

The Practical Challenges and Optimization Strategies for Cultivating Digital Literacy among Nursing Students in Higher Education Institutions

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Abstract: The rapid digital transformation of healthcare systems is fundamentally reshaping nursing practice, establishing digital literacy as an indispensable core competency for future nursing professionals. However, nursing students in higher education institutions face multiple, interrelated challenges in developing the digital capabilities required to adapt to contemporary, technology-rich healthcare environments. This paper systematically reviews and synthesizes recent empirical research and theoretical contributions to analyze the practical difficulties impeding the cultivation of digital literacy among nursing students and to propose comprehensive optimization strategies. Drawing upon frameworks such as the Technology Acceptance Model and Experiential Learning Theory, the analysis identifies four primary categories of challenges: individual-level barriers, including insufficient digital competence, low self-efficacy, and psychological resistance; institutional-level deficiencies, such as curriculum gaps, inadequate faculty preparation, and limited infrastructure; pedagogical challenges, including a persistent theory–practice disconnect and insufficiently interactive teaching methodologies; and systemic inequalities related to the digital divide and resource constraints. Based on five interrelated dimensions—curriculum integration, pedagogical innovation, faculty development, infrastructure upgrading, and policy support—this paper proposes targeted optimization strategies. Particular attention is devoted to evidence-based approaches such as design-oriented learning, simulation-based training, and experiential learning methodologies, which have demonstrated effectiveness in enhancing informatics and digital literacy among nursing students. The review concludes that cultivating digital literacy requires a coordinated, multi-stakeholder approach that integrates technical skills with cognitive, ethical, and sociocultural dimensions of digital competence, offering practical implications for educators, administrators, and policymakers.

Keywords: digital literacy; nursing education; higher education; information literacy; health informatics

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1. Introduction

The digital era has brought about significant transformations across numerous societal sectors, with the healthcare domain undergoing substantial changes as well. The incorporation of digital technologies, such as electronic health records, clinical decision support systems, telemedicine platforms, and artificial intelligence applications, has redefined the framework of nursing practice. Modern nurses are now required to not only exhibit proficiency in utilizing these technologies but also demonstrate the ability to critically evaluate their applications, adapt to evolving scenarios, and strategically implement them to enhance patient outcomes. Higher education institutions, tasked with preparing the next generation of nurses, must prioritize not only the teaching of clinical nursing skills and theoretical knowledge but also the cultivation of digital literacy. Despite these efforts, a significant proportion of nursing students report challenges in this area. Many students express a lack of confidence in using electronic medical records,

perceive their computer skills as inadequate, and feel unprepared in the domain of informatics. These challenges highlight critical gaps that could potentially impact patient safety and the overall quality of healthcare delivery [1]. This paper seeks to thoroughly examine the practical barriers that hinder the development of digital literacy among nursing students in higher education institutions. Furthermore, it aims to propose actionable and evidence-based strategies to address these challenges, thereby offering valuable theoretical insights and practical guidance to support the digital transformation of nursing education.

Moreover, it is essential to understand that digital literacy in nursing extends far beyond mere technical skills. It encompasses the ability to engage in critical thinking, uphold ethical standards, and make data-informed decisions within the complexities of clinical environments. As healthcare systems continue to advance toward deeper digital integration, the expectations placed on nursing graduates are becoming increasingly multifaceted. These expectations demand a holistic approach to education that equips students with a diverse set of competencies. However, current research has yet to fully explore how these varied skills can be systematically developed within the framework of higher education [2]. This underscores the need for a comprehensive and practice-oriented investigation into the challenges and potential strategies for fostering digital literacy. By addressing these gaps, nursing education can be better aligned with the demands of the digital era, ensuring that graduates are well-prepared to contribute effectively to the evolving landscape of healthcare.

2. Practical Challenges in Cultivating Digital Literacy

2.1. Individual-Level Challenges

Nursing students often encounter foundational deficiencies in digital competence upon entering higher education. These gaps are shaped by diverse factors, including prior educational experiences, socioeconomic conditions, and varying levels of exposure to technology. The sudden shift to online learning during the global health crisis further highlighted these challenges, exposing the difficulties students face when adapting to unfamiliar technologies without structured support systems. Beyond technical skill deficits, emotional and psychological barriers also play a significant role in hindering digital literacy development. When digital platforms are perceived as overly complex or prone to technical issues, students may experience heightened anxiety and resistance, which can significantly reduce their engagement and willingness to learn. This psychological burden is particularly acute for nursing students, who must balance the demands of clinical practice with academic responsibilities. Additionally, individuals' perceptions of their own digital capabilities, referred to as digital self-efficacy, are crucial in shaping their motivation and behavior. Self-efficacy acts as a key determinant in the relationship between digital competence and academic performance, often creating a self-reinforcing cycle. Students with low self-efficacy may avoid engaging with technological tasks, leading to stagnation or regression in their abilities [3–5]. Conversely, those with high self-efficacy are more likely to explore and utilize digital tools, thereby achieving greater learning outcomes. These disparities, influenced by psychological, emotional, and skill-related factors, can inadvertently exacerbate the academic development gap among nursing students, underscoring the need for targeted interventions to address both technical and emotional barriers to digital literacy.

2.2. Institutional Challenges

From an institutional perspective, deficiencies in digital literacy among nursing students are deeply rooted in structural challenges that span curriculum systems, faculty preparedness, and infrastructure limitations. Firstly, in terms of curriculum design, while the significance of digital competence is increasingly acknowledged, it often remains a secondary priority within many nursing programs, lacking a cohesive and systematic integration. Digital literacy education is frequently scattered across various courses, with content primarily focused on basic computer operations. This fragmented approach fails

to address the growing need for comprehensive digital skills that align with the demands of contemporary nursing practice. Secondly, the readiness of educators to foster digital literacy represents a significant barrier to student development [6,7]. Many nursing faculty members, having been educated prior to the widespread adoption of digital technologies, face notable challenges in effectively incorporating technology into their teaching methods. Their uneven levels of competence in this area highlight the necessity for tailored training programs that cater to faculty across different generational cohorts. Such programs should aim to transform digital tools into effective instruments for enhancing teaching outcomes. Finally, the adequacy of institutional infrastructure plays a pivotal role in determining the feasibility of cultivating digital literacy. Students require access to stable internet connections, robust learning platforms, and reliable hardware devices. However, financial constraints often limit some students to using smartphones or borrowed devices for online learning. Even when institutions provide support, such as subsidized data plans, these measures frequently fall short of meeting the sustained demands of rigorous academic coursework. The interplay of fragmented curriculum structures, inconsistent faculty preparedness, and insufficient hardware resources creates systemic barriers that hinder the development of digital competence among nursing students. Addressing these interconnected challenges is essential to fostering a digitally competent nursing workforce capable of meeting the evolving demands of healthcare environments.

2.3. Pedagogical Challenges

In nursing digital literacy education, the disconnect between theoretical instruction and practical application represents a persistent and significant challenge. Traditional teaching models often present digital skills as isolated knowledge points, detached from authentic clinical contexts. This approach results in students, even after completing informatics courses, struggling to effectively transfer acquired knowledge to real-world nursing scenarios. The gap between the learning experience and practical clinical application diminishes students' perception of technology's value, which is a critical factor for successful technology adoption. Furthermore, the limitations of current teaching methodologies exacerbate this issue. Many digital literacy courses continue to rely heavily on traditional strategies dominated by theoretical instruction, emphasizing task-oriented skill drills while neglecting to foster deep engagement with complex, realistic informatics problem-solving processes. Even when innovative approaches such as problem-based learning or simulations are introduced, the scenarios are often overly simplified, failing to replicate the multidimensional challenges inherent in authentic healthcare environments. As a result, the skills students acquire remain fragmented and insufficient to meet the integrated competency demands of digital healthcare. Another pressing concern is the inadequacy of current assessment mechanisms for digital literacy. Traditional examination methods primarily evaluate students' ability to memorize knowledge but are ineffective in measuring their comprehensive ability and ethical awareness in applying technology within real-world contexts. Although there has been exploration into specialized assessment tools tailored for nursing students, their implementation remains limited. The absence of robust assessment mechanisms prevents educators from accurately identifying students' weaknesses and hinders their ability to adapt teaching strategies effectively. This further widens the gap between theoretical instruction and practical application, underscoring the need for a more integrated and dynamic approach to nursing digital literacy education.

2.4. Systemic Challenges

The cultivation of digital literacy faces multifaceted challenges that extend beyond educational and pedagogical considerations, encompassing broader systemic and structural issues. A significant barrier is the persistent inequality in access to technology, which creates disparities in the foundational opportunities available to students for developing digital competencies. Students from economically disadvantaged backgrounds often encounter significant obstacles, such as unreliable internet

connectivity and the lack of appropriate hardware devices. This technological disparity, often referred to as the digital divide, is deeply rooted in economic inequities and has far-reaching implications. It not only hinders the academic progress of affected students but also amplifies pre-existing educational inequalities [1,8]. This issue is particularly pronounced in regions with limited financial and infrastructural resources, where high costs of data and inadequate technological infrastructure compel students to depend on unstable public networks. Such environments are not conducive to fostering consistent learning experiences or supporting the systematic acquisition of digital skills. From an institutional perspective, these challenges are compounded by the absence of robust policy frameworks. Many countries have yet to establish comprehensive policies that effectively address the development of digital literacy education. This lack of policy direction results in fragmented approaches to curriculum design, faculty training, and resource allocation. Even when digital skills are included in some educational frameworks, they are often articulated in overly general terms, lacking actionable strategies for implementation. Without clear and cohesive policy guidance, the responsibility for advancing digital literacy education falls on individual institutions, leading to inconsistent development and hindering the establishment of standardized and effective cultivation mechanisms. Addressing these systemic challenges requires a concerted effort to bridge technological gaps and formulate targeted policies that provide a unified and actionable roadmap for digital literacy education.

3. Optimization Strategies for Cultivating Digital Literacy

3.1. Curriculum Integration Strategy

To effectively enhance digital literacy within the teaching process, a deliberate and systematic approach to curriculum design is indispensable. This requires a comprehensive evaluation of the current state of digital competence development, identifying gaps and weaknesses, and formulating strategies to progressively advance learning throughout the entire educational journey. Digital literacy must be seamlessly integrated into all facets of the curriculum, transcending the limitations of standalone courses. A dual approach is essential, encompassing vertical integration, where skills are progressively deepened as students advance through grade levels, and horizontal articulation, ensuring interconnectedness across various subjects and disciplines. For younger students, the focus should be on building foundational information literacy and acquiring basic technical skills. As students mature, the curriculum should shift toward addressing complex challenges in information technology and exploring applications of emerging technologies. Additionally, digital literacy must be consistently reinforced across diverse learning environments, including theoretical instruction, simulated scenarios, and hands-on practical experiences. This ensures that students not only acquire technical proficiency but also understand the broader implications and applications of digital literacy in varied academic, professional, and real-world contexts, fostering a holistic and enduring competence in navigating the digital landscape.

3.2. Teaching Innovation Strategy

In the pathway for cultivating digital literacy, teaching methodologies are undergoing a profound transformation from knowledge transmission to competency construction. Design-oriented experiential learning has proven to be highly effective in nursing informatics education. By guiding students to address authentic clinical informatics problems and integrating interdisciplinary knowledge through iterative inquiry and design processes, this approach enhances professional skills while fostering interdisciplinary thinking and teamwork capabilities. Additionally, the incorporation of virtual reality and simulation technologies creates a safe and immersive learning environment. These tools allow students to practice utilizing digital systems such as electronic health records and telemedicine in settings that closely resemble real clinical scenarios, thereby strengthening the transfer of skills to practical applications. In terms of course organization, the adoption of flipped classrooms and blended learning models

enables students to adapt to technology-integrated learning methods that align with future professional environments. Digital platforms play a crucial role in supporting this transition, ensuring students are equipped to navigate technology-driven educational frameworks. However, the success of these pedagogical innovations depends on addressing students' foundational digital abilities and providing continuous technical support to sustain engagement and effectiveness. Complementing these shifts in teaching strategies is the innovation in assessment methods [9–11]. Moving beyond traditional evaluations of technical knowledge, performance-based authentic assessments focus on students' ability to apply digital tools to complete clinical tasks in realistic contexts. This approach not only aligns with the comprehensive and practical nature of digital literacy but also reinforces learning outcomes by deeply integrating technology application with professional practice, ensuring students are prepared for the demands of modern healthcare environments.

3.3. Faculty Development Strategy

In the process of enhancing nursing students' digital literacy, educational institutions must prioritize faculty professional development as a central strategic focus. To address the varying levels of digital competence among faculty members, institutions should implement tiered and continuous training programs. These programs must not only equip educators of different age groups with foundational technical skills but also empower them to deeply integrate digital tools into their teaching methodologies. This integration should aim to enrich pedagogical practices and foster innovative learning environments. Such training initiatives must be designed as ongoing efforts that evolve in tandem with technological advancements, ensuring their relevance and effectiveness over time. Concurrently, institutions should actively cultivate interdisciplinary faculty learning communities. These communities can serve as platforms for sharing experiences, exchanging best practices, and collaboratively developing strategies among nursing educators, educational technology specialists, and clinical mentors. By fostering collaboration, this approach mitigates the challenges of isolated efforts and accelerates the adoption of effective digital teaching methods. From an organizational standpoint, colleges and universities should establish robust recognition and incentive systems. Faculty achievements in digital teaching innovation should be integrated into criteria for professional advancement and institutional awards [1,12]. This shift redefines digital teaching innovation from being perceived as an additional responsibility to being recognized as a core professional endeavor. Such measures provide sustained institutional motivation, driving systemic reforms in digital literacy education and ensuring long-term progress in this critical area.

3.4. Policy and Partnership Strategy

Cultivating digital literacy in nursing requires a collaborative ecosystem that extends beyond the confines of educational institutions, encompassing clinical and administrative domains. At the micro level, institutions must forge robust partnerships with healthcare organizations. This entails granting students access to real-world healthcare information systems during clinical training, embedding practical skills development into internship programs, and ensuring that clinical preceptors receive comprehensive digital teaching competency training. Such measures enable preceptors to provide effective technical guidance throughout the educational process. Additionally, collaborative efforts in curriculum design are essential to ensure that teaching content aligns seamlessly with the practical demands of clinical roles. At a broader systemic level, government policies and resource allocation serve as critical enablers. The establishment of national digital competence frameworks can provide unified standards and direction for curriculum reform, fostering consistency across institutions. Investments in upgrading hardware infrastructure and implementing targeted faculty training programs can help mitigate resource disparities among institutions. Furthermore, policy-driven incentives for educational innovation can inspire educators to explore and implement more effective models for cultivating digital literacy. By integrating top-down policy support with

bottom-up collaboration among stakeholders, the digital divide can be progressively narrowed [13]. This holistic approach ensures that nursing professionals are equipped with the essential competencies needed to thrive in an evolving healthcare landscape, ultimately fostering a workforce capable of meeting the demands of future healthcare environments.

4. Conclusion

In an era defined by the rapid digitalization of healthcare systems, fostering digital literacy among nursing students has emerged as a critical strategic priority, directly influencing the quality of future nursing care and patient safety. This analysis has delved into the multifaceted challenges nursing students face in acquiring digital competence, highlighting the intricate interplay of personal, educational, and societal factors. These challenges include psychological barriers at the individual level, institutional shortcomings, pedagogical misalignments, and broader systemic gaps. Addressing these issues demands a shift from fragmented, skills-based training to a comprehensive, integrated approach that encompasses curriculum redesign, innovative teaching methodologies, faculty development, enhanced infrastructure, and cohesive policy frameworks. Strategies such as leveraging design-oriented learning models, incorporating virtual reality technologies into pedagogy, establishing tiered faculty training programs, and fostering inter-institutional collaborations all converge on a shared objective: embedding digital literacy as a core competency within nursing education. Achieving this vision requires not only the innovative efforts and pedagogical expertise of educators but also the strategic commitment and resource allocation of policymakers, alongside the active participation and adaptability of clinical practice systems. When digital literacy becomes an intrinsic element of the nursing profession's ethos and competency framework, and when every nursing graduate is equipped to confidently utilize digital tools to deliver compassionate, patient-centered care, nursing education will have effectively responded to the demands of the digital age. Looking ahead, future research must explore how the continuous evolution of digital technologies will redefine the scope of nursing practice and how educational systems can remain agile in adapting to these changes. Furthermore, it is imperative to investigate how emerging technologies can be harnessed to bridge existing gaps in healthcare delivery, ensuring equitable access and improved outcomes. Ultimately, cultivating digitally proficient nursing professionals is not merely an educational goal but a fundamental step toward building a resilient, high-quality, and sustainable healthcare system capable of meeting the complex challenges of the modern era.

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