



Digital Education Transformation: A Study of Security, Privacy, And Learning Technology Trend

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Abstract

Technological developments in education have encouraged various educational institutions, from elementary to tertiary levels, to adapt to digital innovations to improve the quality of the learning process. The purpose of this study is to examine the transformation of digital education in the modern world of learning through a literature review. The method used is descriptive qualitative, with data collection techniques utilizing literature reviews related to educational technologies such as Learning Management Systems (LMS), Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), and big data. Data analysis techniques in this study include collecting data, identifying data, decrypting data, and summarizing data. The results of the study indicate that this technology can increase the effectiveness, flexibility, and personalization of learning. However, this transformation also poses challenges in terms of data security and user privacy. Therefore, digital literacy, a strong security system, and the wise use of technology are needed to support optimal digital education.

Keywords: Education, Digital, Transformation, Technology, Security

INTRODUCTION

The development of digital transformation in education has accelerated following the increasing use of information and communication technology in the learning process. Various digital platforms such as Learning Management Systems (LMS), video conferencing, cloud learning, and artificial intelligence-based applications have become crucial in supporting flexible and adaptive learning. The digitalization of education not only changes the way material is delivered but also alters the interaction patterns between educators and students, expanding access to a wider variety of learning resources that are not limited by time and space. In this context, digital transformation in education is not only seen as an educational innovation but also as a system change that requires strong data protection to prevent misuse of user data. This aligns with research showing that digital transformation in education increases data

security risks and demands enhanced protection systems for digital learning platforms (Mulawarman et al., 2026).

Internet security has become a major concern in education with the increasing use of digital learning media. Sensitive data such as student identities, academic grades, and learning activities are stored in online education systems and other digital platforms. If not properly protected, cyberattacks such as hacking, phishing, malware, and data leaks can occur. Thus, these threats demonstrate that the education industry is not immune to the same digital risks as other industries; in some cases, due to the lack of adequate security systems, the sector can become highly vulnerable. Digital learning systems are highly susceptible to a variety of cyberattacks, which can compromise the integrity, confidentiality, and availability of educational data (Hidayat, 2025).

Digital education transformation hinges on data privacy issues in addition to security concerns. Privacy in digital education relates to the protection of students' personal information stored in digital systems; this includes the methods used to collect, store, and access data by third parties and educational institutions. Due to a lack of privacy awareness among digital education users, many do not fully understand the dangers associated with the use of personal data on websites. This is reinforced by research findings showing that users' understanding of personal data management remains low, increasing the likelihood of privacy breaches in digital education systems (Hakim, 2025).

Conversely, new trends in learning technology, such as the use of artificial intelligence (AI), gamification, cloud learning, and personalized learning systems, are further driving the digital education transformation process. This technology offers numerous opportunities to enhance learning effectiveness because it can tailor materials to individual student needs. However, these changes carry the potential for misuse if not balanced with appropriate regulations and security systems, as well as new challenges in increasingly complex data management. According to several studies, although educational technology continues to advance, data security and ethical use remain major issues when using it in various educational institutions (Amin et al., 2025).

While numerous studies have discussed the use of digital technology in education, most research focuses on the technology's effectiveness in improving learning outcomes, learning motivation, and learning quality. Studies that comprehensively integrate discussions on digital education transformation with aspects of data security, user privacy protection, and developments in learning technology trends are still relatively limited. Yet, these three aspects are crucial, interrelated components in supporting the successful implementation of sustainable digital education.

The study of data security and privacy in digital education is becoming increasingly important given the increasing amount of academic data and personal information stored on various digital learning platforms. If not managed properly, the risk of data leaks, misuse of personal information, and cyberattacks can undermine user trust in digital education systems. Therefore, a comprehensive study is needed to understand the development of digital education transformation, the accompanying security and privacy challenges, and the various trends in learning technology. Based on this description, this study aims to analyze digital education transformation through a literature review, focusing on aspects of data security, user privacy

protection, and learning technology trends in an effort to support the creation of a safe, effective, and sustainable education system.

RESEARCH METHODS

This study employed a library research method with a descriptive qualitative approach. A library study is a type of research that collects data from various written sources, such as books, journals, documents, magazines, and other literature available in libraries (Harahap, 2014). The data sources used in this study were secondary data obtained from national and international journal articles, reference books, seminar proceedings, and supporting documents related to digital education transformation. Data collection was conducted through a literature review selected based on the appropriateness of the topic and research objectives.

The analysis technique used in this study is the Miles and Huberman model (as cited in Sugiono, 2016): 1) Data reduction, where the researcher summarizes the main points and focuses on the research topic, adapting them to the research objectives and problems; 2) Data presentation, where the data is presented in narrative text; 3) Verification, where conclusions are drawn in stages, namely preliminary conclusions and then final conclusions by comparing the suitability of respondents' statements with the meaning contained in the research problem.

RESULTS AND DISCUSSION

Based on a literature review of various journals, the transformation of digital education demonstrates rapid development in modern learning systems. According to Kumar Basak, Wotto, and Bélanger (2018), digital education is part of the development of e-learning and m-learning, which aims to create a flexible learning environment without the constraints of space and time. This aligns with studies showing that the use of Learning Management Systems (LMS), as described by Munir (2010) and Irfandi et al. (2023), has been able to increase learning effectiveness by enabling online interaction, material distribution, and evaluation.

Furthermore, the application of Artificial Intelligence (AI) in education has had a significant impact on personalized learning. According to Raup et al. (2022), AI is a technology capable of mimicking human thinking through machine learning to assist the learning process. This is reinforced by Gunawan and Agustini (2024), who state that AI in education can create adaptive learning systems that adjust materials, methods, and assessments based on student needs. Thus, the concept of personalized learning, also described by Marienko et al. (2020) showed that adaptive technology can increase learning effectiveness because students receive learning experiences tailored to their individual abilities.

Furthermore, technologies such as Virtual Reality (VR) and Augmented Reality (AR) also contribute to improving learning quality. According to Fitria (2023), VR creates an immersive learning environment that allows students to interact in a virtual world, while AR, according to Cahdriyana & Nurnugroho (2023), combines virtual objects with the real world to aid understanding of abstract concepts. Studies show that these technologies can increase student motivation and understanding through more concrete and interactive learning experiences.

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However, on the other hand, digital education transformation also presents significant challenges, particularly in terms of data security and privacy. According to Arfan Dwi Madya et al. (2023), digital education systems are highly vulnerable to threats such as hacking, malware, and data leaks, which can compromise system integrity. This is reinforced by Oktaviani et al. (2023), who emphasize the importance of cryptographic technologies such as AES to protect educational data. Furthermore, Cahyono et al. (2024) add that human factors are also a major cause of weak data security due to low user digital literacy. Beyond security, privacy is also a crucial concern in digital education transformation. According to Andika et al. (2026), the increased use of digital systems in education increases the risk of misuse of students' personal data. This is further supported by Fitri et al. (2025), who state that privacy violations such as data leaks and unauthorized dissemination of information can occur due to weak security systems and low user awareness. Discussions of these various theories demonstrate that digital education transformation is not only related to technological developments but also requires the readiness of human resources to manage them. According to Warsita (2011), learning technology. Aims to increase the effectiveness and efficiency of the learning process through the design and utilization of appropriate learning systems. Therefore, the success of digital education transformation depends heavily on the balance between technology utilization, system security, and user digital literacy in the educational environment.

1. Digital Education Transformation

Digital education is the concept of learning that integrates information and communication technology (ICT) into the entire educational process, including learning interactions, material delivery, and evaluation of learning outcomes. In literature, digital education is often understood as a form of transformation in the education system that utilizes

technology to improve the accessibility, flexibility, and quality of learning. According to Basak, Wotto, and Bélanger (2018), digital education is part of the broader advancement of e-learning and m-learning. Here, technology is used to create learning environments that are not limited by space and time and enable various digital devices for continuous learning (Kumar Basak et al., 2018). With this transformation, students can access a wider range of learning resources through the internet, online learning platforms, and various educational applications that support their learning. Research on blended learning as a supporter of digital education shows that technological advances have transformed learning methods, making them more dynamic and positioning technology as a crucial component of modern education systems. (Arifin et al., 2024), and can meet the needs of a generation growing up amidst the rapid development of information and communication technology (Zohriah et al., 2023) and enable the use of various online devices and platforms that support a more interactive, innovative, and flexible learning process (Dadang and Karep, 2025).

E-learning is one of the rapidly developing digital educational transformations. E-learning is one of the learning innovations that supports the learning process through the use of information and communication technology as the main medium in delivering learning materials and allows students to access various learning resources more easily without being limited by time or space. (Usman, 2019). E-learning is one of the important innovations in contemporary education that helps students learn effectively and efficiently. (Pei Zhao, Sara Sintonen et al., 2015). E-learning can help students gain a more personalized learning experience that suits their needs. In addition, e-learning platforms allow educators to develop more creative learning methods that are in line with technological advances. E-learning is considered one of the learning approaches that can address educational challenges. (Lu et al., 2016). E-learning encourages them to be more active in their own learning process. (Koponen & Nousiainen, 2019).

Blended learning is also a form of digital educational transformation widely applied in the learning process. According to Rohman and Hartanto, blended learning is a learning method that combines face-to-face learning with e-learning to create a more balanced learning experience and align with advances in digital technology. In blended learning, technology is used to complement conventional learning, not to replace it, so students can benefit from both methods. With this learning model, students can access materials, chat, and complete assignments online while still interacting directly with their instructors. Therefore, blended learning is considered to increase learning independence, digital skills, and learning effectiveness in facing educational challenges in the digital era. (Rohman & Anwar Hartanto, 2020)

Artificial intelligence-based learning, also known as AI-based learning, emerged as a result of advances in digital technology. AI-based learning enables a more personalized learning process tailored to students' needs. AI-based systems can customize learning experiences, material recommendations, and feedback using data analysis and automation capabilities. Gunawan and Agustini (2024) state that AI-based learning is a learning method that utilizes artificial intelligence technology to create unique and adaptive learning experiences by tailoring materials, methods, and assessments to meet students' unique needs. (Sutrayasa & Agustini, 2026).

2. Learning Technology

Learning technology is a crucial part of digital education transformation because it supports the learning process through the use of information and communication technology. According to Bambang Warsita, "learning technology" is a term that refers to the theory and practice of designing, developing, utilizing, managing, and evaluating learning processes and resources with the goal of improving the efficiency and effectiveness of learning. This technology utilizes various types of digital media and systems to provide students with broader and more flexible learning options. (Warsita, 2011).

Some technologies widely used in digital education include Learning Management Systems (LMS), Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), and the use of big data in education.

a) Learning Management System (LMS)

A learning management system (LMS) is a digital system or platform used to manage, deliver, document, and facilitate the online learning process. According to Irfandi et al. (2023), an LMS allows teachers and students to interact through the provision of materials, assignments, discussions, and learning evaluations. With an LMS, the learning process becomes more flexible because it can be accessed via the internet anytime and anywhere. (Willem et al., 2023). Meanwhile, according to Munir (2010), a learning management system (LMS) is an information technology-based learning system used to support the teaching and learning process in a more efficient manner. The LMS functions as a medium that enables assignments, communication between teachers and students, and management of learning materials. (Munir, 2010).

b) Artificial Intelligence (AI)

Artificial Intelligence (AI) is a computer-based system that utilizes hardware, software, and machine learning to mimic human intelligence in processing, analyzing, and assisting in decision-making. In education, AI assists teachers in administration, improves personalized learning, and produces a more efficient learning process. (Darwis, 2024). In education, AI is considered capable of accelerating information processing, increasing learning efficiency, and supporting a more modern and effective teaching and learning process. According to Raup et al. (2022), AI is an artificial intelligence technology that has the ability to learn and work like the human brain through systems such as machine learning and deep learning. (Raup et al., 2022).

c) Virtual Reality (VR) & Augmented Reality (AR)

Virtual reality (VR) is a technology that creates an artificial environment in the form of a 3D simulation that allows users to experience an immersive and interactive learning experience. In learning, VR helps students see and experience the virtual world directly, making it easier for them to understand abstract concepts. (Setyawan et al., 2023). Meanwhile, according to research by Fitria (2023), virtual reality (VR) is a technology that creates a fully immersive digital simulation environment where users can interact with virtual objects as if they were in the real world. VR can be used in education as an innovative learning medium that can enhance students' understanding of ideas, increase their motivation to learn, and provide a more realistic and engaging learning experience. (Fitria, 2023). AR is a technology that can combine virtual objects (2D/3D) into a real environment in real time. In education, AR helps students understand abstract concepts through more concrete and interactive

visualizations, which can reduce their cognitive load. (Cahdriyana & Nurnugroho, 2023). Meanwhile, according to Yuss et al (2023), AR is a technology-based learning media that integrates virtual objects into the real world via mobile devices. The use of AR has been proven to increase students' desire to learn and their learning outcomes because conventional learning methods are not as interactive and engaging. (Yusa et al., 2023).

d) Big Data in Education

Big data analytics is a technology that processes massive amounts of data from learning activities, such as student data, academic systems, and e-learning, to generate useful information for decision-making. The results of big data analysis can be used to improve learning, monitor student performance, and help educators develop better strategies to achieve their goals (Siregar and Musawaris, 2023). Meanwhile, according to Yunita et al. (2022), big data in education is defined as the integration of data from various sources, such as digital platforms, academic activities, and educational databases. This data has the characteristics: speed, diversity, value, and veracity. This data is analyzed to help education systems predict student achievement, identify learning challenges, and support data-driven decision-making (Yunita et al., 2022).

3. Data Security (Cybersecurity)

Data security in educational information systems is an effort to prevent cyber threats, which are increasing with the advancement of digital technology, according to Madya et al. (2023). Malware, hacking, and data theft are some of the threats that can disrupt the learning process. According to this study, for educational institutions to maintain the confidentiality and integrity of their data, they must implement robust security systems, such as data encryption, the use of firewalls, and multi-layered security systems. Therefore, data security is not only a technical necessity but also a crucial part of maintaining a safe and reliable digital education system. (Arfan Dwi Madya et al., 2023). According to Cahyono et al. (2024), the security of digital education data depends on the human users of the system and technology. Users are not well-versed in technology, which leads to many cases of phishing, data leaks, and account theft. This study emphasizes that teachers and students must be educated to understand cyber threats, use strong passwords, and avoid malicious links. Therefore, data security must be built on robust technological systems and high user awareness to effectively minimize cyberattacks in educational institutions. (Cahyono et al., 2024).

According to Ujung & Nasution (2023), databases are central to data security because they serve as storage for critical data in the education system. Academic data, which is highly sensitive, is stored in databases and must be properly safeguarded. According to this study, database security is a crucial component in maintaining the stability and reliability of digital education information systems, as it includes preventing unauthorized access, managing user access rights, and using encryption to protect data. Furthermore, the security system must be capable of ensuring data remains available and undamaged. (Adelia Marwah Ujung & Muhammad Irwan Padli Nasution, 2023)

According to Oktaviani et al. (2023), cryptographic technologies such as the Advanced Encryption Standard (AES) can enhance data security. This technology converts original data into a form that cannot be read without a decryption key, ensuring data security both during storage and transmission. This study demonstrates that AES can effectively protect digital data,

including educational data. Cryptography can reduce the risk of data theft and misuse. Therefore, cryptography is an important method for protecting information in the digital age. (Oktaviani et al., 2023). Hoshmand and Ratnawati (2023) stated that information technology infrastructure security is a crucial component in addressing cybersecurity threats in the digital era. Education systems rely heavily on interconnected applications, servers, and networks. Therefore, security measures such as firewalls, access controls, and network monitoring systems are necessary to detect suspicious activity. This research shows that digital education systems are highly vulnerable to disruptions and data leaks if they lack a robust security infrastructure. Therefore, strengthening IT infrastructure is a crucial step in maintaining educational data security. (Munawar et al., 2023).

4. Privacy in Digital Education

Privacy in digital education is a crucial part of protecting students' personal data in technology-based learning systems. Education management systems (LMS) store data such as student identity, academic grades, and learning activities. According to Andika et al. (2026), the rise of digital technology increases the likelihood of data leakage and misuse. Therefore, to safeguard individual privacy rights in digital educational environments, data management must comply with personal data protection principles. (Andika et al., 2026). Furthermore, the prevailing law in Indonesia, Law Number 27 of 2022 concerning Personal Data Protection (UU PDP), regulates privacy in digital education. According to Rejeki (2025), the UU PDP is intended to ensure that all personal data, including student data in the education system, must be managed legally, in a limited manner, and securely by a responsible party. This regulation emphasizes that the data owner's consent is required before the data is used or disseminated. With the PDP Law, educational institutions have a responsibility to protect student data from misuse and ensure transparent digital data management. (Rejeki, 2026).

Privacy violations in digital education can also occur due to data misuse by irresponsible parties or cyberattacks such as doxing and data leaks. According to Fitri et al. (2025), the unauthorized dissemination of personal data is a type of privacy violation that is increasingly common in the digital era, including in education systems and online platforms. This shows that privacy protection depends not only on laws but also on the security systems and user awareness implemented. Therefore, to maximize student data protection, legal policies, security technology, and digital literacy are needed. (Fitri et al., 2025).

5. Learning Technology Trends

Learning technology trends are the development of digital innovations in education that aim to improve the effectiveness, flexibility, and quality of the learning process. This trend has emerged with the rapid digital transformation, which means that learning is no longer limited to the classroom but can be conducted online, interactively, and based on intelligent technology. According to Prabowo & Susianto (2025), the integration of technologies such as artificial intelligence and learning analytics in education enables a more flexible and student-centered learning system using data and cloud technology (Prabowo & Susianto, 2025). Microlearning presents material in short, focused forms on a single topic to make it easier for students to understand, while gamification uses game elements such as points, levels, and rewards to increase student motivation to learn. Furthermore, cloud-based learning systems and

gamification are other trends. However, cloud-based learning allows flexible access to learning materials via the internet from various devices. According to Marienko et al. (2020), adaptive technology and cloud-based learning systems increase learning flexibility and allow students to access content anytime and anywhere. (Marienko et al., 2020).

Overall, the study results show that digital education transformation has brought significant changes to the learning system through the use of various innovative technologies such as LMS, Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), and big data that can increase the effectiveness, flexibility, and personalization of learning. However, the success of digital transformation implementation is determined not only by technological sophistication, but also by the ability of educational institutions to ensure data security, protect user privacy, and improve the digital literacy of all stakeholders to create a digital education ecosystem that is safe, sustainable, and oriented towards quality learning.

CONCLUSION

Based on the study's findings, it can be concluded that digital education transformation has had a significant impact on modern learning systems through the use of technologies such as LMS, Artificial Intelligence, Virtual Reality, Augmented Reality, and big data. These technologies can increase the effectiveness, flexibility, and personalization of learning, allowing students to learn at their own pace. However, this development also poses serious challenges, particularly regarding data security and privacy in digital education systems. Therefore, a balance is needed between technology utilization, data protection, and increased digital literacy to ensure optimal and sustainable educational transformation.

REFERENCES

- Adelia Marwah Ujung, & Muhammad Irwan Padli Nasution. (2023). Sistem Keamanan Database. *Jurnal Penelitian Teknologi Informasi Dan Sains*, 1(2), 50–57. <https://doi.org/10.54066/jptis.v1i2.480>
- Alfawaid, F., Prianggono, J., Tinggi, S., Kepolisian, I., Tree, D., Tree, D., Forest, R., & Model, H. (2023). Penerapan Metode Multiple Machine Learning (Hybrid Model) Untuk Mendeteksi Link Phising Sebagai Upaya. *Jurnal Ilmu Kepolisian*, 17.
- Amin et al. (2025). Cybersecurity Challenges in Educational Technology: Protecting Student Data in Digital Learning Platforms. *Journal Emerging Technologies in Education*, 3(4), 201–212. <https://doi.org/10.70177/jete.v3i4.2797>
- Andika et al. (2026). Perlindungan Hukum Terhadap Data Pribadi dalam Era Digital. *All Fields of Science Journal Liaison Academia and Society*, 3(4), 189–194. <https://j-las.lemkomindo.org/index.php/AFoSJ-LAS/index>
- Arfan Dwi Madya, Bagas Djoko Haryanto, & Devi Putri Ningsih. (2023). Keefektifan Metode Proteksi Data dalam Mengatasi Ancaman Cybersecurity. *Indonesian Journal of Education And Computer Science*, 1(3), 127–135. <https://doi.org/10.60076/indotech.v1i3.236>
- Arifin, A. Z., Fatika Sari, Y., & Sudrajat, S. (2024). Blended learning as an alternative learning method to support the digital education era. *Jurnal Teori Dan Praksis Pembelajaran IPS*, 9(2), 92–101. <https://doi.org/10.17977/um022v9i22024p92>
- Cahdriyana, R. A., & Nurnugroho, B. A. (2023). Analisis Kebutuhan Pengembangan

- Multimedia Pembelajaran Berbasis Augmented Reality Untuk Mengembangkan Keterampilan Berpikir Komputasi. *LITERASI (Jurnal Ilmu Pendidikan)*, 14(1), 9. [https://doi.org/10.21927/literasi.2023.14\(1\).9-14](https://doi.org/10.21927/literasi.2023.14(1).9-14)
- Cahyono, D., Fahrudin, R., Alwiyah, A., & Sinclair, A. (2024). Pentingnya Edukasi dalam Mengatasi Keamanan Data Mobile Banking di Indonesia. *Jurnal MENTARI: Manajemen, Pendidikan Dan Teknologi Informasi*, 3(1) 81–89. <https://journal.pandawan.id/mentari/article/view/624>
- DA, A. G. (2009). Teknologi Pembelajaran : Konsep Dan Aplikasinya untuk Pembelajaran Pendidikan Kewarganegaraan. In *Jurnal Pendidikan Kewarganegaraan dan Hukum* (Vol. 6, Number 1, pp. 1–13).
- Dadang dan karep. (2025). *Transformasi Digital Dalam Pendidikan: Tantangan Dan Peluang Menuju Pembelajaran Di Era Digital*. 2, 306–312.
- Darwis, L. S. D. (2024). Implementasi Teknologi Artificial Intelligence Dalam. *Jurnal Ilmu Pendidikan (Jip)*, 72–79. <https://www.jurnalip2m.umnaw.ac.id/index.php/JIP/article/view/3153>
- Denzin, N. K., & Lincoln, Y. S. (1995). Transforming Qualitative Research Methods: Is It a Revolution? *Journal of Contemporary Ethnography*, 24(3), 349–358. <https://doi.org/10.1177/089124195024003006>
- Dorlince O Hutapea, Daniel David Sidebang, Riski Sakti Lumban Gaol, & Sri Yunita. (2024). Analisis Transformasi Digital dalam Pendidikan dan Implikasinya Terhadap Masa Depan. *CENDEKIA: Jurnal Ilmu Sosial, Bahasa Dan Pendidikan*, 4(3), 101–106. <https://doi.org/10.55606/cendekia.v4i3.2978>
- Fitri, G. A., Rahmadani, N. O., & Wiraguna, S. A. (2025). Perlindungan Privasi dan Data Pribadi Konsumen Daring pada Online Marketplace System. *PESHUM : Jurnal Pendidikan, Sosial Dan Humaniora*, 5(1), 725–730. <https://doi.org/10.56799/peshum.v5i1.9220>
- Fitria, T. N. (2023). Augmented Reality (AR) and Virtual Reality (VR) Technology in Education: Media of Teaching and Learning: A Review. *International Journal of Computer and Information System (IJCIS)*, 4(1), 14–25. <https://doi.org/10.29040/ijcis.v4i1.102>
- Hakim, A. S. (2025). The Role of Digital Education in Protecting User Privacy and Data Security. *International Conference Proceedings*, 4(2), 162–174.
- Harahap, N. (2014). Penelitian Kepustakaan. *Iqra*, 8(1), 68–73.
- Harahap, L. J., & Solihin, S. (2025). Education in the Era of Social Media Trends: Development of Instagram Feed Learning Media Using Canva on Biology Material. *Bioedunis Journal*, 4(1), 13-26.
- Hidayat, D. (2025). Analisis Sistem E-Learning Berbasis ISO 27005:2018 Menggunakan Algoritma Klasifikasi Random Forest Analysis of an ISO 27005:2018-Based E-Learning System Using the Random Forest Classification Algorithm. *Jurnal Teknologi Dan Informasi (JATI)*, 15(September), 110–120. <https://doi.org/10.34010/jati.v15i2.16173>
- Koponen, I. T., & Nousiainen, M. (2019). Pre-service teachers' knowledge of relational structure of physics concepts: Finding key concepts of electricity and magnetism. *Education Sciences*, 9(1). <https://doi.org/10.3390/educsci9010018>

- Kumar Basak, S., Wotto, M., & Bélanger, P. (2018). E-learning, M-learning and D-learning: Conceptual definition and comparative analysis. *E-Learning and Digital Media*, 15(4), 191–216. <https://doi.org/10.1177/2042753018785180>
- Li, Y., Zhou, X., Yin, H. B., & Chiu, T. K. F. (2025). Design language learning with artificial intelligence (AI) chatbots based on activity theory from a systematic review. *Smart Learning Environments*, 12(1). <https://doi.org/10.1186/s40561-025-00379-0>
- Lu, Y., Heatherly, K. A., & Lee, J. K. (2016). Cross-cutting exposure on social networking sites: The effects of SNS discussion disagreement on political participation. *Computers in Human Behavior*, 59, 74–81. <https://doi.org/10.1016/j.chb.2016.01.030>
- Mahesa. (2024). Kecerdasan Buatan Dalam pendidikan: Peluang Dan Tantangan Pemanfaatannya Untuk Personalisasi Pembelajaran. *Jurnal Pendidikan Dan Pengajaran*, 2(3), 454–474.
- Marienko, M., Nosenko, Y., Sukhikh, A., Tataurov, V., & Shyshkina, M. (2020). Personalization of learning through adaptive technologies in the context of sustainable development of teachers' education. *E3S Web of Conferences*, 166. <https://doi.org/10.1051/e3sconf/202016610015>
- Muhammad Yusuf, Dwi Julianingsih, & Tarisya Ramadhani. (2023). Transformasi Pendidikan Digital 5.0 melalui Integrasi Inovasi Ilmu Pengetahuan dan Teknologi. *Jurnal MENTARI: Manajemen, Pendidikan Dan Teknologi Informasi*, 2(1), 11–19. <https://doi.org/10.33050/mentari.v2i1.328>
- Mulawarman, U., Mulawarman, U., Mulawarman, U., Mulawarman, U., Mulawarman, U., & Mulawarman, U. (2026). *Evaluasi Keamanan Dan Manajemen Data Pada Sistem Informasi Sekolah Di Era Transformasi Digital*. 8.
- Munawar, Z., Indah Putri, N., Iswanto, I., & Widhiantoro, D. (2023). Analisis Keamanan Pada Teknologi Blockchain. *Infotronik : Jurnal Teknologi Informasi Dan Elektronika*, 8(2), 67. <https://doi.org/10.32897/infotronik.2023.8.2.2062>
- Munir, M. (2010). Penggunaan Learning Management System (Lms) Di Perguruan Tinggi: Studi Kasus Di Universitas Pendidikan Indonesia. *Jurnal Cakrawala Pendidikan*, 1(1), 109–119. <https://doi.org/10.21831/cp.v1i1.222>
- Nadila. (2025). Pengelolaan Risiko Privasi Data Siswa : Kerangka Kerja Administrasi Pendidikan Digital Di SDN 08 Cupak. *Jurnal Ilmu Manajemen Dan Pendidikan*, 02(03), 792–797.
- Oktaviani, S., Rizky, F., & Gunawan, I. (2023). Analisis Keamanan Data Dengan Menggunakan Kriptografi Modern Algoritma Advance Encryption Standar (AES). *Jurnal Media Informatika*, 4(2), 97–101. <https://doi.org/10.55338/jumin.v4i2.435>
- Pei Zhao, Sara Sintonen, H. K., Currie, K. L., & J.Courduff. (2015). The pedagogical functions of arts and cultural-heritage education with ICTs in museums. *International Journal of Instructional Technology and Distance Learning*, 7.
- Prabowo, R. Y., & Susianto, D. (2025). The Triad of Cloud, Analytics, And Pedagogy: A Systematic Review of Ai-Driven Personalization in Cloud-Based Learning Environments. *Edcomtech: Jurnal Kajian Teknologi*, 10(1), 44–59

- <https://journal-fip.um.ac.id/index.php/edcomtech/article/view/3901%0Ahttps://journal-fip.um.ac.id/index.php/edcomtech/article/download/3901/1766>
- Puspitasari, M. L., Syafitri, D. A. R., & Muhlis. (2025). Konsep Dan Teori Dasar Pendidikan Serta Transformasinya Di Era Digital. *STUDIA ULUMINA: Jurnal Kajian Pendidikan*, 2(1), 97–114.
- Raup, A., Ridwan, W., Khoeriyah, Y., Supiana, S., & Zaqiah, Q. Y. (2022). Deep Learning dan Penerapannya dalam Pembelajaran. *JiIP - Jurnal Ilmiah Ilmu Pendidikan*, 5(9), 3258–3267. <https://doi.org/10.54371/jiip.v5i9.805>
- Rejeki, S. K. (2026). *Analisis Yuridis terhadap Perlindungan Hak Privasi dalam Komunikasi Digital Berdasarkan Undang-Undang Pelindungan Data Pribadi di Indonesia*. 7607–7621.
- Rohman, A., & Anwar Hartanto, M. (2020). Implementasi Teori Pembelajaran Blended Learning dalam Menyeimbangkan Kapabilitas Belajar pada Era Digital (Studi Kasus di Prodi PAI Universitas Alma Ata Yogyakarta). *An-Nuha : Jurnal Kajian Islam, Pendidikan, Budaya Dan Sosial*, 7(1), 33–51. <https://doi.org/10.36835/annuha.v7i1.343>
- Siregar dan musawaris. (2023). Pemanfaatan Big Data dalam Bidang Pendidikan. *Medium*, 4(2), 274–285. <https://medium.com/@fira901/pemanfaatan-big-data-dalam-bidang-kesehatan-244e3b130d88>
- Sutrayasa, G. G., & Agustini, K. (2026). *Pembelajaran Adaptif Berbasis Artificial Intelligence : Integrasi Multi-Teori Belajar Untuk Personalized*. 6(1).
- Usman, U. (2019). Komunikasi Pendidikan Berbasis Blended Learning Dalam Membentuk Kemandirian Belajar. *Jurnal Jurnalisa*, 4(1), 136–150. <https://doi.org/10.24252/jurnalisa.v4i1.5626>
- Warsita, B. (2011). Metodologi Penelitian Bisnis Akutansi dan Manajemen. *Jurnal Teknodik*, XV, 84–96.
- Widodo, A., & Nursaptini, N. (2020). Merdeka belajar dalam pandemi: Persepsi mahasiswa terhadap pembelajaran jarak jauh berbasis mobile. *Jurnal Pembangunan Dan Pendidikan: Fondasi Dan Aplikasi. Pembangunan Pendidikan Fondasi Dan Aplikasi*, 8 (2)(PENDIDIKAN), 86–96.
- Willem, J., Pasar, I., & Utara, S. (2023). *Jurnal Pendidikan Fisika The Use Of Learning Management System (Lms) In The Teaching And Learning Process : Literature Review Department Of Science Education , Universitas Negeri Padang*. 12, 81–90.
- Yunita, A., Santoso, H. B., & Hasibuan, Z. A. (2022). ‘Everything is data’: towards one big data ecosystem using multiple sources of data on higher education in Indonesia. *Journal of Big Data*, 9(1). <https://doi.org/10.1186/s40537-022-00639-7>
- Yusa, I. W., Wulandari, A. Y. R., Tamam, B., Rosidi, I., Yasir, M., & Setiawan, A. Y. B. (2023). Development of Augmented Reality (AR) Learning Media to Increase Student Motivation and Learning Outcomes in Science. *Jurnal Inovasi Pendidikan IPA*, 9(2), 127–145. <https://doi.org/10.21831/jipi.v9i2.52208>
- Zohriah, A., Muin, A., & Muslihat, M. (2023). Paradigma Pendidikan di Era Digital. *JiIP - Jurnal Ilmiah Ilmu Pendidikan*, 6(7), 4546–4554. <https://doi.org/10.54371/jiip.v6i7.1797>