feels too rigid and has features that are too complicated to be easily understood.
- Thinks, teachers think that the existing LMS is too difficult to use and want an alternative that is easier to use with features that can be more easily understood.
- Does, what the teachers have done when using the LMS and find it difficult to use is to ask for help from others who understand better. This behavior highlights the critical role of social factors in user experience. This finding aligns with the perspective of Jahnke et al. [20] on the social dimension within the sociotechnical-pedagogical usability framework and is supported by Maslov et al. [21], who emphasize that the social dimension in UX encompasses empathetic and interpersonal aspects, even though it is structurally excluded from the adaptation model they used.
- Feels, during observations and interviews, several feelings were felt by teachers when using the LMS, namely fear of new technology, frustration at not being able to work optimally, lazy learning, excitement at new challenges, and embarrassment at not being able to use the LMS properly.

2. Define

The define stage is the stage where researchers define the information obtained in the previous stage. At this stage,

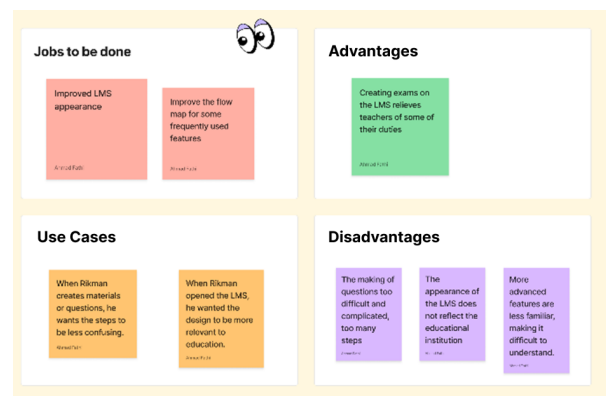


Figure 5. User Persona

researchers create a user persona and user journey as a tool in understanding users. User personas are created to find out the representation of a group of users. The user persona created has a biography, jobs to be done, use cases, advantages, and disadvantages of the user. A user journey is created to represent the steps that users take when interacting with the product. User journey helps in identifying opportunities and what makes it difficult for users during an activity.

Table 3 shows the scenario of a persona trying to enter questions into the quiz activity in the LMS. This persona did not feel happy when doing so because, as shown in Figure 7, this step was too complicated. This finding is consistent with Abdoli et al. [22], who developed a usability framework for LMSs and identified factors such as efficiency, ease of use, and navigation as key determinants of the usability quality in online learning systems.

Table 3. User Journey

Scenario	Rikman wants to create a multiple-choice question. He wants to create the question manually without the help of any tools.		
Expectation	Questions can be made, making questions not too many steps		
Journey Step	Preparation	Creation	Completion
User Action	Preparing questions to be entered into the LMS Open the question creation page	Entering questions one by one manually Organize question layout	Set up settings for question processing Complete question entry
Goals	Collecting questions that will be entered	Insert question	Complete question making
Feelings	Normal	Hard	Hard
Opport.		Question entry can be done automatically at once	Providing tooltips or using more understandable language
Pain Points		Tiring to enter questions one by one	Many settings are too hard to be understood



Figure 7. Login Page Wireframe

Figure 7 shows the scenario of a user persona who has difficulties when using the current LMS. This persona considers that there are too many steps when trying to enter questions into the quiz.

3. Ideate

The ideate stage is a stage where, based on the information that has been compiled in the previous stage, creative ideas are made to overcome existing problems. At this stage, researchers used the help of How Might We (HMW) questions and wireframe creation. During this process, the researcher also took into account the principles outlined in the User Experience Honeycomb [23]. These principles stress the importance of creating solutions that are not only problem-solving but also valuable, useful, accessible, credible, and desirable for users.

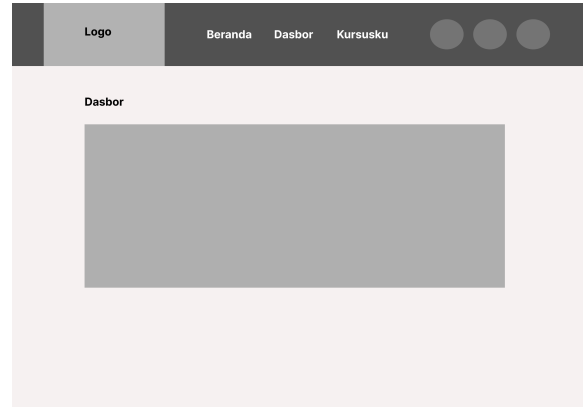


Figure 9. Dashboard Page Wireframe

Table 4. How Might We Question

Question	Answer
How might we make the user feel comfortable when creating an assignment?	We could try to simplify the process of creating an assignment We could try to change the language to those the user understood
How might we make the user to feel less intimidated when opening the LMS?	We could make the UI more user friendly by using UI/UX principles

Wireframes can illustrate basic ideas that will then be developed as a guide in designing pages on the LMS, such as guidelines for layout, content placement, and features that will be implemented.

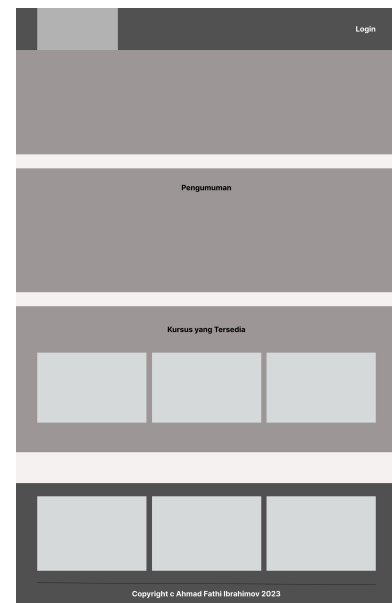


Figure 8. Landing Page Wireframe

4. Prototype

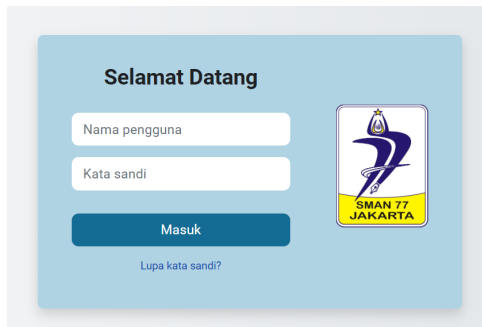


Figure 10. Login Page Prototype

The stage after wireframe creation is to construct a prototype by following the wireframe guidelines. Prototyping helps address problems that may arise and solves them before the product goes to end users. The prototype was created by considering factors that

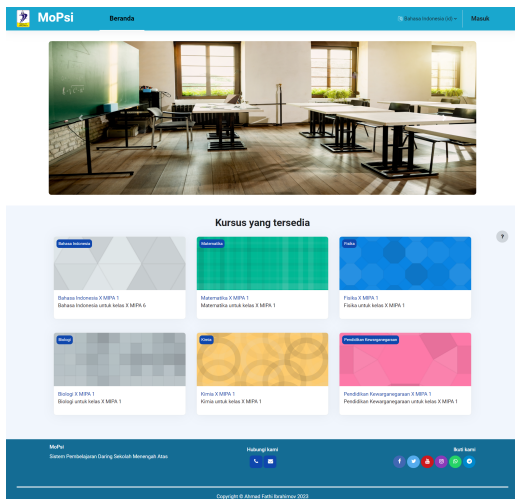


Figure 11. Landing Page Prototype

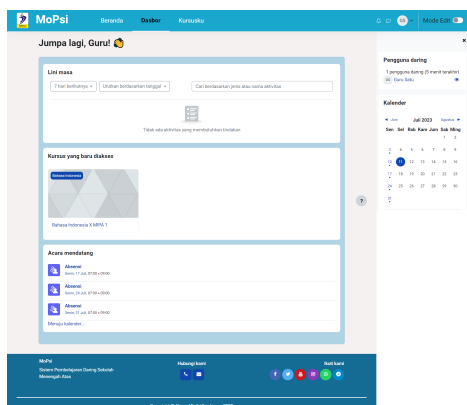


Figure 12. Dashboard Page Prototype

can help older people, such as the selection of bright colors and aspects of familiarity, to motivate seniors to use a new technology [24].

5. Test

The test stage is the step where the final prototype proceeds validation by a UX expert to ensure that the UX principles have been implemented properly. The prototype testing also involves the UEQ and SUS tools to assess the level of user experience and usability.

1) Expert Validation

Expert validation was conducted to evaluate the application of UX principles in the interface design of an LMS, based on the five stages of the Design Thinking process. The validation involved semi-structured interviews with two experienced UX experts. Both experts have educational backgrounds in Human-Computer Interaction (HCI) and over four years of experience in developing application interfaces.

This process involved evaluating the implementation of Gestalt design principles, Jakob's Law, and Miller's Law, as well as visual and navigation aspects of the prototype. According to the experts, the application of Gestalt Theory in grouping visual elements supports perceptual ease and user comfort. Miller's Law was considered successfully implemented through the limitation of the amount of information presented, thereby reducing users' memory load. Meanwhile, adherence to Jakob's Law indicated that the LMS interface aligns with familiar interaction patterns from similar systems, enhancing navigation efficiency. The experts also provided suggestions on simplifying interactive elements, emphasizing the importance of tooltips, and utilizing familiar icons. These suggestions were used to revise the design before conducting UEQ and SUS testing.

2) UEQ and SUS

Table 5. Prototype UEQ Result

UEQ Scale	Mean	Variance
Attractiveness	2.272	0.59
Perspicuity	2.194	0.67
Efficiency	2.046	0.77
Dependability	2.093	0.81
Stimulation	2.343	0.65
Novelty	1.815	0.78

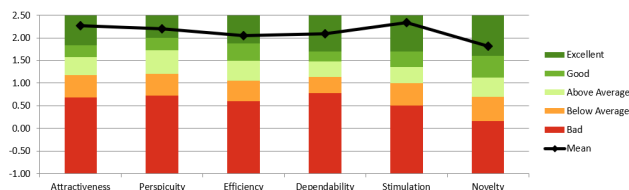


Figure 13. Prototype UEQ Result Visualization

Table 6. Previous LMS UEQ Result

UEQ Scale	Mean	Variance
Attractiveness	0.969	0.35
Perspicuity	0.833	0.43
Efficiency	0.657	0.70
Dependability	0.833	0.80
Stimulation	0.963	0.97
Novelty	0.296	0.32

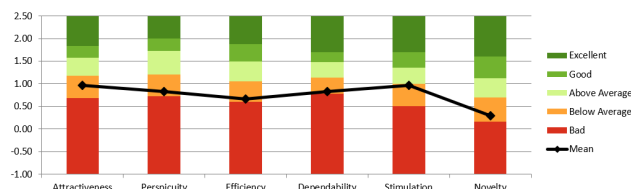


Figure 14. Previous LMS UEQ Result Visualization

Table 5 presents the results of the UEQ for the developed LMS prototype, which are visualized in Figure 13. All six UX aspects fall into the Excellent category, indicating an overall positive user experience as perceived by the participating teachers. Among these, the highest mean score is found in the Stimulation aspect (2.343), suggesting that users found the system not only easy to use but also enjoyable, motivating, and emotionally engaging. This is particularly significant given that most of the participants were elderly teachers, a group often associated with anxiety or reluctance when engaging with digital tools. The high stimulation score reflects the success of the design thinking approach, especially during the empathy and Definition stages, in addressing users' emotional needs and translating them into effective design features.

The elevated stimulation may be attributed to the use of a friendly and accessible design, which includes a clean visual layout, intuitive navigation, and supportive elements such as tooltips and clear instructions. These design elements play an important role in making users feel more confident and motivated when using the LMS.

In contrast, Table 6 and Figure 14 show the UEQ results for the previous version of the LMS. These results are notably lower across all aspects, particularly Efficiency and Novelty, with mean scores of just 0.657 and 0.296, respectively. The low efficiency score indicates that the previous system made it difficult for users

to complete basic tasks such as adding quizzes or managing course content. The low novelty score further suggests that users found the system outdated and lacking innovation or engaging features.

Although the prototype's Novelty score (1.815) is still within the Excellent category, it is the lowest among the six aspects. This suggests that while users appreciated improvements in design and functionality, the system may not have felt entirely new or unique, possibly due to the continued use of Moodle as the underlying platform, which maintains a familiar user interface. Therefore, the contribution of the Novelty aspect to the overall user experience is not as significant as others, such as Stimulation or Efficiency.

The System Usability Scale (SUS) survey results in consistent findings with the UEQ survey. The redesigned LMS prototype achieved a SUS score of 76, which falls into the Good category and is considered acceptable according to SUS interpretation standards. In comparison, the previous LMS scored 50, which indicates a low level of usability. This improvement reinforces the conclusion that the redesigned system is easier to use, learn, and understand for teachers.

A SUS score above 68 is typically regarded as above average, and the prototype's score of 76 approaches the threshold of Excellent. The result confirms that the system is well-received and has the potential for effective adoption in real educational settings. Most of the participating teachers, including elderly teachers—the primary focus of this study—found the system user-friendly and accessible. The finding highlights that the design not only succeeded in terms of structure and aesthetics but also ensured ease of use and reduced learning barriers for its intended users.

However, despite these positive outcomes, testing limitations need to be considered. First, the number of respondents was limited to 30 teachers from a single school (SMAN 77 Jakarta), which may limit the diversity of perspectives captured in the evaluation. Although most participants were elderly teachers, which aligns with the system's primary target users, the study may not fully reflect variations in needs or preferences among older teachers from different regions or educational backgrounds.

In addition, the testing was conducted in a controlled environment using a prototype, rather than in the real-world context of daily teaching activities. In practical use, factors such as time pressure, multitasking demands, and physical or cognitive limitations that elderly teachers commonly experience could have a greater impact on the overall user experience. Although UX validation was conducted using three key principles—Gestalt Theory, Miller Law, and Jakob Law—which cover aspects of perception and cognitive load, the evaluation did not comprehensively assess other usability factors. These include system performance, interface response time, and mental strain during long-term and complex usage.

4. Discussion

This research demonstrates that the Design Thinking approach successfully produced an LMS design that is more intuitive, user-friendly, and tailored to the specific needs of elderly teachers. This is evidenced by the significant improvements in both UEQ and SUS scores, along with positive validation from UX experts.

Principles such as Gestalt Theory, Miller's Law, and Jakob's Law were effectively applied throughout the design process, reinforcing the system's usability and emotional accessibility. The final prototype is positioned as a strong successor to the previous LMS, showing high user experience scores in the "Excellent" category and usability scores that indicate ease of use and acceptance by the target users.

These findings underline the importance of inclusive design in future LMS development, with an emphasis on accessibility, simplicity, and emotional comfort, especially for users with limited technological literacy. The success of the empathize-first approach in this study suggests that Design Thinking can serve as a practical and replicable framework for developing digital education platforms aimed at diverse user groups.

In addition, this study contributes to the broader effort of supporting national digital education transformation programs by enabling more inclusive participation from educators who may have previously faced technological barriers. However, the relatively lower score in the Novelty aspect suggests opportunities for further innovation, particularly in creating more engaging and adaptive features that can accommodate a wider range of user needs and expectations.

Based on the research findings, the direction for sustainable and user-responsive LMS development using the Design Thinking approach includes the following aspects:

1. Integration of Adaptive Features and Personalization

The LMS should be developed with features that adapt the interface and user experience based on factors such as age, subject background, or teaching region, in order to enhance comfort and usage efficiency. The improved SUS and UEQ scores observed in this study indicate the success of applying a user-centered design approach. In particular, this highlights that paying attention to the needs of elderly teachers can lead to more inclusive and effective technological solutions.

2. Expansion of Trial Scale and Number of Respondents

Future research is recommended to involve more than one educational institution and a larger sample population to produce more representative findings and avoid data inconsistencies.

3. Improved Accessibility and Mobile Support

Developing accessibility features such as voice commands, text-to-speech, high contrast, large icons, and responsive design for various devices (desktop, tablet, and mobile) is crucial, especially for senior teachers or users with physical limitations.

4. Expansion of User Segments and Usage Contexts

5. Longitudinal Evaluation

It is recommended to conduct longitudinal studies to assess the extent to which the Design Thinking approach in LMS development improves technology adoption and the long-term quality of learning.

6. Multidisciplinary Collaboration in LMS Development

Collaboration among UX experts, educators, and developers should be established as a standard approach to produce digital

education solutions that are more relevant, inclusive, and impactful.

With these steps, LMS platforms can evolve into inclusive, sustainable, and more responsive systems that truly meet the real needs of users.

5. Conclusion

Overall, this study confirms the effectiveness of the **Design Thinking** approach in creating a Learning Management System (LMS) that is specifically optimized for elderly teachers. By prioritizing user empathy and applying established design principles, the research successfully produced a prototype with high usability and user experience scores, validated by both quantitative data and expert feedback. This demonstrates that a user-centered design framework is effective for developing inclusive digital education tools that break down technological barriers and contribute to national digital transformation efforts. The success of this study paves the way for a more thoughtful and deliberate approach to technology design in the education sector.

Based on these findings, future development should focus on building on this success by implementing a roadmap for sustainable and user-responsive systems. This involves integrating **adaptive features** for greater personalization and comfort, expanding the scope of trials to a larger, more diverse user base, and enhancing **accessibility** across various devices. Moreover, conducting long-term studies and fostering multidisciplinary collaboration will ensure that LMS platforms not only meet current needs but also continue to evolve into truly inclusive and impactful tools for all educators. This comprehensive approach will ensure that future digital solutions are not only technologically advanced but also genuinely supportive of every user.

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