

DEVELOPMENT GUIDELINES FOR DIGITAL LITERACY SKILLS OF NURSING STUDENTS AT SHANDONG COLLEGE OF TRADITIONAL CHINESE MEDICINE*

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Abstract

The objectives of this research were: 1) To study the current situation of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine, and 2) To suggest the development guidelines of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine. The sample was 302 Nursing Science students enrolled in the 2025 academic year at Shandong College of Traditional Chinese Medicine. The research employed a mixed-methods research design, combining questionnaire surveys with structured interviews. The statistics to analyze the data were percentage, mean, standard deviation, and content analysis.

The results showed that: 1) The current situation of digital literacy skills for students' programs in nursing in five aspects was at a high level. 2) The development of guidelines for digital literacy skills for students' programs in

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Nursing Science at Shandong College of Traditional Chinese Medicine. There are multiple approaches as follows: 1) From the first semester onwards, the graduation competency indicators and core curriculum framework will incorporate information literacy, 2) Increase or decrease case-based teaching, concept maps and structured debates, 3) Introduce elective courses in digital media production, establish standardized copyright and accessibility protocols, and organize university-wide digital works competitions to showcase achievements, 4) Developing a digital skills platform integrating databases and learning systems, and 5) Establish a compulsory cybersecurity module, implement a data breach response mechanism, and integrate digital risk assessment into course assessments.

Keywords: Digital Literacy Skills, Digital awareness, Digital integration, Critical thinking, Information literacy

Introduction

Digital literacy is an essential skill for learners in the 21st century. Information can be located and evaluated. Another one of their capabilities is digital content creation. The ability to generate worthwhile results using a range of digital equipment is what they consist of. (Nguyen & Habók, 2024). Research shows that students who are better at using digital tools tend to perform better in exams and assignments and improve their overall academic performance by finding better ways to learn. This skill can help them be more proactive in planning their study schedule and managing their learning activities during online classes. (Chen, 2025; Zakir et al., 2025). In the fields of health and nursing, nursing practice depends on the ability to master and use digital tools and systems. The ability to operate various electronic medical devices, use telemedicine tools, and utilize systems assisted by artificial intelligence, while strictly adhering to relevant safety protocols, is therefore essential for healthcare professionals. (World Health

Organization, 2025) In China, improving citizens' digital literacy has been listed as a key national strategic task. (Cyberspace Administration of China, 2021). The Chinese government has established a national intelligent education platform, in which digital literacy skills are seamlessly integrated with teaching. (Central Committee of the Communist Party of Cyberspace Administration of China, China and State Council, 2023). Efforts are underway to advance nationwide digital learning and capability development, intending to build a digital literacy education system that encompasses the entire society. (Cyberspace Administration of China, Ministry of Education, Ministry of Industry and Information Technology, Ministry of Human Resources and Social Security, 2022). Shandong has advanced the digital transformation of education through policy measures (Shandong Provincial Education Informatization 14th Five-Year Plan, 2022). Research into the digital literacy skills of nursing students at the college level is still in its infancy. It is therefore essential to develop educational strategies targeted at nursing students that align with the digital transformation of healthcare and medical education. This can only be achieved by first understanding the current level of digital literacy among these students.

This study aims to evaluate the current level of digital literacy among nursing students, construct a tailored digital literacy education framework to address their practical learning needs, and address these challenges. The study aligns with China's national strategy to accelerate the digital transformation of education, as well as the 2022 transformation plan.

Objectives

1. To study the level of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine.

2. To suggest the development guidelines of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine.

Literature Review

Theory of digital literacy skills:

1) Lanham, R. A. (1995) defines digital literacy as extending beyond traditional forms to encompass the comprehension of information presented through multiple channels and formats in the digital age. The manner in which information is presented is undergoing a transition from a state of uniformity, characterized by monolithic printed text, towards a more hybridized expression that integrates textual, auditory, and visual records. This shift in presentation mode is believed to give rise to more complex information combinations. Digital literacy is not merely about technical operation; it is also about achieving equal adeptness in comprehension and expression across textual, visual, and auditory symbolic systems.

2) Gilster, P., & Glister, P. (1997) developed the idea of 'digital literacy' in their work, taking its meaning beyond the conception of physical technical proficiency in operating devices and keyboard input. Digital literacy skills are more than just proficiency with digital tools. It is argued that this evolves into a comprehensive cognitive and practical competence within the digital ecosystem.

3) UNESCO (2025) defines digital literacy as the ability to access, handle, process, share, evaluate, and update information safely and ethically using digital tools and applications.

Concept of digital literacy skills: 1) Policy of digital literacy skills: Systematically promote citizens' competencies in digital access, creation, application, evaluation, interaction, sharing, innovation, and security (Cyberspace Administration of China, 2021). Development of digital platforms and resource

repositories to advance nationwide digital learning initiatives (Cyberspace Administration of China et al., 2022). An inclusive digital society by implementing the national education digitalisation strategy, enhancing the National Smart Education Platform (Central Committee of the Communist Party of China & State Council, 2023). It promotes digital transformation in education by enhancing the digital literacy of teachers and students, building dedicated networks and new infrastructure, establishing smart education and big data governance platforms, improving the provision of resources and learning spaces, and strengthening cybersecurity (Shandong Provincial Department of Education, 2022). And 2) Digital literacy skills are widely conceptualised as a multidimensional and integrated competency framework encompassing (Abubakari et al., 2025; Zakir et al., 2025). Digital literacy skills within the Digital Competence Framework are the ability to use digital tools and systems appropriately for learning, work and social participation. This is accompanied by the ability to think critically and to adhere to legal and ethical standards (Vuorikari et al., 2022). Digital literacy is about knowledge. It is also about skills. And it is about attitudes. These cover the cognitive, affective and behavioural domains. It reflects responsible online behaviour and the ability to adapt to technological change (Avinç & Doğan, 2024). In the 21st-century healthcare sector, nursing techniques are becoming more dependent on digital literacy skills. This means that practitioners must learn to use electronic medical devices, telemedicine tools, artificial intelligence-assisted systems and security protocols (World Health Organisation, 2025).

In this study, digital literacy skills refer to the ability to use digital tools effectively and critically, with a focus on security, in contexts such as learning, work, and social participation. Alongside knowledge of digital tools and systems, digital literacy encompasses the capacity to think critically and evaluate digital tools in professional settings. Digital literacy also emphasizes the ability to access, manage, analyse, evaluate, integrate, create, and communicate/disseminate

digital information and content, while adhering to privacy protection, data security, legal compliance, and ethical responsibility throughout the process. Digital literacy skills are organized into five aspects: Information Literacy, Critical Thinking, Digital Content Creation, Digital Integration, and Digital Awareness.

Methodology

Population and Sample Group: The population of this research are 1,331 students' program in Nursing Science at Shandong College of Traditional Chinese Medicine. Based on Krejcie and Morgan's sampling table (1970), the sample group for this research comprises 302 students' programs in Nursing Science enrolled in the 2025 academic year at Shandong College of Traditional Chinese Medicine. By using simple random sampling, the randomness and scientific validity of the sampling process were ensured.

Research Instruments: This study adopted a mixed-methods approach, utilizing questionnaires and interviews as the primary research instruments. All responses are provided freely based on actual circumstances and will be used solely for statistical analysis. All information collected will be kept strictly confidential.

Questionnaire: The questionnaire consists of the following two parts: The first section collected basic demographic information of the respondents, classified by gender, age, frequency of daily use of digital platforms and campus. The second section employed the 5-point Likert scale to assess the current situation of digital literacy skills for students' program in Nursing Science at Shandong College of Traditional Chinese Medicine. The questionnaire was designed based on digital literacy skills in five aspects: 1) Information Literacy, 2) Critical thinking, 3) Digital content creation, 4) Digital integration, and 5) Digital awareness. To ensure the reliability and validity of the questionnaire, the index of objective congruence (IOC) of the questionnaire was examined by three

experts, the IOC of questionnaire was 0.67-1.00, and through the distribution and collection of 30 questionnaires, a test was conducted, resulting in the overall Cronbach's alpha coefficient of the questionnaire being 0.916.

Interview: The first part is the Introduction of background information. The second part includes a series of open-ended interviews. The interview aimed to collect the respondents' opinions on the guidelines for digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine. The interviewee in this research was 5 experts from the college. The qualifications of interviewee are as follows: 1) at least 7 years of work experiences in college, 2) College department-level leaders or above, and 3) graduated with master's degree or above.

Data Collection

A total of 302 questionnaires were distributed to students the sample group, and 302 valid questionnaires were returned, yielding a 100% effective response rate. To propose the development guidelines of digital literacy skills for students' program in Nursing Science at Shandong College of Traditional Chinese Medicine, structured interviews were conducted with five experts from the college. The interviews were conducted either face-to-face or online, depending on participants' availability, and each session lasted approximately 30 to 40 minutes.

Data Analysis

The personal information of the respondents was analyzed by frequency and percentage. The current situation of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine in five aspects, the data was analyzed by mean and standard deviation. The data interpretation for average value is based on Rensis Likert (1932). The data

interpretation is as follows: 4.50-5.00 refers to the highest level, 3.50-4.49 refers to high level, 2.50-3.49 refers to medium level, 1.50-2.49 refers to low level, and 1.00-1.49 refers to the lowest level. The structured interview about the development guidelines for digital literacy skills of students' program in the college was analyzed by content analysis.

Results

Objective 1: To study the level of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine.

The analysis of the current state of digital literacy skills in students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine. The researcher presented the data as means and standard deviations.

Table 1 Mean and standard deviation of digital literacy skills for students' program in Nursing Science in five aspects (n = 302)

Digital literacy skills for students' program in Nursing Science		$\bar{X}$	S.D.	Level	Ranking
1	Information literacy	3.92	0.90	high	5
2	Critical thinking	3.93	0.91	high	3
3	Digital content creation	3.93	0.92	high	4
4	Digital integration	3.96	0.92	high	2
5	Digital awareness	3.98	0.92	high	1
Total		3.95	0.91	high	

According to Table 1, it was found that digital literacy skills for students' program in Nursing Science was at a high level ($\bar{X}$ = 3.95, S.D. = 0.91). Considering the results from the highest to the lowest mean were as follows: the highest

mean was Digital awareness ($\bar{X}$ = 3.98, S.D. = 0.92), followed by Digital integration ($\bar{X}$ = 3.96, S.D. = 0.92), and Critical thinking (= 3.93, S.D. = 0.91), respectively. And information literacy was the lowest mean ($\bar{X}$ = 3.92, S.D. = 0.90).

Objective 2: To suggest the development guidelines of digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine.

The development guidelines for digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine include: 1) From the first semester onward, information literacy should be embedded into graduation competencies and core courses, while strengthening database retrieval and evidence appraisal through practice and developing online reference management training modules in collaboration with the library. 2) Critical thinking can be enhanced by integrating dialectical clinical reasoning into teaching, applying visualization tools to deepen decision-making logic, and organizing structured online debates to cultivate the evaluation of health information credibility. 3) Digital content creation should be promoted through elective courses in digital media production related to Traditional Chinese Medicine, adherence to copyright and accessibility standards, and interdisciplinary evaluation via university-wide digital competitions. 4) Digital integration can be strengthened by ensuring access to updated cloud-based reference management tools, developing a specialized digital platform for Traditional Chinese Medicine nursing, and simulating clinical workflows through sandbox and flowchart tools. 5) Digital awareness should be reinforced by making cybersecurity training compulsory, embedding digital risk assessment into coursework, and cultivating ethical judgment in technology use through case-based analysis.

Discussion

Objectives 1: The current situation of digital literacy skills for students' program in Nursing Science at Shandong College of Traditional Chinese Medicine.

The results showed that digital literacy skills for students' program in Nursing Science were at a high level. This is consistent with the research and Chinese policy. In recent years, China has defining digital literacy and skills as a comprehensive set of competencies encompassing access, creation, use, evaluation, interaction, sharing, innovation, security, and ethics. (Cyberspace Administration of China, 2021; Cyberspace Administration of China et al., 2022).

Information literacy is at a high level. The research results indicate that the highest mean was students can use digital tools to search the reliable information from digital sources, but students can manage the literature about nursing through digital platforms was the lowest mean. This is because students excel more with tools than with information management. Research on digital literacy frameworks shows that levels of digital literacy develop at different rates across different learning contexts. They are often used to improve learning resources and support systems (Abubakari et al., 2025). In contexts with scarce digital resources, digital learning depends on access to the right tools and support, as well as practical strategies (UNESCO, 2025). In China, policies priorities developing a lifelong digital learning system and enhancing digital resource provision. This supports students in progressing from using digital tools to retrieve information to managing literature via digital platforms (Cyberspace Administration of China, 2021; Cyberspace Administration of China et al., 2022).

Critical thinking is at a high level. The highest mean was students can assess the reliability of healthcare-related information from digital resources. Students can make comprehensive decisions on treatment plans based on all the patient's diagnostic reports was the lowest mean. Pupils achieved higher

marks in evaluating the legitimacy of data, indicating they possess a fundamental grasp of evidence and risk. This suggests they need more training using real-life examples to learn how to assess the credibility of information when making clinical decisions. Digital health transformation requires talent development and the right systems (WHO, 2025). The Dig Comp framework also draws attention to urging that these abilities be applied to real-world tasks and situations (Abubakari et al., 2025).

Digital content creation is at a high level. The results showed that the highest mean was students can publish content that complies with nursing professional regulations on academic platforms; students can use digital tools to improve the clarity of digital teaching media for nursing was the lowest mean. This is because students are more familiar with content compliance and integration, but lack training in media quality enhancement. These competencies often require support from templates, example libraries, and rubrics, rather than being addressed through one-off assignments. Improving digital learning quality requires actionable strategies and resource support (UNESCO, 2025). China's policy definition of digital literacy encompasses elements such as creation, and security, and stresses the simultaneous advancement of standardization and capability enhancement (Cyberspace Administration of China, 2021).

Digital integration is at a high level. The results showed that the highest mean was students can create patient follow-up plans through digital platforms; students can seamlessly switch between different digital platforms to ensure continuity of care was the lowest mean. This is because that students have the basic skills needed for collaboration and process support. However, switching between platforms and ensuring continuity of care involves more complex system interoperability, permissions and data flows. Without simulation-based training and assessment, proficiency may be limited to operating within a single system rather than integrating across systems. Digital health systems are seen as

a means to improve service processes and enhance governance skills (WHO, 2025). The Digital China Initiative plans to establish an integrated advancement framework improving digital governance and security measures to create a policy environment that will facilitate the coordinated digital transformation of healthcare and education (Central Committee of the Communist Party of China, State Council, Cyberspace Administration of China, 2023).

Digital awareness is at a high level. The results showed that the highest mean was students can use digital tools in compliance with intellectual property regulations; students can demonstrate the basic usage of digital communication tools in team collaboration was the lowest mean. This is because students' heightened sensitivity towards privacy, compliance, and risk. This correlates with the sustained intensification of social education on cybersecurity and data compliance, alongside campus-wide online awareness campaigns in recent years. However, the relatively weaker proficiency in demonstrating collaborative communication tools suggests students may priorities individual compliance and self-protection, indicating room for improvement in team communication protocols. The National Action Plan explicitly incorporates security safeguards and ethical conduct into the core elements of digital literacy and skills, emphasizing the enhancement of digital security protection capabilities (Cyberspace Administration of China, 2021). The 2022 Work Priorities further set objectives, including the construction of digital security protection barriers and the advancement of legal and ethical standards (Cyberspace Administration of China et al., 2022).

Objectives 2: The development guidelines of digital literacy skills for students' program in Nursing Science at Shandong College of Traditional Chinese Medicine.

The development of guidelines of digital literacy skills for students' program in Nursing Science at Shandong College of Traditional Chinese Medicine. There are multiple approaches as follows: 1) The current situation of digital

literacy skills for students' programs in nursing in five aspects was at a high level.

2) The development of guidelines for digital literacy skills for students' programs in Nursing Science at Shandong College of Traditional Chinese Medicine. There are multiple approaches as follows: 1) From the first semester onwards, the graduation competency indicators and core curriculum framework will incorporate information literacy, 2) Increase or decrease case-based teaching, concept maps and structured debates, 3) Introduce elective courses in digital media production, establish standardized copyright and accessibility protocols, and organize university-wide digital works competitions to showcase achievements, 4) Developing a digital skills platform integrating databases and learning systems, and 5) Establish a compulsory cybersecurity module, implement a data breach response mechanism, and integrate digital risk assessment into course assessments. This approach will ensure that digital literacy supports the Chinese nursing tradition while also meeting the demands of smart healthcare development. Students will develop systems-thinking capabilities and an awareness of data responsibility through highly realistic healthcare ecosystem simulations and cross-platform, integrated training programmes. In the future, efforts should be made to strengthen practical training in data interface operations using real hospital information systems and to provide more in-depth training in the critical applications of AI-assisted decision-making. This approach will ensure that digital literacy serves the unique heritage of Chinese nursing practice and aligns with the demands of smart healthcare development. Digital literacy should be systematically developed and cultivated. This should be done through a tiered approach. It should be part of a core skills framework for citizens (Vuorikari et al., 2022). Digital literacy education requires an approach that advances skills, assessments, and teaching methods in tandem (Angel-Urdinola et al., 2025). The digital skills of nursing students are affected by technology, thinking, and social and emotional factors. This means they need to

be improved by teaching them systematically and getting them to use the skills in real situations (Erdat et al., 2023). Structural disparities exist among university nursing students in their ability to acquire information and their online practical skills, necessitating enhanced, discipline-specific, contextualized training (Martzoukou et al., 2024). Digital literacy shows significant correlations with academic performance and self-regulated learning, warranting its integration into core higher education development frameworks (Zakir et al., 2025).

Recommendation

For college administrators: Information literacy should be embedded from the first semester and aligned with graduation competencies through structured modules on database retrieval, evidence grading, credibility evaluation, and reference management, supported by coordinated library training and a centralized digital platform integrating professional resources.

For teacher: Instructional design and assessment should target identified weaknesses, using platform-based literature management tasks and evidence-based case discussions to strengthen analytical reasoning and justification of evidence, while improving the clarity and standardization of digital teaching materials.

For students: Learners should develop an evidence-based closed-loop learning process, strengthen cross-platform information integration skills, and uphold academic integrity and data security awareness.

Future research should address relatively weak information literacy by designing and implementing structured interventions. These interventions should be evaluated for their sustained effects using tests conducted before and after the intervention, with follow-up assessments. Objective performance measures should also be incorporated to enhance validity and reduce self-report bias.

Samples should be expanded to include different campuses, academic years and clinical placements to improve generalizability.

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