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Integrating UX Five Elements and Design Thinking to Design a Learning Management System

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Abstract.
Purpose: This study aims to enhance the user experience of Learning Management Systems (LMS) by integrating two established design frameworks: the UX Five Elements and Design Thinking. The research addresses the need for a more structured yet human-centered design process to improve the usability and engagement of LMS platforms in higher education.
Methods: The research adopts a design and development approach by combining the UX Five Elements, which offer a systematic structure across five user experience layers, with Design Thinking, which emphasizes empathy and iterative user involvement. This integration forms an Extended Model Design (EMD) used to guide the development of a new LMS interface. The final system was evaluated using usability testing involving students as target users.
Result: Evaluation of the LMS prototype using the User Experience Questionnaire (UEQ) showed positive perceptions on all six dimensions, with the highest scores on the Efficiency (1.644) and Attractiveness (1.634) aspects, reflecting a practical and attractive system design. Although the Novelty (1.203) aspect had the lowest score, its value was still above the positive threshold, indicating that the system was functionally good but could still be improved in terms of innovation to strengthen user engagement.
Novelty: This study introduces a novel design framework by integrating UX Five Elements with Design Thinking in the context of LMS development. Extended Model Design (EMD) offers a replicable model that balances structure and user empathy, contributing to user-centered e-learning system design.

Keywords: UX five elements, Design thinking, Learning management system, Student, Usability
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INTRODUCTION

Learning Management System (LMS) is a web-based content management technology facility provided by institutions to support the management of the learning process [1], both inside and outside the classroom [2]. Where the quality of the system, such as the usability aspect, needs to be appropriately considered [3]. Usability and user experience (UX) are essential in designing and evaluating systems that aim to facilitate users [4][5][6]. Usability provides consistent system performance, such as efficiency, ease of learning, ease of remembering, minimizes errors in use, and is fun to use [7]. UX covers all aspects of the user experience, including subjective experiences, such as the emotional consequences of use and the resulting behavior [8].

One factor that needs to be considered to improve usability in LMS is learning content [7]. The arrangement of learning content in LMS or e-learning can be categorized into two categories: learning material content and system interface or user interface (UI) content [9]. Good management of learning material needs to be considered because content can significantly affect learning tasks carried out by students [10][11]. In addition, the design of the e-learning system interface is another factor that needs to be considered [12] because it can affect student satisfaction [13][14][15]. Usability emphasizes the aesthetics of the interface and the functional aspects. Aesthetics and functionality have the same importance and combining them can provide a good experience for users [16]. A good aesthetic design is intended to motivate users to understand the system efficiently and provide good functionality to users [17]. Functionality in software development refers to specific capabilities or services that the system must perform to meet user needs.

Personalization services include functionality that benefits users because the system can adjust content, appearance, or learning flow based on the user's needs [18]. Personalization is an LMS service that can support user accessibility and adaptive learning carried out by students [19]. Personalization makes user

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navigation easier to manage, with a specific flow according to the learning preferences carried out by students [20]. However, its application must also be adjusted to the curriculum design, a series of learning activities that help users achieve learning goals [21]. Designers must apply a framework to produce a functional LMS design and provide a positive experience for users. The hierarchical approach [22] that maps the UX design process from strategy to visual design is obtained from applying the Five Elements UX design framework discovered by Jesse James Garrett [17]. This model has been shown to provide critical conceptual contributions in forming a user experience-based evaluation structure for educational software [23]. This model has also been shown to help create functional, intuitive, and emotionally meaningful products, while demonstrating the model's flexibility to be used outside the web realm, into the design of technology-based physical products [22].

However, the development of LMS design does not only refer to the systematic design process but also needs to pay attention to the specific needs of users, namely, user-centered design. The Design Thinking (DT) method is one of the more iterative approaches [24] that is centered on users (human-centered), which emphasizes a deep understanding of user needs and perspectives [25]. The application of DT in research can produce deep insights into the cognitive processes of designers in the early stages of concept development [26], in addition to producing emotional experiences and physical artifacts that help users understand why and how certain cultures support the effective use of certain devices [27]. Previous research only applied the methods separately, but combining the two methods can improve the performance process and results. Therefore, to prove this, it can be said that the research gap of this study is by integrating these two models. This is intended so that LMS designers get a structured approach from the Five Elements of UX that synergizes with the human-centered Design Thinking approach; hereinafter, this model is called the extended model design (EMD). Based on this explanation, this study was conducted to develop and apply a system design framework to design an LMS. Furthermore, usability measurements will be carried out on the system for students. This development aims to produce UI/UX LMS design as an effective and more personal learning system solution. The results of the UI/UX LMS design recommendations can be used as a reference for developing a website-based LMS system according to user needs.

METHODS

EMD is a research model designed for an LMS, emphasizing UI/UX aspects. This model was developed by integrating Garrett's five elements framework and the design thinking (DT) model. Integration is done to obtain structured UI/UX design results from the human-centered perspective. The EMD model consists of a series of stages, as shown in Figure 1.

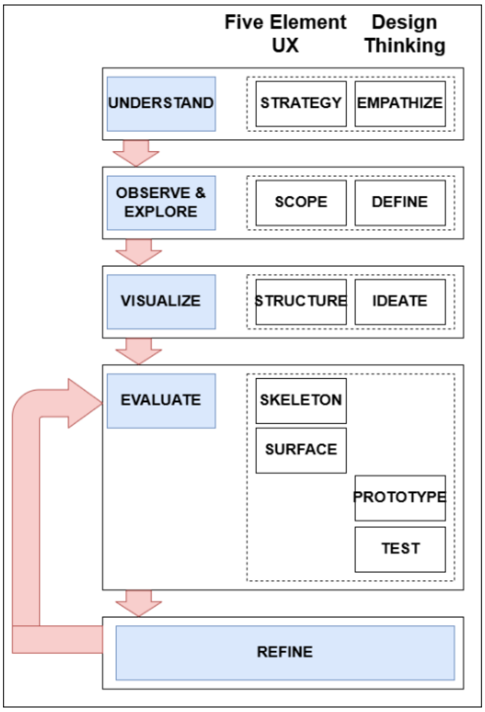

Figure 1. Extended model design (EMD)

Figure 1 shows the EMD framework, which integrates Jesse James Garrett's Five Elements of User Experience and the Design Thinking framework in an iterative interactive design process flow. The diagram is divided into five main stages: Understand, Observe & Explore, Visualize, Evaluate, and Refine. Each stage relates to elements from both frameworks to form a comprehensive approach to developing a learning system design. The first stage, Understand, combines Garrett's strategy element with Design Thinking's empathize stage. At this stage, the primary focus is on understanding user needs and business goals through initial research and empathic observation. Next, the Observe & Explore stage links the scope element with the Define stage, where the results of the initial understanding are used to define the needs and constraints of the system or product to be developed. The third stage, Visualize, includes Garrett's structure element and Design Thinking's ideate stage. This is the phase where ideas are created based on the structure of the information that has been determined, and potential solutions begin to be visualized. This phase is followed by the Evaluate phase, which consists of the skeleton, surface (Garrett), and prototype and test phases of Design Thinking. At this stage, the visualized idea is tested through prototyping and testing with users to evaluate the functionality and overall user experience. After evaluation, enter the Refine phase, where the findings from the evaluation process are used to iterate improvements to the design. The EMD framework also shows a feedback loop from Evaluate to Visualize, indicating that the design process is carried out iteratively, where the design can return to the visualization phase after evaluation to develop a better solution. Overall, this diagram illustrates a design process flow that combines the depth of the conceptual structure of Garrett's Five Elements with the empathetic and iterative approach of Design Thinking. This integration allows the creation of design solutions for learning systems that are more aligned with user needs, while still paying attention to the strategic and structural aspects of user experience design.

Understand phase

The initial step taken, namely at the understanding stage, functions to explore a deep understanding of the context, needs, challenges, and problems faced by users when interacting with the learning system. Deep knowledge is achieved by examining the needs and issues faced by students when using the learning system.

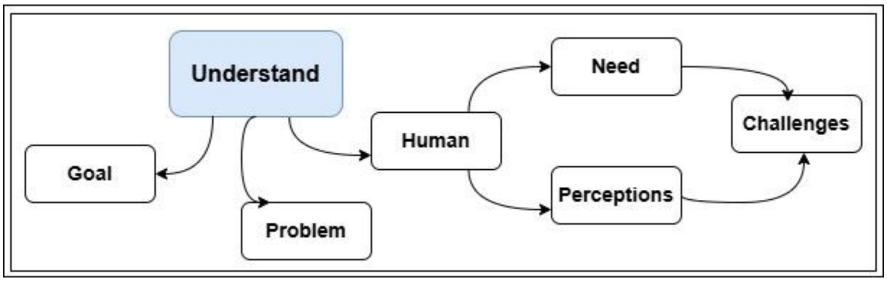

Figure 2. Understanding process

As shown in Figure 2, the understanding stage can be classified into two main elements, namely Goals and Problems, which are the basis for the design team to start building an initial understanding. These two elements lead to the primary entity, Human, which is the center of this understanding process. From the human aspect, the process continues with identifying Need, Perceptions, and Challenges. Users must play an essential role in determining what features or solutions should be provided in the system. Meanwhile, perception refers to how users view or feel a problem or solution, significantly influencing their acceptance and experience. Challenges are obstacles or barriers users face in achieving goals or meeting their needs and understanding this will be very helpful in designing relevant solutions. The relationship between elements in the diagram shows an iterative and interrelated thinking process. This process emphasizes the importance of a human-centered approach, placing humans at the center of the understanding process to produce design solutions tailored to the user's context. In the context of research, this stage includes data collection. The data needs to be analyzed, and activities are carried out by several students and lecturers who use LMS as a supporting medium for the learning process.

Observed and explored phase

The Observe and Explore stage in the context of user-centered design serves to understand more deeply about user experiences, preferences, and needs, to then formulate needs (system needs) more precisely and accurately. This process is divided into two main parts: Observe and Explore, which are interrelated and form the basis for compiling functional and content system needs.

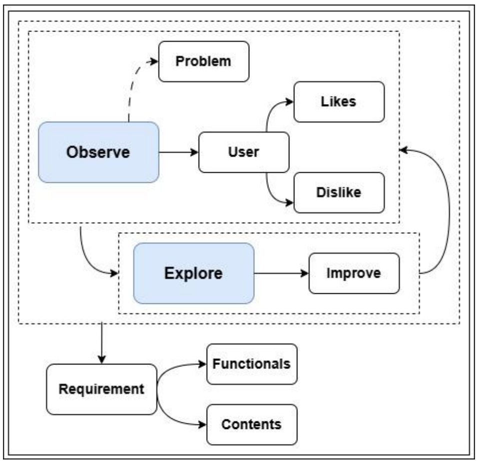

Figure 3. Observe & explore process

The observations' results are used to identify the main problems, which are then formulated into a precise problem formulation, accompanied by steps for solving and resolving them.

Figure 4. How-Might-We (HMW)

As shown in Figure 3, this stage begins with the observed stage, which focuses on direct observation of users and their usage context. Starting from the Problem, which triggers the need for observation of Users. From this observation, information is obtained about what users like and dislike in the context of using the learning system. This observation is important for capturing user perceptions, behaviors, and interaction patterns that may not be revealed in interviews or surveys. The path between Problem → User → Likes/Dislike emphasizes that system problems can only be understood by observing real user interactions. After gaining an understanding from the observation stage, the process continues to the Explore phase, which is an exploration stage that focuses on analyzing and interpreting previous findings. This stage aims to find opportunities for improvement marked by Improve activities. At this stage, the design team begins to identify things that can be optimized from the user's perspective and create initial solutions. The tool used is the concept of how might-we, as a technique for conducting problem-framing techniques in formulating open questions that encourage exploration of creative solutions to a problem, the results of which are shown in Figure 4. In the case of the LMS being designed, we identified five major groups, namely Enhancing LMS User Experiences, Improving LMS Usability, Enhanced Personalization in the LMS, Increasing Engagement, and Optimization Evaluation & Feedback.

Finally, the result of this stage is summarized in the form of a Requirement, which is divided into two main aspects: Functionals (system functions needed by users) and Contents (content or information that needs to be presented in the system). This requirement is the foundation for the next design stages, such as creating information structures, wireframes, and prototypes.

Visualize

The visualization stage is the process of describing ideas or concepts to produce various solutions to previously defined development problems. This stage involves brainstorming and developing creative ideas, interaction design, and user interaction experience flow, which is carried out to ensure that all elements are connected logically and intuitively.

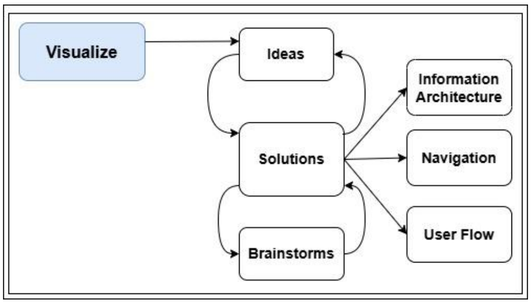

Figure 5. Visualization process

Figure 5 shows a process flow diagram in system design, where there are three main elements in the visualization stage, namely Ideas, Solutions, and Brainstorms. These three elements are interconnected and form a repeating cycle, or repeating through ideas, solutions, and brainstorming. These elements then produce other important components in system design, such as information architecture, navigation, and user flow. Therefore, at this stage, the importance of collaborative and exploratory thinking is emphasized in creating an effective and structured user experience. The functions and features that have been described will then be grouped into a structured menu. A structured menu is the flow between features in information architecture.

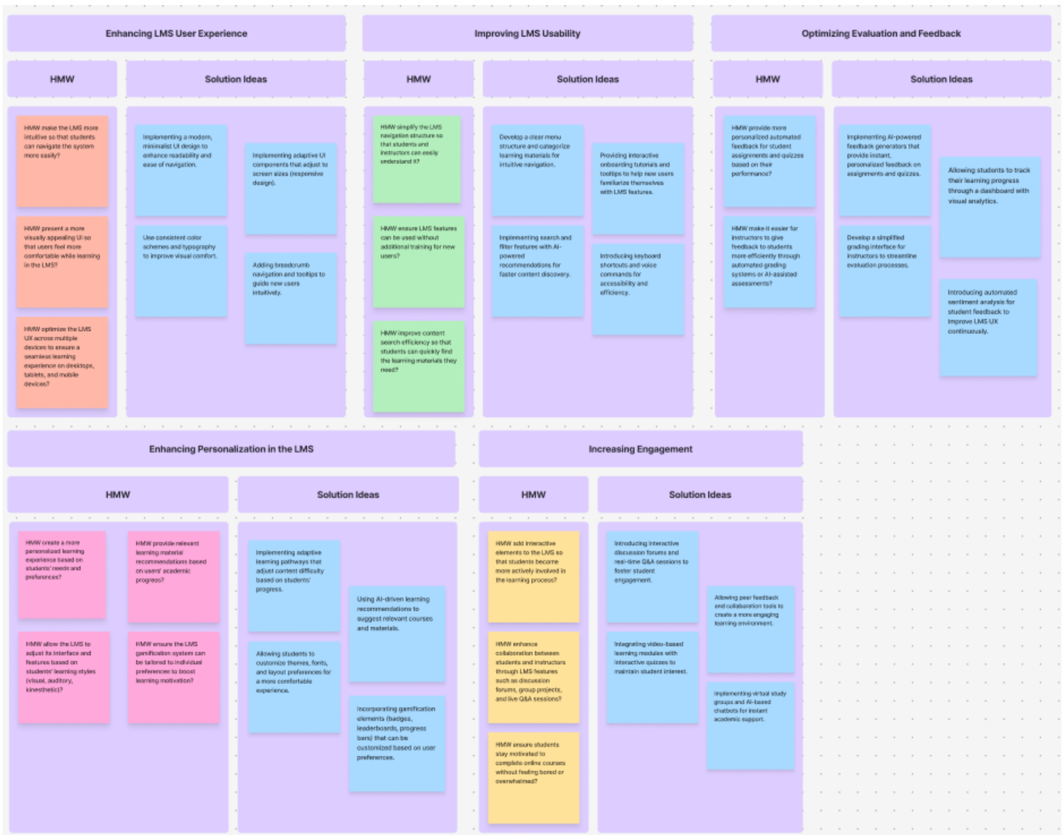

Figure 6. Identification of solution ideas based on how might we

One of the activities carried out is to present the results of identifying challenges and solution ideas based on six main aspects in LMS development, shown in Figure 6. These six main aspects were obtained in the previous stage, as shown in Figure 4. The six main aspects in LMS development are: (1) Enhancing LMS User Experience, (2) Improving LMS Usability, (3) Optimizing Evaluation and Feedback, (4) Enhancing Personalization in the LMS, (5) Increasing Engagement, and one additional category that explicitly connects How Might We with innovative solution ideas.

In the Enhancing LMS User Experience aspect, HMW questions focused on improving the interface appearance, visual design consistency, and ease of navigation. Proposed solutions include the implementation of interface design based on modern UI/UX principles, consistent use of colors, and the addition of adaptive guides for novice users. In the Improving LMS Usability side, identification was directed at the need for a simpler interface and an efficient content search system. Solutions included the development of an organized menu structure, smart search features, and a recommendation system based on user preferences to accelerate the discovery of learning materials. Furthermore, in the Optimizing Evaluation and Feedback aspect, the focus was on increasing the effectiveness of the assessment and feedback process. Solutions that emerged included assessment automation, integration of visual dashboards for tracking learning progress, and simplification of the evaluation system through a customized rubric system. For Enhancing Personalization, HMW questions were directed at how the system could adapt materials to students' learning styles, interests, and academic needs. Solutions involved the use of AI-based adaptive learning, content personalization, and the implementation of gamification elements according to user preferences. In the Increasing Engagement category, the focus was directed at increasing emotional engagement and student interaction. The solutions include interactive media integration, real-time feedback systems, and the formation of virtual study groups to support collaborative learning. Overall, the results of this mapping provide a comprehensive picture of the main problems faced by LMS users and a series of innovative solutions that can be used as a basis for developing an LMS system based on a human-centered and persuasive design approach. This identification also serves as a basis for designing prototypes and testing the system at the next stage in the iterative design process.

Evaluate phase

The evaluation process stage in Figure 7 illustrates the design development process flow that focuses on creating, evaluating, and testing previously generated solution prototypes. At this stage, it is also ensured that users can navigate the product quickly. This process begins with the Solution that was generated in the previous stage. This Solution is then developed into two types of design representations: Low-Fidelity and High-Fidelity. Low-fidelity refers to rough sketches or simple wireframes that are used to test ideas quickly and cheaply. The use of low-fidelity prototypes in the early stages allows design testing to be done quickly and cheaply without sacrificing the utility or basic usability of the product being developed [28]. It is also emphasized that a quick evaluation of the structure and user interaction flow can be done before designers move on to a high-fidelity form that is more interactive and similar to the final product [29]. High-fidelity prototypes are more detailed and realistic versions of the design, including visual and interactive elements that more closely resemble the final product.

These two forms of fidelity interact with each other, indicating that the design process is iterative—designers can move from high fidelity to low fidelity (and vice versa) to refine the solution. Low-fidelity prototypes encourage active user participation, where both levels of fidelity are equally effective in identifying usability issues, but low-fidelity is more appropriate for obtaining big-picture feedback, while high-fidelity produces detailed visual feedback [30]. The iterative process from low to high fidelity has been proven to improve the quality of e-learning systems [31].

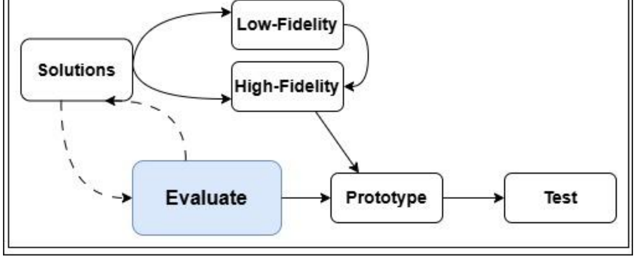

Figure 7. Evaluation process

The visual aspects of the design are completed to ensure that the product looks attractive and supports a positive learning experience. A physical or digital representation of the idea is developed into a more concrete form in the form of a prototype. A prototype is an interactive model that is simulated to illustrate the overall function and interaction of a product. Furthermore, this prototype needs to be tested on users in real conditions to obtain feedback or internal assessments to assess its effectiveness and efficiency, and whether the solution meets user needs. If the evaluation results show that the solution is less than optimal, the process can be returned to the initial stage for revision. This stage is also carried out to ensure that the resulting solution is acceptable and meets user needs.

Refine phase

The Refine stage is a refinement process by refining ideas, interactions, visuals, or user experiences based on the results of previous evaluations or tests. At this stage, designers fix weaknesses, refine features, clarify flows, or improve usability so that the prototype is closer to the optimal final solution. This stage is carried out to ensure that the design is based on user needs before final implementation.

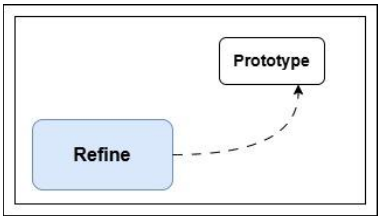

Figure 8. Refine Process

The arrow to the Prototype as shown in Figure 8 indicates that the results of this refinement are then re-implemented in a new version of the prototype. The prototype is not the final product, but rather an artifact that continues to be developed to suit user expectations and needs. This is in accordance with the principle of user-centered design, which emphasizes iteration as the key to success. The process at this stage is carried out iteratively on the LMS prototype, where design improvements are made based on reviewed user feedback to achieve the optimal UI/UX design.

RESULTS AND DISCUSSIONS

Prototype learning management system

The Learning Management System (LMS) prototype developed in this study serves as a practical outcome of the Extended Model Design (EMD), which integrates the Five Elements of UX and the Design Thinking framework. The prototype was designed to reflect a user-centered, structured, and iterative process that aligned with the identified user needs gathered during the understanding and exploration phase. The prototype was developed through low-fidelity and high-fidelity representations. The low-fidelity prototype was created using wireframes to map out core functionality and navigation flows, allowing for initial validation of user interaction patterns. This prototype was then refined into a high-fidelity prototype using an interactive digital tool that simulated the final interface design with realistic visuals and dynamic interactions. The resulting design focused on improving several key aspects of the user experience, including visual consistency, usability, personalized learning paths, and engaging content delivery. The teacher dashboard interface, as shown in Figure 9, features intuitive navigation, efficient content management, and access to evaluation analytics, aimed at improving teaching efficiency and decision-making. This prototype served as a baseline for user experience testing, aligning each design decision with pre-defined functional and content requirements.

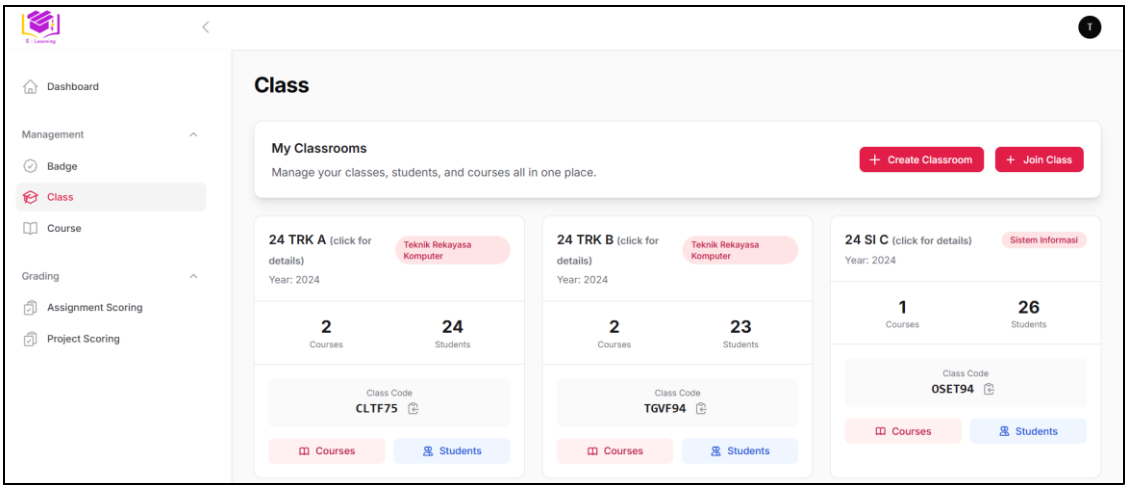

Figure 9. Dashboard teacher

User experience questionnaire (UEQ) testing

Measurement using the User Experience Questionnaire (UEQ) to measure UX on the LMS system is carried out so that the evaluation produces a more comprehensive analysis. Several aspects of user experience are analyzed, such as attractiveness, ease of use, efficiency, reliability, motivation, and innovation. UEQ can help developers identify strengths and areas that need improvement, thus improving the overall quality of LMS UX.

Table 1. LMS system UEQ results

UEQ Dimension	Mean Score	Variance Score
Attractiveness	1.634	1.19
Perspicuity	1.582	1.16
Efficiency	1.644	1.10
Dependability	1.500	1.09
Stimulation	1.574	1.31
Novelty	1.203	1.26

The processing was carried out based on the results obtained from 101 respondents, which produced results as shown in Table 1. Table 1 shows the results of the user experience evaluation using the User Experience Questionnaire (UEQ) instrument, which consists of six main dimensions: Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty. Each dimension is presented with an average value (Mean Score) and a variance value (Variance Score). The mean results indicate the user's positive perception of the system interface, while the variance reflects the consistency or distribution of answers between respondents. In general, the mean UEQ value is in the range of +3 to -3, with an interpretation of > 0.8 meaning a positive perception. Table 1 shows that all dimensions have a mean score above +1.2, indicating a strong positive perception from users of the tested system. The highest value is in Efficiency (1.644), indicating that users feel the system is efficient to use. Followed by Attractiveness (1.634), which shows a positive assessment. A variance of 1.19 indicates little variation among user responses, but user perceptions are consistent. Overall, most users find the system attractive and consistent. A mean value of 1.582 for the Perspicuity aspect indicates that the system is rated positively. A variance of 1.16 indicates that the consistency of user responses is relatively stable. Users find the system easy to understand and operate, with minimal variation in assessments. The efficiency aspect produces a mean value of 1.644, which is considered very positive by users. However, a variance value of 1.10 indicates that the variation in responses is low, meaning that most users agree with the efficiency of the system. Users consider the system to be very efficient, with consistent perceptions among them. The mean value for the Dependability aspect is 1.500, with a variance value of 1.09. This indicates that the system has a positive value and has good consistency among user responses. It can be said that the system is considered reliable by users, with uniform perceptions. The Stimulation aspect produced a mean value of 1.574 and a variance value of 1.31, indicating that the aspect was considered positive and there was little variation in user responses. Users felt that the system was quite stimulating and enjoyable, with differences of opinion that existed but were not significant. Meanwhile, the Novelty aspect was considered positive approaching the neutral threshold, with a mean value of 1.203. The variance value of 1.26 indicated greater variation than other aspects. This means that users felt that the system had some new elements, but the variation in opinions was more significant, indicating varied experiences related to this novelty aspect.

CONCLUSION

This research study has successfully developed a prototype Learning Management System (LMS) using the Extended Model Design (EMD), which integrates the Five Elements of UX and the Design Thinking framework. The evaluation results using the User Experience Questionnaire (UEQ) showed very positive user perceptions across all six dimensions, with Efficiency rated as the highest (1.644), confirming that users found the system practical and supportive of their learning tasks. Although Novelty received the lowest score (1.203), the system still exceeded the positive threshold, indicating potential for future improvements in feature innovation. These findings confirm that combining a structured UX model with a human-centered iterative process can result in an LMS design that is not only functional but also emotionally satisfying. The EMD framework has proven to be a valid approach to guide the development of LMS interfaces that align with actual user needs.

For future developments, improvements can be focused on enhancing the novelty aspect by incorporating more innovative features such as gamification, adaptive learning paths, or AI-based recommendations. Further usability studies across different user groups and educational contexts are recommended to strengthen the generalizability of the framework.

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