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Transforming Learning Management through Virtual Learning Environments: A Multiple Case Study Approach

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ABSTRACT

The rapid advancement of digital technology has transformed the educational landscape, prompting institutions to rethink conventional learning management practices. The integration of Virtual Learning Environments (VLEs) has emerged as a strategic innovation that fosters inclusive, interactive, flexible, and learner centered education. This study adopts a qualitative multiple case study design to explore how VLE integration transforms learning management across three schools with distinct characteristics. The findings indicate that transformation occurs across three dimensions planning: shifting from traditional design to digitally integrated curriculum development, implementation: evolving from instructional teaching to facilitative digital engagement and evaluation: transitioning from manual assessment to adaptive digital analytics. Major challenges include teachers limited digital competence, low self efficacy, and resistance to pedagogical change. Continuous professional development and emotional readiness programs are essential to strengthen teachers' capacity for technology integration. The qualitative scope and limited number of cases constrain the generalizability of the findings, as contextual and infrastructural variations may influence implementation. Future studies should broaden contextual coverage and employ mixed methods to enhance the validity and applicability of results. Theoretically, this study advances understanding of digital pedagogy transformation, while practically emphasizing the importance of teacher competence, robust infrastructure, and adaptive learning cultures in sustaining educational innovation.

Keywords: Virtual Learning Environments (VLEs); Learning management; Digital pedagogy transformation

INTRODUCTION

The rapid advancement of digital technology has profoundly transformed the global educational landscape. It has reshaped how learning is managed, delivered, and experienced across various levels of education. Educational technology plays a pivotal role in this transformation by enabling interactive, personalized, and data driven learning. Platforms such as Learning Management Systems, Virtual Reality, and hybrid learning models enhance engagement, flexibility, and academic performance (Arvind, 2024; Izouaouen et al., 2025). These technologies facilitate individualized and adaptive learning pathways that respond to

students' diverse needs, shifting the paradigm from teacher centered instruction toward more learner centered and autonomous environments (Broich, 2015). Empirical evidence further demonstrates that the integration of digital and immersive tools can significantly boost student motivation, engagement, and academic outcomes when effectively embedded within the curriculum (Delgado Kloos et al., 2017; Sinaj & Xhabafti, 2025). Beyond its pedagogical value, Educational technology has also redefined educational management. It bridges temporal and spatial barriers, fosters collaboration, and expands access through blended and online learning ecosystems (Khwankaew, 2023). The COVID 19 pandemic accelerated this digital transformation, underscoring the urgency for strategic leadership, technological readiness, and innovative learning management to ensure educational continuity and quality in virtual and hybrid contexts (Chomunorwa & Mugobo, 2023; Kumar & Manjula, 2024).

A Virtual Learning Environment (VLE) is an integrated digital platform designed to enhance the quality, flexibility, and accessibility of education using computer based technologies. It enables educators to manage courses, monitor learner progress, and deliver structured and goal oriented learning experiences that align with pedagogical objectives (Hu et al., 2010; Jan, 2021a). By integrating diverse tools for teaching, learning, and communication, VLEs foster interactive, adaptive, and learner centered educational processes that promote engagement and autonomy (Darwaish & Wang, 2012; Jan, 2021a). They play a pivotal role in supporting distance and blended learning by allowing students to access materials, collaborate, and participate beyond spatial and temporal constraints (Darwaish & Wang, 2012; Hu et al., 2010; Jan, 2021a). Furthermore, VLEs strengthen engagement, communication, and inclusivity by facilitating personalized and self paced learning experiences that bridge the gaps inherent in traditional educational models (Aijuan & Honglin, 2005; Darwaish & Wang, 2012; Jan, 2021a).

VLEs play a pivotal role in enhancing the effectiveness and efficiency of learning management in modern educational institutions. By improving accessibility and flexibility, VLEs enable both learners and educators to access instructional materials and learning activities anytime and anywhere, thereby supporting the optimal implementation of distance and hybrid learning models (Aijuan & Honglin, 2005; Hosni et al., 2020). From a managerial perspective, VLEs streamline the learning management process by facilitating the delivery of materials, participant administration, assessment, and systematic monitoring of learning progress in an integrated manner (Jan, 2021a; Jimenez et al., 2010). The built in analytical and reporting features of VLEs provide comprehensive data that enable educators to conduct timely and evidence based pedagogical interventions (Jan, 2021a; van Eck & Waltman, 2017). Furthermore, VLEs contribute to operational cost efficiency by reducing dependence on physical resources and conventional infrastructure while centralizing learning content to optimize resource utilization (Baloch, 2010; Islam & Mahmud, 2020; Jimenez et al., 2010)

Despite offering substantial benefits, Virtual Learning Environments (VLEs) continue to face critical challenges that constrain their optimal implementation across technical, pedagogical, and socio emotional dimensions. Pedagogically, educators often encounter difficulties in designing engaging digital content, sustaining meaningful learner interactions, and providing effective feedback due to limited pedagogical competence and the presence of transactional distance, which may undermine motivation and learning quality (N. Ahmad et al., 2024; Davis et al., 2022; Herodotou et al., 2025; Iqbal et al., 2022; Lane & Wray, 2012; Zilka & Zeichner, 2019). Technically, hardware limitations, unstable internet connectivity, and device incompatibility frequently hinder seamless access to learning

resources (Badilla Quintana et al., 2017; Costa et al., 2022; Power et al., 2010; Spiteri et al., 2017; Stewart et al., 2010). Moreover, the adoption of advanced technologies such as virtual reality remains restricted by high costs and the complexity of data integration (Carruth, 2017; Ip & Li, 2015; Ismayilzada et al., 2025). From a socio emotional perspective, learners may experience isolation, frustration, and a weakened sense of belonging due to the lack of direct social interaction, posing ongoing challenges to community building and identity formation within virtual learning spaces (Delahunty et al., 2014; Ifenthaler et al., 2023; Intolubbe-Chmil et al., 2025; Karimi & Ashkani, 2025; Zilka & Zeichner, 2019).

Virtual Learning Environments (VLEs) have emerged as a transformative force that bridges traditional pedagogical practices with technology driven innovation (Holmes, 2018; Lopez-Ozieblo et al., 2025; Shah & Riener, 2025). Their integration has reshaped the management of teaching, learning, and administration by promoting flexibility, accessibility, and data informed decision making (Keraminiyage et al., 2009; Lopez-Ozieblo et al., 2025; Shah & Riener, 2025). However, the success of VLE implementation extends beyond technological adoption it requires understanding how these systems transform learning management at institutional, pedagogical, and human interaction levels (Keraminiyage et al., 2009; Wilson et al., 2007). While most previous studies have emphasized technological and instructional dimensions, limited research has explored their broader managerial implications within educational organizations (Gordon & Brayshaw, 2017; Huggins-Manley et al., 2019). Hence, a qualitative inquiry is essential to capture how educators, administrators, and learners experience and adapt to these systemic changes, providing context rich insights into the dynamics of learning management transformation in digital environments (Ip & Li, 2015; Iwin Thanakumar Joseph et al., 2020).

Related Literature

Learning and Teaching Management

Learning and teaching management refers to the systematic process of planning, delivering, and evaluating educational activities. This process is essential for ensuring effective education and involves several key components that collectively contribute to achieving desired learning outcomes. In the planning phase, curriculum design plays a crucial role in developing structured learning programs that align with educational goals and standards (Prapawong, 2019). Effective resource allocation is equally important to ensure the availability of appropriate facilities, technologies, and learning materials that support instructional activities (Revano & Juanatas, 2023). Moreover, creating supportive and adaptive learning environments helps address the diverse needs of students, thereby promoting inclusivity and engagement throughout the learning process (Palomino et al., 2017).

The delivery stage emphasizes the pivotal role of technology in facilitating instruction. Learning Management Systems (LMS), such as Moodle and Blackboard, are widely utilized to organize courses, deliver content, and manage communication between students and instructors (Dahal et al., 2023; Kasim & Khalid, 2016; Wisudiawan & Kurniati, 2022). Various teaching methods ranging from traditional classroom based instruction to online, blended, and distance learning are implemented to accommodate diverse learning preferences (Dahal et al., 2023). Furthermore, the integration of technology enhances the overall learning experience by providing interactive tools, real time feedback, and adaptive learning environments (Omoda-Onyait et al., 2012; Palomino et al., 2017).

During the evaluation phase, a range of assessment tools embedded within LMS are employed to measure student performance and provide timely feedback (Divya et al., 2025; Garrison et al., 2015). Data generated from these systems can be analysed to assess student engagement and learning outcomes, enabling educators to identify areas that require improvement (Winfield et al., 2023; Wisudiawan & Kurniati, 2022). Continuous improvement is achieved through the systematic review and revision of teaching practices and learning materials, ensuring that the educational process remains dynamic and effective (Abbasnejad et al., 2024; Sawarkar & Sawarkar, 2020).

Despite these advancements, several challenges persist in learning and teaching management. Maintaining high levels of student engagement and participation remains a critical concern for achieving successful learning outcomes (Winfield et al., 2023). Furthermore, there is an increasing demand for personalized learning pathways that accommodate individual student needs (Divya et al., 2025). Institutions must also address technological barriers related to infrastructure, connectivity, and the digital divide (Abbasnejad et al., 2024; Sawarkar & Sawarkar, 2020) while ensuring that teachers receive adequate professional development to effectively integrate LMS and technology into their pedagogical practices (Abbasnejad et al., 2024).

Virtual Learning Environments

VLE is a software system designed to facilitate teaching and learning through integrated digital tools and resources. It enables educators to design, manage, and deliver courses effectively, particularly in distance and blended learning settings (Hu et al., 2010; Jan, 2021a). The primary objective of VLEs is to enhance the learning process by promoting engagement, communication, and accessibility to learning materials (Abeldina et al., 2015; Darwaish & Wang, 2012).

VLEs typically consist of multimedia tools, interactive platforms, and structured learning materials that allow both teachers and students to track progress and performance (Aijuan & Honglin, 2005; Jan, 2021a). Some advanced systems incorporate virtual reality technologies to create immersive and interactive learning experiences (Y. Wang, 2021). These innovations demonstrate how VLEs adapt to diverse educational contexts and evolving technological advancements.

In educational practice, VLEs are widely adopted across institutions to support collaborative and flexible learning. They provide online spaces for interaction among teachers, students, and resources, fostering both synchronous and asynchronous communication (Darwaish & Wang, 2012; Galofré & Minguillón, 2008; McArdle et al., 2010). Such interactions enhance learner participation, collaboration, and overall learning outcomes.

However, VLEs still face several challenges, including interface rigidity, limited interactivity, and inadequate collaborative tools (Darwaish & Wang, 2012; Y. Wang, 2018). Poor interface design and low user engagement can contribute to higher dropout rates in e learning environments (McArdle, 2009; McArdle et al., 2010). Therefore, improving usability, interactivity, and multimedia integration is essential to sustaining learner motivation and retention.

Technological integration remains central to the ongoing development of VLEs. The incorporation of Information and Communication Technologies (ICTs) including cloud computing and virtual reality enhances system performance, accessibility, and overall learning

effectiveness(Kasapakis & Dzardanova, 2021; Y. Wang, 2018, 2021). As digital transformation accelerates, VLEs are expected to play an increasingly strategic role in fostering inclusive, interactive, and learner cantered education.

METHOD

This study employed a qualitative approach (Vredenberg, 1983) to examine the transformation of learning management through the integration of VLEs in three Indonesian secondary schools. This approach was chosen as it enables an in depth exploration of data without imposing restrictions on the types of questions asked or responses provided (Creswell, 2014). To enhance the credibility and generalizability of the findings, a multi case study design was adopted (Bogdan, 2017), allowing for a comparative analysis of similarities and differences across the three cases.

The selected schools shared common characteristics in implementing best practices for VLE integration but differed in the technologies employed. Al Hikmah Islamic Boarding School developed its own system, Madrasah Aliyah Negeri 1 Malang utilized an e learning platform provided by the Ministry of Religious Affairs, and State Vocational High School 1 Malang adopted the open access Moodle platform. A cross case analysis was conducted to identify emerging patterns and themes, which were subsequently synthesized into findings, propositions, and substantive theories (Yin, 1996).

Data collection technique

This study employed multiple data collection techniques, including in depth interviews, participant observation, and document analysis. The interviews were conducted using open ended guidelines to enable flexible and in depth exploration of information, while the selection of participants adhered to specific criteria (Guba, 1981) based on their expertise, proximity to the context, and roles in the integration of the VLEs.

A total of fifteen participants were involved, comprising school principals, IT staff, teachers, and students. The selection process began with principals and management teams as key informants, followed by teachers and technical staff, and finally students, who were the most directly affected by the integration process.

Participant observation was carried out in three stages descriptive, focused, and selective to obtain a comprehensive understanding of the process (Spreadly, 1980). Additionally, document analysis was effectively employed, as many school documents were digitally archived, thereby facilitating data access and analysis (Guba, 1981).

Data analysis techniques and validity checks

In this study, data analysis was conducted simultaneously across all cases, following the analytical flow model proposed by Miles and Huberman. Data condensation was achieved through the identification and coding of relevant themes, which were subsequently visualized using the attribute value chart feature in Nvivo (Miles, 2014).

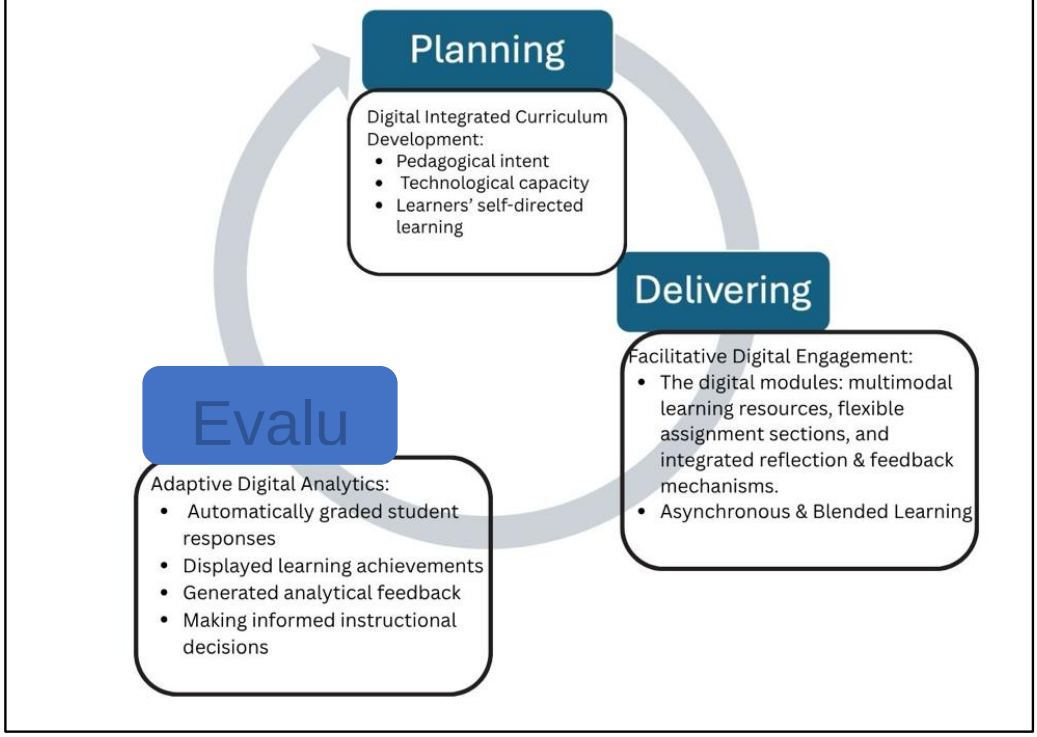
The validity of the data was ensured through four key criteria: credibility, transferability, dependability, and confirmability. Credibility was established through triangulation of multiple data sources and techniques, including interviews, participant observations, and document analyses related to VLEs, complemented by member checking

involving 15 informants. Transferability was ensured through the careful selection of three schools with comparable characteristics and a three month data collection period. Dependability and confirmability were reinforced through an external audit of the research methodology by experts in digital education, ensuring the reliability and trustworthiness of both the research process and its findings.

DISCUSSION

This multiple case study investigated how the integration of Virtual Learning Environments (VLEs) transforms pedagogical and managerial practices in schools with different levels of digital maturity. Findings are organized into three interrelated clusters Planning, Delivering, and Evaluating to illustrate how digital systems reshape learning management processes. Cross case comparison highlights both shared trajectories and distinctive innovations, shaped by pedagogical philosophies, institutional capacities, and technological affordances. The following figure presents the research findings, illustrating the learning management process resulting from the integration of VLEs.

Picture 1
The learning management process resulting from the integration of VLEs



Planning: From Traditional Design to Digital Integrated Curriculum Development

The planning stage in Case 1 demonstrates a robust implementation of the Self Directed Learning (SDL) model through the life proposal system a three year learning plan independently designed by students. This approach emphasizes learner autonomy and personal accountability in determining the direction, content, and pace of learning. Teachers serve as reflective facilitators, consistent with SDL principles that position learners as the central agents in the educational process (Dogra, 2023; Garcia et al., 2017).

In comparison to SDL practices in VLEs, both approaches foster learner independence and lifelong learning, requiring advanced self regulation skills such as time management, goal setting, and self monitoring (Dogra, 2023; Garcia et al., 2017; Huang & Hew, 2025). However, a key distinction lies in their contextual and technological orientation. SDL in VLEs operates entirely within digital ecosystems, supported by Learning Management Systems (LMS) and online collaborative tools (Colque-Quispe et al., 2025; Dogra, 2023; Foo & Hussain, 2010), whereas the life proposal system in Case 1 represents a blended learning model that integrates face to face interaction with digital self directed study.

Unlike SDL in VLEs, which often assumes that learners possess high levels of self regulation and digital literacy (Garcia et al., 2017; Huang & Hew, 2025), the life proposal system in Case 1 functions as a pedagogical scaffolding mechanism that gradually cultivates learner autonomy through structured and reflective experiences. Thus, the Case 1 approach can be regarded as a contextual and developmental form of SDL, effectively preparing students for full self directed learning within a digital learning ecosystem (Colque-Quispe et al., 2025; Dogra, 2023; Foo & Hussain, 2010; Garcia et al., 2017; Huang & Hew, 2025).

The planning processes in Case 2 and Case 3 demonstrate a more structured and teacher centered approach, focusing on curriculum standardization and digital system integration. Teachers conduct core and basic competency analyses, develop learning sequences, and design semester and annual programs. However, Case 2 is fully integrated into a Moodle based e learning system, connecting lesson plans, learning resources, and assessment instruments, while Case 3 operates outside the e learning platform due to its limited planning features.

This aligns with international practices emphasizing the importance of structured planning in VLEs. Conceptual models and tools such as Norway's Curriculum Planning Tool (CPT) help align national curriculum standards with pedagogical autonomy (da Silva et al., 2025; Stubbs & Range, 2011). Moreover, initiatives like Virtual Course Planning (VCP) at the Federal University of ABC and the integrated VLE at Manchester Metropolitan University highlight the significance of collaboration and flexibility in digital curriculum design (Bernotaite & Ottesen, 2025; De Carvalho et al., 2023).

These cross case findings reveal a continuum of digital transformation in learning design, ranging from student centered personalization (Case 1) to teacher centered standardization (Cases 2 and 3). All three cases share a common understanding that effective digital based learning planning requires alignment between pedagogical intent, technological capacity, and learners' self directed learning autonomy.

Delivering: From Instructional Teaching to Facilitative Digital Engagement

The implementation stage demonstrates a transformation from teacher centered instruction to technology mediated, student centered learning. In Case 1, the learning process

follows a scientific approach encompassing observation, exploration, experimentation, and reflection. The learning modules are systematically organized with step by step guidance to support students' self directed learning. As all students reside in dormitories, the school does not employ synchronous online learning, making face to face interaction the most effective mode of engagement. Consequently, digital learning in Case 1 is primarily asynchronous, fostering individual exploration and allowing students to progress at their own pace.

In contrast, Cases 2 and 3 implement a blended learning model that integrates both synchronous and asynchronous modes. During synchronous sessions, teachers and students engage directly in virtual classrooms, while asynchronous learning enables students to access materials, videos, and assignments independently through the Virtual Learning Environment (VLE). The digital modules in both cases comprise three core components: (1) multimodal learning resources (texts, videos, and external links), (2) flexible assignment sections, and (3) integrated reflection and feedback mechanisms. Teachers can design, distribute, and assess assignments in real time using the platform's built in features.

All three cases exhibit a similar pedagogical pattern in which technology functions not only as a medium for information delivery but also as a space for students' cognitive and social engagement. Through blended learning design, teachers strategically integrate digital components into the stages of knowledge exploration, assignment, and evaluation to enhance active learning (Ghanbari-Ghazijahani, 2025; Juang, 2010; Zimmermann et al., 2021). The flexibility of digital platforms strengthens learner autonomy by allowing students to manage their own time and learning processes effectively(Ghanbari-Ghazijahani, 2025; Krishnan, 2018a; Lorimer & Hilliard, 2007), while collaborative online tools foster active participation and meaningful peer interaction (Krishnan, 2018a; Ramadevi et al., 2023). Consequently, blended learning transforms the learning process into a more student centered, interactive, and reflective experience, leading to higher motivation and improved learning outcomes (Krishnan, 2018b; Martín-Martínez et al., 2020).

Findings from the three cases indicate that the tiered learning control system in digital contexts serves not merely as a monitoring mechanism but as an instrument for enhancing the adaptiveness and data driven quality of learning. At the institutional level, control operates vertically teachers monitor students' activities, task completion, and evaluation outcomes, while school management oversees teachers' performance in real time to ensure accountability and consistency in instructional quality. Supported by VLEs, however, this control function evolves into a more autonomous and responsive system. VLEs enable automated tracking of student activities(Jan, 2021b; Khajuria et al., 2023a), generate adaptive learning paths tailored to individual needs (Calderón et al., 2025; Hovorushchenko et al., 2025), and provide real time feedback and predictive analytics (Balasubramani et al., 2025; Khajuria et al., 2023b; Kuzilek et al., 2019; Nazempour & Darabi, 2023; L. Wang & Du, 2026). Teachers can also utilize comprehensive dashboards to conduct timely interventions for students who exhibit learning difficulties (Alves et al., 2015; Jan, 2021b; Kuzilek et al., 2019; Młynarska et al., 2016) Thus, the digital learning control system fosters a synergy between managerial accountability and pedagogical intelligence, transforming supervision into a transparent, adaptive, and student centered learning ecosystem that promotes learner autonomy and improves learning outcomes.

Evaluating: From Manual Assessment to Adaptive Digital Analytics

At the evaluation stage, a notable shift is evident from traditional manual assessment toward adaptive, data driven evaluation supported by digital analytics. Across all cases, teachers

employed digital platforms to design and administer various forms of assessments directly within the e learning system. These platforms automatically graded student responses, displayed learning achievements, and generated analytical feedback to support teachers in making informed instructional decisions.

Case 1 is distinguished by an assessment approach integrated with the Self Directed Learning (SDL) model. Student outcomes exhibited considerable variation due to differences in learning pace high achieving students were able to complete lessons more rapidly and progress to additional topics aligned with their interests. In contrast, Cases 2 and 3 implemented standardized digital evaluations directly connected to the school's assessment system. Teachers could reutilize digital item banks and conduct outcome analyses to determine mastery levels and identify areas requiring pedagogical improvement.

Across all three cases, real time performance dashboards enable teachers to provide immediate, targeted feedback, enhancing instructional responsiveness. In advanced VLEs, learning analytics dashboards present real time data on student performance, engagement, and progress, supporting timely pedagogical interventions (Chen et al., 2022; Kannan & Zapata-Rivera, 2022; Mühlbeier et al., 2015). They balance task and process oriented feedback, aid classroom management by visualizing collaboration, and foster autonomous learning through insights into students' learning patterns(Carlon & Cross, 2021; Knoop-van Campen et al., 2023; Mirzakhalov et al., 2020). Adaptive technologies further personalize learning paths and feedback to individual needs (Geurts et al., 2025). Overall, these dashboards transform traditional monitoring into a proactive, learner centered system that promotes autonomy and optimizes learning outcomes.

Challenges and Enhancement of Technology Acceptance

The main challenge in implementing digital learning across Cases 1, 2, and 3 lies in human resource factors, particularly among teachers who struggle to shift from traditional mindsets to technology integrated learning paradigms. Limited competencies in digital instructional design hinder the development of interactive and innovative learning processes. This finding is consistent with previous studies indicating that many teachers possess only basic digital skills and lack specialized training for online instruction, leading to suboptimal utilization of VLEs (Derboven et al., 2017; Ogodo et al., 2021). Moreover, low levels of teachers' self efficacy in using technology further constrain their ability to fully explore the potential of VLEs (N. L. Ahmad et al., 2023a; Ogodo et al., 2021). Therefore, improving the effectiveness of digital learning requires a comprehensive strategy that incorporates continuous professional development and the enhancement of teachers' self efficacy in technology integration.

To address these challenges, a series of dialogues, orientations, and subject based training programs were implemented to strengthen teachers' understanding and skills in integrating VLEs. The findings indicate that continuous professional development is vital for enhancing teachers' digital competencies, as structured training that integrates both technical and pedagogical dimensions enables more effective utilization of VLEs (N. L. Ahmad et al., 2023b; Kapıcı, 2025; Sinlapaninman & Yonwilad, 2025). Moreover, enhancing teachers' emotional readiness helps them manage stress and adapt more effectively to virtual teaching environments (Sinlapaninman & Yonwilad, 2025). Training programs that emphasize practical application further improve teachers' ability to translate digital competencies into effective instructional practices (Kapıcı, 2025; Sinlapaninman & Yonwilad, 2025). Therefore,

comprehensive and sustained professional development remains a key strategy for strengthening teachers' capacity and confidence in implementing technology integrated learning.

From the perspective of facilities and infrastructure, technical barriers such as application complexity and network disruptions emerged as major issues in Cases 1 and 2. The intricate integration of multiple hardware and software components made the maintenance of online learning systems particularly challenging, consistent with the view that VLEs often require complex integrations that influence both functionality and user experience (Stojanov & Dobrilovic, 2016). To mitigate these challenges, a user feedback driven Learning Content Management System (LCMS) was developed, accompanied by network upgrades to enhance overall system performance. In Case 3, improvement efforts focused on exploring open source platform features to optimize learning functionality. This strategy aligns with previous findings indicating that advanced features in VLEs, such as virtual laboratories and immersive environments, increase system complexity and necessitate continuous adaptation to operational conditions and the number of concurrent users(Forsyth et al., 2009).

CONCLUSION

This study confirms that the integration of VLEs has transformed learning management across three key dimensions planning, implementation, and evaluation. The transformation is reflected in the enhancement of self directed learning, the utilization of learning analytics, and the adoption of adaptive digital management. The success of VLE implementation depends on the synergy between pedagogical design, technological readiness, and teacher competence. Strengthening teachers' digital literacy and emotional readiness is essential to ensure the sustainability of technology enhanced learning.

This study is limited to three cases, which may not fully capture the diversity of educational contexts. The qualitative focus also constrains the generalizability of the findings. Additionally, variations in digital infrastructure and institutional policies may influence implementation outcomes. Future research should broaden contextual coverage and incorporate quantitative methods to improve the validity and applicability of the results.

Theoretically, this study contributes to a deeper understanding of digital pedagogy transformation and adaptive learning. Practically, the findings underscore the importance of teachers' digital competence and robust infrastructure in successful VLE implementation. Educational institutions should prioritize practice based continuous professional development and user centered LCMS enhancement. At the policy level, fostering a collaborative and adaptive digital learning culture is vital to sustaining educational innovation.

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