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Analysis of the Effectiveness of Cloud-Based Learning Management Systems (LMS) in University

1st Izzatul Munawwaroh*, 2nd Hasan Baharun
[1] Pascasarjana, Universitas Nurul Jadid, Probolinggo, Jawa Timur
2352600002@unuja.ac.id

Abstract—*This research evaluates the effectiveness of implementing a cloud-based Learning Management System (LMS) at universities. This research stems from the need to overcome the challenges of accessibility, flexibility and efficiency in an increasingly digital learning process. Using a qualitative approach and case studies, data was collected through in-depth interviews and observations at several university institutions implementing cloud-based LMS. The research results show that this system significantly improves real-time access to learning materials, allows flexibility in the teaching and learning process, and increases administrative efficiency and interaction between lecturers and students. However, this research also faces several limitations and challenges. One of the main challenges is resistance to change among lecturers and students who have yet to become familiar with cloud technology and limited technological infrastructure in some institutions, which hinders optimal implementation. Additionally, although the results show significant benefits, this research is limited to a limited number of institutions. It needs to include a long-term analysis of the impact of cloud-based LMS on educational quality and student satisfaction. These findings show that cloud-based LMS strengthens educational management and creates a more responsive and adaptive learning environment. This research provides a strong justification for the adoption of cloud technology at universities and provides a basis for further research into its long-term impact.*

Keywords— *Learning Management System (LMS), Cloud Based, University*

1 Introduction

Implementing a cloud-based Learning Management System (LMS) in university is expected to improve the quality of learning. However, its effectiveness depends on technological readiness, human resources, and a supportive academic culture [1][2]. Because a cloud-based LMS allows more flexible and affordable access to learning and provides various features that can support interactions between lecturers and students more effectively [3][4]. It can be seen from various research and evaluation reports that have been carried out at several universities. For example, a study at a university in Indonesia showed that after implementing a cloud-based LMS, there was a significant increase in student participation in online discussions and access to course materials, improving their learning outcomes(Riono, Hadiatullah, and Rahma, nd). However, at other universities, where technological infrastructure is still limited and training for lecturers could be more optimal, the use of LMS does not show a significant increase in the quality of learning [6][7]. Thus, implementing cloud-based LMS in university has great potential to improve the quality of learning. However, its success is greatly influenced by the readiness of technological infrastructure, user competence, and the adaptation of academic culture to digital technology.

In the digital era, universities worldwide are increasingly adopting technology to improve the quality of learning and academic administration. One significant innovation is the implementation of a cloud-based Learning Management System (LMS), which offers real-time access, flexibility and efficiency in the teaching and learning process. Although

*Corresponding author

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many studies have explored the general benefits of LMS, few have specifically examined the effectiveness of cloud-based systems in the university context. This research aims to fill this gap by evaluating how cloud-based LMS affects accessibility, interaction between lecturers and students, and administrative efficiency in higher education environments. [8] [9][10] By focusing on the practical impact of this technology, this research not only expands the existing literature but also offers more profound insight into the challenges and opportunities educational institutions face in implementing cloud-based LMS.

The novelty of this research lies in a holistic approach that combines a comprehensive analysis of the effectiveness of cloud-based LMS with the dynamics of academic and cultural adaptation in higher education, which has yet to be widely discussed in previous research [11][12]. This research not only assesses the effectiveness of LMS from a technical and usage perspective but also considers how values, habits, and academic and cultural resistance to digital technology influence the final results of LMS implementation [13][14]. Thus, this research offers new insights into integrating technology with institutional culture and policy changes to achieve more comprehensive success in technology-based higher education transformation.

This research analyzes how various university stakeholders implement, accept, and utilize cloud-based LMS [15][16]. However, its success is greatly influenced by the readiness of technological infrastructure, user competence, and the adaptation of academic culture to digital technology. Empirical evidence shows that LMS effectiveness can be optimized with adequate support in these aspects [17][18]. Therefore, universities must ensure that all supporting factors are met to achieve the expected results from a cloud-based LMS [19][20]. This research argues that cloud-based LMSs offer greater flexibility and accessibility than traditional systems, enabling more inclusive and efficient learning processes.

2 Method

This research uses a qualitative method with a descriptive approach to analyze the effectiveness of the cloud-based Learning Management System (LMS) system in higher education. Nurul Jadid University, Paiton, Probolinggo, was chosen as the research location because it has implemented a comprehensive cloud-based LMS, making it relevant to the research topic. This method was chosen because of its ability to understand the phenomenon of using technology in education in depth and its flexibility in adapting to various complex learning situations. The type of research used is a case study, where the researcher explores using a cloud-based LMS at a higher education institution, collecting data through observations, interviews, and related documents over a certain period.

In this research, the validity and reliability of the data are maintained through several systematic steps in the research method. Data validity is maintained using source triangulation, where data is collected through various methods, such as in-depth interviews, observation, and analysis of relevant documents. This ensures that the information obtained is consistent and accurate. In addition, to ensure reliability, data collection and analysis procedures were carried out consistently across all cases studied. Researchers also conducted trial interviews at the initial stage to test the interview guide and ensure that respondents could clearly understand the questions asked. The data obtained was then analyzed using a uniform coding method, and cross-checking was carried out between researchers to ensure consistency in data interpretation. With this approach, this research seeks to ensure that the results obtained are reliable and have a high degree of validity so that the resulting findings can significantly contribute to understanding the effectiveness of cloud-based LMS in university environments.

Participants were selected using a purposive technique; they were chosen with specific considerations and objectives. The reason for using this technique is that researchers need data in the form of information that can only be obtained from informants who certainly have more knowledge about the data that researchers want to get to produce data that meets expectations and is relevant to the title that has been determined. This research involved 25 participants: the Chancellor, Vice Chancellor, Faculty Deans, Study Program Leaders,

Lecturers, and Staff. The informants have different occupational, educational, and gender backgrounds, so they must provide accurate information about the research theme. Selected participants meet specific criteria: they already know how to understand career adaptability and ensure diverse representation in various stakeholder groups, allowing for in-depth exploration of the dynamics of a cloud-based learning management system (LMS) capabilities in university.

Table 1. Research Informants

Participants	Gender		Educational background			Informant Code
	Male	Female	Bachelor	Masters	Doctor	
Head of the Rectorate	1	-	-	1	-	AH
Vice Chancellor	2	-	-	-	2	HM, NF
(LP3M)	2	-	-	2	-	AF, AZ
Lead Faculty Dean	3	-	-	1	2	AFD, CM, ZA
Study Program Leader	5	-	-	2	3	AM, HA, UM, FR, IGH
Lecturer	3	4	-	5	2	AB, BM, MR, HF, ZR, ED, NA
Staff	2	3	1	4	-	HR, RZ, FM, FL, RH
Amount	**18**	**7**	**1**	**15**	**9**	**-**
Total	**25 Participants**					

Apart from interview techniques, researchers used secondary data sources to observe archives and several documents owned by related parties. The steps in obtaining data for this research activity used interviews, observation, and documentation.

In this research, data analysis was carried out in three stages, namely 1) Data reduction, data presentation, and conclusions. Data is categorized, directed, clarified, and organized at this stage, and irrelevant data is removed. This process helps simplify and focus the data obtained to make it easier to analyze; 2) Data Presentation. The reduced data is presented in various forms, such as matrices, graphs, charts, and networks. This presentation aims to visualize the data to facilitate further understanding and analysis and 3) Draw conclusions. Based on the data that has been presented, the researcher makes conclusions. This process involves interpreting data and generating new ideas or understanding that did not exist before, contributing to the knowledge or theory being researched.

3 Findings And Discussion

Accessibility

Cloud-based accessibility in higher education provides significant convenience for students and lecturers accessing learning materials and academic resources. As stated by HM, with a cloud-based LMS, all content can be accessed from various devices, including laptops, tablets, and smartphones, anytime and anywhere as long as there is an internet connection. This allows students to study flexibly, both on and off campus, without being tied to a physical location. In addition, lecturers can upload materials, assign assignments, and interact with students more efficiently through an integrated platform. However, a challenge that

needs to be considered is the digital divide, especially in areas with limited internet access or for students who need more adequate devices. Therefore, although the cloud provides broad accessibility, it is essential to ensure that all students have equal access so that the benefits of this technology can be felt equally.

The informant's statement above shows that the use of the cloud in higher education offers extraordinary flexibility for the academic community, facilitating access to teaching materials through a variety of devices and platforms that enable learning to take place anywhere and at any time, supporting a more independent and adaptive learning style [21][22][23]. Lecturers also benefit from the ability to distribute materials and communicate digitally with students efficiently [24]. However, obstacles such as disparities in technology access and uneven internet networks remain challenges [25][26]. Therefore, although this technology broadens learning horizons, further efforts are needed to ensure that every student can access it fairly and equally [27].

Figure 1. Cloud-based Accessibility

The figure 1, shows that the accessibility of using cloud technology in higher education includes several essential aspects, such as ease of accessing teaching materials via various devices and the ability to study independently anywhere and at any time. Device integration is critical to ensuring a seamless experience for users. However, challenges arise in the form of unequal access to technology, which creates a digital divide between users who have adequate infrastructure and those who do not. In addition, the quality of communication between lecturers and students via digital platforms plays a vital role in learning effectiveness. Efforts to ensure equal access to resources are necessary so that all students can experience equal benefits from this technology.

The research results show that implementing a cloud-based Learning Management System (LMS) significantly increases accessibility in the learning process in higher education. Students and lecturers can access learning materials, assignments and academic resources anytime and anywhere without being limited by time and location [28][29]. These findings represent a paradigm shift from traditional systems often limited by physical infrastructure and fixed schedules towards more flexible and responsive learning environments [30]. However, critical analysis of these findings reveals that despite increasing accessibility, there are gaps regarding the ability of students and lecturers to utilize this technology effectively. Challenges such as limited digital literacy and uneven internet access, especially in remote areas, can limit the optimal benefits of a cloud-based LMS [31]. Apart from that, increasing accessibility also raises new problems, such as the potential for overworking for lecturers who are expected always to be available online [32][33]. Therefore, while the accessibility of a cloud-based LMS provides clear advantages, these findings also highlight the importance of more comprehensive support and training to ensure that all users can get the most out of this technology.

Flexible

Cloud-based flexibility in higher education provides significant freedom for students and lecturers in managing the teaching and learning process. With a cloud-based system, students can learn at their own pace, access material at any time, repeat difficult-to-understand content, and adjust study time to suit their needs. In addition, lecturers can create a more dynamic teaching schedule, providing assignments and feedback without being bound by strict physical classroom or time constraints [34][35]. This flexibility also supports students with special needs or those who have limited time due to working while studying [36]. However, even though the cloud allows greater access, there is the potential for problems such as procrastination and lack of self-discipline among students who are used to a more rigorous learning structure.

The flexibility offered by cloud-based systems is significant. Students can now set their study schedule, access material whenever needed, and study content at a pace that suits their abilities. This is very helpful, especially for students who have other commitments, such as working while studying. Next, how to teach and interact. AF said it can arrange teaching schedules flexibly, provide assignments online, and provide feedback without being tied to time or a physical classroom. This makes the teaching and learning process more dynamic and adaptive. Besides that, lecturers also need to ensure a clear structure and guidance even though learning is carried out flexibly. That way, the benefits of this flexibility can be maximized.

In the informant's statement above, that a cloud-based Learning Management System (LMS) significantly increases flexibility in university learning processes. A cloud-based LMS allows students to organize their study time according to individual needs, enabling more personalized and self-paced learning. Lecturers also gain flexibility in compiling and delivering material and providing feedback to students, which can be done asynchronously. However, a critical analysis of these findings reveals that cloud-based LMS flexibility also brings challenges [37]. For example, although this flexibility allows for more dynamic learning, only some students can make good use of it; some may need help managing their time independently, which can negatively impact their academic performance. In addition, this flexibility can also blur the lines between work time and personal time for lecturers, which may lead to excessive workload and burnout [38]. Therefore, although the flexibility of a cloud-based LMS offers many advantages, it is essential to develop supporting strategies that ensure students and lecturers can manage their time and responsibilities effectively so that the positive impact of this flexibility can be optimized without compromising user well-being.

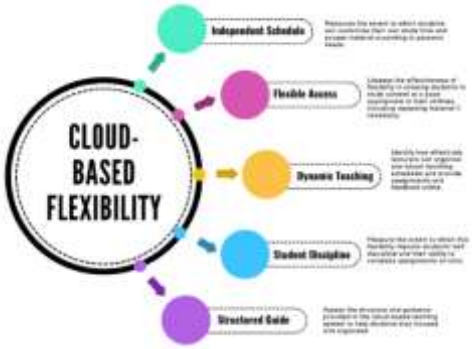

Figure 2. Cloud-based Flexibility

The figure 2, reveals that the flexibility in cloud-based learning systems allows students to set their schedules and access material at their own pace, supporting a more dynamic way of teaching [39][40]. However, challenges arise regarding managing students' self-discipline and establishing clear guidelines to maintain learning structures [41]. The impact of this flexibility on the quality of learning and the system's effectiveness in dealing with procrastination problems that may arise must be measured.

Academic Efficiency

Academic efficiency in higher education driven by cloud-based systems significantly impacts various aspects of the educational process. With this technology, administrative management becomes simpler, enabling real-time collection and analysis of academic data. Lecturers can provide feedback more quickly and assess student progress, while students gain faster and easier access to learning materials and the results of their evaluations. This saves time and reduces the administrative burden that often interferes with the teaching and learning process. However, this efficiency depends on the quality of the technology used and the user's ability to utilize it optimally. Potential technical problems and system limitations can reduce expected efficiency benefits if not managed well.

As stated by Andika, this technology simplifies administration by making it easier to collect and analyze real-time data, which can provide faster feedback and assess student progress more efficiently. In contrast, students get speedier access to material and their evaluation results. Meanwhile, AH said that with a cloud-based system, the administration process becomes more streamlined, allowing lecturers and students to focus on more critical aspects of learning. This also helps reduce delays in submitting assignments and providing feedback. Ensuring that the technology is of high quality and has adequate technical support is essential. In addition, proper training of lecturers and students on using the system is necessary so that they can make optimal use of it.

The informant's statement above shows that cloud-based systems significantly increase academic efficiency by simplifying administration and enabling real-time data collection and analysis [42]. Lecturers can provide feedback and assess student progress more quickly, while students get faster access to materials and their evaluation results [43]. While these efficiencies save time and reduce administrative burden, challenges remain regarding technology quality and potential technical issues [44]. To ensure optimal benefits, it is essential to have a reliable system and provide adequate training to users on utilizing the technology.

Technopedagogical Resistance

Resistance to techno pedagogy in higher education often arises from discomfort with change and uncertainty regarding using new technologies in teaching. AFD says that resistance to techno pedagogy usually stems from discomfort with change and concerns regarding new technology. Many lecturers may feel anxious or hesitant about adopting technology-based teaching methods due to a lack of technical skills, concerns about effectiveness, or a feeling that traditional methods are more proven. In addition, AM said resistance could be fueled by concerns about data security and privacy, as well as the inability of technology to completely replace face-to-face interactions that are considered essential in the learning process. To overcome this resistance, it is vital to provide adequate training, demonstrate the real benefits of tech pedagogy, and ensure adequate technical support so that the transition to new methods can be smoother and better accepted.

With this informant's statement, it can be concluded that resistance to techno pedagogy in higher education often arises from discomfort with change and uncertainty regarding applying new technology in teaching [45][44]. Some lecturers may feel reluctant to switch to technology-based methods due to a lack of technical skills, concerns regarding the effectiveness of the technology, or the belief that traditional methods are more effective[46]. In addition, there are concerns regarding data security and privacy and the inability of technology to replace face-to-face interaction, which is considered necessary in the learning process [47]. To overcome this, it is essential to provide adequate training, demonstrate the concrete benefits of tech pedagogy, and ensure sufficient technical support to ensure a smooth and well-received transition to new methods.

Table 1. Technopedagogical Resistance Interview Results

Statement	Coding	Informant
"Resistance to technopedagogy often stems from discomfort with change and concerns regarding new technology."	Discomfort	Lead Faculty Dean
"major factors include concerns about data security and privacy, as well as the inability of technology to replace the face-to-face interactions considered essential to learning."	Data Security	Lecturer
"It is important to provide adequate training for lecturers so that they feel more comfortable with technology. Demonstrating the concrete benefits of technopedagogy and providing adequate technical support can also help."	Training	Staff

From the table 1, it can be understood that resistance to techno pedagogy often arises due to discomfort with change and concerns regarding new technology. Many educators are reluctant to adopt technology-based teaching methods due to limited technical skills and doubts about their effectiveness, while traditional methods are considered more proven. In addition, there are concerns regarding data security and privacy, as well as the inability of technology to replace face-to-face interaction, which is regarded as necessary in learning. Uncertainty about the impact of new technologies on the quality of teaching and relationships with students is also a contributing factor. To overcome this resistance, educators need adequate training to feel more comfortable with technology. Demonstrating concrete benefits and providing adequate technical support are also essential, as they help educators understand how technology can improve the teaching process and provide examples of success.

4 Conclusion

Research into the effectiveness of cloud-based Learning Management Systems (LMS) in higher education shows significant changes in how teaching and learning are managed. Implementing a cloud-based LMS provides easy access to material and flexibility in learning time that supports independent and adaptive learning. In addition, efficiency in administrative management and providing feedback is better, improving the academic experience for students and lecturers. Although challenges such as resistance to technology and unequal access still exist, these systems' benefits include improved interaction quality, more structured learning management, and support for more innovative teaching methods. These findings suggest that integrating cloud-based LMS in higher education enhances the effectiveness of teaching and learning and offers a more flexible and responsive learning environment. The following discussion will explore the challenges faced and strategies for maximizing the benefits of cloud-based LMS systems in modern higher education.

The practical implication of this research for policymakers and educational practitioners is the need for cloud-based LMS adoption accompanied by a comprehensive supporting strategy. Policymakers should consider investing in equitable technology infrastructure and widespread internet access, especially in remote areas, to ensure all students can use the system optimistically. Additionally, ongoing training for faculty and students in using cloud-based LMS is essential to address the digital literacy gap and maximize the benefits of its flexibility. Education practitioners also need to develop policies that support work and personal life balance for lecturers and provide guidance for students in effective time management. With this approach, adopting a cloud-based LMS will strengthen learning effectiveness and support the welfare of all parties involved in the educational process.

While this research offers in-depth insight into the adoption of cloud-based LMS in higher education, several limitations need to be noted: 1) This research focuses on specific institutions that may not reflect various higher education institutions' diversity of conditions and needs. 2) These studies have yet to examine the long-term impact of a cloud-based LMS on teaching effectiveness, student satisfaction, and overall academic outcomes. 3)

Methodological limitations such as limited sample size and data collection methods that may not be fully representative may affect the generalizability of the findings. Therefore, further research is needed to address these limitations by expanding the scope of the analysis to a broader range of educational institutions and evaluating the long-term impact of implementing cloud-based LMSs in higher education contexts.

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