The Role of Digital Technologies in Health Science Education

Dinianti Marselia[1], Anggoro Galih Niswantoro[1], Della Cyntia Azzahra[1], Hikmah Putra Perdana[1], Suciana Wijirahayu[2]

[1] Department of Informatics Engineering, Universitas Muhammadiyah Prof. DR. HAMKA, Jakarta 13460, Indonesia
[2] Faculty of Education, Universitas Muhammadiyah Prof. DR. HAMKA, Jakarta 13460, Indonesia

Corresponding Author:
Nama:Suciana Wijirahayu
Email: sucianawijirahayu@uhamka.ac.id

Author
Dinianti Marselia (dinianti.marselia@gmail.com)
Anggoro Galih Niswantoro (niswantorogalih@gmail.com)
Della Cyntia Azzahra (dellacyntia00@gmail.com)
Hikmah Putra Perdana (hikmahputraperdana99@gmail.com)
Suciana Wijirahayu (sucianawijirahayu@uhamka.ac.id)

Abstract

The rapid development of digital technologies in 2025 has transformed the delivery of health science education. E-learning platforms, mobile health applications, social media, and artificial intelligence (AI) offer innovative approaches to enhance transformative learning and health awareness. This study aims to analyze how digital technologies influence learning quality, equity, and ethical practices in health science education in Indonesia. This paper reviews the role of digital technologies in advancing health science education and their contribution to patient safety. A literature-based review was conducted using PubMed, ScienceDirect, SpringerLink, IEEE Xplore, and ResearchGate. Findings indicate that digital technologies improve students' comprehension and accessibility to health-related knowledge, while mobile applications and social media significantly promote public health literacy. Simulation-based learning in nursing strengthens clinical competence and reduces medical errors, while blended learning supports knowledge acquisition, satisfaction, and self-directed learning. In Indonesia, applications such as Halodoc, Alodokter, and KlikDokter are increasingly used for medical consultation and health education. However, rapid digitalization also introduces challenges such as data security risks, misinformation, and digital inequality. Sustainable integration of digital technologies into health science education is essential to enhance professional competence, digital literacy, and patient safety.

Keywords: AI in healthcare, Digital education, Digital technologies, Health awareness, Health science education

Introduction

Digital transformation has profoundly reshaped the delivery of education in health sciences, especially after the COVID-19 pandemic accelerated the adoption of online learning, telemedicine, and mobile health platforms. Globally, e-learning systems, simulation-based training, and artificial intelligence (AI) applications have emerged as key innovations that promote flexible, interactive, and data-driven learning experiences [1,3,14]. In Indonesia, this transformation has been particularly evident as universities and healthcare institutions increasingly adopt digital platforms for education, training, and health promotion.

According to the 2024–2025 national survey by Katadata Insight Center and Lokadata, approximately 69% of young Indonesians (Gen Z and Millennials) reported using telehealth applications for healthcare access. The most widely used platforms are Halodoc (54%), followed by Alodokter (27%) and KlikDokter (5%), while others such as GrabHealth and LinkSehat accounted for less than 5% [16,17]. This trend highlights the growing digitalization of healthcare services in Indonesia, reflecting both opportunities for innovation and disparities in digital health literacy between urban and rural populations [10,12].

The increasing reliance on digital health platforms also influences health science education, as universities integrate these technologies into simulation-based learning, teleconsultation training, and digital literacy courses. Previous studies have shown that simulation-based education enhances clinical competence and patient safety [1,2], while blended learning promotes satisfaction and self-directed learning [3,5]. Moreover, mobile applications and social media platforms have become vital for improving public health literacy and community engagement [8,13]. However, despite these benefits, challenges such as data security risks, misinformation, and digital inequality persist, especially in low-resource settings [10,11,12]. Addressing these challenges is essential to ensure equitable access and ethical use of digital technologies in education and healthcare. Research Questions: How do digital technologies influence the quality and accessibility of learning in health science education in Indonesia?. What challenges—such as digital inequality, data privacy, and ethical considerations—arise in the integration of these technologies?. How can digital tools contribute to improving patient safety and professional competence among health students?.

This study aims to analyze how digital technologies influence learning quality, equity, and ethical practice in health science education in Indonesia by 2025. Specifically, it seeks to (1) identify the key benefits and challenges of digital adoption, (2) examine its impact on educational outcomes and patient safety, and (3) provide insights for the sustainable integration of digital technologies in health education. Transformative Learning Theory: Digital technologies enable experiential learning, reflective thinking, and skill development for health professionals. Digital Literacy Framework: Proficiency in using digital tools is essential for students to access, evaluate, and apply health information effectively. Patient Safety Principles: Integration of simulation-based learning and e-learning modules can reduce medical errors and improve clinical decision-making. Together, these frameworks provide a holistic lens for analyzing how digital technologies transform educational experiences while maintaining patient safety and promoting digital literacy among future health professionals.

Material and Methods

Material

This study used secondary data obtained from previous peer-reviewed research, reports, and databases. The main materials included journal articles, policy documents, and institutional reports relevant to digital education and health science learning. Data were collected from major scientific databases such as PubMed, ScienceDirect, SpringerLink, IEEE Xplore, and ResearchGate.

The inclusion criteria were: Articles published between 2010 and 2025; Studies focusing on digital learning, blended learning, simulation, mobile health applications, digital literacy, or patient safety in health science education; Peer-reviewed papers in English or Indonesian. Exclusion criteria were non-academic reports, opinion pieces, and non-peer-reviewed sources. The materials were selected to represent both global and Indonesian contexts to provide a comprehensive overview of digital health education practices.

Methods

This research employed a qualitative literature review design to synthesize and analyze relevant studies on the role of digital technologies in health science education. The methodological steps were as follows:

Data Collection: Searches were performed using keyword combinations such as *"digital education," "health science," "simulation-based learning," "AI in healthcare," "digital literacy,"* and *"patient safety."* Articles meeting the inclusion criteria were screened for relevance and credibility.

Data Analysis: The collected studies were analyzed using thematic analysis. Each article was categorized based on: Type of digital technology (e-learning, simulation, AI, mobile app, social media), educational outcome (knowledge, competence, satisfaction, self-directed learning), context (global or Indonesian case)

Synthesis and Interpretation: Key findings were synthesized across studies to identify trends, benefits, and challenges in digital health education. The results were then interpreted through the lens of Transformative Learning Theory, Digital Literacy Framework, and Patient Safety Principles to ensure theoretical coherence. This methodological approach enabled a systematic and contextually grounded understanding of how digital technologies enhance educational quality, promote equity, and address ethical considerations in Indonesia's health science education sector**.**

Results and Discussion

Result 1: E-learning and Blended Learning
Online and blended learning approaches significantly improve students' knowledge acquisition, satisfaction, and self-directed learning [3,5]. During and after the COVID-19 pandemic, these platforms became indispensable for working students and those in remote regions, offering flexibility and inclusivity.

Result 2: Simulation-Based Learning
Simulation technologies—ranging from high-fidelity mannequins to VR and AR systems—enhance clinical competence and reduce patient risk [1]. Simulation-based training prepares students for real-world medical cases and promotes patient safety awareness.

Result 3: Patient Safety Awareness
Digital platforms integrate patient safety principles into clinical training. Choi et al. [2] found that digital modules improved motivation and awareness among nursing students to practice safer procedures.

Result 4: Social Media as a Tool for Health Education
Platforms such as TikTok, Instagram, and YouTube serve as health education tools, especially for younger audiences. Meliyani [13] reported that short-form visual content increases engagement and improves health literacy.

Result 5: Mobile Health Applications

Applications such as Halodoc, Alodokter, and KlikDokter improve access to medical consultations and health information [8]. However, Safitri [10] noted that limited digital literacy in rural areas constrains effectiveness, while BSSN [11] emphasized the need for stronger data protection frameworks to ensure patient confidentiality.

Result 6: Artificial Intelligence (AI) in Education and Healthcare

AI-driven chatbots and diagnostic systems enhance analytical skills among health students [14]. WHO [9] recommended ethical frameworks for AI use to safeguard fairness and transparency.

Result 7: Challenges—Cybersecurity and Health Misinformation

Digitalization introduces challenges such as data privacy risks and misinformation. Syamsuddin [12] highlighted digital inequality as a barrier to equitable access in rural areas.

Table 1. Summary of Reviewed Literature on Digital Health Education

No	Author & Year	Research Focus	Method	Key Findings	Relevance
1	Kim et al. (2016)	Simulation-based education	Meta-analysis	Enhances clinical competence	Strengthens simulation education
2	Choi et al. (2020)	Patient safety awareness	Survey	Digital education improves motivation and awareness	Highlights patient safety role
3	George et al. (2014)	Online e-learning for health professions	Systematic review	Improves knowledge and accessibility	Supports e-learning approach
4	Elhoseny & Shankar (2019)	IoT-based healthcare security	Model development	Ensures secure data transmission	Addresses cybersecurity
5	Gagnon et al. (2013)	Blended teaching impact	Empirical	Improves self-directed learning	Supports blended learning
6	Alotaibi & Federico (2017)	Health IT and patient safety	Review	Emphasizes IT in safety	Strengthens patient safety
7	Reyes-Gonzalez et al. (2024)	Governance and information exchange	Network analysis	Highlights motivation and exchange role	Contextualizes collaboration
8	Nasution & Santoso (2022)	Digital health communication	Case study	Effective message delivery	Links to community engagement
9	WHO (2021)	Global digital health framework	Policy report	Guides ethical digital health	Provides global framework

10	Safitri (2021)	Digital health transformation	Qualitative	Notes digital literacy barriers	Highlights rural limitations
11	BSSN (2022)	Data protection in health apps	Policy brief	Stresses need for secure data	Addresses privacy issues
12	Syamsuddin (2020)	Digital divide in health promotion	Descriptive	Rural access gaps persist	Notes equity challenges
13	Meliyani (2023)	Social media & health literacy	Content analysis	Engages youth effectively	Supports public health education
14	Kurniawan (2022)	AI in medical education	Descriptive	AI supports clinical reasoning	Advances AI integration
15	Prasetyo & Lestari (2023)	Digital literacy among health students	Survey	Highlights need for skill enhancement	Supports educational reform

Implementation and Trends in Indonesia

Between 2024 and 2025, digital health application usage in Indonesia became more diversified. While Halodoc and Alodokter continued to dominate, government-driven platforms such as BPJS Kesehatan experienced substantial growth due to national health insurance digitalization. SehatQ and other smaller platforms also gained attention among niche users.

Table 2. Trends in Digital Health App Usage in Indonesia

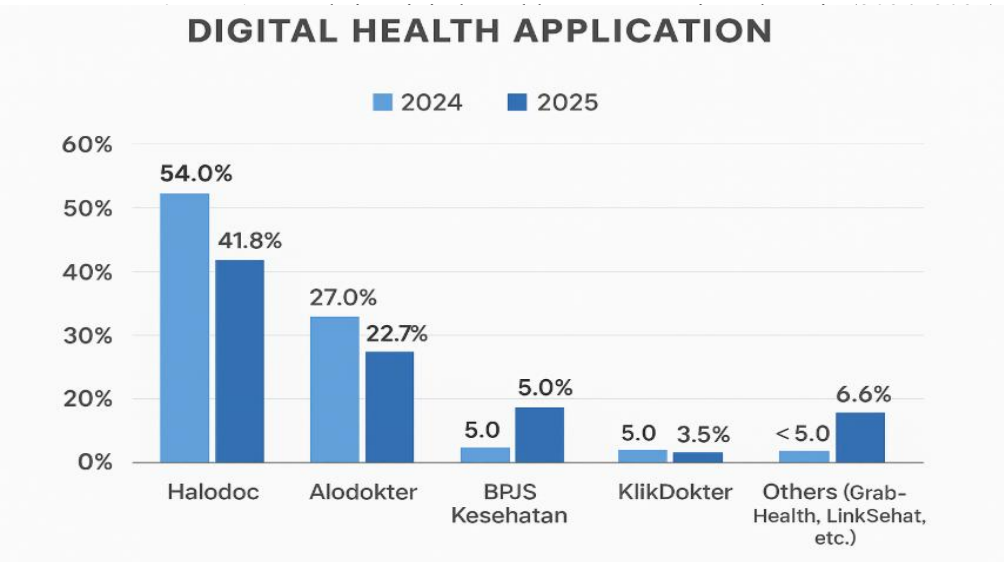
Example	Platform / Method	Description	Impact / Benefit
Telehealth Simulation	Halodoc, Alodokter	Students practice patient consultation virtually	Improves clinical communication and patient understanding
E-learning Module	Moodle / Edmodo	Online health modules with quizzes & interactive videos	Provides flexible learning and enhances self-directed learning
Social Media Education	TikTok / Instagram	Short videos and infographics on health topics	High engagement with youth, increases health literacy
AI Chatbot	Local AI platforms	Virtual diagnosis practice for students	Safe clinical practice and improved digital competency

Table 3. Trends in Digital Health App Usage in Indonesia 2024-2025

Digital Health Application	2024 (%)	2025 (%)	Trend / Description

Halodoc	54.0	41.8	Slight decline, remains most popular among Gen Z & Millennials
Alodokter	27.0	22.7	Moderate decrease; strong in education & teleconsultation
BPJS Kesehatan	5.0	13.6	Significant growth after digital integration in national insurance
SehatQ	-	5.0	Newly emerging platform with increasing adoption
KlikDokter	5.0	3.5	Slight decline; used for health articles and literacy
Others (GrabHealth, LinkSehat, etc.)	<5.0	6.6	Gradual increase in niche communities

Source: Katadata Insight Center & Lokadata (2024); APJII Digital Health Report (2025)



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Conclus

Digital nd simulation-based methods and engagement and literacy. eriences. However, challenges remain in cybersecurity, privacy, and digital inequality. Strengthening digital literacy, infrastructure, and ethical governance is crucial for sustainable digital transformation in Indonesia. Future studies should explore digital ethics, governance, and the long-term impacts of AI adoption in health education to ensure sustainable and equitable innovation.

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