Journal of Artificial Intelligence and Software Engineering
Vol. 5, No. 3, September 2025, pp. 1193~1200
E-ISSN: 2777-001X, DOI: 10.30811/jaise.v5i3.7401

Evaluating LMS Usability by Integrating Nielsen and Budd Principles

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Article Innformation

Accepted : 18 Juli 2025
Revised : 22 September 2025
Published : 30 September 2025

Keywords:

Usability
Heuristics Evaluation
LMS (Learning Management Systems)
Andy Budd
Nielsen

ABSTRAK

Sistem Manajemen Pembelajaran (Learning Management Systems/LMS) merupakan bagian penting dari pendidikan modern, mendukung penyampaian materi, keterlibatan mahasiswa, dan fungsi administratif. Tantangan dalam keterpakain (usability) sering mengalihkan perhatian pengguna dari konten pembelajaran ke navigasi sistem yang kompleks. Meskipun evaluasi heuristik (Heuristic Evaluation/HE) telah banyak diterapkan untuk menilai antarmuka LMS, sebagian besar penelitian masih menggunakan satu kerangka kerja saja dan melibatkan evaluator ahli. Penelitian ini mengatasi kesenjangan tersebut dengan mengintegrasikan pendekatan HE berbasis dua kerangka kerja, yaitu Heuristik Jakob Nielsen dan Heuristik Andy Budd. Kombinasi baru ini, yang melibatkan evaluator pemula/non-ahli, memungkinkan identifikasi masalah keterpakain yang lebih luas dan praktis yang mungkin tidak terlihat oleh para ahli. Penelitian ini menemukan sekitar 158 masalah yang dilaporkan oleh 23 evaluator pemula, dengan rata-rata tingkat keparahan masing-masing 2,52 dan 2,51 untuk heuristik Nielsen dan Budd. Heuristik Nielsen menyoroti prinsip inti seperti umpan balik, visibilitas, dan pencegahan kesalahan, sementara heuristik Budd menekankan kesederhanaan, konsistensi, dan kepuasan pengguna. Temuan ini menunjukkan bahwa integrasi beberapa kerangka heuristik dengan perspektif pengguna akhir memberikan wawasan yang lebih kaya untuk meningkatkan keterpakain LMS.

ABSTRACT

Learning Management Systems (LMS) are integral to modern education, supporting course delivery, student engagement, and administrative functions. Usability challenges often divert users' focus from learning content to navigating system complexities. While the heuristics evaluation (HE) has been widely used to assess LMS interfaces, those mostly rely on a single framework and expert evaluators. This study addresses this gap by integrating a dual framework of HE approaches: Jakob Nielsen's Heuristics and Andy Budd's Heuristics. The new combination involving non-expert evaluators can identify broader and more practical usability issues which might not be revealed by experts. The study revealed about 158 issues found by 23 novice evaluators with a severity rating of 2.52 and 2,51 for Nielsen's and Budd heuristics, respectively. Those were found according to Nielsen's and Budd's HE within the average of severity rating of about 2.52 and 2.51, respectively. Nielsen's heuristics highlight core principles such as feedback, visibility, and error prevention, while Budd's heuristics emphasize simplicity, consistency, and user enjoyment. The findings demonstrate that integrating multiple heuristic frameworks with end-user perspectives provides richer insight for improving LMS usability.

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How to cite:

Z. Maulidawati, B. D. Meilani, & A. Sodik, "Evaluating LMS Usability by Integrating Nielsen and Budd Principles," *Journal of Artificial Intelligence and Software Engineering (J-AISE)*, vol. 5, no. 3, pp. 1193-1200, September 2025, doi: 10.30811/jaise.v5i3.7401

1. INTRODUCTION

Learning management systems (LMS) play a pivotal role in education, which involves some features and functionalities such as course delivery, student engagement, and administrative functions [1], [2]. Since online learning emerged in the mid-to-late 1990s, the technologies and tools supporting learning have continuously evolved [3]. The need to use digital platforms such as LMS has been increasing as long as the development of technology itself [4]. In Asia Pacific alone, e-learning is growing at an annual rate of 20.28% from 2022 to 2030 [5]. In Indonesia, the online learning platform users are expected to amount to 21.6 million users by 2029 [6]. While numerous LMS options are available in the online market, many universities and educational institutions choose to develop their own platforms to offer unique features tailored to their specific needs and values.

The use of LMS not only provides the learning context but also can be used in other class settings, such as distance learning. It has affected the way learners learn and communicate in the educational environment, and learning management systems are being developed [1]. Several studies reviewed the implementation of LMS and the internet in learning, which has been highly welcomed by students [7]. The whole experience of studying, preceding the information from the online platform, is essentially considered. A learning management system's user experience (UX) plays a crucial yet often overlooked role in the overall success and effectiveness of the learning process.

Usability is a critical determinant of LMS effectiveness, impacting user satisfaction and system adoption. The term usability is defined as a method of knowing how easy the design process of digital products [8]. It refers to the quality of products and how easily users can navigate and learn the user interface with less effort. Usability, defined by the International Organization for Standardization (ISO) refers to the degree to which a product enables users to accomplish their objectives efficiently, effectively, and with satisfaction within a specific context of use [9]. There are five main components defined as usability [9], [10]:

- Learnability – How easy is it for new users to perform basic tasks?
- Efficiency – What time does it take for users to find what they came for?
- Memorability – How hard is it for users to repeatedly perform their tasks?
- Error rate – Errors made by users.
- Satisfaction – The comfort users feel when using the design.

Usability in human-computer interaction (HCI) aims to achieve the balance among elements of human-centered design such as people, activities, context, and technology (PACT) [11]. There are two relations in need to be optimized: (1) technology and humans while using the user interface and (2) the interaction between technology and humans with their context and activities. The two relations define how user relations to technology are precisely not only the relationship between the user and the screen of the device but also the way in which the user is affected by the environment. UI designers are always expected to follow the standard when building interactive UIs.

Heuristics evaluation (HE) is a methodological evaluation which was first developed in collaboration by Jacob Nielsen and Rolf Molich in 1990 [8]. In 1994, the methodology was developed and refined based on a factor analysis of 249 usability problems which focused on 5 quality components: learnability, efficiency, memorability, error, and satisfaction [8]. HE is developed as a rule of thumb for many UI/UX designers and researchers to obtain a better understanding of user experience and feedback. The set of usability principles, Nielsen, is as follows [8]:

Table 1. Jacob Nielsen Heuristics

Jakob's - Usability Heuristics	
N1: Visibility of System Status	The design should always keep users informed about what is going on, through appropriate feedback within a reasonable amount of time.
N2: Match Between System and the Real World	The design should speak the users' language. Use words, phrases, and concepts familiar to the user, rather than internal jargon.

Jakob's - Usability Heuristics	
N3: User Control and Freedom	Users often perform actions by mistake. They need a clearly marked "emergency exit" to leave the unwanted action without having to go through an extended process.
N4: Consistency and Standards	Users should not have to wonder whether different words, situations, or actions mean the same thing.
N5: Error Prevention	Good error messages are important, but the best designs carefully prevent problems from occurring in the first place.
N6: Recognition Rather than Recall	Minimize the user's memory load by making elements, actions, and options visible.
N7: Flexibility and Efficiency of Use	Shortcuts — hidden from novice users — may speed up the interaction for the expert user such that the design can cater to both inexperienced and experienced users.
N8: Aesthetic and Minimalist Design	Interfaces should not contain information that is irrelevant or rarely needed.
N9: Help Users Recognize, Diagnose, and Recover from Errors	Error messages should be expressed in plain language (no error codes), precisely indicate the problem, and constructively suggest a solution.
N10: Help and Documentation	It's best if the system doesn't need any additional explanation.

As website development has changed a lot, the Nielsens heuristics did not address the problems of the continuously evolving website [12], [13]. Andy Budd constructed the heuristics sets specifically for modern website design underlying the same principles [13], [14]. The Andy Budd heuristics evolution is described in the following list:

Table 2 Andy Budd Heuristics

Andy Budd – Heuristics Evaluation	
A1: Design for User Expectations	Design the system around the users, their goals and expectations
A2: Clarity	Make the system as clear, concise and meaningful as possible for the intended audience.
A3: Minimize Unnecessary Complexity and Cognitive Load	Make the system as simple as possible for users to accomplish their tasks, but no simpler.
A4: Efficiency and Task Completion	Design for user productivity, not the systems. Optimize the system for the most common tasks.
A5: Provide Users with Context	Interfaces should provide users with a sense of context in time and space
A6: Consistency and Standards	Labels, processes and interface elements should be used consistently throughout the system.
A7: Prevent Errors	The system should help prevent errors wherever possible.
A8: Help users notice, understand and recover from errors	Errors should be obvious and easy to recover from. Error messages should be clear, concise and easy to notice.
A9: Promote a pleasurable and positive user experience	The user's interactions with the system should be positive and where possible enhance their quality of life.

Heuristic evaluation (HE), a cost-effective usability inspection method, helps identify and address interface design flaws to improve the overall user experience. Various studies have evaluated the usability of user interface products. Specifically, the usability evaluation of LMS in many universities has successfully revealed that even though the application is accepted among learners and educators, it cannot be hindered from overcoming some challenges [15]. First, the study by [16] revealed that HE could identify the problem issues of the LMS, such as inappropriate content, unpleasant user interaction, and many violations of basic principles of design and usability. Other research work by [1] showed that the evaluated LMS failed to comply with some HE principles, such as 'error prevention' and 'Help and documentation'. Most of the findings showed and strongly concluded that if the usability of LMS is not at the desired standard, the user tends to focus on learning the system instead of the content of the course [1], [17].

As a common technology developed using human-centred design principles, the LMS user interface should be developed with high usability. When the system of LMS is developed effectively following the usability principles, the learner will easily navigate to focus on digesting learning materials instead of getting frustrated and annoyed UI [18]. The LMS content makes usability highly crucial in tailoring to learners. The development of a common user interface particularly needs repeated iterative evaluation and feedback from the users.

Although heuristic evaluation has been widely applied to assess system usability, including LMS platforms, most studies rely on a single framework and involve only expert evaluators. This limits the diversity of usability issues identified, particularly from the perspective of students as end users. To address this gap, the study employs a **dual-framework approach**, combining Jakob Nielsen's 10 Usability Heuristics and Andy Budd's Design Heuristics, to capture a broader and more comprehensive range of usability problems. Furthermore, **novice evaluators** are involved to reflect the experiences and insights of actual end users. By integrating multiple heuristic frameworks with non-expert perspectives, this study contributes both to HCI research and the practical development of LMS with improved usability.

2. METHOD

The study evaluated the usability of learning systems management used at Institut Teknologi Adhi Tama Surabaya, called classroom ITATS, using two heuristics evaluation frameworks. There were 23 evaluators who were students in the Human-Computer Interaction class. They were trained in human-centred design principles during the class and specifically trained using the heuristics method before the evaluation process.

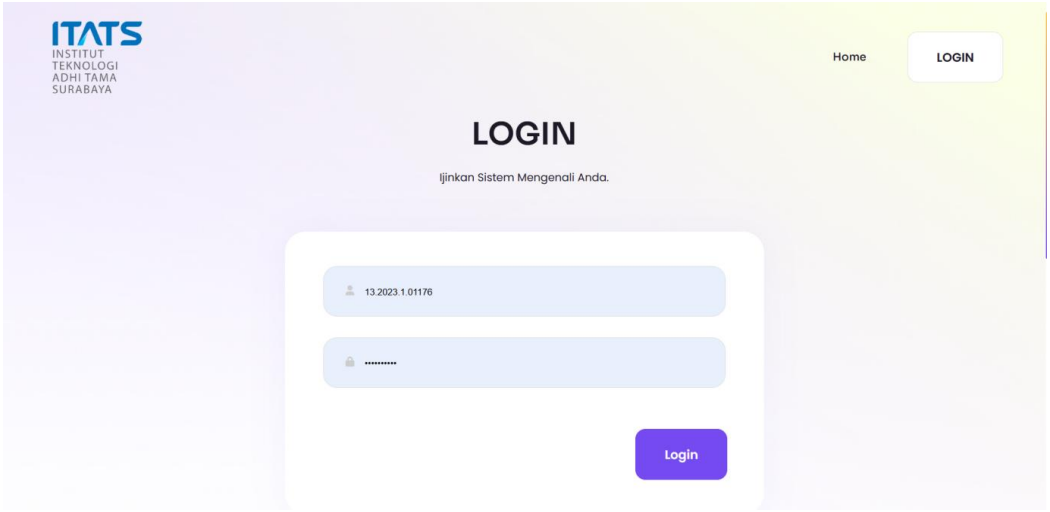

Figure 1. ITATS Classroom Login Page

The reasonable thing for using novice evaluators in this study is to reveal a fresh perspective while they are also the targeted users. This perspective helps uncover usability issues that might be overlooked by experts who are overly familiar with design standards or technical constraints [19]. Furthermore, some studies also emphasized some benefits of heuristic evaluation by non-expert evaluators. Novices often represent the typical end-users of many applications, and their input ensures the interface is accessible and intuitive to a wider audience [19]. The studies highlighted that novice evaluators often identify major usability problems that significantly affect user experience, and also could avoid bias [20], [21]. In addition, involving novices in usability evaluation, academic or training exercises can also contribute to educational values [22]. The process of conducting heuristic evaluations can help novice evaluators learn usability principles and improve their understanding of user-centred design.

The study was conducted within some phases to ensure the evaluation process was conducted effectively. First, the novice evaluators were trained and provided the HE workbook and handout for doing the evaluation. Before starting the evaluation process, they were given an explanation and a discussion on how to conduct the evaluation. The workbook consists of Jacob Nielsen and Andy Budd's HE method as well as an explanation to help them comprehend each HE's rule. The workbook was adopted from Angela HE's workbook [13].

The evaluator should follow the instructions/tasks in evaluating the interface: (**1) doing presence in the classroom, (2) uploading the assignment, (3) making a post in the discussion room, and (4) exploring in detail what interests them more.** The instruction was designed to reveal issues in the key access while also giving freedom to the evaluator to find unexpected findings. It can help provide more perspective and reveal more diversity instead of the other three tasks.

Furthermore, each problem issue found was identified with the severity rate, and recommendations were provided. The technique of heuristic evaluation involves analyzing and identifying usability issues of the website and marking them using a severity rating by Nielsen [23]:

Table 3. Severity Rating Score

Severity Rating	
S0	I don't agree that this is a usability problem at all
S1	Cosmetic problem only: need not be fixed unless extra time is available on a project
S2	Minor usability problem: fixing this should be given low priority
S3	Major usability problem: important to fix, so should be given high priority
S4	Usability catastrophe: imperative to fix this before the product can be released

The finding list of usability problems was assessed by the evaluators using the rating described above. Then, those were recapped and analyzed together to generate the result. The average severity rating was considered the final rating, which was declared in percentage (%). The findings were documented in the HE worksheet document with detailed explanations in order to minimize the understanding among evaluators. Furthermore, in this study, the result was discussed and debated using the usability principles of ISO. It uses descriptive analysis to reveal any issues relating to the principles and also highlights the user perspective and recommendations.

3. RESULTS AND DISCUSSION

Based on the two heuristics, namely Nielsen and Budd heuristics, the study found 158 usability issues in LMS. The findings came from the three tasks initiated in the HE workbooks and also from a deep evaluation by evaluators in their preference part of the LMS. According to the statistical data in Table 5, Jacob Nielsen's heuristics (N1-N10) show a broader distribution of usage, with N1: visibility of system status (29%) being the most cited and the least referenced heuristic is N10: help and documentation (9%). Andy Budd's heuristics (A1-A9) have a narrower range, with A4: efficiency and task Completion (26%) as the highest, while A6: consistency and standard was considered as the lowest (5%).

The overall severity rating of the issues found was remarkably high. The data showed the rate is higher than 2 in both HE frameworks, within the severity range between 0 and 4. The highest severity rating is for N10 (2.86), indicating participants perceive issues related to this heuristic as highly severe. Although the FR of N10 was the lowest, the SR rate indicated that issues have a considerable impact. Moreover, the severity rating performed by Budd HE was dominated by A4, with a score of 2.57, and also acted as the highest in FR, accounting for approximately 26%.

Table 4. HE Result

Jacob Nielsen	FR	Ave. SR	Andy Budd	FR	Ave. SR
N1	29%	2.69	A1	9%	2.36
N2	17%	2.48	A2	21%	2.52
N3	20%	2.68	A3	17%	2.31
N4	15%	2.25	A4	26%	2.57
N5	14%	2.78	A5	20%	2.76
N6	19%	2.63	A6	5%	2.38
N7	23%	2.27	A7	16%	2.50
N8	15%	2.06	A8	7%	2.73
N9	13%	2.47	A9	6%	2.50
N10	9%	2.86			
Final Ave. SR		2.52	Final Ave. SR		2.51

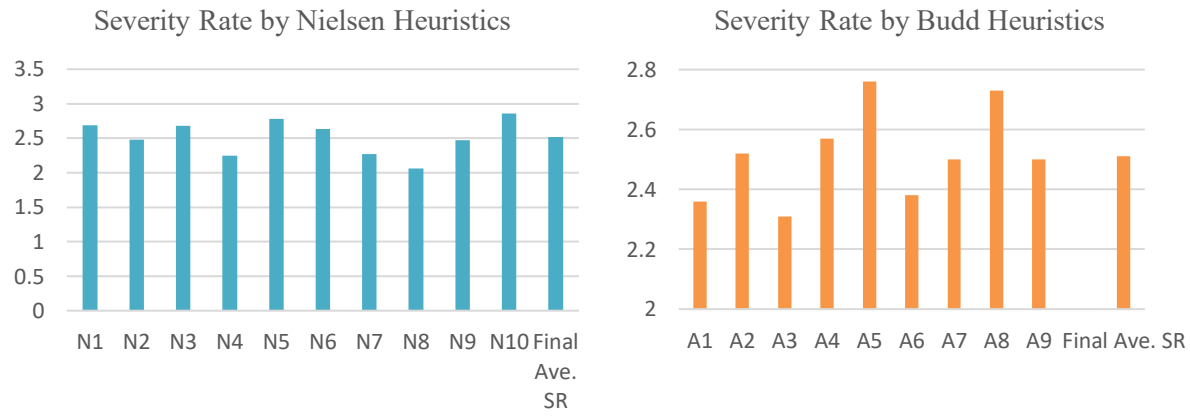

Figure 2. Severity Rate Comparison

To ease descriptive analysis and present the result, the study maps each heuristic from Nielsen and Budd with the principles it most directly supports. The mapping was developed based on the explanation from references relating to usability and design research [24], [25], [26]. It is presented in Table 5.

Tabel 5. *Mapping HE to Usability Principles*

Usability Principle	Nielsen's Heuristics	Budd's Heuristics
Learnability	N1, N2, N4	A1, A2, A4
Efficiency	N3, N6, N7	A5, A6
Memorability	N2, N6, N8	A3, A9

Error Rate	N3, N5, N9	A4, A7, A8
Satisfaction	N2, N8, N10	A1, A9

3.1. Learnability

Learnability focuses on helping new users quickly understand and use the system effectively [27]. The study reveals that the LMS might have tried to deliver the principles very well in helping the users escalate their learning process. The evaluators showed critical issues in the learnability principle, with some HE code cited. N1: Visibility of system status, ensuring users know what the system is doing, and aiding initial comprehension, are the most common HE rules cited by evaluators, highlighting that the LMS should considerably fix these problems. The visibility status and clarity (A2) are essential to show the users where they are and the system's progress. The findings in the study are, for example, some evaluators showed that the system has visibility status in systems such as the status of being absent and present in the presence button, no progress bar when uploading the task to the submission page, no updated information about the material uploaded by a lecturer, etc.

3.2. Efficiency

Efficiency focuses on helping users' complete tasks quickly and with minimal effort. Both Nielsen's and Budd's heuristics in this study showed efficiency issues in the LMS. N7: Flexibility and efficiency of use, and A6: Consistency and Standard align with the efficiency principles. The most highlighted finding related to the principle and both HE is the system failed to make the UI simple. Some UI are inconsistence and a little bit frustrating. The inconsistency of UI between home and home class seems like two different interfaces. This issue relates to how efficiently tasks are completed by the user. It affects other usability principles, where the UI inconsistency and complex impact on user pleasure and satisfaction. The other feedback and the evaluation result given by evaluators are missing functionality to get feedback and notes for the tutor after revealing their assignment mark. This is code in HE Budd A5: Provide Users with Context.

3.3. Memorability

Memorability ensures that returning users can re-engage with the system without needing to relearn its functions [27]. Heuristics such as N6: Recognition rather than recall and N8: Aesthetic and minimalist design emphasize simplicity and visible cues. The evaluator highlighted the findings relating to the principles of how UI presents the contents organized and simple. One of the evaluators mentioned with a high severity rating of 3 that the content cannot prioritize the upcoming tasks or assignments. Hence, the students tend to miss the deadline, resulting in the unmemorable location of the task. The A9 HE by Budd showed the issue that the UI cannot make the users pleased in navigating the systems, especially when it is used in a mobile phone browser. Two evaluators mentioned this issue, and both gave a severity rating of 4, which means that the problem was a catastrophe.

3.4. Error Rate

Reducing errors and helping users recover from them is a cornerstone of usability. The systems need to have some handling to prevent any errors made by the users. The theory of the mental model forces the systems to cover and recover from any mistakes and inputs [28]. Nielsen's N5, N9 and Budd's A7, A8 emphasize proactive and reactive error handling [24]. The error handling function has been found in LMS, but other errors still appear. The evaluator emphasized that one of the error functions did not function as normally. While the mandatory sign has been placed in the UI design, the system still allows a blank form. The information about the file size was also not presented well, allowing the user to upload a larger and the LMS was rejected without any information. Another issue with the error prevention was no notification and information when the uploaded file fails. Those issues emphasized that the LMS have not developed a pleasant UI which can help the user avoid any errors.

3.5. Satisfaction

Satisfaction measures the comfort and enjoyment users feel when using a system [27], [29]. Among HE rules relating to the satisfaction principles namely, N2, N8, N10, A3, and A9; N2: Match Between System and the Real World was the most cited within 17% and the severity rate was about 2. 48. The evaluators highlighted the navigation not presented clearly, while there were also some uncommon label and information. The other highlighted finding was that the documentation and help functions were not presented in the system. Representing the system as matching the real situation is key to increasing user satisfaction. Uncommon labels and information make users frustrated [30] and tend to use the LMS. The users are forced to independently explore the system without a guide. documentation and help make the level of satisfaction lower.

4. CONCLUSION

This study clearly shows that the novices can conduct the usability heuristic evaluation, finding any problems as an end user of the LMS. The study successfully exposes some problem areas which may not have been considered by an expert, such as adding functionality to give feedback from the tutor or lecturer. This is part of gathering user requirements found during the evaluation process. This analysis highlights the crucial role of usability heuristics in implementing the five principles of user-centered design. The final severity rating found approximately 2.51 and 2.52, which means the usability of the LMS systems is slightly good in providing usability for users. Both Heuristics have been used in revealing any problems or issues in the design of LMS, with each having a focus. Nielsen's heuristics emphasize foundational principles such as feedback, visibility, and error prevention, while Budd's heuristics complement these with a focus on simplicity, consistency, and enjoyment. Addressing high-severity heuristics, such as N10 (Help and documentation) and A5 (Provide the user with context), should be prioritized to enhance usability across learnability, efficiency, and satisfaction.

While the study reveals many issues with recommendations, the weakness of the study needs to be highly considered for better future research. Involving novice evaluators has benefited as mentioned above, but other challenges, such as poor preparation and wrong severity rating. They might not prioritize and assess as validly as the expert evaluator, but their findings are valuable. The training programs are a must to ensure the accuracy of the result. Furthermore, the study also brings implications and contributions to academic research about usability evaluation, which is highly relevant in HCI (human-computer interaction) disciplines and also reveals the contribution of novice evaluators in doing heuristic evaluation.

ACKNOWLEDGMENT

The authors gratefully acknowledge the support and involvement of the evaluators, who significantly aided in completing this work. We also thank our colleagues and peers who offered insight and suggestions to make meaningful contributions to this paper.

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