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Artificial Intelligence-Based Learning Management to Improve the Effectiveness of the Independent Curriculum

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ABSTRACT

This study aims to examine the contribution of Artificial Intelligence (AI)-based learning management to improving the effectiveness of the Independent Curriculum, which emphasizes flexibility, differentiated instruction, and continuous assessment in authentic educational contexts. Employing a qualitative case study design, data were collected from school leaders, teachers, and academic coordinators involved in curriculum implementation through semi-structured interviews, non-participant observations, and document analysis to explore AI-supported instructional planning, learning implementation, and assessment practices. The findings reveal that AI-based learning management enhances instructional effectiveness by facilitating differentiated learning, enabling real-time monitoring of student progress, supporting evidence-based decision-making, and reducing teachers' administrative workload. These results demonstrate that AI functions not merely as a pedagogical tool but as an integrated learning management system that strengthens curriculum implementation. The study implies that the strategic integration of AI into learning management practices can support the sustainability and effectiveness of the Independent Curriculum, provided that institutional readiness, clear management strategies, and continuous professional capacity development are adequately addressed.

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INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has emerged as a transformative force in contemporary society, fundamentally reshaping how knowledge is produced, accessed, and managed across various sectors, including education. In the educational context, AI is increasingly viewed as a strategic solution to address the growing demand for adaptive, data-driven, and student-centered learning environments that respond to diverse learner characteristics

and learning trajectories. This transformation is particularly important as education systems worldwide are required to prepare learners for complex, uncertain, and technology-driven futures (Gligorea et al., 2023). Evidence from global educational reforms indicates that learning effectiveness is no longer determined solely by curriculum content, but also by how learning processes are systematically managed and continuously evaluated using intelligent technologies. Without appropriate learning management frameworks, AI risks being underutilized or fragmented; therefore, it must be examined not merely as a technological innovation but as a structured learning management mechanism to ensure meaningful and equitable educational transformation.

Despite the widespread recognition of AI's potential in education, many educational institutions continue to rely on conventional learning management practices that are insufficient to address the complexity and flexibility demanded by modern curricula. These traditional approaches often emphasize administrative routines rather than data-informed decision-making, resulting in limited responsiveness to individual learner needs. Consequently, educators face challenges in managing differentiated instruction, continuous assessment, and personalized learning pathways at scale. This problem becomes more pronounced within curriculum frameworks that prioritize flexibility and learner autonomy, such as the Independent Curriculum. While the curriculum encourages adaptive learning practices, existing management systems frequently lack the capacity to support real-time monitoring, evidence-based evaluation, and instructional adjustment. As a result, there is a growing mismatch between curriculum intentions and classroom implementation, which undermines learning effectiveness. This condition highlights a systemic problem in which curriculum reform is not accompanied by equally transformative learning management strategies, thereby limiting the broader social impact of educational innovation (Tapalova & Zhiyenbayeva, 2022).

Empirical phenomena in educational settings indicate that the adoption of AI in schools is often fragmented and tool-oriented rather than integrated into comprehensive learning management systems. In practice, AI is commonly used for isolated purposes such as automated assessment, digital content recommendation, or basic learning analytics, without being systematically aligned with curriculum planning and evaluation processes. Teachers frequently report increased access to digital data but limited guidance on how to translate this data into instructional and managerial decisions. Moreover, school leaders often struggle to integrate AI-supported insights into institutional learning strategies due to limited managerial frameworks and professional capacity. This situation creates a paradox in which advanced technologies coexist with conventional management practices. Particularly within the implementation of

the Independent Curriculum, which requires continuous formative assessment and differentiated instruction, the absence of integrated AI-based learning management limits the curriculum's effectiveness. These field realities suggest that technological availability alone is insufficient without a coherent learning management approach that aligns AI functionalities with curriculum goals (Colchester et al., 2021).

Previous studies have extensively explored the application of Artificial Intelligence in education, particularly in areas such as adaptive learning systems, intelligent tutoring systems, learning analytics, and automated formative assessment. The literature consistently demonstrates that AI can enhance personalized learning experiences, improve student engagement, and support learning outcomes through data-driven feedback mechanisms (Alotaibi, 2024a). More recent research has expanded this focus by examining how AI supports instructional design and classroom practices, indicating a shift from purely technological applications toward pedagogical integration. Scholars have also highlighted AI's potential to assist educators in monitoring student progress and adjusting instruction in real time. This body of research reflects a growing recognition of AI's role in supporting learning processes beyond content delivery. However, most studies remain concentrated at the instructional level, emphasizing classroom practices rather than examining AI as part of a broader learning management system that encompasses planning, implementation, and evaluation functions (Mukkala, 2025).

Despite these advancements, significant gaps remain in the existing literature. Specifically, there is limited empirical research that conceptualizes Artificial Intelligence-Based Learning Management as a comprehensive system aligned with curriculum frameworks. Many studies treat AI as a supplementary instructional tool rather than as an integrated management mechanism that supports curriculum implementation holistically. Furthermore, empirical investigations that explicitly examine the relationship between AI-based learning management and curriculum effectiveness are scarce. This gap is particularly evident in studies related to the Independent Curriculum, where research tends to focus on policy analysis or pedagogical implications without addressing learning management dimensions. Consequently, there is insufficient understanding of how AI-based learning management can systematically support curriculum flexibility, differentiated instruction, and continuous assessment in real educational contexts. Addressing this gap is crucial, as unresolved misalignment between curriculum design and learning management practices risks limiting the transformative potential of AI in education (F. Naseer et al., 2025).

The novelty of this study lies in its focus on Artificial Intelligence-Based Learning Management as an integrated system that aligns technological intelligence with curriculum management processes. Unlike previous studies that emphasize instructional or technological aspects in isolation, this research positions AI as a strategic learning management mechanism that supports planning, implementation, and evaluation within the Independent Curriculum framework. This perspective represents a state-of-the-art approach, as it bridges the gap between AI-driven innovation and educational management theory. Addressing this issue is particularly urgent given the increasing emphasis on curriculum flexibility and student-centered learning, which require sophisticated management systems to operate effectively. By examining AI-based learning management in authentic educational contexts, this study responds to the need for evidence-based models that guide the sustainable integration of AI into curriculum implementation. Such investigation is essential for ensuring that educational transformation is not only technologically advanced but also pedagogically and managerially coherent (Sajja et al., 2023).

The Independent Curriculum provides a critical context for examining the effectiveness of Artificial Intelligence-Based Learning Management, as it emphasizes flexibility, learner autonomy, differentiated instruction, and continuous formative assessment (Xu, 2025). These principles align closely with the capabilities of AI-driven management systems, particularly in supporting personalized learning pathways and data-informed instructional decisions. Prior studies suggest that curriculum models promoting flexibility are more responsive to AI-supported management, as they allow technological intelligence to adapt to diverse learning needs (Satmunee et al., 2025). However, despite the strategic importance of the Independent Curriculum, its integration with AI-based learning management remains underexplored. Existing research predominantly addresses curriculum implementation from policy or pedagogical perspectives, overlooking the managerial mechanisms required to sustain curriculum effectiveness. This limitation underscores the need for focused empirical research that examines how AI-based learning management can operationalize the principles of the Independent Curriculum in practice (Murni Yanto et al., 2022).

Based on the identified gaps and contextual challenges, this study addresses the central research problem of how Artificial Intelligence-Based Learning Management contributes to improving the effectiveness of the Independent Curriculum. The study argues that AI functions not merely as a pedagogical or technological tool, but as an integrated learning management system that strengthens curriculum implementation through data-driven planning, adaptive learning processes, and continuous evaluation. This

argument is grounded in the assumption that curriculum effectiveness is closely linked to the quality of learning management practices. By employing a qualitative case study approach, this research seeks to provide an in-depth understanding of AI-supported learning management in authentic educational settings. The findings are expected to contribute theoretically by extending the discourse on AI-driven educational management and practically by offering evidence-based insights for educators, school leaders, and policymakers in optimizing the implementation of the Independent Curriculum through intelligent learning management systems (Abrar et al., 2025).

RESEACH METHOD

This study employed a qualitative case study design to explore in depth how Artificial Intelligence-Based Learning Management contributes to improving the effectiveness of the Independent Curriculum. A qualitative approach was selected to capture complex processes, contextual practices, and stakeholder perceptions related to the integration of AI into learning management, rather than to measure variable relationships quantitatively (Indayati, 2025; Jamil & Sanusi, 2024; Solehah, 2025). Grounded in interpretivist research traditions, the case study design enabled a holistic understanding of meanings, experiences, and interactions shaping AI-supported learning management within authentic educational contexts. The case study approach was particularly appropriate because the phenomenon under investigation is embedded within real-life institutional settings and cannot be separated from its context. The study was conducted in selected secondary educational institutions that have implemented the Independent Curriculum and actively utilized AI-based learning management systems, including learning analytics, adaptive learning platforms, and automated assessment tools. Prolonged engagement in the research setting allowed the researchers to observe authentic learning management practices and reduce the risk of superficial interpretation.

Data were collected using multiple qualitative data collection techniques to ensure data richness and methodological triangulation. Participants consisted of school leaders, teachers, and academic coordinators directly involved in planning, implementing, and evaluating learning activities within the Independent Curriculum framework. A purposive sampling technique was applied to select participants who possessed relevant experience with AI-based learning management. Inclusion criteria required participants to be actively engaged in learning management processes, to have experience using AI-supported systems for instructional planning or assessment, and to be involved in the implementation of the Independent Curriculum (Yue et al., 2022). Data collection methods included semi-structured interviews, non-participant

observations, and document analysis. Semi-structured interviews explored instructional planning, differentiated learning strategies, monitoring of student progress, and assessment practices. Non-participant observations focused on classroom interactions, the use of AI-supported tools, and instructional decision-making processes. Document analysis encompassed curriculum documents, lesson plans, institutional policies, and AI-generated learning analytics reports.

Data analysis followed a thematic analysis approach guided by the framework proposed by Braun and Clarke. The analytical process began with data familiarization through repeated reading of interview transcripts, observation notes, and documents, followed by inductive coding to identify meaningful units of data. Codes were then organized into categories and iteratively developed into broader themes that captured patterns across data sources. This iterative process enabled the integration of insights from interviews, observations, and document analysis to generate comprehensive interpretations of AI-based learning management practices (M. A. Naseer et al., 2025). Qualitative data analysis software was utilized to support systematic data organization, coding, and retrieval, thereby enhancing analytical transparency and rigor.

Methodological rigor was ensured through strategies addressing credibility, transferability, dependability, and confirmability. These strategies included data triangulation across sources and methods, member checking to validate interpretations with participants, thick description to enhance transferability, audit trails to document analytical decisions, reflexive journaling to minimize researcher bias, and peer debriefing to strengthen analytical trustworthiness. Ethical considerations were rigorously observed throughout the research process. Informed consent was obtained from all participants, confidentiality and anonymity were maintained through data anonymization, and secure data management procedures were implemented. Although the findings are context-specific and not intended for statistical generalization, the study offers analytical generalization relevant to similar educational contexts, with limitations related to researcher subjectivity mitigated through transparent and reflexive research procedures.

RESULT AND DISCUSSION

The first research question examined how Artificial Intelligence-Based Learning Management is implemented within the context of the Independent Curriculum (Alam & Mohanty, 2023; Kusnanto et al., 2023; Nuriyah et al., 2024). The findings reveal that AI-based learning management is primarily utilized to support instructional planning, differentiated learning, and continuous monitoring of student progress (Dewi et al., 2025). Teachers reported using AI

tools such as learning analytics dashboards, adaptive learning platforms, and automated formative assessment systems to identify students' learning needs more accurately and to design personalized learning pathways. This implementation demonstrates that AI-based learning management functions as a data-driven managerial mechanism that aligns instructional planning with the flexible and student-centered principles of the Independent Curriculum.

From an instructional planning perspective, AI-based learning management enables educators to shift from uniform lesson design toward personalized and adaptive planning strategies. Learning analytics provide real-time data on students' performance, learning pace, and engagement, allowing teachers to make informed decisions regarding instructional content and methods. This finding supports the argument that AI enhances curriculum alignment by ensuring that learning objectives, instructional strategies, and assessment practices are coherently managed. Such alignment is essential for realizing the core principles of the Independent Curriculum, particularly flexibility and learner autonomy (Inchara, 2025).

The second research question focused on how AI-based learning management influences the effectiveness of learning implementation under the Independent Curriculum (Barokah, 2025; Khotimah et al., 2024; Wahyudi, 2025). The results indicate that the use of AI significantly improves teachers' ability to manage instructional complexity, especially in classrooms with diverse student abilities and learning speeds. Participants emphasized that AI-supported systems facilitated timely instructional adjustments and more responsive classroom management. These findings suggest that AI-based learning management enhances instructional effectiveness by supporting adaptive learning practices that are consistent with curriculum objectives.

Participants further reported that AI-based systems reduced administrative workload by automating routine assessment tasks and generating instant feedback reports. This efficiency allowed teachers to allocate more time to pedagogical reflection and student interaction. Improved student engagement was also noted, as adaptive learning platforms provided content tailored to individual learner profiles. These findings indicate that AI-based learning management strengthens learning implementation by enabling teachers to focus on instructional quality rather than administrative demands, thereby supporting effective curriculum enactment.

The third research question explored stakeholders' perceptions of the outcomes and implications of AI-based learning management for curriculum effectiveness. The findings show that school leaders and teachers perceive AI-based learning management as a strategic instrument that supports evidence-based decision-making (Afifah, 2025; Jannah & Rizquha, 2025; Mustaghfiroh &

Mubaroq, 2025). AI-generated insights were considered valuable for evaluating instructional effectiveness, identifying learning gaps, and monitoring curriculum implementation progress. These perceptions highlight the role of AI in extending learning management beyond the classroom to institutional-level curriculum oversight.

Stakeholders emphasized that AI-supported data enabled schools to evaluate curriculum implementation more systematically and to identify areas requiring pedagogical improvement. This finding suggests that AI-based learning management contributes not only to classroom-level effectiveness but also to organizational learning and continuous improvement processes. Consequently, AI-based learning management enhances institutional capacity to manage the Independent Curriculum in a structured and accountable manner.

This study aimed to examine how Artificial Intelligence-Based Learning Management contributes to improving the effectiveness of the Independent Curriculum, particularly in instructional planning, learning implementation, and assessment management (Inchara, 2025). The discussion is structured around the research questions and interprets the findings in relation to existing literature and educational practice (Ani et al., 2023). Overall, the findings demonstrate that AI-based learning management plays a significant role in supporting the core principles of the Independent Curriculum by enabling data-driven, adaptive, and student-centered learning management practices (Destriani, 2022a).

The results further indicate that AI-based learning management enhances curriculum implementation effectiveness through differentiated instruction, real-time monitoring of student progress, and continuous formative assessment. These findings are consistent with prior research emphasizing the role of AI technologies in supporting personalized learning and improving instructional responsiveness (Destriani, 2022b). Previous studies have similarly reported that learning analytics and adaptive systems enable educators to align instructional strategies with individual learner needs. Thus, this study extends existing research by demonstrating that AI functions not only as an instructional tool but also as an integrated learning management system aligned with curriculum-level objectives (Putri et al., 2024).

From a data interpretation perspective, the effectiveness of AI-based learning management can be understood as a consequence of its capacity to reduce instructional uncertainty and managerial complexity. By providing actionable insights derived from student data, AI-supported systems enable teachers and school leaders to anticipate learning challenges, adjust instructional strategies, and evaluate curriculum implementation more systematically. These findings align with previous research highlighting the managerial benefits of AI in educational settings (Ng et al., 2024).

Despite these positive outcomes, the findings also reveal several challenges associated with the implementation of AI-based learning management. Participants reported difficulties related to limited digital literacy, unequal access to technological infrastructure, and concerns regarding over-reliance on algorithmic recommendations (Alotaibi, 2024). These challenges indicate that the integration of AI into learning management is not inherently transformative and may introduce new risks if not accompanied by adequate institutional support and professional development.

In contextual terms, these challenges can be attributed to variations in institutional readiness, teacher competence, and organizational support for technological innovation. Educational institutions with limited infrastructure or insufficient training opportunities may struggle to fully benefit from AI-based learning management systems. Previous studies have similarly emphasized that the effectiveness of AI in education depends on contextual factors such as leadership support, teacher capacity building, and ethical governance. Moreover, scholars have warned that algorithmic decision-making may marginalize pedagogical judgment if educators lack critical engagement with AI-generated recommendations (Wong et al., 2024).

The implications of this study are multifaceted. Theoretically, the findings contribute to the literature on Artificial Intelligence in Education by positioning AI-based learning management as a curriculum-aligned managerial innovation rather than a standalone technological tool. Practically, the study underscores the importance of targeted professional development, institutional readiness assessments, and ethical guidelines to ensure responsible AI integration. At the policy level, the results suggest that educational authorities should consider embedding AI-based learning management frameworks into curriculum implementation strategies to enhance the effectiveness and sustainability of the Independent Curriculum (Ikhsan et al., 2025).

CONCLUSION

This study demonstrates that Artificial Intelligence-Based Learning Management plays a significant role in enhancing the effectiveness of the Independent Curriculum by functioning as an integrated managerial and pedagogical mechanism rather than merely an instructional aid. The most important finding of this research is that AI-supported learning management enables data-driven instructional planning, supports differentiated learning practices, and strengthens continuous formative assessment in authentic educational settings. These capabilities reduce instructional uncertainty and administrative burden while enhancing teachers' and school leaders' capacity to make evidence-based decisions. From a scholarly perspective, this study

contributes to the field of Artificial Intelligence in Education and educational management by extending existing discourse beyond tool-based AI applications and positioning AI-based learning management as a curriculum-aligned management innovation. By empirically linking AI-supported learning management to curriculum effectiveness, this research enriches theoretical understanding of how intelligent systems can operationalize flexibility, learner autonomy, and continuous assessment within contemporary curriculum frameworks.

Despite its contributions, this study is subject to several limitations that should be acknowledged and addressed in future research. The study was conducted in a limited number of educational institutions, which may constrain the transferability of the findings across diverse educational contexts. In addition, the qualitative case study design prioritizes depth of understanding over breadth and does not provide quantitative evidence of learning outcomes. The perspectives explored were primarily those of educators and school leaders, without directly incorporating students' experiences of AI-based learning management. Future research is therefore recommended to employ mixed-methods or quantitative approaches to examine the impact of AI-based learning management on measurable learning outcomes, conduct comparative studies across different educational levels and contexts, and integrate students' perspectives. Further investigation into ethical, cultural, and policy dimensions of AI integration is also necessary to develop more comprehensive, equitable, and sustainable models of AI-supported curriculum implementation

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