



STRATEGIES FOR ENHANCING DIGITAL LEARNING ENVIRONMENTS: TEACHERS' PERSPECTIVES ON OVERCOMING CHALLENGES AND MAXIMIZING ENGAGEMENT

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Abstract:

This study explores the creation of positive digital learning environments (DLEs) by integrating digital technologies and teaching strategies that promote personalized and interactive learning. A well-designed DLE includes digital media, online platforms, and intelligent learning systems that work together to enhance education. However, challenges such as inconsistent implementation across schools, especially between urban and rural areas, highlight the need for effective strategies to ensure equal access to these tools. Teachers play a crucial role in this transformation, yet many face difficulties in effectively using digital tools despite positive attitudes towards technology in education. Professional development and strong leadership are essential to overcoming these challenges, but time constraints and varying levels of motivation among teachers can limit the effectiveness of such programs. Infrastructure also plays a vital role, with the Malaysian government recognizing the need to improve technological resources in schools. However, disparities in access to technology, particularly in rural areas, remain a significant concern. This study uses thematic analysis to identify key factors that contribute to a positive digital learning environment. Sixty pre-service teachers from diverse educational backgrounds participated, providing insights into effective strategies for digital learning. The analysis revealed themes such as engagement and interaction, infrastructure and accessibility, effective classroom management, teacher competency and creativity, support systems, and the importance of a positive learning environment. The findings emphasize the need for engaging content, reliable technology, well-prepared teachers, and strong support systems to

create effective DLEs. The results highlight both the potential and challenges of digital education, stressing the importance of addressing existing gaps to ensure that all students benefit from high-quality digital learning experiences. This study suggests that collaborative efforts among educators, administrators, parents, and policymakers are crucial for building a successful and inclusive digital learning environment.

Keywords:

Digital Learning Environments; Teacher Competency; Educational Technology Integration; Student Engagement

Introduction

A digital learning environment (DLE) is defined by the integration of digital technologies and teaching strategies that create personalized and interactive learning experiences. It includes various components such as digital media, online platforms, and intelligent learning systems, which work together to enhance the educational process. DLEs encourage learner engagement through gamification and interactive features, which help increase motivation and participation both of which are essential for effective learning outcomes (Naeem et al., 2023; Poonsawad et al., 2022). Additionally, DLEs support personalized learning paths, allowing students to manage their learning and adjust to their individual needs (Noskova et al., 2021; Peng et al., 2019). They also promote collaboration between learners and educators, improving communication and resource sharing on a global scale (Hendarwati et al., 2021; Rudenko et al., 2021). As education continues to evolve, the DLE serves as a key framework for integrating technology into teaching and learning, ultimately preparing students for the demands of the digital economy (Lunev et al., 2021).

In DLE, effective teaching and learning approaches rely on fostering engagement through collaboration and communication. Research shows that the quality of the digital environment significantly affects student motivation and engagement, especially when using digital educational games (Li, 2024). Additionally, effective communication and collaboration are essential for enhancing learning interactions, as students still view instructors as key to helping them understand the material (Supiyati et al., 2022). The integration of collaborative online learning, particularly following the COVID-19 pandemic, has become a crucial approach to using technology to improve educational experiences (Ridwan, 2023). The shift towards blended learning methods has also led educators to reconsider traditional approaches, incorporating online tools to support collaborative efforts (Siddiquee, 2023). The importance of inclusivity and collaboration cannot be overstated, as they are fundamental to creating an engaging online educational atmosphere.

This study aims to form a strategy towards creating positive digital learning environments based on input from pre-service teachers. Ultimately, the combination of elements, such as technology, collaboration, and effective communication, forms the foundation of successful digital learning strategies, encouraging active participation and leading to better learning outcomes.

Literature Review

The current status of the digital learning environment in primary and secondary schools in Malaysia reflects a significant transformation driven by technological advancements and educational reforms. The Malaysian education system, guided by the Malaysian Education Development Plan (PPPM) 2013-2025, emphasizes integrating digital tools and resources into teaching and learning processes. This initiative aims to create a 21st-century learning environment (PAK-21) that enhances student engagement through problem-based exercises and the incorporation of technology into teaching practices (Anuar et al., 2019). The focus on digital pedagogy highlights the need for educators to adapt their teaching methods to effectively use technology (Vääätäjä & Ruokamo, 2021). However, while these efforts are commendable, the actual implementation of these strategies can be inconsistent across schools, particularly between urban and rural areas. The challenge lies in ensuring that all schools can adopt these digital tools effectively, regardless of their location or resources.

A key aspect of this transformation involves the role of teachers and their readiness to integrate technology into their classrooms. Research shows that many Malaysian teachers have a positive view of using technology in education, but they often face challenges in effectively implementing digital tools (Leow, 2024; Had & Rashid, 2019). Professional development for teachers is essential, as it provides them with the skills needed to use digital resources effectively. Studies have shown that improving teachers' digital pedagogy through meaningful learning activities can greatly enhance their teaching practices (Sailin & Mahmor, 2018). Additionally, the leadership of school principals is important in promoting a culture of technology integration, as their support and training can influence teachers' willingness to adopt new technologies (Sharma, 2021; Raman et al., 2019). Despite these initiatives, the effectiveness of professional development programs is often limited by time constraints and varying levels of teacher motivation. Moreover, the extent to which school leadership can influence technology adoption may depend on the availability of resources and support from higher education authorities.

Infrastructure plays a crucial role in the successful implementation of digital learning environments. The Malaysian government has recognized the need to improve the technological infrastructure in schools, ensuring that all educational institutions have the necessary tools to support digital learning (Lokman et al., 2022). This includes providing access to high-speed internet and modern computing devices, which are essential for creating an effective digital learning environment. However, despite these efforts, disparities in access to technology remain a challenge, especially in rural areas where resources are limited (Anuar et al., 2019; Lokman et al., 2022). The persistence of these disparities raises concerns about the equity of educational opportunities in Malaysia. While urban schools may benefit from advanced technological resources, rural schools could continue to lag, potentially widening the educational gap between different regions.

The integration of digital tools into the curriculum is also a key focus of the Malaysian education system. The introduction of STEM (Science, Technology, Engineering, and Mathematics) education, as outlined in the Malaysia Education Blueprint, aims to prepare students for the demands of the 21st-century workforce (Idris et al., 2023). This initiative encourages the use of technology in teaching STEM subjects, promoting critical thinking and problem-solving skills among students. Furthermore, the use of artificial intelligence (AI) tools in Technical and Vocational Education and Training (TVET) is becoming more common,

providing personalized learning experiences that meet the diverse needs of students (Amdan, 2024). However, the success of these initiatives largely depends on the availability of trained educators who can effectively incorporate these technologies into their teaching. Without adequate support and continuous professional development, the potential benefits of STEM and AI integration may not be fully realized.

The COVID-19 pandemic has accelerated the shift towards digital learning, forcing educators and students to adapt to online platforms for instruction. This sudden transition highlighted both the potential and challenges of digital education in Malaysia. While many institutions successfully adopted online learning methods, issues such as digital literacy, access to technology, and the effectiveness of online teaching emerged as significant concerns (Jidon, 2023; Ferrari et al., 2018). The experiences gained during this period have led to discussions on the need for a more structured approach to digital education, including the development of comprehensive digital pedagogy policies (Jidon, 2023). This rapid shift also exposed the lack of preparedness among many educators and institutions, highlighting the need for ongoing support and the development of more resilient digital learning strategies. Moving forward, it is crucial to address these weaknesses to ensure that the education system can adapt to future disruptions effectively.

The current status of the digital learning environment in primary and secondary schools in Malaysia is marked by ongoing efforts to integrate technology into education. While significant progress has been made, challenges related to infrastructure, teacher readiness, and equal access to technology remain. Future initiatives must focus on improving digital literacy among educators and students, enhancing technological infrastructure, and creating a supportive environment for technology integration in teaching and learning. The commitment of the Malaysian government and educational institutions to these goals will be crucial in building a strong digital learning landscape that meets the needs of all learners. However, the success of these efforts will depend on the ability to address the existing gaps and disparities, ensuring that every student, regardless of their location or background, can benefit from a high-quality digital education.

Methodology

Sixty pre-service teachers from various educational backgrounds participated in this study by answering an open-ended question. The question they were asked was,

"How do you create a positive digital learning environment based on your experience as a teacher and student?"

Figure 1 shows the analysis flow for this study.

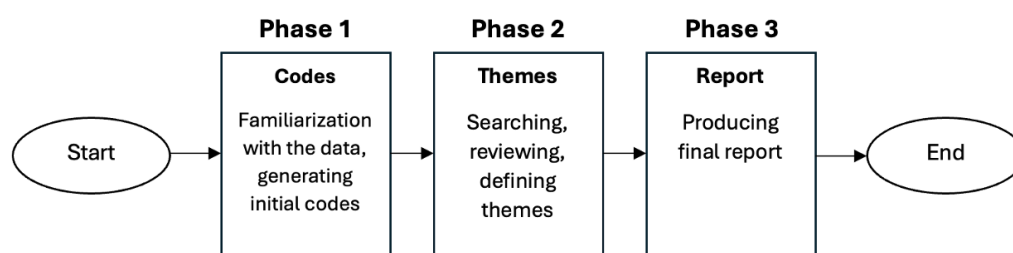


Figure 1: Analysis Flow Using a Thematic

This study uses thematic analysis to analyze the data. The process of thematic analysis typically follows a structured approach, which includes several key phases. Phase 1 consists of familiarization with the data and generates initial codes. Phase 2 consists of searching for themes, reviewing themes, and defining and naming themes, and Phase 3 includes producing the final report (Filia et al., 2018; Salija et al., 2016; Naeem, 2023). This systematic approach ensures that the analysis is rigorous and transparent, allowing for the identification of meaningful patterns across diverse datasets.

Results and Discussion

Phase 1: Familiarization With Data and Generating Initial Codes

Table 1 shows the codes based on quotes from the study participants.

Table 1: Codes/Sub-Themes Reflecting Best Practices in Digital Learning

No.	Codes/Sub-Themes	Quotes
1.	Interactive Learning	<i>"Providing an interactive and student-centered learning environment."</i> <i>"Engagement through innovative materials."</i>
2.	Digital Tools and Infrastructure	<i>"Complete digital equipment."</i> <i>"Good internet connection."</i>
3.	Two-Way Communication	<i>"Practice two-way communication with students."</i> <i>"Teachers and students should establish two-way communication."</i>
4.	Student Engagement	<i>"Innovative and engaging materials."</i> <i>"Gamified platforms like Kahoot, Quizizz."</i>
5.	Teacher Preparedness	<i>"Teachers should always be prepared with teaching aids."</i> <i>"Continuous improvement of teaching methods."</i>
6.	Classroom Management	<i>"Establish rules and procedures."</i> <i>"Monitor student participation."</i>
7.	Digital Citizenship and Etiquette	<i>"Teach proper online interaction etiquette."</i> <i>"Students should follow digital classroom rules."</i>
8.	Creativity in Content Delivery	<i>"Creative in preparing digital learning materials."</i> <i>"Use of multimedia learning materials like videos."</i>
9.	Parental and Administrative Support	<i>"Support from school administration."</i> <i>"Parents need to be open-minded and supportive."</i>

10.	Continuous Feedback and Assessment	<i>"Regularly hold idea-sharing sessions."</i> <i>"Assess and analyze students' knowledge levels."</i>
11.	Student-Centered Learning	<i>"Encourage students to use applications that match their skills."</i> <i>"Focus on student engagement through digital activities."</i>
12.	Building a Conducive Environment	<i>"Create a relaxed atmosphere."</i> <i>"Use well-organized digital materials."</i>
13.	Technology Integration	<i>"Teachers should master digital skills."</i> <i>"Incorporate technology into teaching."</i>
15.	Digital Accessibility	<i>"Access to technology and internet."</i> <i>"Inclusivity in digital learning."</i>
16.	Motivation and Encouragement	<i>"Offer praise and motivation."</i> <i>"Support and encourage students' achievements."</i>

Interactive Learning emerged as a crucial component, with participants emphasizing the importance of providing an interactive and student-centered environment. Quotes like *"Providing an interactive and student-centered learning environment"* and *"Engagement through innovative materials"* suggest that when students are actively engaged, their learning experiences are significantly enhanced. This aligns with modern educational approaches that prioritize student interaction and active participation (Sun et al., 2022). The sub-theme of Digital Tools and Infrastructure was also prominent, where students highlighted the necessity of having complete digital equipment and a good internet connection. The availability of reliable digital tools and infrastructure forms the backbone of any digital learning environment, ensuring that both teachers and students can fully participate without technical hindrances (Akayoğlu et al., 2020). Two-way communication was another significant sub-theme, with participants stressing the importance of establishing clear and consistent communication between teachers and students. Quotes such as *"Practice two-way communication with students"* and *"Teachers and students should establish two-way communication"* indicate that open dialogue is essential for understanding student needs and fostering a collaborative learning environment. Student Engagement was highlighted using innovative and engaging materials, with examples like *"Gamified platforms like Kahoot and Quizizz"* being mentioned. Engaging students with creative content and gamification not only enhance participation but also makes learning more enjoyable and effective (Kaya & Sagnak, 2022).

Teacher Preparedness emerged as a critical factor, with participants noting that teachers should be well-prepared and continuously improve their teaching methods (Vääätäjä & Ruokamo, 2021). Statements such as *"Teachers should always be prepared with teaching aids"* and *"Continuous improvement of teaching methods"* suggest that effective teaching in a digital environment requires ongoing professional development and adaptation to new tools and methodologies. Classroom Management in a digital context involves establishing clear rules and procedures, as well as monitoring student participation. Quotes like *"Establish rules and*

procedures" and *"Monitor student participation"* reflect the need for structured and well-managed online classrooms to maintain order and ensure that students are focused and engaged. The sub-theme of Digital Citizenship and Etiquette highlights the importance of teaching proper online behavior and ensuring that students follow digital classroom rules (Fajri et al., 2022). With the growing prevalence of digital learning, understanding and practicing good digital citizenship is essential for creating a respectful and productive online learning environment (Fajri et al., 2022). Creativity in Content Delivery was also emphasized, with students advocating for the use of multimedia learning materials and creative approaches to content delivery. Statements such as *"Creative in preparing digital learning materials"* and *"Use of multimedia learning materials like videos"* underscore the need for diverse and dynamic teaching methods that cater to different learning styles.

Parental and Administrative Support was identified as a key factor in creating a positive digital learning environment (Tavares et al., 2021). The quotes *"Support from school administration"* and *"Parents need to be open-minded and supportive"* highlight the role of external support systems in facilitating successful digital learning experiences. The sub-theme of Continuous Feedback and Assessment involves regularly assessing students' knowledge and holding idea-sharing sessions. This approach ensures that students receive ongoing feedback and that their progress is continuously monitored, leading to better learning outcomes. Student-Centered Learning was another important sub-theme, where the focus was on encouraging students to engage with applications that match their skills and to participate in digital activities. This sub-theme emphasizes the importance of tailoring learning experiences to individual student needs and preferences. The sub-theme of Building a Conducive Environment includes creating a relaxed atmosphere and using well-organized digital materials. This sub-theme suggests that the physical and digital environment should be conducive to learning, fostering comfort and accessibility (Morris & Imms, 2022; Jia et al., 2022). Technology Integration was highlighted by the need for teachers to master digital skills and incorporate technology into their teaching practices. This sub-theme underscores the importance of effectively blending technology with pedagogy to enhance the learning experience. Finally, Digital Accessibility and Motivation and Encouragement were sub-themes, with students stressing the need for access to technology and the importance of inclusivity in digital learning. Additionally, offering praise and encouragement was seen as vital for maintaining student motivation and fostering a supportive learning environment (Mhd Salim et al., 2019). These sub-themes list the importance of interactive and engaging content, strong communication, well-prepared teachers, and a supportive and inclusive environment. Together, these elements form the foundation of effective digital learning experiences.

Phase 2: Searching And Defining Themes

Table 2 shows themes reflecting the best practices in online learning based on the codes/sub-themes.

Table 2: Themes Reflecting Best Practices in Digital Learning

No.	Codes/Sub-Themes	Themes
1.	Interactive Learning	Engagement and Interaction
	Student Engagement	
	Two-Way Communication	
	Student-Centered Learning	

2.	Digital Tools and Infrastructure Digital Accessibility Technology Integration	Infrastructure and Accessibility
3.	Classroom Management Digital Citizenship and Etiquette	Effective Classroom Management
4.	Teacher Preparedness Creativity in Content Delivery Continuous Feedback and Assessment	Teacher Competency and Creativity
5.	Parental and Administrative Support Motivation and Encouragement	Support Systems
6	Building a Conducive Environment	Positive Learning Environment

Engagement and Interaction is the first theme, which includes ideas like Interactive Learning, Student Engagement, Two-Way Communication, and Student-Centered Learning. This theme highlights the importance of keeping students actively involved in their learning. Students stressed the need for content that is engaging and interactive, making it easier for them to stay focused and interested (Mhd Salim et al., 2019). Two-way communication between students and teachers is also crucial, as it allows for better understanding and support. Focusing on student-centered learning means tailoring the learning experience to meet the individual needs and preferences of each student (Mhd Salim et al., 2022). The second theme, Infrastructure and Accessibility, emphasizes the importance of having the right digital tools and technology in place. This theme includes ideas like Digital Tools and Infrastructure, Digital Accessibility, and Technology Integration. Students noted that having reliable internet and the right digital tools is essential for effective learning (Tang, 2024). Moreover, integrating technology into teaching is not just about having the tools but also about using them effectively to enhance learning for all students, ensuring that everyone has access to the resources they need.

Effective Classroom Management is another important theme. This theme includes Classroom Management, Digital Citizenship, and Etiquette. Managing a digital classroom involves setting clear rules and procedures to keep students focused and on track. Teaching proper online behavior is also essential to creating a respectful and productive learning environment where students know how to interact appropriately in a digital setting (Fajri et al., 2022). The theme of Teacher Competency and Creativity focuses on the role of teachers in digital learning. This theme includes Teacher Preparedness, Creativity in Content Delivery, and Continuous Feedback and Assessment. It highlights the need for teachers to be well-prepared and continuously improve their teaching methods to meet the demands of digital education. Being creative in how they present content is important for keeping students engaged. Regular feedback and assessment help track student progress and ensure that learning goals are being met (Kupriyanov et al., 2021).

Support Systems is another theme that emerged, covering Parental and Administrative Support and Motivation and Encouragement. This theme stresses the importance of support from both parents and school administrations in making digital learning successful. Encouragement from teachers and parents is vital for keeping students motivated, especially in an online learning

environment where it can be easy to feel disconnected (Mhd Salim et al., 2023). Finally, the theme of a Positive Learning Environment includes ideas related to Building a Conducive Environment. This theme emphasizes the need to create a supportive and well-organized environment where students feel comfortable and ready to learn. Whether online or in person, a positive learning environment is essential for helping students succeed.

Phase 3: Reporting The Outcome/Strategies

Table 3 shows the explanation for every theme.

Table 3: Themes Description

No.	Themes	Description
1.	Engagement and Interaction	The focus is on ensuring that students are actively participating in the learning process. Interactive and student-centered approaches, along with innovative and engaging materials, foster a positive digital learning environment. Two-way communication between students and teachers is also emphasized as critical for keeping students engaged and ensuring they do not feel isolated in a virtual setting.
2.	Infrastructure and Accessibility	Having access to the right digital tools and infrastructure is foundational. This includes providing students and teachers with laptops, tablets, and a stable internet connection. Accessibility also involves making sure that all students, regardless of their location, can participate in digital learning.
3.	Effective Classroom Management	Classroom management in a digital environment involves setting clear rules and procedures to ensure smooth operations. Teachers must also instill proper digital etiquette, teaching students how to interact respectfully and effectively in an online setting.
4.	Teacher Competency and Creativity	Teachers must be well-prepared and continuously improve their skills, particularly in digital learning. Creativity in delivering content and adapting teaching methods to keep students engaged is vital. Regular feedback and assessment help teachers refine their approaches and address students' needs more effectively.
5.	Support Systems	Both parental and administrative support are necessary for creating a positive digital learning environment. The school administration should back teachers, and parents should be engaged in their children's learning process. Providing motivation and encouragement is also important

		for maintaining students' enthusiasm and commitment.
6	Positive Learning Environment	A conducive and relaxed learning environment helps students feel comfortable and open to learning. Continuous improvement of teaching methods ensures that the learning experience remains effective and enjoyable.

Engagement and Interaction are about keeping students actively involved in their learning. This theme shows the importance of using methods that make learning interactive and centered on the students. When students are engaged, they are more likely to stay motivated and participate. In a digital setting, it's easy for students to feel disconnected, so having strong communication between teachers and students is crucial. This helps build a sense of community and makes sure students don't feel alone in their learning journey (Mhd Salim et al., 2022). Infrastructure and Accessibility highlight the need for the right tools and resources to support digital learning. Students and teachers need access to devices like laptops or tablets and a reliable internet connection. Without these, it's hard for anyone to participate in online learning fully (Anuar et al., 2019). This theme also points out the importance of making sure all students, no matter where they live or what their background is, can join in. However, not everyone has the same access to technology, which can create gaps in learning opportunities.

Effective Classroom Management in the digital world involves setting clear rules and guidelines to keep things running smoothly. Teachers need to teach students how to behave properly online, which is just as important as in a physical classroom. Managing a digital classroom can be more difficult because teachers can't be physically present to monitor students (Mhd Salim et al., 2022). Distractions at home and the challenges of keeping students focused online can make this even harder. Teachers have to use digital tools effectively to manage and engage students. Teacher Competency and Creativity focuses on the need for teachers to be well-prepared and continuously improve their skills, especially for online teaching (Väättäjä & Ruokamo, 2021). Teachers need to be creative in how they present content to keep students interested. Traditional methods might not work as well online, so teachers have to adapt (Jia et al., 2022). Regular feedback from students helps teachers understand what's working and what needs to change. However, this can be more challenging online because it's harder to pick up on non-verbal cues and immediate feedback.

Support Systems are essential for making digital learning successful. This theme highlights the role of both parents and school administration in supporting the learning process. Schools need to provide teachers with the resources they need, and parents should be involved in their children's education (Sailin & Mahmor, 2018). However, the level of support can vary, and some parents may not have the time or knowledge to help, and not all schools are equipped to support digital learning fully. This makes it important to ensure that both teachers and students receive the help they need. Finally, a Positive Learning Environment is crucial for helping students feel comfortable and ready to learn. Creating this environment online can be challenging because students and teachers are not in the same physical space, which can make students feel isolated (Mhd Salim et al., 2022). Teachers need to improve their methods to make learning effective and enjoyable continuously. Building a sense of community and ensuring all students feel included and supported are key to maintaining a positive atmosphere online.

In summary, these themes show that while there are many important factors in creating a positive digital learning environment, there are also challenges that need to be addressed. Keeping students engaged, providing the necessary tools, managing classrooms, supporting teachers, involving parents, and creating a positive atmosphere all require ongoing effort and collaboration. The success of digital learning depends on everyone working together to create an environment where students can succeed.

Conclusion

This study identifies several key themes essential for creating a positive digital learning environment, including Engagement and Interaction, Infrastructure and Accessibility, Effective Classroom Management, Teacher Competency and Creativity, Support Systems, and a Positive Learning Environment. These elements form the foundation for successful digital learning strategies. Yet, significant challenges remain, such as unequal access to technology, the need for ongoing teacher development, and varying levels of support from parents and school administrations. Addressing these challenges is crucial to ensure that digital learning environments are inclusive and effective for all students. Future research should focus on conducting longitudinal studies to assess the long-term impact of digital learning, comparative studies between urban and rural schools to address disparities and exploring effective models for teacher training in digital pedagogy. Additionally, examining the implementation of student-centered learning approaches and the role of parents and communities in supporting digital education could provide deeper insights. As technology evolves, investigating the integration of emerging technologies like artificial intelligence and virtual reality into digital learning environments is also essential to enhance personalization and the overall learning experience. By focusing on these areas, future studies can contribute to the continuous improvement of digital learning environments, ensuring they are adaptable, inclusive, and capable of meeting the diverse educational needs of all students. The commitment of educators, administrators, parents, and policymakers to addressing these issues will be crucial in building a strong, equitable digital learning landscape that supports every learner's success. This collaborative effort will be fundamental in overcoming the existing challenges and ensuring that digital education is accessible, effective, and sustainable in the long term.

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