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Analysis of Learning Management System (LMS) Utilization in Hybrid Learning Environments

Samsidar[1]

Universitas Islam Negeri Sulthan Thaha Jambi, Indonesia

*Correspondence: dharsamsidar@gmail.com

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Abstract

The rapid development of digital technology has accelerated the adoption of hybrid learning, positioning Learning Management Systems (LMS) as a central component in supporting flexible and integrated learning environments. This study aims to analyze the effectiveness of LMS utilization in hybrid learning and identify the technological and pedagogical factors influencing its optimization. A quantitative approach with an explanatory design was employed, involving students and lecturers who actively use LMS in hybrid learning settings. Data were collected through structured questionnaires using a Likert scale and analyzed using descriptive statistics and multiple linear regression. The results indicate that LMS utilization is highly effective in enhancing student engagement, satisfaction, and learning outcomes. Technological factors, particularly system quality and ease of use, have a more dominant influence, while pedagogical factors such as instructional design and learning strategies also significantly contribute to effectiveness. The discussion highlights that LMS serves not only as a learning platform but also as a central hub that integrates face-to-face and online learning. However, challenges related to infrastructure, pedagogical design, and user readiness remain critical. In conclusion, the effectiveness of LMS in hybrid learning depends on the alignment between technology and pedagogy, supported by institutional readiness and continuous improvement strategies.

Keywords:
Hybrid Learning, Learning Management System, Student Engagement, Technological Factors, Pedagogical Factors

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1. INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed the landscape of education, particularly in the aftermath of the COVID-19 pandemic, which accelerated the global shift toward more flexible and technology-driven learning models. One of the most prominent transformations is the emergence of hybrid learning, also commonly referred to as blended learning, which integrates face-to-face instruction with online learning environments. This model is increasingly adopted by educational institutions due to its ability to combine the strengths of traditional classroom interaction with the flexibility and accessibility of digital platforms. Within this context, the Learning Management System (LMS) has become a central infrastructure that supports the organization, delivery, and evaluation of learning activities. LMS platforms facilitate the distribution of learning materials, enable synchronous and asynchronous communication, and provide tools for assessment and feedback, thereby creating a more dynamic, adaptive, and contextually relevant learning environment (Ibasco, 2024; Gudoniene et al., 2025; Firman et al., 2024; Inyutina & Kartashova, 2023; Dakir & Fauzi, 2022).

The integration of LMS into hybrid learning environments reflects a broader paradigm shift in education from teacher-centered approaches to more student-centered and technology-enhanced learning ecosystems. In hybrid settings, LMS platforms are not merely repositories of content but serve as interactive environments that support collaboration, self-paced learning, and continuous engagement. This transformation aligns with contemporary educational theories that emphasize flexibility, personalization, and lifelong learning. Moreover, LMS-based hybrid learning enables institutions to respond to diverse learner needs, geographical constraints, and varying learning styles, making education more inclusive and accessible. As a result, LMS adoption is no longer optional but has become a strategic necessity for educational institutions aiming to remain relevant in the digital era (Ibasco, 2024; Firman et al., 2024; Gudoniene et al., 2025).

Despite the widespread adoption of LMS in hybrid learning, significant challenges remain regarding its effectiveness and optimal utilization. Although numerous studies have demonstrated that LMS can enhance learning outcomes, student motivation, and overall satisfaction, these findings are often inconsistent and context-dependent. The effectiveness of LMS in hybrid learning is influenced by multiple factors, including instructional design, course structure, technological infrastructure, and the level of student engagement. In many cases, LMS implementation focuses primarily on technical functionalities, such as content delivery and system integration, while neglecting critical pedagogical considerations. Consequently, the potential of LMS to support meaningful learning experiences is not fully realized (Wang et al., 2024; P, 2024; Firman et al., 2024; Made et al., 2025).

Furthermore, recent systematic reviews highlight that the development of LMS in hybrid learning contexts is still dominated by technical approaches, such as application programming interfaces (API), interoperability, and recommendation systems. While these advancements contribute to system efficiency and scalability, they often overlook the importance of integrating robust pedagogical principles into LMS design and implementation. This imbalance creates a gap between technological capability and educational effectiveness, limiting the ability of LMS to foster deep learning, critical thinking, and active participation among students (Rofiuddin & Aulia, 2025). As a result,

there is a growing need to shift the focus from purely technological innovation to a more holistic approach that combines technological excellence with pedagogical soundness.

In addition to these limitations, hybrid learning environments present unique challenges that further complicate the effective use of LMS. Unlike fully online or fully face-to-face learning, hybrid learning requires the seamless integration of synchronous and asynchronous activities, which can be difficult to manage and coordinate. Studies indicate that hybrid teaching often faces issues such as reduced student interaction, lower levels of motivation compared to traditional classroom settings, and increased workload for instructors. Educators must simultaneously manage in-person and online learners, design engaging learning activities, and monitor student progress across multiple platforms. These complexities can hinder the effectiveness of LMS and reduce the overall quality of the learning experience (Li et al., 2023; Gudoniene et al., 2025).

Moreover, the challenge of monitoring and evaluating student learning in hybrid environments is particularly significant. LMS platforms provide various analytics and tracking features; however, their utilization is often limited due to a lack of training, awareness, or integration with pedagogical strategies. As a result, instructors may struggle to identify students' learning needs, provide timely feedback, and support self-regulated learning. This issue is further compounded by the diversity of student backgrounds, digital literacy levels, and access to technology, which can create disparities in learning outcomes. Therefore, understanding how LMS can be effectively utilized in hybrid learning requires a comprehensive analysis that considers both technological and pedagogical dimensions (Wang et al., 2024; Made et al., 2025).

The existing literature also reveals a significant research gap concerning the comprehensive evaluation of LMS in hybrid learning contexts. While many studies focus on specific aspects, such as user satisfaction or system usability, there is a lack of integrative research that examines the interplay between technological features and pedagogical practices. Additionally, most studies are conducted in controlled or specific institutional settings, limiting the generalizability of their findings. This gap underscores the need for more holistic and context-sensitive research that explores how LMS can be optimized to support diverse learning environments and educational objectives (Rofiuddin & Aulia, 2025; Wang et al., 2024).

Another important gap lies in the limited exploration of factors that influence the successful implementation of LMS in hybrid learning. From a technological perspective, factors such as system quality, ease of use, information quality, infrastructure stability, cross-platform integration, and the use of advanced technologies like learning analytics and artificial intelligence play a crucial role in determining the effectiveness of LMS. Studies suggest that well-designed systems with intuitive interfaces and reliable performance can significantly enhance user experience and engagement (Allam et al., 2024; Al-Nuaimi et al., 2022; Raihan et al., 2025). However, these technological factors alone are insufficient without corresponding pedagogical strategies that guide their use.

From a pedagogical perspective, the effectiveness of LMS in hybrid learning is influenced by instructional design, teaching strategies, and the role of educators. Approaches such as flipped learning, active learning, and learner-centered pedagogies, including

heutagogy, peeragogy, and cybergogy, have been shown to enhance student engagement and learning outcomes. Additionally, the use of formative assessment, continuous feedback, and support for self-regulated learning are critical components of effective hybrid learning environments. The role of instructors is also crucial in facilitating interaction, fostering a sense of community, and guiding students through the learning process. However, the integration of these pedagogical elements into LMS-based hybrid learning remains limited, highlighting the need for further research and development in this area (Bizami et al., 2022; Gudoniene et al., 2025; Li et al., 2023; Desai et al., 2023; Paavilainen et al., 2024).

Based on these considerations, this study offers a novel contribution by adopting a comprehensive approach to analyzing the use of LMS in hybrid learning environments. Unlike previous studies that focus on isolated aspects, this research integrates both technological and pedagogical perspectives to provide a more holistic understanding of LMS effectiveness. It examines not only the impact of LMS on learning outcomes and student engagement but also the underlying factors that influence its optimal utilization. By bridging the gap between technology and pedagogy, this study aims to provide practical insights for educators, institutions, and policymakers seeking to enhance the quality of hybrid learning.

Therefore, the primary objective of this study is to analyze the effectiveness of Learning Management System (LMS) utilization in hybrid learning environments and to identify the key technological and pedagogical factors that influence its optimization. Through this analysis, the study seeks to contribute to the development of more effective and sustainable hybrid learning practices that can meet the evolving demands of education in the digital age (Ibasco, 2024; Wang et al., 2024; Firman et al., 2024; Made et al., 2025; Dakir & Fauzi, 2022).

2. METHOD

This study employs a quantitative research approach with an explanatory design to analyze the effectiveness of Learning Management System (LMS) utilization in hybrid learning environments and to identify the technological and pedagogical factors influencing its optimization. The population of this study consists of students and lecturers involved in hybrid learning implementation in higher education institutions. A purposive sampling technique is applied to select respondents who actively use LMS platforms in their learning or teaching processes. The criteria for sample selection include (1) experience in hybrid learning for at least one academic semester, (2) active engagement with LMS features such as content access, discussion forums, and assessments, and (3) willingness to participate in the study. Data are collected using a structured questionnaire designed based on validated constructs from previous studies, covering variables such as LMS effectiveness (learning outcomes, student engagement, user satisfaction), technological factors (system quality, ease of use, information quality, infrastructure reliability, and integration), and pedagogical factors (instructional design, teaching strategies, formative assessment, and support for self-regulated learning). The questionnaire uses a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). In addition, limited documentation analysis is conducted to support the interpretation of LMS usage patterns.

The data analysis technique is carried out in several stages to ensure the validity and reliability of the findings. First, a descriptive statistical analysis is used to provide an

overview of respondents' perceptions regarding LMS usage in hybrid learning. Second, validity and reliability tests are conducted using Pearson correlation and Cronbach's alpha to ensure the measurement instruments meet academic standards. Third, inferential statistical analysis is performed using multiple linear regression to examine the influence of technological and pedagogical factors on LMS effectiveness. Prior to regression analysis, classical assumption tests, including normality, multicollinearity, and heteroscedasticity tests, are conducted to ensure the robustness of the model. Furthermore, the coefficient of determination (R^2) is used to measure the explanatory power of the independent variables, while hypothesis testing is conducted using t-tests and F-tests to determine the significance of the relationships between variables. The results of the analysis are then interpreted comprehensively to provide insights into how LMS can be optimized in hybrid learning environments from both technological and pedagogical perspectives.

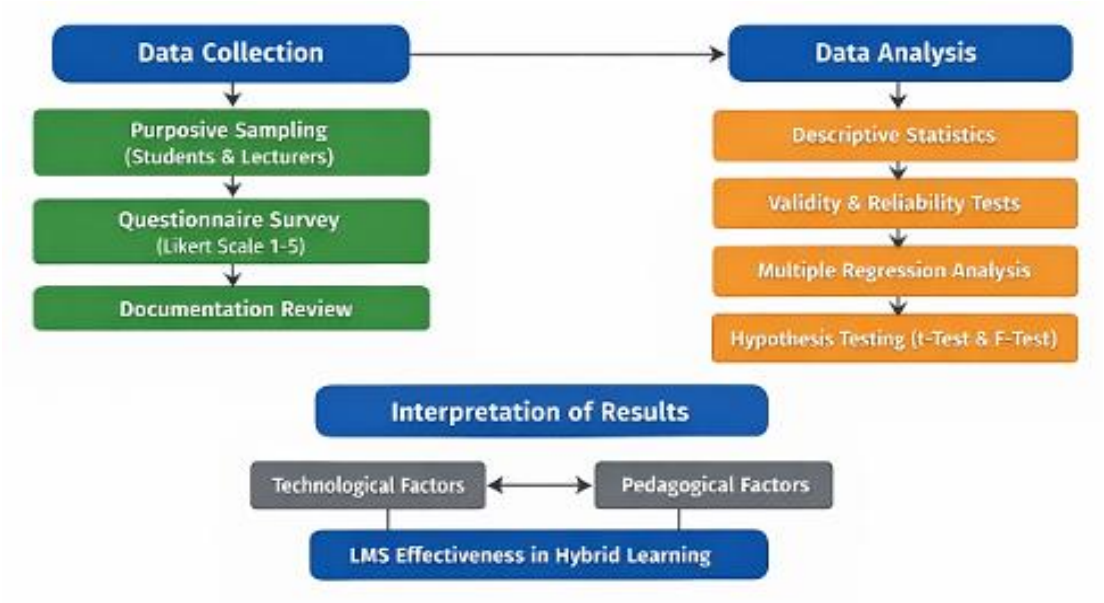

Figure 1. Journal of Learning Spectrum

3. RESULTS AND DISCUSSION

3.1. Results

To provide an overview of respondents' perceptions regarding LMS utilization in hybrid learning environments, descriptive statistical analysis was conducted on the main research variables, including LMS effectiveness, technological factors, and pedagogical factors.

Table 1. Descriptive Statistics of Research Variables

Variable	Mean	Std. Deviation	Category
LMS Effectiveness	4.12	0.56	High
Student Engagement	4.05	0.60	High

User Satisfaction	4.08	0.58	High
Technological Factors	4.15	0.52	High
System Quality	4.18	0.50	High
Ease of Use	4.20	0.48	Very High
Information Quality	4.10	0.55	High
Pedagogical Factors	4.02	0.62	High
Instructional Design	3.98	0.65	High
Learning Strategies	4.05	0.60	High

The results in Table 1 indicate that the overall effectiveness of LMS in hybrid learning is categorized as high, with a mean score of 4.12. This suggests that respondents generally perceive LMS as a valuable tool in supporting hybrid learning processes. Among the technological factors, ease of use shows the highest mean score (4.20), indicating that system usability plays a critical role in enhancing user experience. Meanwhile, pedagogical factors, although still categorized as high, show slightly lower mean values compared to technological factors. This finding implies that while LMS platforms are technically adequate, there is still room for improvement in instructional design and pedagogical integration to maximize learning outcomes. Overall, these findings highlight the importance of balancing technological robustness with pedagogical effectiveness in hybrid learning environments.

To examine the influence of technological and pedagogical factors on LMS effectiveness in hybrid learning, a multiple linear regression analysis was conducted.

Table 2. Results of Multiple Regression Analysis

Variable	Beta Coefficient (β)	t-value	Sig. (p-value)	Result
(Constant)	1.215	3.210	0.002	Significant
Technological Factors	0.482	5.876	0.000	Significant
Pedagogical Factors	0.367	4.912	0.000	Significant
R Square	0.68			
F-value	112.45		0.000	Significant

The regression results in Table 2 demonstrate that both technological and pedagogical factors have a positive and significant effect on LMS effectiveness in hybrid learning environments. Technological factors have a stronger influence ($\beta = 0.482$) compared to pedagogical factors ($\beta = 0.367$), indicating that system quality, ease of use, and infrastructure reliability are the primary drivers of LMS success. However, pedagogical factors also show a substantial contribution, emphasizing the importance of instructional

design, teaching strategies, and student engagement. The R Square value of 0.68 indicates that 68% of the variance in LMS effectiveness can be explained by the two independent variables, while the remaining 32% is influenced by other factors not examined in this study. The significant F-value further confirms that the model is statistically robust. These findings suggest that optimal LMS utilization in hybrid learning requires an integrated approach that combines strong technological infrastructure with effective pedagogical practices.

3.2. Discussion

The findings of this study provide a comprehensive understanding of the effectiveness of Learning Management System (LMS) utilization in hybrid learning environments, particularly in relation to technological and pedagogical factors. Based on the results presented in Tables 1 and 2, it is evident that LMS plays a significant role in enhancing learning effectiveness, as indicated by the high mean scores for LMS effectiveness (4.12), student engagement (4.05), and user satisfaction (4.08). These findings align with previous studies which emphasize that LMS serves as a critical infrastructure in hybrid learning by facilitating the integration of face-to-face and online learning components. In this context, LMS functions as the central hub for organizing course schedules, distributing materials, managing assessments, and enabling communication between instructors and students, thereby ensuring continuity and coherence in hybrid learning processes (Ibasco, 2024; Ichsan & Susanti, 2025; Mei, 2025; Nuruddin, 2024).

The high level of student engagement observed in this study further reinforces the argument that LMS contributes significantly to improving the quality of learning experiences in hybrid environments. Features such as discussion forums, online quizzes, and real-time feedback mechanisms enable students to actively participate in the learning process, even when they are not physically present in the classroom. This is consistent with systematic review findings that highlight the positive impact of LMS on student motivation and engagement, particularly in blended and online learning contexts (Rofiuddin & Aulia, 2025; Herniawati et al., 2025; Bizami et al., 2022). The ability of LMS to provide interactive and flexible learning opportunities allows students to take greater control of their learning, which ultimately enhances their academic performance and satisfaction.

Another important finding of this study is the strong contribution of technological factors to LMS effectiveness, as evidenced by the higher beta coefficient ($\beta = 0.482$) compared to pedagogical factors ($\beta = 0.367$). This suggests that system quality, ease of use, and infrastructure reliability are fundamental determinants of successful LMS implementation in hybrid learning. The descriptive analysis also indicates that ease of use has the highest mean score (4.20), highlighting the importance of user-friendly interfaces in facilitating LMS adoption. These findings are supported by previous research which emphasizes that technological attributes such as system quality, information quality, and platform integration significantly influence user experience and engagement (Allam et al., 2024; Al-Nuaimi et al., 2022; Raihan et al., 2025). In hybrid learning environments, where students and instructors rely heavily on digital platforms, the stability and usability of LMS become critical factors that directly impact learning outcomes.

However, despite the strong influence of technological factors, the role of pedagogical factors cannot be overlooked. The results indicate that pedagogical factors also have a significant positive effect on LMS effectiveness, albeit to a slightly lesser extent. This finding underscores the importance of instructional design, teaching strategies, and learner-centered approaches in maximizing the potential of LMS. Previous studies have highlighted that LMS is most effective when it is integrated with pedagogical models such as flipped classroom, active learning, and collaborative learning. These approaches encourage student participation, critical thinking, and knowledge construction, which are essential components of meaningful learning (Ashraf et al., 2022; Mulenga & Shilongo, 2024; Bizami et al., 2022). Therefore, while technological infrastructure provides the foundation for LMS implementation, pedagogical strategies determine how effectively the platform is utilized to achieve learning objectives.

The findings of this study also reveal that LMS enables greater flexibility and personalization in hybrid learning. The ability to access learning materials anytime and anywhere allows students to learn at their own pace, which is particularly beneficial in diverse learning environments. Additionally, LMS platforms provide features such as progress tracking, adaptive learning, and personalized recommendations, which support individualized learning pathways. These findings are consistent with previous research that highlights the role of LMS in promoting flexible and personalized learning experiences (Musa et al., 2022; Rofiuddin & Aulia, 2025; Inyutina & Kartashova, 2023; Abaricia & Santos, 2023). Such flexibility is especially important in hybrid learning, where students must balance online and offline learning activities.

Furthermore, the use of learning analytics within LMS presents significant opportunities for improving teaching and learning processes. LMS platforms generate large amounts of data related to student activities, which can be analyzed to identify learning patterns, monitor progress, and provide targeted interventions. Although this study did not specifically measure the use of analytics, the high level of LMS effectiveness suggests that such features may contribute to enhanced learning outcomes. Previous studies have emphasized the importance of learning analytics in supporting data-driven decision-making and personalized learning in hybrid environments (Etinger, 2024; Mei, 2025; Khalid & Rahman, 2025). Therefore, the integration of analytics into LMS represents a promising area for future research and development.

Despite these positive findings, several challenges associated with LMS implementation in hybrid learning were also identified. One of the primary challenges is related to technical constraints, such as unstable internet connectivity and limited access to digital devices. These issues can significantly hinder the effectiveness of LMS, particularly in regions with inadequate technological infrastructure. Previous studies have highlighted that technical barriers remain a major obstacle to the successful implementation of hybrid learning, especially in developing countries (Susanto & Ibrahim, 2023; Ashraf et al., 2022; Rofiuddin & Aulia, 2025; Anshary et al., 2024; Rose et al., 2025). Therefore, addressing these challenges requires coordinated efforts from educational institutions and policymakers to improve infrastructure and provide equitable access to technology.

In addition to technical challenges, this study also highlights the limitations of pedagogical design in LMS-based hybrid learning. Although LMS platforms offer a wide range of features, their effectiveness depends on how they are used by instructors. Many educators tend to use LMS primarily as a content repository rather than as an interactive learning environment. This finding is consistent with previous research which indicates that LMS implementation often focuses on technical aspects, such as system integration and functionality, while neglecting pedagogical considerations (Ashraf et al., 2022; Rofiuddin & Aulia, 2025; Bizami et al., 2022; Gudoniene et al., 2025). As a result, the potential of LMS to support active and collaborative learning is not fully realized.

Another critical factor influencing LMS effectiveness is user readiness and acceptance. The success of LMS implementation depends not only on the availability of technology but also on the willingness and ability of users to adopt it. Previous studies suggest that factors such as performance expectancy, perceived enjoyment, learning value, and facilitating conditions play a significant role in shaping users' intention to use LMS (Musa et al., 2022). However, some students may experience difficulties in understanding course materials, feel overwhelmed by the workload, or lack motivation due to limited face-to-face interaction (Susanto & Ibrahim, 2023; Anshary et al., 2024). These challenges highlight the importance of providing adequate training and support for both students and instructors to enhance their digital literacy and confidence in using LMS.

Institutional support and policy frameworks also play a crucial role in determining the success of LMS in hybrid learning. Effective implementation requires not only technological infrastructure but also clear guidelines, training programs, and quality assurance mechanisms. Educational institutions must develop standardized approaches to course design, assessment, and data management to ensure consistency and effectiveness in hybrid learning. Previous studies emphasize that institutional support, including professional development for instructors and the establishment of hybrid learning standards, is essential for maximizing the benefits of LMS (Ichsan & Susanti, 2025; Rose et al., 2025; Herniawati et al., 2025; Gudoniene et al., 2025). Without such support, the implementation of LMS may remain fragmented and ineffective.

Based on these findings, this study offers several practical implications for improving LMS utilization in hybrid learning. First, LMS should be positioned as the central hub of the hybrid learning ecosystem, rather than merely a repository of learning materials. This requires the integration of LMS with other digital tools, such as video conferencing platforms, communication applications, and academic information systems, to create a seamless and cohesive learning experience (Ichsan & Susanti, 2025; Inyutina & Kartashova, 2023; Abaricia & Santos, 2023). Second, there must be a strong alignment between technology, pedagogy, and user experience. LMS platforms should be designed to support interactive and collaborative learning activities, while also ensuring ease of use and accessibility (Ashraf et al., 2022; Rofiuddin & Aulia, 2025; Bizami et al., 2022).

Third, efforts should be made to address the digital divide and improve access to technology. This includes providing alternative low-bandwidth solutions, such as lightweight learning materials and the use of complementary communication platforms, to ensure that all students can participate in hybrid learning (Susanto & Ibrahim, 2023; Ichsan

& Susanti, 2025; Anshary et al., 2024; Herniawati et al., 2025). Finally, the use of LMS data should be optimized to support continuous improvement in teaching and learning. By analyzing student engagement and performance data, educators can identify areas for improvement and implement targeted interventions to enhance learning outcomes (Etinger, 2024; Musa et al., 2022; Jayasekaran et al., 2024; Khalid & Rahman, 2025).

In conclusion, this study confirms that LMS plays a vital role in supporting hybrid learning, particularly in enhancing student engagement, learning flexibility, and overall effectiveness. However, its success depends on a combination of technological and pedagogical factors, as well as user readiness and institutional support. By addressing the identified challenges and leveraging the strengths of LMS, educational institutions can create more effective and sustainable hybrid learning environments that meet the demands of the digital age.

4. CONCLUSION

This study concludes that the utilization of Learning Management Systems (LMS) in hybrid learning environments is generally effective in enhancing student engagement, learning flexibility, and overall learning outcomes, as evidenced by the high levels of user satisfaction and system usability. The findings confirm that both technological and pedagogical factors significantly influence the effectiveness of LMS, with technological aspects such as system quality, ease of use, and infrastructure reliability playing a more dominant role, while pedagogical elements such as instructional design and active learning strategies remain essential in optimizing learning experiences. Therefore, achieving optimal LMS implementation in hybrid learning requires an integrated approach that aligns technological capabilities with sound pedagogical practices, supported by user readiness and institutional policies. This study successfully answers its objective by demonstrating that the effectiveness of LMS is not solely determined by the system itself, but by the synergy between technology, pedagogy, and the learning ecosystem as a whole.

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