Research Article

Design and User Analysis of a Learning Management System: Student Competency-Based Learning

[1,*]Eko Harry Pratisto, [1]Daffa Raszya Danoetirta

1 Department of Vocational School, D3 Informatics Engineering, Sebelas Maret University, Surakarta, Indonesia

* Corresponding Author: ekoharry@staff.uns.ac.id

Abstract: The rapid evolution of digital technology in education has highlighted the need for robust platforms that support student competency-based learning, wherein each learner progresses at an individualized pace and demonstrates mastery of specific competencies. Building on evidence that personalized instruction improves engagement and learning outcomes, this study aims to develop a Learning Management System (LMS) capable of enhancing both formative and summative assessments. The primary objectives are to facilitate the uploading of learning materials, manage user roles (teachers, students, administrators), and provide flexible assignment distribution—all while promoting self-directed, sustainable learning. An Agile methodology was adopted to ensure iterative development and close collaboration with stakeholders, allowing for quick adaptations to evolving requirements. System architecture was designed using UML, focusing on role-based workflows and clear user interfaces. Throughout the process, regular sprints were conducted, incorporating continuous testing and feedback loops to refine functionality. The LMS was then evaluated through usability testing using the System Usability Scale (SUS). Findings from 80 student participants yielded an average SUS score of 81.75, which falls into the “very good” category, suggesting high user acceptance and ease of use. These results affirm the system’s effectiveness in supporting competency-based learning, as students can monitor individual progress in real-time and receive timely feedback from teachers. Moreover, teachers benefit from streamlined assessment processes, enabling them to devote more attention to pedagogical improvements. Although this research was conducted in a single school environment and over a relatively short period, the encouraging results indicate strong potential for broader implementation. Future development may integrate features such as learning analytics, gamification, and personalized content recommendations, thereby further enhancing adaptive learning experiences across diverse educational contexts.

Keywords: learning management system, e-learning, agile, formative assessment, system usability scale

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1. Introduction

Assessing student competencies is a crucial aspect of the educational process aimed at measuring the understanding and skills that students have acquired during their studies. In modern education, especially with the rapid development of digital technology, the role of student assessments has become increasingly central, as they help educators evaluate the success of curriculum implementation and the effectiveness of teaching methods [1]. Moreover, assessment results can provide constructive feedback to identify strengths and weaknesses in the learning process, thereby enabling educational institutions to make appropriate adjustments to improve overall educational quality [2].

There is no doubt that student assessments serve various purposes—from determining whether students have achieved certain competencies to mapping the development of critical, creative, and collaborative thinking skills. For educators, assessment data serve as an important reference for a comprehensive evaluation of the effectiveness of the teaching strategies implemented. In this context, student assessments encompass not only final (summative) evaluations but also formative assessments that can be conducted continuously throughout the learning process. Through formative assessments, teachers and students can monitor learning progress in real-time, provide early feedback, and implement interventions if any learning obstacles are encountered [3, 4].

Various forms of student assessments have been developed. In addition to traditional written exams, there are practical tests that emphasize skill demonstration and project-based assessments that evaluate students' creative problem-solving abilities. Research has shown that using e-portfolios as an assessment tool can increase student engagement and provide deeper opportunities for self-reflection [5, 6]. With e-portfolios, students can compile and present their work in digital form, allowing teachers and other stakeholders to observe their comprehensive progress. This approach also encourages students to become more aware of their learning processes, ultimately enhancing their metacognitive abilities—the capacity to "think about thinking."

Blended learning, which combines face-to-face instruction with online learning, is gaining popularity as an innovative approach to education. By integrating classroom teaching with online platforms, blended learning enables the delivery of materials, collaboration, and evaluation in a flexible manner. Chang et al. [7] reported that blended learning significantly improves student performance compared to traditional face-to-face methods, as it allows students to access instructional materials via an LMS or other e-learning platforms at their own pace and even review content when necessary.cs

E-learning itself has become a widely discussed topic, particularly regarding its effectiveness and the challenges it poses. E-learning offers increased flexibility and accessibility since students can access materials at any time and from anywhere [8, 9]. This flexibility allows for personalized learning, where students can adjust the pace of their studies according to their individual needs. However, implementing e-learning is not without challenges. One frequently mentioned issue is the need for digital skills and technical support [9]. For students and teachers unfamiliar with technology, transitioning to online learning can be problematic. Additionally, unstable internet connections or insufficient devices can hinder the overall effectiveness of e-learning.

Apart from technical challenges, student characteristics such as motivation, self-discipline, and support from their learning environment also significantly influence the success of e-learning [10]. Student motivation tends to increase when they perceive clear benefits and ease of use from digital learning platforms, yet it may decline if they experience boredom due to limited social interaction or monotonous content. Therefore, educators are expected to design interactive and engaging learning experiences—such as online quizzes, discussion forums, or gamification—to maintain student interest. Support from both family and educational institutions is equally important; a comfortable study environment at home and parental guidance can help students remain focused during online learning sessions.

Various LMS platforms have been developed to facilitate online learning. For instance, SEVIMA EdLink (https://edlink.id/) is an Indonesian LMS designed to support higher education activities. Its main features include online attendance, video conferencing, course material management, and digital assignment assessments. Online attendance simplifies the monitoring of student participation in each session, while video conferencing facilitates virtual face-to-face interactions. Another example is Belajar Bareng (http://belajarbareng.id/), an LMS that offers features such as teacher administration, academic calendars, course material management, as well as evaluation and assessment of student learning outcomes. Moodle (https://moodle.org/) is also widely recognized as an open-source LMS popular among educational institutions. Moodle offers various features including course management, discussion forums, assessments, feedback mechanisms, and tools for quizzes and surveys. Its open-source nature allows it to be customized according to each institution's specific needs—from interface design to the addition of modules that enhance functionality. The diversity of LMS platforms reflects the dynamic and evolving needs of Indonesia's educational landscape.

Overall, the implementation of e-learning in education underscores the need for innovative teaching and assessment methods to improve educational quality. By leveraging digital technology, educators can apply a more personalized approach that is tailored to individual learning styles and comprehension levels [11, 12]. In parallel, students are encouraged to take a more active and independent role in their learning—for example, by seeking additional learning resources or participating in online discussion forums [13]. The success of such innovations largely depends on the willingness and ability of all stakeholders to adapt to change [14]. Educational institutions must provide training and technical support for teachers to effectively design and manage online learning. Similarly, students and parents should be equipped with digital literacy skills to prevent difficulties when accessing LMS or other e-learning platforms. Thus, challenges such as the digital divide, limited device availability, and low digital literacy can be mitigated [14].

In addition to innovative efforts, there is an urgent need to provide an adaptive and responsive learning system that caters to the diverse abilities of students. The approach of differentiated instruction emphasizes that the learning process, content, and assessment outcomes should be tailored to each student's abilities, interests, and learning needs [15, 16]. This can be achieved by offering various assignment or project options, adjusting the difficulty level of accessible materials, and providing individualized guidance when necessary. Ultimately, this approach allows every student to develop according to their potential without being burdened by a one-size-fits-all standard [17].

Technology further facilitates the implementation of differentiated instruction. An LMS can be designed to record each student's progress and then provide recommendations for advanced materials or additional assignments based on evaluation results. Likewise, online assessment systems can be made more flexible—for example, by offering diverse types of questions, adjustable deadlines, or varied assignment formats [18]. When students perceive that the tasks assigned are relevant to their abilities and interests, their motivation to learn increases. Moreover, teachers can more easily monitor individual progress since data on student activity and performance are available in real-time through the system [19].

Ultimately, the primary objective of these innovative efforts is to ensure that every student gains a meaningful learning experience, fostering 21st-century skills such as critical thinking, creativity, communication, and collaboration. Student assessments are no longer solely a one-dimensional measure of cognitive ability but now also include evaluations of other relevant skills and competencies [20, 21]. By combining various assessment methods—from written tests to technology-based projects—educators can construct a more comprehensive profile of student capabilities.

The novelty in this study focuses on deeply integrating competency-based approaches—aligning learning objectives, pacing, and assessments with individualized competency milestones—into an LMS framework. This dedicated focus provides a clearer roadmap for educators seeking to ensure that learners meet specific skill benchmarks before advancing further. Through the Agile approach, the system's design, development, and evaluation cycles involve continuous input from administrators, teachers, and students, ensuring that the LMS is practical, user-friendly, and capable of meeting real-world educational challenges. By integrating functionalities such as differentiated assignments, role management, and formative feedback mechanisms, this LMS seeks to address the diverse capabilities and learning styles found within a single classroom. The primary aim is to facilitate a more adaptive and student-centered learning environment, ultimately contributing to improved educational quality and sustainable learning outcomes.

2. Material and Method

2.1 Theoretical Framework

This research employs the Agile method in system design and development—a widely used approach in contemporary studies. Agile emphasizes iterative and incremental system development, where the development process is divided into short cycles known as sprints. Each sprint has specific targets, and at the end of each sprint, the development team conducts evaluations with the stakeholders. Should there be changes in requirements or new feedback, adjustments can be immediately integrated into the next cycle. This adaptive method enables the team to remain responsive to changes in the business environment, technology, or regulations [22, 23].

In the context of this research, using the Agile method offers several advantages. First, close collaboration between the development team and stakeholders ensures that any changes in requirements are promptly addressed and incorporated into the system [24, 25]. Second, continuous feedback from end users allows researchers to assess whether the functionalities developed meet expectations or require further adjustments [26]. Third, the Agile method encourages continuous evaluation of both technical and managerial aspects of the development process so that any obstacles or inefficiencies can be swiftly rectified [27, 28]. Although Agile demands high flexibility from all team members, it generally results in a product that more accurately reflects actual field requirements [29].

The system development process under the Agile methodology still comprises key stages—analysis, design, development, testing, and implementation—but these stages are executed iteratively in smaller segments. For example, in one sprint, the team might focus solely on developing the login and registration module. Once that sprint is complete, the module is tested and improved if any deficiencies are found. In the subsequent sprint, the team develops a more complex module. With this workflow, a functional product can be delivered quickly and immediately validated by the end users [30, 31].

The testing phase is equally important to ensure that the system is truly ready for use. One common approach is usability testing, which is frequently applied to measure how comfortable and easy it is for users to interact with the system's interface [32]. The results of usability testing provide valuable feedback for refining the interface design—such as menu placement, icon selection, and overall visual consistency [32].

The first stage in system development—system analysis—involves data collection and the creation of diagrams that detail the system's functionalities. This process is crucial to ensure that all stakeholders agree on the scope and objectives of the system [33]. After gathering the requirements, the next stage is system design, which formulates the system architecture, database structure, and the selection of appropriate technologies [34]. The third stage, development, uses the design as a technical blueprint to build the system. Finally, usability testing is conducted as a final verification to ensure that the system is ready for deployment [32].

By understanding each of these stages—analysis, design, development, testing, implementation, and maintenance—organizations can ensure that the resulting system not only meets technical specifications but also truly adds value and operational efficiency. Ultimately, an effective information system is designed and developed based on the real needs of the organization and is capable of adapting to the dynamic changes in the business and technological environment.

2.2 Research Phases

The process of designing an information system involves several sequential steps aimed at producing a system that genuinely meets user needs. The process begins with requirement analysis, during which both functional and non-functional requirements are identified using various data collection techniques such as interviews, observations, and document reviews. The primary goal is to ensure that both the development team and stakeholders share a common understanding of what is expected from the system. Documenting these requirements is crucial, as it forms the foundation for the entire subsequent development process.

Once the requirement analysis is complete, the next stage is system design. This stage involves designing the system architecture, database, and user interface. Diagrammatic models—such as those provided by the Unified Modeling Language (UML)—are used to visualize the structure and interactions among the system components.

The following stage is development and testing. During the development phase, programmers begin writing source code based on the established design. This is where various programming languages, frameworks, and supporting tools are employed to build the system. To ensure quality, testing is conducted regularly—for example, through unit testing and integration testing. Unit testing is performed to ensure that each component or module functions correctly, while integration testing verifies that the modules work together without conflict. Testing is a critical phase because any discrepancies between the specifications and the actual implementation can be promptly corrected before the system advances to the next stage.

During the testing phase, usability testing is performed to assess the level of user acceptance of the system. This is achieved using the System Usability Scale (SUS). Participants are asked to interact with the system or product being evaluated and then complete a SUS questionnaire consisting of 10 statements rated on a Likert scale from 1 to 5, reflecting their perceptions of the system's ease of use. The SUS score is calculated to yield an overall score ranging from 0 to 100, which is then interpreted to determine the system's usability level. This systematic and objective evaluation helps in refining the design and functionality of the system.

3. Result and Discussion

3.1 Theoretical Framework

In collaboration with the school, the researchers conducted discussions to understand the business processes underlying the system to be developed. The LMS is intended for use by both teachers and students. Teachers will be able to upload modules and assignments related to their course materials, while students will access these modules and assignments at a pace that suits their learning speeds. Students will then upload their completed assignments to the LMS, and teachers will provide grades accordingly. In general, the system will involve three user roles: teacher, student, and administrator. Each role is provided with specific features based on its responsibilities. These features are illustrated in the use case diagram shown in Figure 1.

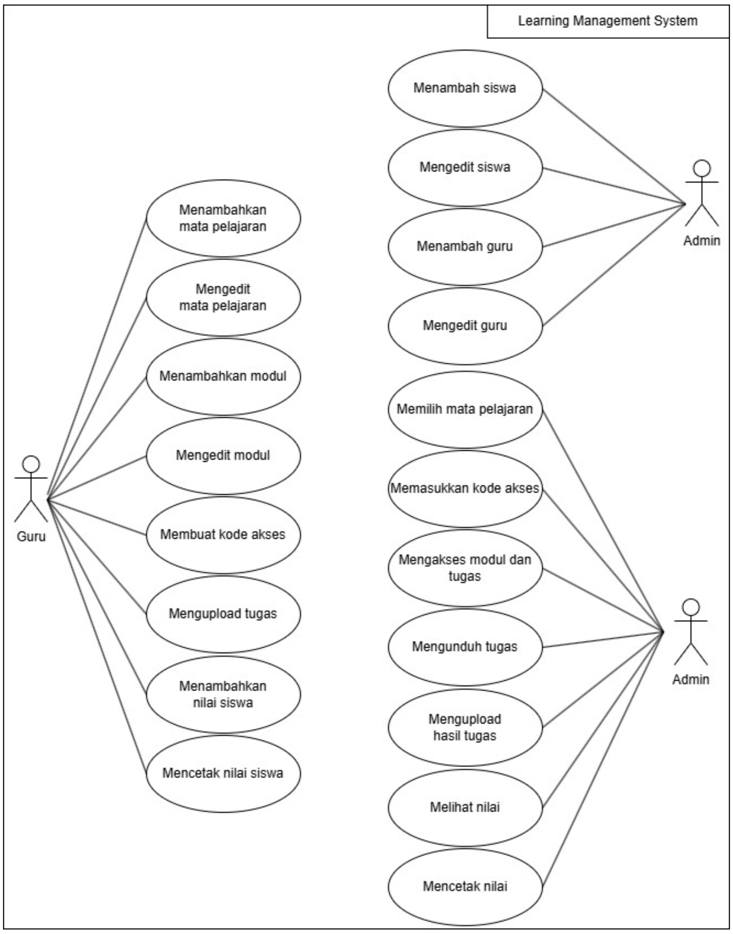

Figure 1. Use case diagram

Furthermore, Figure 2 illustrates the LMS login page. On this page, users are required to enter their username and password. If the information entered is correct, the user is directed to their dashboard; otherwise, they remain on the login page until the correct credentials are provided.

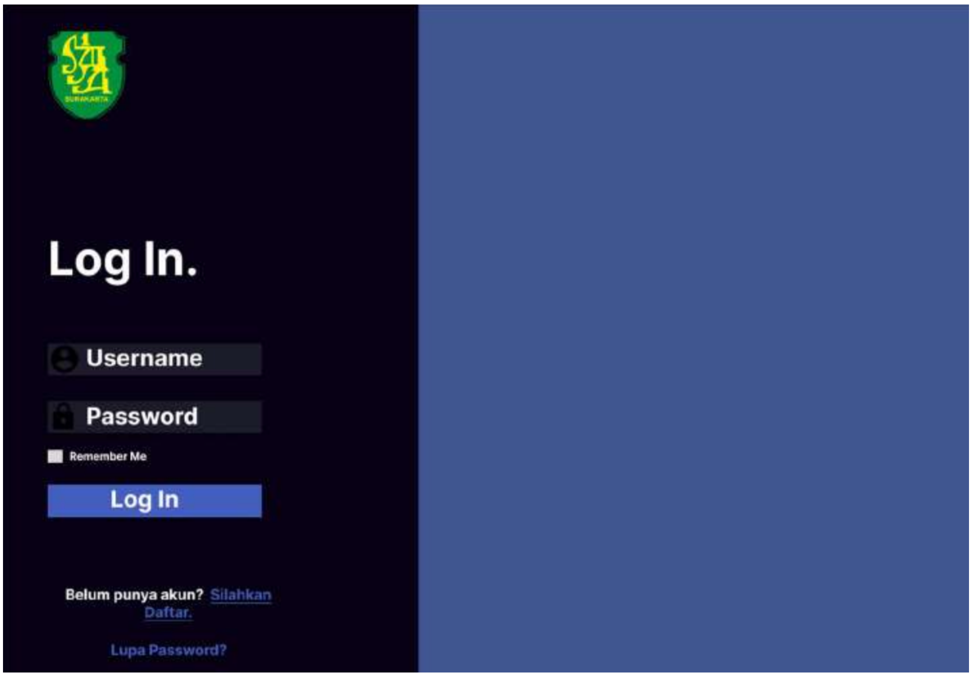

Figure 2. User login page

Moreover, Figure 3 displays the teacher list page, which is accessible only by the administrator. On this page, the administrator can add new teacher accounts for system access. The administrator can also modify or delete teacher account details as needed. Similarly, Figure 4 shows the student list page, which is also accessible exclusively by the administrator. The administrator can view all student accounts registered in the system and can modify or delete student data.

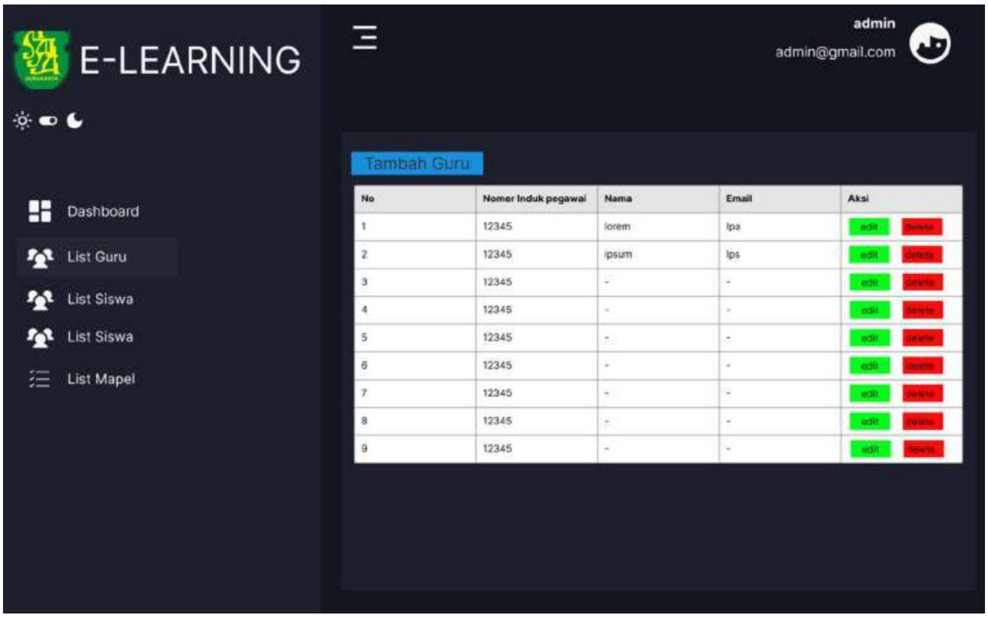

Figure 3. Teacher list page

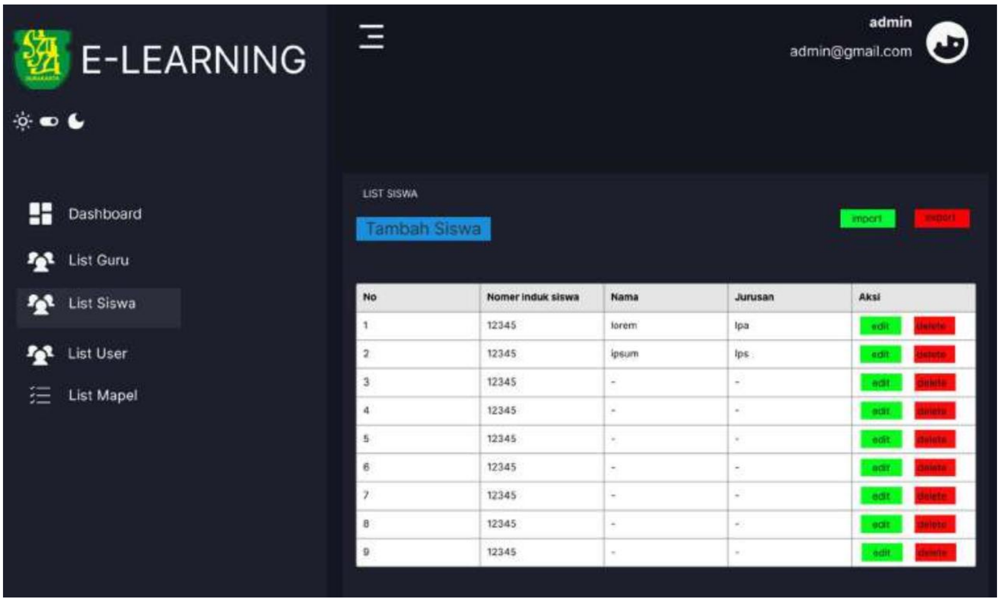

Figure 4. Student list page

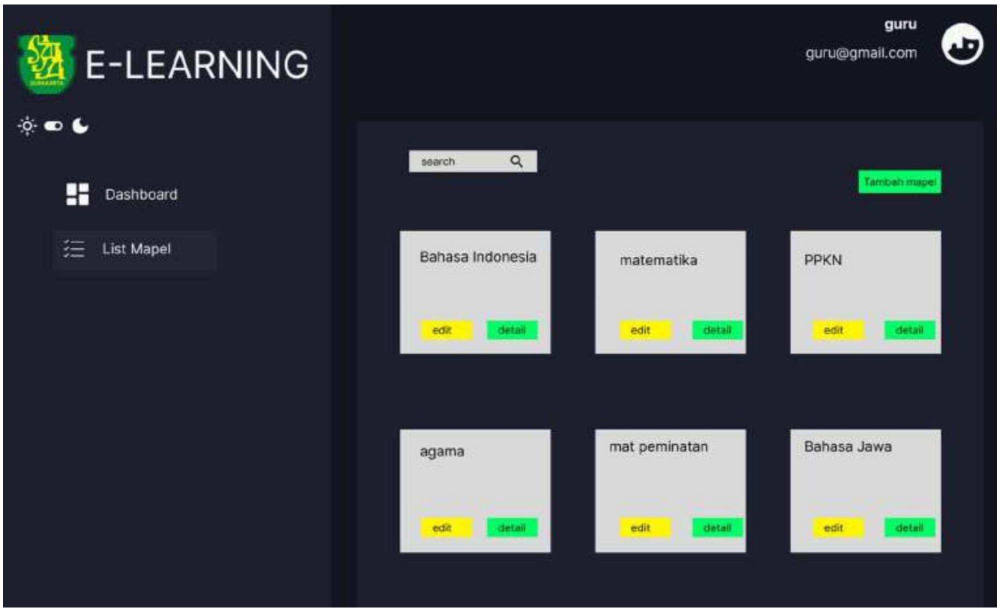

Figure 5. Subject list page

Figure 5 shows the page listing the subjects. Teachers can access this page to see the subjects they are assigned to within the LMS. For each subject, a list of learning materials—uploaded by the teacher—is available. Additionally, teachers can upload assignments related to the learning materials to assess student competencies. Figure 6 displays the learning materials page for one of the subjects. Figure 7 shows the page where both learning materials and assignments for a subject are presented.

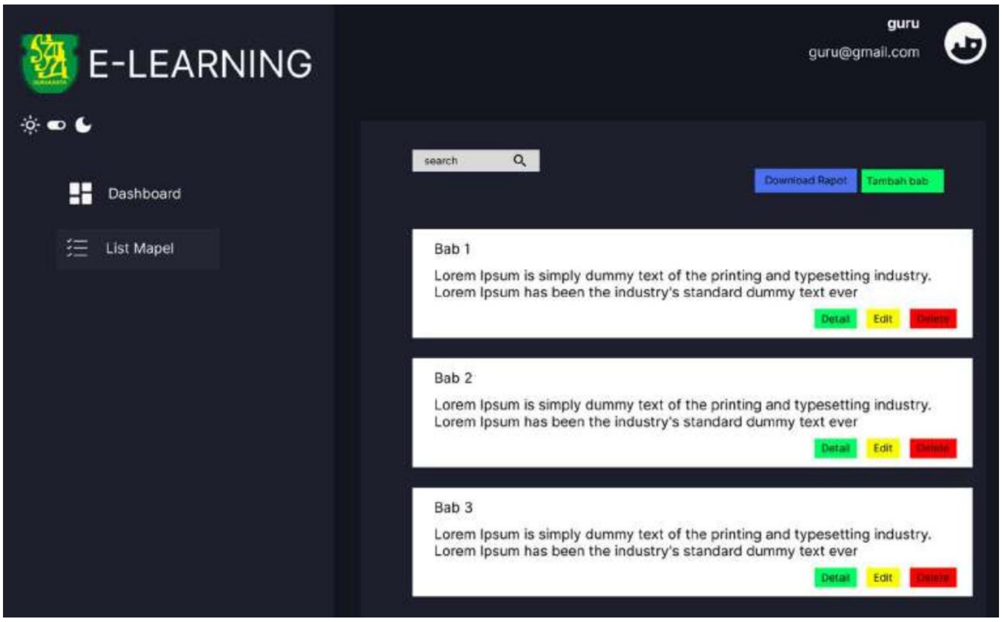

Figure 6. Learning materials page for a specific subject

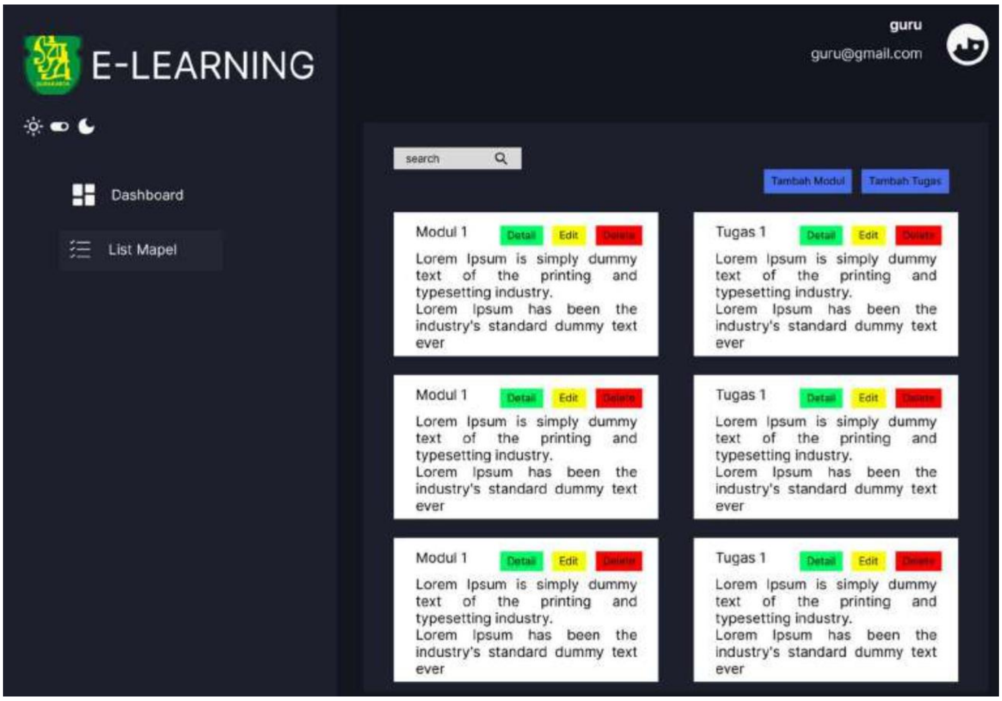

Figure 7. Learning materials and assignments page for a specific subject

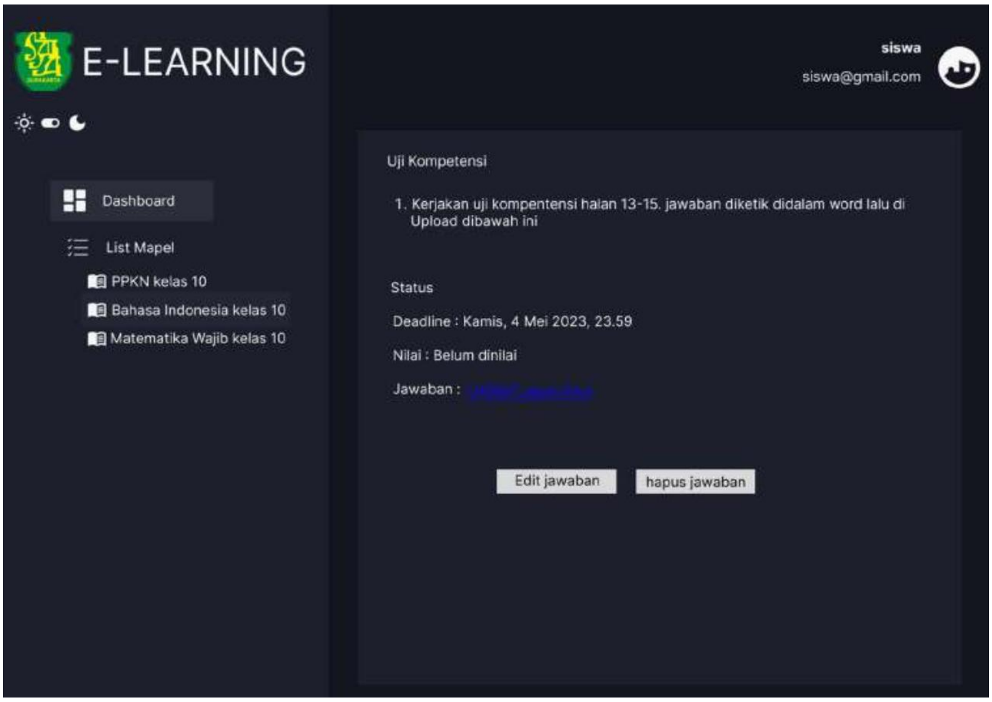

Figure 8. Student assignment upload page

Figure 8 illustrates the page where students can upload their completed assignments. This page displays the submission deadline, and students have the option to delete or replace their uploaded assignments until the deadline passes.

3.2 Usability Testing

The final phase of the system development was usability testing. This testing utilized ten statements developed by Brooke [35], as listed in Table 1. The participants were 80 tenth-grade students. Each student was asked to use the developed LMS and complete a questionnaire regarding the system's usability by rating the 10 statements on a Likert scale from 1 to 5. The questionnaire items are in Bahasa Indonesia.

Table 1. System usability scale items

Code	Statement
Q1	*Saya merasa akan sering menggunakan sistem ini.*
Q2	*Sistem ini terlalu kompleks.*
Q3	*Sistem ini mudah digunakan.*
Q4	*Saya merasa membutuhkan bantuan teknis untuk dapat menggunakan sistem ini.*
Q5	*Fitur-fitur dalam sistem ini terintegrasi dengan baik.*
Q6	*Saya merasa bahwa ada banyak inkonsistensi dalam sistem ini.*
Q7	*Sebagian besar orang akan bisa belajar menggunakan sistem ini dengan cepat.*
Q8	*Sistem ini terasa rumit untuk digunakan.*
Q9	*Saya merasa percaya diri ketika menggunakan sistem ini.*
Q10	*Saya merasa perlu mempelajari banyak hal sebelum saya bisa mulai menggunakan sistem ini.*

Survey responses were then collected and processed to compute the SUS score. For each odd-numbered statement, 1 was subtracted from the user's rating. For each even-numbered statement, the user's rating was subtracted from 5. The total adjusted score was then multiplied by 2.5 to yield the final SUS score. Finally, the average SUS score was calculated from all participants. Table 2 provides an example of the SUS score calculation for the first five participants. The overall average SUS score from the 80 participants was 81.75, which falls into the "very good" category [36]. A deeper analysis suggests that participants value the system's ability to track competency milestones and offer targeted feedback, highlighting how these specific features enhance overall usability in a classroom setting.

Table 2. Example of SUS score simulation for the first five participants

User	User response										Adjusted score										SUS
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	score
1	5	2	4	1	5	3	5	1	4	2	4	3	3	4	4	2	4	4	3	3	85
2	5	2	4	2	5	3	5	1	4	1	4	3	3	3	4	2	4	4	3	4	85
3	4	2	5	2	3	3	4	2	5	1	3	3	4	3	2	2	3	3	4	4	77.5
4	5	2	4	2	3	2	5	1	5	1	4	3	3	3	2	3	4	4	4	4	85
5	5	2	4	2	5	2	4	1	5	1	4	3	3	3	4	3	3	4	4	4	87.5

4. Conclusion

This study successfully developed an LMS tailored to meet the needs of a school in managing the learning process more adaptively. The Agile method was employed to ensure that the development process could quickly respond to changes in requirements and feedback. The implementation results indicate that the system includes several key features: user management (for administrators, teachers, and students), uploading and management of learning materials, assignment distribution, and a mechanism for students to upload their completed assignments. Usability testing using the System SUS produced an average score of 81.75, which is categorized as "very good." This indicates that the developed LMS is both well-received and user-friendly for students. A deeper conclusion underscores how competency-based learning elements can enhance personalization and motivation. By allowing each student to move at an appropriate pace and by equipping teachers with real-time data on skill mastery, this LMS can significantly improve educational outcomes. Future research should test the system across diverse institutional contexts and incorporate additional analytics to measure how effectively competency markers predict long-term student performance.

Despite its promise, there are limitations. First, the research was conducted at a single school with 80 student participants, which limits the generalizability of the findings to a broader population or different educational contexts. Second, the system was implemented over a relatively short period, so its long-term effectiveness and stability have not been thoroughly evaluated. Third, the LMS was tested on a limited variety of devices, and its performance on different devices (e.g., tablets, and smartphones with various operating systems) has not been deeply examined.

For future development, several suggestions are offered. Enhancements such as integrating advanced features—like learning analytics, gamification, and a content recommendation system—could further enrich the learning experience and tailor content to individual learning styles. Future research is recommended to involve more schools or educational institutions with diverse backgrounds and a larger number of students so that the reliability and effectiveness of the system can be assessed more comprehensively. Additionally, integrating the LMS with other platforms, such as a Student Information System or online assessment tools, would expand its functionality and facilitate the synchronization of academic data for a more integrated analysis.

Overall, this study contributes a specialized competency-based approach to LMS design, demonstrating how features that measure and respond to individual mastery can drive usability, user satisfaction, and potentially better learning outcomes. Expansion of this model could yield a robust and customizable framework, advancing personalized education strategies for diverse learning environments.

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References

1. Waskito, Irzal, R. E. Wulansari, and K. Z. Ya, "The Adventure of Formative Assessment with Active Feedback in The Vocational Learning: The Empirical Effect for Increasing Students' Achievement," Journal of Technical Education and Training, vol. 14, no. 1, pp. 54-62, 2022, doi: 10.30880/jtet.2022.14.01.005.
2. D. Jones, "The intrinsic value of formative assessment and feedback as learning tools in the acquisition and improvement of a practical legal skill," The Law Teacher, vol. 54, no. 3, pp. 443-454, 2020/07/02 2020, doi: 10.1080/03069400.2020.1717830.
3. Y. Yang, J. van Aalst, and C. K. Chan, "Dynamics of reflective assessment and knowledge building for academically low-achieving students," American Educational Research Journal, vol. 57, no. 3, pp. 1241-1289, 2020.
4. C. C. Deneen, G. T. L. Brown, and D. Carless, "Students' conceptions of eportfolios as assessment and technology," Innovations in Education and Teaching International, vol. 55, no. 4, pp. 487-496, 2018/07/04 2018, doi: 10.1080/14703297.2017.1281752.
5. M. Sharifi, H. Soleimani, and M. Jafarigohar, "E-portfolio evaluation and vocabulary learning: Moving from pedagogy to andragogy," British Journal of Educational Technology, vol. 48, no. 6, pp. 1441-1450, 2017, doi: 10.1111/bjet.12479.
6. A. E. Yastibas and G. C. Yastibas, "The Use of E-portfolio-based Assessment to Develop Students' Self-regulated Learning in English Language Teaching," Procedia - Social and Behavioral Sciences, vol. 176, pp. 3-13, 2015/02/20/ 2015, doi: 10.1016/j.sbspro.2015.01.437.
7. C.-C. Chang, K.-M. Shu, C. Liang, J.-S. Tseng, and Y.-S. Hsu, "Is Blended e-Learning as Measured by an Achievement Test and Self-Assessment Better than Traditional Classroom Learning for Vocational High School Students?," (in En), International Review of Research in Open and Distributed Learning, vol. 15, no. 2, pp. 213-231, 2014, doi: 10.19173/irrodl.v15i2.1708.
8. A. Sapi, S. W. Israr, I. Khanjar, H. Atifnigar, and Z. u. R. Zaheer, "Factors Influencing the Success of E-Learning Implementation: A Study of Afghan-Postgraduate Students at UTM-Malaysia," European Journal of Theoretical and Applied Sciences, vol. 1, no. 2, pp. 301-312, 04/11 2023, doi: 10.59324/ejtas.2023.1(2).26.
9. D. M. Mahmoud, N. M. Tantaewy, and H. M. Allam, "E-Learning; Barriers and Opportunities; Nursing Students Perspectives," Egyptian Journal of Health Care, vol. 11, no. 4, pp. 1077-1093, 2020.
10. R. Auliana, F. Rahmawati, T. Mahanani, and Marwanti, "The Factors that Influence Student Satisfaction During Online Learning on the Subject of Culinary in the Bachelor of Applied Culinary Program of UNY," Pedagogia: Jurnal Pendidikan, vol. 13, no. 1, 11/21 2023, doi: 10.21070/pedagogia.v13i1.1539.
11. K. Agustini, "The Adaptive Elearning System Design: Student Learning Style Trend Analysis," in Proceedings of the 2nd International Conference on Innovative Research Across Disciplines (ICIRAD 2017), 2017/08 2017: Atlantis Press, pp. 50-54, doi: 10.2991/icirad-17.2017.10.
12. D. W. Rachmawati, E. Yuliani, N. P. Sari, M. Sari, and I. Suryani, "Student Perceptions in Using Sisfo E-Learning Applications at PGRI Palembang University," 2022, E-Learning, SISFO, application vol. 14, no. 4, p. 10, 2022-09-05 2022, doi: 10.35445/alishlah.v14i4.2252.
13. R. Alotaibi and A. Alghamdi, "Studying faculty members' readiness to use Shaqra University e-learning platform," Indonesian Journal of Electrical Engineering and Computer Science, vol. 22, no. 3, pp. 1556-1564, 2021.
14. S. Mpofu and S. Ndlovu, "Covid-19 Pandemic and Pedagogic Learning Innovations in the 'New' Classroom: Views from educators in the Global North and South," International Journal of Social Learning (IJSL), vol. 4, no. 2, pp. 210-224, 04/27 2024, doi: 10.47134/ijsl.v4i2.266.
15. H. Didik and K. Thomas, "An Adaptive User Interface for an E-learning System by Accommodating Learning Style and Initial Knowledge," in Proceedings of the International Conference on Technology and Vocational Teachers (ICTVT 2017), 2017/09 2017: Atlantis Press, pp. 16-23, doi: 10.2991/ictvt-17.2017.4.

16. G. Xinyua, C. Chuangqib, B. Yujingc, H. Liyuand, and G. Baoliane, "Research on Mathematical Computation Training Based on Gamified Adaptive Learning System," Frontiers in Educational Research, vol. 6, no. 24, 2023.
17. M. L. Jundillah, J. E. Suseno, and B. Surarso, "Evaluation of E-learning Websites Using the Webqual Method and Importance Performance Analysis," E3S Web Conf., vol. 125, p. 24001, 2019, doi: 10.1051/e3sconf/201912524001.
18. B.-H. Kim, "Analysis of Learning Effect through Voice Signal Analysis in Online Education Environment," Journal of Curriculum and Teaching, vol. 11, no. 5, pp. 95-104, 2022.
19. Z. A. Mohammad, "Subject Review: The Effectiveness Of Integrating E-Learning On Learning Outcome And Student Perceptions In Tertiary Education," International Journal of Research in Social Sciences and Humanities, vol. 6, 2023, doi: 10.37648/ijrssh. v13i02.
20. O. V. Yanuschik, E. G. Pakhomova, and K. Batbold, "E-learning as a Way to Improve the Quality of Educational for International Students," Procedia - Social and Behavioral Sciences, vol. 215, pp. 147-155, 2015/12/08/ 2015, doi: 10.1016/j.sbspro.2015.11.607.
21. W. Erlia, "Roles of the teacher for increasing learning quality of students," ETUDE: Journal of Educational Research, vol. 1, no. 3, pp. 77-86, 03/31 2021, doi: 10.56724/etude.v1i3.35.
22. H. Edison, X. Wang, and K. Conboy, "Comparing Methods for Large-Scale Agile Software Development: A Systematic Literature Review," IEEE Transactions on Software Engineering, vol. 48, no. 8, pp. 2709-2731, 2022, doi: 10.1109/TSE.2021.3069039.
23. A. Hinderks, F. J. D. Mayo, J. Thomaschewski, and M. J. Escalona, "Approaches to manage the user experience process in Agile software development: A systematic literature review," Information and Software Technology, vol. 150, p. 106957, 2022/10/01/ 2022, doi: 10.1016/j.infsof.2022.106957.
24. D. Martinez, X. Ferre, G. Guerrero, and N. Juristo, "An Agile-Based Integrated Framework for Mobile Application Development Considering Ilities," IEEE Access, vol. 8, pp. 72461-72470, 2020, doi: 10.1109/ACCESS.2020.2987882.
25. V. Huck-Fries, F. Nothaft, and M. Wiesche, "Investigating the Role of Stakeholders in Agile Information Systems Development Projects: A Mixed Methods Approach," in Annual Hawaii International Conference on System Sciences, Hawaii, 2021, 2021, doi: 10.24251/hicss.2021.816.
26. O. A. Popoola, H. E. Adama, C. D. Okeke, and A. E. Akinoso, "Conceptualizing agile development in digital transformations: Theoretical foundations and practical applications," Engineering Science & Technology Journal, vol. 5, no. 4, pp. 1524-1541, 2024, doi: 10.51594/estj.v5i4.1080.
27. P. Abrahamsson, N. Oza, and M. T. Siponen, "Agile Software Development Methods: A Comparative Review1," in Agile Software Development: Current Research and Future Directions, T. Dingsøyr, T. Dybå, and N. B. Moe Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2010, pp. 31-59.
28. K. Kaur, A. Jajoo, and Manisha, "Applying Agile Methodologies in Industry Projects: Benefits and Challenges," in 2015 International Conference on Computing Communication Control and Automation, 26-27 Feb. 2015 2015, 2015, pp. 832-836, doi: 10.1109/ICCUBEA.2015.166.
29. T. Žužek, Ž. Gosar, J. Kušar, and T. Berlec, "Adopting Agile Project Management Practices in Non-Software SMEs: A Case Study of a Slovenian Medium-Sized Manufacturing Company," Sustainability, vol. 12, no. 21, p. 9245, 2020. [Online]. Available: https://www.mdpi.com/2071-1050/12/21/9245.
30. E. Stelzmann, "Contextualizing agile systems engineering," IEEE Aerospace and Electronic Systems Magazine, vol. 27, no. 5, pp. 17-22, 2012, doi: 10.1109/MAES.2012.6226690.
31. M. Kohlbacher, E. Stelzmann, and S. Maierhofer, "Do agile software development practices increase customer satisfaction in Systems Engineering projects?," in 2011 IEEE International Systems Conference, 4-7 April 2011 2011, pp. 168-172, doi: 10.1109/SYSCON.2011.5929091.
32. J. B. Dabney and J. D. Arthur, "Applying standard independent verification and validation techniques within an agile framework: Identifying and reconciling incompatibilities," Systems Engineering, vol. 22, no. 4, pp. 348-360, 2019, doi: 10.1002/sys.21487.
33. A. Ahmed, S. Ahmad, N. Ehsan, E. Mirza, and S. Z. Sarwar, "Agile software development: Impact on productivity and quality," in 2010 IEEE International Conference on Management of Innovation & Technology, 2-5 June 2010 2010, pp. 287-291, doi: 10.1109/ICMIT.2010.5492703.
34. T. Dingsoeyr, D. Falessi, and K. Power, "Agile Development at Scale: The Next Frontier," IEEE Software, vol. 36, no. 2, pp. 30-38, 2019, doi: 10.1109/MS.2018.2884884.
35. J. Brooke, "SUS: A Quick and Dirty Usability Scale," Usability Evaluation in Industry, 1996.
36. J. R. Lewis and J. Sauro, "Item benchmarks for the system usability scale," Journal of Usability Studies, vol. 13, no. 3, 2018.