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Integration of Digital Technology in Learning as A Strategy to Strengthen Student Learning Independence

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Abstract

The development of digital technology has significantly changed the educational landscape and presented new opportunities to strengthen students' learning independence. This article examines the integration of digital technology including Learning Management System (LMS), Massive Open Online Courses (MOOC), artificial intelligence (AI), and collaborative platforms as a strategy to strengthen independent learning and self-regulation. The study uses a descriptive quantitative approach based on a literature review from Scopus indexed journal articles in the period 2022–2025. The search process is carried out through Boolean queries that are relevant to the themes of technology, independence, digital education, and integration, then selected using PRISMA guidelines. Of the 146 articles identified at the initial stage, the application of inclusion criteria (empirical articles, published in journals, relevant to the topic) resulted in 8 articles that were further analyzed. The results of the synthesis show that the integration of digital technology is positively correlated with improved academic performance, motivation, and learning engagement. AI-based technologies, such as chatbots and intelligent tutoring systems, contribute through real-time feedback, adaptive learning paths, and learning personalization that strengthen students' self-regulation skills (planning, monitoring, and reflection). However, the implementation of technology still faces challenges in the form of inequality of access, infrastructure readiness, and educators' digital competence in designing learning that is in line with pedagogical goals. In addition, there is a risk of over-reliance on technology, especially AI, which has the potential to lower deep cognitive engagement and inhibit critical thinking if not accompanied by proper instructional guidance. Therefore, the integration of digital technology needs to be placed as a scaffolding that supports learning autonomy, while at the same time being balanced by strengthening digital literacy, mature instructional design, and developing educator competencies so that the benefits of digital transformation can be optimal and sustainable.

Keywords: Digital Technology, Learning Independence, Artificial Intelligence, Adaptive Learning, Self-Regulation

Introduction Section

The development of digital technology in the past decade has drastically changed the global education landscape. A systematic analysis of 121 articles in the field of self-learning shows that the use of various technologies such as Learning Management Systems (LMS), Massive Open Online Courses (MOOCs), artificial intelligence (AI), and collaborative platforms contributes significantly to improving academic performance, motivation, and student learning engagement in the digital era (Faza & Lestari, 2025). Another review of 77 studies found that AI-based tools such as intelligent tutoring systems, chatbots, and conversation agents consistently support self-paced learning by providing real-time feedback, adaptive learning paths, and learning personalization support(Del Rosario Navas Bonilla et al., 2025). At the policy level, studies on the transformation of higher education confirm that almost all lecturers in many countries have made substantial progress in integrating digital technology to expand access to information and cooperative learning opportunities for students(Alenezi et al., 2023). Quantitative data in the context of Islamic education show an average high level of learning independence, especially in the ability to access materials independently and utilize digital resources, as well as indicate limitations in digital competence and dependence on lecturers for the use of digital resources (Faza & Lestari, 2025), (Ramdhani & Hakiman, 2025).

Studies of lecturers/affiliates of Islamic Religious Education at the University of Muhammadiyah Surakarta show that the integration of digital technology in PAI learning is no longer just *"move classes online",* But reshaping student learning patterns from the original highly dependent on teachers to more active, collaborative, and responsible learners for the learning process. In the context of madrasahs, Mizan studies**,** Misbahul, & Inayati (2025) affirm that Google Workspace for Education can be contextualized to support interactive and collaborative PAI learning, while providing a foundation for how technology *practices that were originally designed for general education can be adapted to Islamic learning environments. With the support of features such as Classroom, Meet, Docs, Forms, and Chat, this ecosystem allows teachers to manage materials, assignments, communication, and monitoring learning progress in a more structured manner. Within the framework of learning independence, this kind of digital structure can act as a *scaffolding* which helps students build the habit of planning their studies, completing assignments on time, and developing personal accountability for their learning outcomes. Furthermore, Google Workspace integration is also relevant to be understood as a strengthening strategy *self-regulated learning* through learning that combines access to materials, activities, and feedback in a single workflow. In practice, when materials are accessible before classes and assignments are managed through the platform, students are encouraged to prepare themselves early and set their learning rhythm. However, the same article also emphasizes that the implementation of technology is heavily influenced by ecosystem readiness factors: training, organizational support, and especially connectivity. One of the real obstacles noted is the instability of the internet that interferes with access and learning interaction. These findings are important to put in the introduction, because they show that strengthening learning independence through technology is not a matter of "what platform is used", but rather

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how learning design and learning environment readiness allow students to truly practice independent learning consistently (Mizan et al., 2025).

In addition to strengthening through the productivity ecosystem (Workspace), digital media innovation based on *Game* also shown its relevance in PAI. The article Nadifa & Inayati (2025) emphasizes that the integration of educational games in PAI learning significantly increases learning motivation, strengthens understanding of religious concepts, and fosters critical thinking skills through interactive and engaging activities. From the point of view of learning independence, motivation and *Commitment* is an important entrance, students who are interested and feel challenged tend to be more ready to take the initiative to learn, retry the material, and reflect on mistakes without always having to *"Withdrawn"* by the teacher's instructions. In fact, this article also emphasizes the logic of the digital age that digital-based systems allow individuals to operate more independently; The implication is that PAI learning needs to prepare students to be able to direct themselves responsibly in the digital space. Thus, digital game media can be positioned not as entertainment, but as a design of learning experiences that spark *agency* (initiative), perseverance, and independent learning habits (Nadifa & Inayati, 2025).

However, strengthening learning independence is not enough if it only relies on access and media, what aspects of evaluation are assessed, how they are assessed, and what values are instilled need to be emphasized from the beginning. An article in the Ainara Journal (2025) emphasizes that the evaluation of Islamic Religious Education (PAI) must be holistic in nature, including cognitive, affective, and psychomotor domains that are integrated with the values of the Qur'an as the foundation for character formation. This article also emphasizes the need for teachers to use operational verbs to formulate evaluations at different skill levels, referring to the work of Aly & Nurul Latifatul Inayati (2019). Interestingly, the article provides a concrete example that evaluation innovations can be developed, for example through the use of technology for religious creative activities such as digital calligraphy or other interactive formats that enrich the psychomotor-creative realm of students. This strengthens the argument that the integration of digital technology can be directed as a strategy to strengthen learning independence that remains based on the goal of Islamic Religious Education (PAI) not only the achievement of knowledge, but also the internalization of religious values and practices (Abid et al., 2025).

Based on these three findings, the integration of digital technology in learning can be understood as a strategy to strengthen student learning independence through three interlocking paths: (1) productivity/collaboration platforms (e.g. Google Workspace) that build structure, access, communication, and progress monitoring; (2) game-based interactive media that increases motivation, participation, and courage to learn independently; and (3) holistic and valuable PAI evaluation so that learning independence does not shift to just *"quickly completing tasks",* but develops as the ability to manage oneself, think critically, and be spiritual-social responsible. With this framework, the integration of digital technology is most appropriately placed as a pedagogical *scaffolding*: helping students set goals, strategies, monitoring, and reflection on learning, while maintaining the orientation of Islamic education on the formation of knowledgeable and moral people.

Digitization of education not only moves conventional learning practices to the online realm, but also reconceptualizes the way students access, process, and produce knowledge. The integration of information and communication technology (ICT) makes digital learning a key pillar of 21st century education, with the aim of increasing accessibility, engagement, and personalization of the learning process (Haleem et al., 2022). Various technologies ranging from online learning platforms, educational applications, to virtual reality (VR) and interoperability standards such as Learning Tools Interoperability (LTI) enable more dynamic, adaptive, and resource-rich learning(Haleem et al., 2022). In a variety of disciplinary contexts, digital learning environments have been shown to facilitate the understanding of complex concepts, provide instant feedback, and support continuous monitoring of learning progress(Kumari, 2025). However, a number of studies emphasize that this potential is only optimal when accompanied by mature instructional design, infrastructure readiness, and improved digital competence of educators(Haleem et al., 2022), (Viberg et al., 2020), (Kumari, 2025). On the other hand, the demand for self-directed/learner autonomy is getting stronger as a key competency in the midst of a complex and unpredictable world. Learning independence is understood as the ability of students to set goals, choose strategies, monitor, and evaluate the learning process actively and responsibly(Faza & Lestari, 2025). The literature shows that in the context of higher education, the shift from a teacher-centered approach to a student-centered approach places learning autonomy as a prerequisite for academic success and lifelong learning(Mynbayeva et al., 2025). A review of independent learning in children in formal education confirms that this competency needs to be developed from an early age, considering that there are still few empirical studies that examine the facilitation of self-directed learning at the elementary school level in the digital ecosystem(Parsel & Uzunboylu, 2025). In various contexts, the integration of digital technologies including AI, online platforms, and learning analytics tools is associated with strengthening self-regulation, time management, self-reflection, and independent problem-solving skills(Faza & Lestari, 2025), (Mynbayeva et al., 2025), (Parsel & Uzunboylu, 2025).

However, research also shows that there is a gap between the theoretical potential of digital technology and the reality of practice in the classroom. In the realm of children's education, many students do not have the competence to use digital technology effectively for learning purposes, so they still need teacher support, especially in the stages of planning, monitoring, and reflection learning (Morris & Rohs, 2021). Studies in primary schools found that technology-assisted self-learning skills increased as grades increased; For example, fifth-graders show higher technology-based self-learning competencies than fourth-graders, signaling the importance of curriculum design that gradually strengthens learning autonomy. In mathematics learning in secondary school, the main obstacle to technology integration is not only the technical aspect, but also the weak social practices related to the use of digital tools; When teachers do not develop structured and integrated technology practices with the curriculum, students experience confusion and view technology as competing "two sources", rather than as an integrated support for the learning process(Cirneanu & Moldoveanu, 2024).

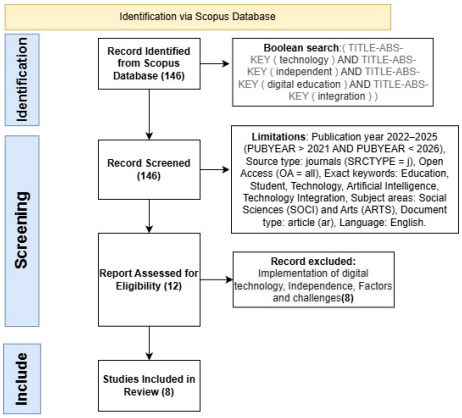
Systematic reviews confirm that digital technologies have strong potential to support self-directed learning by providing a flexible, resource-rich, and feedback-oriented environment, but this success depends heavily on students' ability to manage distractions, overcome information overload, and develop self-regulation skills (Del Rosario Navas Bonilla et al., 2025). Additional challenges include technology access gaps, connectivity issues, resistance to change, as well as a lack of training for educators in designing learning that is truly centered on developing learning independence(Mexhuani, 2024). Thus, the integration of digital technology in learning cannot be understood simply as the provision of tools and platforms, but as a pedagogical strategy that is consciously directed to strengthen students' learning autonomy through the support of structure, scaffolding, and assignment design that encourages initiative taking and independent reflection(Faza & Lestari, 2025), (Del Rosario Navas Bonilla et al., 2025), (Mexhuani, 2024).

Based on these conditions, it is important to conduct a more focused study on how the integration of digital technology in learning can be used strategically as an effort to strengthen students' learning independence. Studies have shown a positive correlation between the use of digital learning resources, tasks designed to encourage independence, as well as the facilitative role of teachers with increased student autonomy in various educational contexts(Ribahan & Muslimin, 2025). However, there are still limitations in a systematic understanding of what models of technology integration are most effective, at which levels of education interventions are most crucial, and what forms of pedagogical support students most need to transition from dependence on teachers to independent learners. Therefore, this article raises the theme *"Integration of Digital Technology in Learning as a Strategy to Strengthen Student Learning Independence"* as an effort to elaborate the conceptual and empirical relationship between digital technology and learning independence, as well as identify practical implications for learning design in the era of digital transformation (Ribahan & Muslimin, 2025).

Research Methodology

This study uses a descriptive quantitative approach by relying on articles published in the Scopus database to investigate the theme of technology in digital education and technology integration. The article selection process begins with a literature search conducted using the following Boolean queries: (TITLE ABS-KEY (technology) AND TITLE-ABS-KEY (independent) AND TITLE-ABS KEY (digital education) AND TITLE-ABS KEY (integration)) AND PUBYEAR > 2021 AND PUBYEAR < 2026 AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ARTS")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (EXACTKEYWORD , "Education") OR LIMIT TO (EXACTKEYWORD , "Student") OR LIMIT-TO (EXACTKEYWORD , "Technology") OR LIMIT-TO (EXACTKEYWORD , "Artificial Intelligence") OR LIMIT-TO (EXACTKEYWORD , "Technology Integration")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))

Table 1. PRISMA Diagram



From the initial search, 146 articles were found, which were then filtered with strict inclusion criteria, including selecting only empirical research articles published in journals. After applying this criterion, the number of articles remaining is reduced to 12 articles. In the next stage, the selected articles go through a follow-up screening process to ensure their suitability with specific topics regarding the integration of technology in digital education. As a result, only 8 articles were truly relevant to the topic discussed.

The entire selection and selection process of this article follows the guidelines of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which are used to ensure quality and transparency in article selection. Using PRISMA, the PRISMA flowchart is compiled to illustrate the stages of article selection from the initial search to the selected article for further analysis. In this diagram, the steps include article identification, screening, meeting inclusion criteria, and articles that are finally included for analysis, with a total of 8 relevant articles.

After the selected articles, an analysis was conducted to explore key findings related to the application of technology in digital education. The main focus of this analysis is to understand the impact of the use of technology on learning, education policies, and the challenges and opportunities faced by educational institutions in integrating technology. With this approach, the research is expected to contribute to the development of education policies in the future, as well as provide deeper insights into the integration of technology in the context of digital education.

Table 2. Number Of Publication

Country	Number of Publications
Brazil & United States	1
Hungary	1
Taiwan	1
Nigeria	1
Spain (European multi-country project)	1

Jordan (with international affiliations)	1
Israel	1
China	1

Results and Discussion

Table 3. Inclusions

Authors	*Title*	*Year*	*Journal*	*Country*	*Author Affiliation*	*Subject or Educational Level*
Wallace Entringer Bottacin; Thais Teles de Souza; Ana Carolina Melchiors; Walleri Christini Torelli Travel	*Preparing Pharmacists for the Digital Age: How Pharmacy Courses are Adapting to Challenges and Opportunities*	*2024*	*American Journal of Pharmaceuti cal Education*	*Brazil & United States*	*Federal University of Paraná; Federal University of Paraíba*	*Higher Education (Undergraduate & Professional Pharmacy Education)*
Dora Horváth	*Curtain Call for AI: Transforming Theatre Through Technology*	*2025*	*Sustainable Futures*	*Hungary*	*Corvinus University of Budapest*	*Higher Education & Professional Practice (Cultural and Creative Industries)*
Li-Wen Huang; New Hsing-Yu	*Bridging the Gap: A Technology-Assisted Communicative Approach to Developing English and Workplace Competencies in Aeronautical Engineering Students*	*2025*	*Educational Process: International Journal*	*Taiwan*	*Language Center, Chaoyang University of Technology, Taichung, Taiwan*	*Higher Education (Undergraduate – Aeronautical Engineering Students)*
Hannah Bosede Bankole; Musa Adekunle Ayanwale	*Digital Assessments Boost Science Attitudes and Sustainable Education*	*2025*	*Discover Sustainabilit y*	*Nigeria*	*Department of Mathematics, Science and Technology Education, Faculty of Education, University of Johannesburg, South Africa*	*Secondary Education (Junior Secondary School – Basic Science)*
Ana Pérez-Escoda; Manuel Carabias-Herrero	*Practices and Awareness of Disinformation for a Sustainable Education in European Secondary Education*	*2025*	*Sustainabilit y (MDPI)*	*Spain (European multi-country project)*	*University Francisco de Vitoria (Faculty of Communication Sciences); University Nebrija (Faculty of Education)*	*Secondary Education (Students aged 12–17 and Secondary School Teachers)*
Omar Ali Al-Smadi; Radzuwan Ab Rashid; Raed Awad Al-Ramahi; Marwan Harb Alqaryouti;	*Jordanian English Language Learners' Engagement with AI-Supported Self-Regulated Learning*	*2025*	*Research in Learning Technology (Association for Learning Technology)*	*Jordan (with international affiliations: Malaysia, Uzbekistan)*	*Universiti Sains Malaysia; Sultan Zainal Abidin University; Applied Science Private University (Jordan);*	*Higher Education (Undergraduate University Students – English Language Majors)*

Holmatov Shakhriyor Zokhidjon Ugli; Abdurakhmon Norinboev Vokhidovich					*University of Jordan; Zarqa University; Fergana State University; Tashkent State University of Economics*	
Roman Yavich	*Will the Use of AI Undermine Students' Independent Thinking?*	*2025*	*Education Sciences (MDPI)*	*Israel*	*Department of Mathematics, Ariel University, Ariel, Israel*	*Higher Education (Undergraduate & Graduate University Students)*
Yunhui Li	*Research on the Development of Environmental Design Education Based on Digital Media Technology*	*2025*	*International Journal of Web-Based Learning and Teaching Technologies (IGI Global)*	*China*	*Shijiazhuang College of Applied Technology, China*	*Higher Education (Undergraduate, Vocational, and Postgraduate Environmental Design Students)*

Trends and Gaps in the Use of Digital Technology

Trends and gaps in the use of digital technology can be seen from various sectors, including education, health, and the creative industries. Various studies have shown that although the use of digital technology is growing rapidly, there is a significant gap in its adoption and application in various fields of education.

In the education sector, Huang and Hou (2025) revealed that the use of technology in English language teaching and work competencies among aviation engineering students has proven to be effective. The program they developed, which integrates technology through interactive activities such as role-playing and problem-solving, has succeeded in improving English language skills and work skills such as communication, teamwork, and problem-solving among students. These findings confirm that technology, when applied in innovative ways, can narrow gaps in academic achievement and practical skills, particularly for lower-performing students (Li-Wen & Yu Hou, 2025). In the creative industries, especially theater, Horvath (2025) explores the application of artificial intelligence (AI) in this sector. The study found that the application of AI in theater is more prevalent in operational areas such as marketing and audience management, with some experiments in independent theaters using AI to support artistic creation. Despite the use of AI in this sector, there are still huge differences in how AI is accepted and applied. This shows that while AI has the potential to transform the creative industry, its adoption has not been evenly distributed and is still influenced by factors such as the size of theaters and their orientation towards technological experimentation (Horváth, 2025).

Bankole and Ayanwale (2025) highlight how technology-based assessments can improve students' attitudes towards science in Nigeria. They found that the use of technology-enabled assessment tools, particularly those that provide feedback and remediation, can increase students' positive attitudes towards science, regardless of their socio-economic background. These results show that technology can play an important role in creating a more inclusive education system and supporting educational sustainability by providing equal opportunities for all students to thrive (Bankole & Ayanwale, 2025).

Artificial intelligence (AI) technology has also begun to be applied in education to support the development of students' independent thinking. According to Yavich (2025), AI tools such as ChatGPT and adaptive learning platforms offer personalized learning experiences and adaptive feedback, which can support the development of critical thinking if used wisely. Nonetheless, there are concerns that have arisen regarding over-reliance on these tools. Over-reliance on AI can reduce students' cognitive engagement, make them less engaged in in-depth analysis, and reduce their ability to think independently and reflectively. This shows that while AI has great potential to enrich the learning experience, it is important to ensure that it does not replace the critical thinking that students are supposed to develop (Yavich, 2025).

The integration of digital technology in education has also increased awareness of disinformation, a major challenge in today's information age. In a study by Pérez-Escoda and Carabias-Herrero (2025), it was found that the increased use of digital tools in the classroom has encouraged the importance of media literacy and awareness of the dangers of disinformation, especially among adolescents. Disinformation spread through social media has become a profound global problem, and the ability to critically evaluate information has become a much-needed skill. However, the study also reveals a digital divide between students and teachers in terms of their readiness to handle disinformation. Many teachers do not have adequate training to help students understand and respond to disinformation effectively. This shows that while digital tools have great potential to raise awareness about

disinformation, better training for teachers and students is needed to ensure more sustainable education and responsiveness to these challenges (Pérez-Escoda & Carabias-Herrero, 2025).

Based on the data in the inclusion table, it can be interpreted that research on the transformation of media and teaching resources in digital learning shows increasingly significant developments, especially in the period 2024–2025. The dominance of publications in those years indicates an increasing academic attention to the integration of digital technology in education, both at the higher education level and in professional contexts. This reflects the response of the education world to the demands of the digital age that emphasizes flexibility, personalization, and the use of data-based technology and artificial intelligence.

Thethematically, the researches analyzed show a variety of forms of learning media transformation, ranging from the use of artificial intelligence (AI) in arts and theater education, the development of digital teaching materials for professional education such as pharmacy, to the use of digital-assisted communication technology in language learning and the field of aeronautics. This shows that the transformation of teaching media is not limited to one specific discipline, but extends to various scientific fields with different characteristics and pedagogical needs. In terms of geographical context, countries such as Brazil, Hungary, Taiwan, and China were recorded to actively contribute to this study. These countries place digital technology as a strategic means to bridge learning gaps, improve professional competencies, and adapt education to global social and technological changes. This cross-border contribution confirms that the transformation of media and teaching resources is a global phenomenon, not just an educational agenda in a particular country. Viewed from the pedagogical aspect, most of the research emphasizes a shift from conventional learning approaches to a more interactive, collaborative, and learner-centered model. Technology not only serves as a material delivery tool, but also as a medium to build a learning experience that is contextual, reflective, and adaptive to individual needs. This approach is clearly seen in the use of AI, digital communication technology, and creative media that encourage active participation and a deeper meaning of learning.

Overall, the data in the inclusion table shows that there is a multidimensional trend of digital learning transformation, including technological innovations, changes in pedagogical strategies, and expanding the context of implementation in various fields of education. The transformation of media and teaching resources is no longer positioned as a complement to learning, but rather as a core element in modern learning design. These findings confirm that the development of digital learning in the future will increasingly demand the integration of technology that is in line with pedagogical goals and the needs of students, while opening up opportunities for sustainable innovation in the world of global education.

The Role of Digital Technology in Strengthening Students' Learning Independence

The role of digital technology in strengthening student learning independence is increasingly clearly seen in various fields of education. The use of technology not only makes it easier to access information, but also gives students more control over their learning process, allowing them to learn more independently and reflectively. One concrete example of the role of technology in strengthening learning independence is the application of technology in digital assessments (Technology-Enabled Assessments (TEAs) applied in science education. Research conducted by Bankole and Ayanwale (2025) shows that technology that provides instant feedback and remediation allows students to learn independently by monitoring their own progress. With TEAs, students can learn through more interactive and reflective assessments, which support them to think critically and address their mistakes without having to rely entirely on instructors. This encourages the creation of independent learning, as students have direct access to learning materials that suit their needs and can tailor their own learning based on the feedback provided (Bankole & Ayanwale, 2025). The development of digital technology also has an important role in strengthening students' learning independence in Islamic Religious Education (PAI) learning. Through the use of digital media, students can access PAI materials more flexibly, learn at their own pace, and develop independent learning responsibilities and initiatives.

Technology-based approaches to language learning, such as those implemented in the "Fun Language Club" program supported by Huang and Hou (2025), also play an important role in developing learning independence. The program integrates digital learning tools that allow students to practice English independently through a variety of interactive and collaborative activities. With digital tools, students can improve their communication skills outside of formal lesson hours and learn more independently in a more natural context and in accordance with their real-world needs. This not only improves students' language skills, but also fosters their independence in learning English and communicating with others (Li-Wen & Yu Hou, 2025). In the field of creative industries, the use of artificial intelligence (AI) also shows how technology can support the independence of creative thinking. In a study by Horvath (2025), it was found that AI is beginning to be applied in various aspects of theater, from scripting to audience management. Although the focus is on performing arts, these AI applications provide opportunities for individuals to develop their creative ideas independently, explore their own potential, and create more innovative works. It shows how technology is not only changing the way we learn, but also enabling professionals in different fields to explore and develop their abilities independently (Horváth, 2025).

The role of digital technology in strengthening student learning independence is increasingly clearly seen in various fields of education. In the midst of rapid technological advancements, many education systems have begun to integrate digital tools to support a more independent and effective learning process. However, the application of

this technology also poses challenges, especially related to its impact on students' critical thinking and independence. One important example comes from a study conducted by Yavich (2025), which highlights the role of artificial intelligence (AI) in education. While AI offers opportunities to enhance learning by providing personalized feedback and supporting analytical tasks, there are concerns that over-reliance on AI can reduce students' critical thinking. Yavich notes that if AI is overused without proper supervision, students may become overly dependent on the tool, which can reduce thinking independence and deep cognitive engagement. Therefore, the integration of AI must be accompanied by a pedagogical approach that supports the development of students' critical thinking skills and independence, not just as a tool that replaces the intellectual role of humans (Yavich, 2025).

On the other hand, digital technology can also increase media literacy and awareness of disinformation, which in turn can strengthen students' learning independence. Pérez-Escoda and Carabias-Herrero (2025) in their research show that the integration of digital technology can help students become more critical of the information they encounter, especially in the face of the ever-expanding challenge of disinformation. By providing digital tools that can help students evaluate and verify information, this technology can empower them to learn more independently and responsibly. However, the study also warns that without adequate guidance, excessive use of digital tools can lead to students engaging only superficially, without deep reflection on the information they consume. Therefore, a self-regulated learning (SRL) approach that is integrated with technology must be accompanied by teaching that emphasizes critical thinking skills (Pérez-Escoda & Carabias-Herrero, 2025).

In the context of education, Li (2025) highlighted how digital media technologies such as virtual reality (VR) and AI-generated content (AIGC) can improve students' abilities in spatial cognition and technology integration. The use of this technology allows students to learn independently by experiencing design in a highly immersive environment, which not only enhances their understanding of design principles but also gives them complete control over when and how they learn. With VR, for example, students can practice and experiment with a variety of space designs without being constrained by time or physical space, thus supporting greater learning independence. This technology combines creativity and innovation that allows students to develop critical thinking independently in a more practical context and connect with the needs of the design industry today (Li, 2025).

Factors Influencing the Success of Digital Technology Integration

The successful integration of digital technology in education and other sectors is influenced by various interrelated factors. While technology can provide many benefits, challenges related to access, training, and adoption of technology remain an important factor in determining how effectively it is accepted and utilized in various fields. In the context of science education, research by Bankole and Ayanwale (2025) highlights how *Technology-Enabled Assessment Packages (TEAPs)* can improve students' attitudes towards science learning. The success of this technology integration is highly dependent on access to compatible technology offline, which facilitates the implementation of learning despite the limitations of infrastructure. In addition, adequate teacher training and policy support play a role in ensuring that technology can be used effectively to bridge educational gaps, especially in resource-constrained environments. The study also showed that students' socio-economic backgrounds did not affect their engagement with technology, reflecting the inclusivity potential of using technology-based assessments to improve student learning outcomes (Bankole & Ayanwale, 2025).

Teaching English among aviation engineering students, research by Huang and Hou (2025) shows how the "Fun Language Club" program supported by digital learning tools can narrow the language ability gap between students with different skill levels. The success of the program depends on student motivation, engagement with technology, and a student-centered approach to learning. Technology plays an important role in providing opportunities for students to learn independently, while support from international teaching provides the added benefit of improving students' communication skills and cultural awareness. This shows that interactivity and adaptation of the curriculum to the needs of the professional world are essential in ensuring the successful integration of technology in learning (Li-Wen & Yu Hou, 2025).

In the field of pharmacy education, the research of Bottacina et al. (2024) highlights significant differences between the curriculum in the United States and Brazil related to the integration of health informatics in pharmacy education. The success of the program in the United States is largely influenced by the flexibility of the curriculum and the emphasis on digital health, which allows students to obtain a more targeted education according to the needs of the industry. In contrast, in Brazil, a curriculum that is less integrated with pharmaceutical practices and limited access to health informatics courses is a major challenge in preparing students to face the demands of the digital world of work. This research shows that the success of technology integration is highly dependent on curriculum changes that can respond to digital advances as well as cooperation between academics and industry professionals to ensure the relevance of education to the evolving needs of professionals (Entringer Bottacin et al., 2024).

The performing arts sector, particularly theatre, Horvath (2025) found that the adoption of artificial intelligence (AI) in theatre, both in the operational and artistic sectors, is strongly influenced by bottom-up approaches and collaboration between creative professionals. The success of AI adoption is more visible in independent theater and contemporary productions that are more open to technological experimentation. While AI can improve efficiency in audience management, marketing, and ticket sales, there are concerns that over-reliance on technology could reduce

human creativity in the artistic process. Therefore, successful AI integration requires a balance between technological innovation and the value of human art, as well as transparent education and policies to ensure the responsible application of AI in the creative industries (Horváth, 2025).

The success of digital technology integration in education is greatly influenced by various interrelated factors. While digital technology offers a lot of potential to improve the quality of learning, its implementation is not always seamless. Based on several studies that have been analyzed, several key factors can influence the success of the use of digital technology in education, especially in the context of student-focused learning. One of the main factors that determine the success of technology integration is the competence and skills of teachers. In a study conducted by Li (2025), it was found that teachers who have expertise and a deep understanding of the use of technology, such as virtual reality (VR) and AI-generated content (AIGC), can more effectively direct students to make optimal use of these technologies. In addition, pedagogical guidance provided by teachers is essential to ensure that technology is used as a tool that enriches students' creativity, not as a substitute for students' roles in innovating and thinking critically. The success of technology integration also depends heavily on the use value of the technology itself, which must be felt by students so that they are more motivated to use it (Li, 2025).

On the other hand, in the Yavich study (2025), the right pedagogical strategy factors greatly influence how technology can support the development of students' critical thinking. AI should not be considered as a substitute for intellectual processes, but rather as a tool that enriches students' cognitive engagement with learning materials. Therefore, the success of technology integration also depends on the teaching role provided by educators, which must include ongoing mentoring and learning design that supports metacognitive learning. In other words, technology must be integrated in a way that can stimulate students to think more critically and reflectively, not just to save time or make tasks easier (Yavich, 2025).

In the context of language learning, research by Al-Smadi et al. (2025) shows that students' technology skills and their digital literacy play an important role in the successful use of technology. Students who have higher digital competencies are likely to be able to utilize AI tools more effectively in support of their self-regulated learning (SRL). However, the main challenge in the application of this technology is accessibility and inclusivity. Technology that is not accessible to all students or is not sufficiently tailored to individual needs can create gaps in learning outcomes. In addition, social and cultural factors, such as differences in perceptions of technology or language barriers, can also influence how technology is received and used in educational contexts (Al-Smadi et al., 2025).

According to a study presented by Pérez-Escoda and Carabias-Herrero (2025), teachers' perception factors towards technology and students' ability to manage information are key to successfully integrating digital technology in learning. This research reveals that although many students are well technologically literate and aware of the dangers of disinformation, the gap between teachers and students in the understanding and application of digital literacy is still very large. This shows that the success of digital technology in education depends not only on access to technology, but also on the ability of educators to support the development of good digital literacy skills among students. Successful technology integration, especially in the face of challenges such as disinformation, requires a holistic approach, which teaches not only technical skills, but also ethical values and critical literacy to identify and counteract disinformation (Pérez-Escoda & Carabias-Herrero, 2025).

Key Challenges in Digital Technology Implementation

The implementation of digital technology in various education sectors and professional industries presents a number of challenges that need to be overcome so that this technology can provide maximum benefits. Based on the analysis of several studies, the main challenges faced in the integration of digital technologies include infrastructure issues, dependence on technology, accessibility, and the readiness of professionals and educators to use technology effectively.

The main challenges in the use of technology in Islamic Religious Education learning include limited infrastructure, low digital literacy of teachers and students, and gaps in access to technology. In addition, over-reliance on technology has the potential to reduce critical thinking and deepening spiritual values. Therefore, pedagogical assistance is needed so that technology is used wisely and in harmony with the goals of Islamic Religious Education. In the context of science education, a study conducted by Bankole and Ayanwale (2025) shows that one of the biggest challenges in the implementation of Technology-Enabled Assessment Packages (TEAPs) is the lack of infrastructure in many schools, especially in areas with limited resources. Although digital technology has great potential to increase student engagement, many schools do not yet have compatible devices or adequate internet access, especially for the use of offline-compatible tools. In addition, another challenge is the limited training for teachers, who still need assistance in integrating technology with their teaching methods. Unequal access is a problem, especially for students from low-economic backgrounds who struggle to access digital devices at home (Bankole & Ayanwale, 2025).

The use of artificial intelligence (AI) in education, as discussed by Yavich (2025), also brings major challenges related to dependence on technology. While AI can enhance the learning experience through personalized feedback and self-paced learning, there are concerns that students may become overly dependent on these technologies, thereby reducing their independence of thinking. Therefore, the integration of AI in learning requires a balanced pedagogical

framework, where technology is used as a complement, not a substitute, for students' intellectual engagement. This requires careful curriculum planning and training for teachers to use technology wisely without sacrificing students' critical thinking skills (Yavich, 2025).

In the field of research, Al-Smadi et al. (2025) highlight the challenges related to students' digital literacy. Varying technological skills among students lead to a gap in the use of AI tools for self-regulated learning. Some students have higher digital competencies and can easily take advantage of this technology, while others struggle. In addition, the accessibility of technology is another major challenge, with many students lacking device access or stable internet connections, which limits the use of these technologies in their learning. An adaptive feedback system that can adapt to the individual needs of students is also a challenge in the effective application of this technology (Al-Smadi et al., 2025). In the arts industry, particularly theater, Horvath (2025) identifies the main challenges related to resistance to change. Many art practitioners, especially those involved in the creative process, are concerned that the use of AI in scriptwriting or production design could reduce human creativity. AI, while useful in improving operational efficiency and audience management, is considered by some to be a threat to human creative work. In addition, ethical issues related to copyright and potential bias in AI-generated results are also a concern. The lack of legal frameworks and ethical guidelines for the use of AI in the creative industry is an additional obstacle to its effective implementation (Horváth, 2025).

The implementation of digital technology in education presents a number of significant challenges. While technology offers great potential to improve the quality of learning, challenges related to access, educator readiness, and impact on students' critical thinking skills and learning independence need to be considered. Based on the analysis of several studies, here are the main challenges in the integration of digital technology in education. One of the biggest challenges in the application of digital technology, especially in environmental design education, is the lack of adequate infrastructure. Li's (2025) research shows that although digital technologies such as virtual reality (VR) and artificial intelligence (AI) can improve students' learning experiences and creativity, many educational institutions still rely on traditional teaching methods that cannot make optimal use of these technologies. Teachers' unpreparedness in integrating technology is also a big problem, where many teachers are less skilled in using the latest digital tools. In addition, limited access to the necessary devices, especially in areas with low resources, is a major barrier in ensuring that technology can be used equally by all students (Li-Wen & Yu Hou, 2025).

In the context of artificial intelligence (AI)-based education, Yavich's research (2025) reveals another major challenge, namely over-reliance on technology. Although AI offers generalized personalized flips and self-paced learning, there are concerns that students may become overly reliant on these tools to complete their assignments, which reduces critical thinking and deep reflection skills. This highlights the importance of having a balanced pedagogical framework that not only utilizes technology as a tool, but also ensures that students remain engaged in a more critical and independent thinking process. In this regard, a well-designed curriculum and effective training for educators are indispensable so that technology is used wisely and does not reduce the intellectual quality of students (Yavich, 2025).

Another challenge arises in the application of AI in technology-enabled learning among students who focus on self-regulated learning (SRL), as shown by Al-Smadi et al. (2025). Here, the challenge lies in the students' varied digital literacy and technological competencies. Students with higher tech skills tend to be able to make better use of AI, while students who are less skilled in using technology have a hard time. In addition, accessibility to the devices needed to make optimal use of AI is a major barrier. Social and cultural differences also play an important role, with some students perhaps feeling uncomfortable or even rejecting the use of this technology, as they see it as a substitute for more personalized human interaction (Al-Smadi et al., 2025).

Research by Pérez-Escoda and Carabias-Herrero (2025), a greater challenge arises in the context of disinformation, where digital inequalities between teachers and students create barriers in the implementation of technology. While students may be more proficient in using social media and the internet to obtain information, many teachers do not have sufficient training in teaching digital literacy and how to counter disinformation. While technology has the potential to raise awareness of disinformation, the lack of adequate training for educators in dealing with misleading information remains a major problem. This creates a gap in the ability of these two groups to effectively leverage technology to address global challenges such as disinformation (Pérez-Escoda & Carabias-Herrero, 2025).

In the discussion section of this study, the results of systematic literature review of articles that the use of digital technology in various sectors has shown a rapidly growing trend, but on the other hand, the gap in its application is also still very real. Sectors such as education, healthcare, and creative industries, each face different challenges in integrating digital technologies into their practices.

The development of digital technology has brought changes in the learning practices of Islamic Religious Education. The use of technology opens up opportunities to increase the effectiveness of material delivery and students' learning independence. However, the implementation of technology in Islamic Religious Education learning still faces various challenges that need to be studied comprehensively. In the education sector, digital technology plays an important role in learning Islamic Religious Education (PAI) as a means of supporting the delivery of Islamic materials that are more

interactive and easily accessible. The use of digital media helps students learn more independently and reflectively. However, the use of technology needs to be accompanied by teacher guidance and strengthening digital literacy so as not to reduce critical thinking and spiritual values. Thus, technology in PAI learning must be used in a balanced manner and in harmony with the goals of Islamic education.

The use of technology to develop practical skills, as found in the research of Huang and Hou (2025), has been shown to be effective in improving the English language competencies and employability skills of aviation engineering students. Programs that integrate technology through interactive activities, such as role-playing and problem-solving, have been successful in reducing the gap in academic achievement among students, especially those with lower performance. Technology, when applied in an innovative and structured manner, provides greater opportunities for students to improve the practical skills that are so much needed in the world of work. This shows that technology has great potential to narrow the gap in academic achievement and practical skills, provided it is used with the right approach (Li-Wen & Yu Hou, 2025). However, the gap in the use of digital technology is more clearly seen in the health sector, particularly in pharmacy education. Research by Bottacina et al. (2024) reveals that the pharmacy education curriculum in the United States is much more advanced in integrating health informatics compared to Brazil. In the United States, pharmacy programs not only offer more specific health informatics courses, but also integrate pharmaceutical practices with the latest digital developments. On the other hand, Brazil still has limitations in terms of the number of courses and the integration of health informatics with real practice, which hinders pharmacists' readiness to face the challenges of the digital age. These difficulties demonstrate the importance of equitable adoption of technology in the healthcare sector to prepare professionals who are better prepared for the demands of global digitalization (Entringer Bottacin et al., 2024).

The creative industry, especially in the field of theatre, has also experienced significant differences in the application of digital technology. Horvath's research (2025) shows that the use of artificial intelligence (AI) in this sector is more applied to operational aspects, such as marketing and audience management, while the application of AI in artistic creations is still limited. The use of AI in independent theaters is more for artistic experimentation, but this is not evenly distributed across industries, depending on the size and orientation of the theater to the technology. While AI has great potential to transform the creative industry, the application of this technology is still limited and requires more experimentation and openness from industry players (Horváth, 2025). In the context of science education, research by Bankole and Ayanwale (2025) shows that the use of technology in digital-based assessments can increase students' positive attitudes towards science, regardless of their socio-economic background. The use of assessment tools that provide instant feedback and remediation helps students to monitor their own progress, learn from mistakes, and overcome challenges independently. This creates opportunities for students to narrow learning gaps, allowing them to learn more independently and reflectively without being fully dependent on instructors (Bankole & Ayanwale, 2025).

On the other hand, digital technology also introduces new challenges, especially related to students' reliance on AI-based tools. Yavich (2025) notes that while AI provides a personalized learning experience, the overuse of this technology can reduce students' cognitive engagement and inhibit their ability to think critically and independently. Over-reliance on AI has the potential to reduce students' reflective thinking, which should be at the heart of the learning process. Therefore, it is important to balance the use of AI with pedagogical approaches that support the development of students' critical thinking, rather than replace their intellectual processes (Yavich, 2025).

The role of digital technology in strengthening students' learning independence is becoming clearer. With a variety of tools and platforms that support digital learning, students are given more control over their learning process. For example, technology in digital assessments (Technology-Enabled Assessments (TEAs) allows students to learn independently by providing instant feedback that helps them correct mistakes and monitor their progress (Bankole & Ayanwale, 2025). Thus, students can learn according to their own pace and needs, strengthening independence in learning (Bankole & Ayanwale, 2025). Technology-based approaches to language learning, such as those implemented in the "Fun Language Club" program by Huang and Hou (2025), also make a significant contribution to students' learning independence. The program allows students to practice English independently using digital aids. With technology, students can develop their language skills beyond formal lesson hours, providing opportunities for them to improve their communication skills in a more natural context and according to their real-world needs (Li-Wen & Yu Hou, 2025). In the field of pharmacy education, health informatics technology integrated into the curriculum provides students with the opportunity to learn independently and access information relevant to their professional development. Although the main focus of this study is digital health literacy, ultimately, this technology strengthens students' independence in managing their own learning (Bottacina et al., 2024). This confirms how technology can empower students to learn more independently and be ready to face challenges in the world of work (Entringer Bottacin et al., 2024).

However, while technology can strengthen students' learning independence, challenges related to over-reliance on AI-based tools remain. Therefore, it is important to apply technology in education with an approach that emphasizes the development of critical and reflective thinking skills. This also applies in the context of media literacy and awareness of disinformation. According to research by Pérez-Escoda and Carabias-Herrero (2025), digital technology can help students to be more critical of the information they receive. With digital tools that can evaluate and verify information, students are empowered to learn independently, but without adequate guidance, the use of this technology can lead to a superficial understanding of the information they encounter (Pérez-Escoda & Carabias-Herrero, 2025).

The success of digital technology integration in education is greatly influenced by various interrelated factors, such as infrastructure, teacher training, and policies that support the application of technology. Research by Bankole and Ayanwale (2025) shows that the successful implementation of technology-based assessment tools is highly dependent on adequate access to offline-compatible technologies, especially in resource-constrained areas. In addition, ongoing teacher training and policy support are essential to ensure technology is used effectively in educational contexts (Bankole & Ayanwale, 2025). Research conducted by Li (2025) revealed that teachers' competence in using technologies such as VR and AI-generated content (AIGC) greatly affects the effectiveness of using technology in learning. Teachers who have a deeper understanding of the use of technology can be more effective in directing students to take advantage of it, which increases the success of technology integration in education (Li, 2025). While digital technology has great potential to improve the quality of learning, its implementation faces a variety of challenges, including infrastructure issues, accessibility, and over-reliance on technology. Research by Bankole and Ayanwale (2025) shows that in many schools, especially in resource-constrained areas, lack of infrastructure is a major challenge. In addition, reliance on AI is also a major problem, as this can reduce students' independence of thinking and inhibit deeper cognitive engagement. Therefore, a more careful approach is needed in applying technology so that technology can be used as a tool to enrich the learning experience without replacing students' intellectual engagement (Bankole & Ayanwale, 2025).

Conclusion

Advances in digital technology in the field of education have had a considerable impact, especially in encouraging the formation of learning independence in students. Technology no longer only functions as a means of providing information, but also plays a role in providing space for students to manage and direct their learning process more independently. Through the use of various digital devices, such as online learning platforms, technology-based evaluation systems, and artificial intelligence, students have the opportunity to access learning materials according to their needs and abilities. In addition, technology allows for quick feedback, so students can immediately evaluate and improve their understanding. The flexibility of time and speed of learning offered by technology also support differences in learning styles between individuals.

However, the application of digital technology in learning is inseparable from a number of obstacles. One of the problems that arises is the tendency of students to depend on technology, especially in the use of artificial intelligence-based tools. This dependence has the potential to weaken critical thinking skills, because students can get used to completing tasks without going through a process of deep analysis and reflection. Therefore, the use of technology needs to be balanced with a learning strategy that encourages students to continue to think critically, reflectively, and responsibly about their own learning process. In addition, the issue of access and availability of infrastructure is also a serious challenge. Not all educational units have adequate technology facilities or stable internet networks, especially in areas with limited resources. This condition can hinder the optimal use of digital technology by students. The success of the integration of digital technology in education is also highly determined by the readiness of educators. Teachers who have good digital literacy and competence will be better able to integrate technology into the learning process effectively. Thus, training and professional development programs for educators are important aspects that need to be considered so that technology can be used in accordance with pedagogical goals.

In general, digital technology has great potential in supporting the strengthening of student learning independence. However, in order for these benefits to be felt optimally, careful planning and implementation are needed by considering pedagogical aspects, equal access distribution, and educator readiness. Technology integration should be done wisely, so that technology not only functions as a learning tool, but also as a means to foster students' critical and reflective thinking skills, which ultimately contributes to improving the quality of learning and learning independence.

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