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The Development Guidelines of Freshmen's Digital Literacy Skills at Hechi University

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Abstract

Background and Aims: Digital literacy skills are essential for students' academic and career success in the 21st century. The report of the 20th National Congress of the Communist Party of China emphasizes the need to advance digitalization in education. However, disparities in students' digital literacy persist and are further exacerbated by unequal access to digital resources. This study aims to examine the status of freshmen's digital literacy skills at Hechi University and propose enhancement guidelines to support their development.

Methodology: This study employed a mixed-methods design, which consisted of two parts: 1) Questionnaire survey: A quantitative survey was conducted among 356 freshmen at Hechi University selected via simple random sampling. Mean, standard deviation, and percentage were used to analyze the status of their digital literacy skills, and 2) Structured interviews: Structured interviews were held with five experts possessing relevant experience. A development guideline for digital literacy skills among freshmen at Hechi University was proposed.

Results: Freshmen's overall digital literacy skills were at a medium level (M = 3.36). Cybersecurity skills were at a high level, while the other four dimensions, namely communication skills, information literacy skills, problem-solving skills, and digital technical skills, remained at a medium level, indicating an unbalanced development pattern. In particular, the latter four dimensions showed significant potential for improvement, suggesting the need for targeted adjustments in university educational planning. Based on these findings, experts proposed specific guidelines that emphasize the integration of theory and practice to enhance overall digital literacy skills.

Conclusion: A sustainable and integrated approach is required to enhance freshmen's digital literacy. The proposed guidelines emphasize curriculum alignment, student-centered pedagogy, and practice-oriented learning. From a technology education management perspective, they support universities' digital transformation and improve talent cultivation for long-term adaptability.

Keywords: Education Management; Digital Literacy Skills; Cybersecurity Skills; Communication Skills; Information Literacy Skills

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Introduction

In the 21st century, digital literacy skills have become an essential competency in the digital age. As a core skill for lifelong learning, it underpins personal growth, employment, and social participation, and is widely recognized as a vital survival skill in modern society (Vuorikari, 2022). Globally, digital literacy constitutes a key component of higher education, greatly advancing educational innovation, equity, and talent cultivation quality (Yan, 2022; Kong, 2023; Ministry of Education of the People's Republic of China, 2022). For university students, digital literacy strongly supports academic performance and long-term development (Gou, 2023; Zhang et al, 2025). For freshmen, it helps them adapt rapidly to digital learning environments, conduct information retrieval and collaborative learning, and develop critical thinking, teamwork, and communication (Zhu & Jiang, 2019; Olalere, 2022). It also boosts learning engagement and cognitive flexibility, eases cognitive burden, and lays a firm foundation for deep learning and sustainable adaptation to digital society (Caton, 2024; Yu, 2025). However, many freshmen encounter prominent challenges in developing digital competencies, including insufficient mastery of digital tools, heavy technological cognitive pressure, and inadequate training in information evaluation, critical thinking, and innovative application, which limit their efficient use of digital resources for academic learning and long-term development.

Against this background, although the significance of digital literacy has been widely acknowledged, systematic research on the digital literacy status of freshmen at Hechi University remains limited, and targeted and feasible promotion strategies for this group have not yet been formed. Therefore, this study investigates the current situation of digital literacy among Hechi University freshmen and puts forward practical improvement countermeasures. This research is of great significance for enhancing students' digital literacy, optimizing the university's talent cultivation system, and promoting the high-quality development of educational digitalization.

Objectives

1) To study the current situation of digital literacy skills of freshmen in Hechi University.

2) To propose the enhancement guidelines of freshmen's digital literacy skills at Hechi University.

Literature Review

Digital literacy skills are widely recognized as a core competency for individuals in the digital age, with scholars conducting in-depth research on their importance from diverse perspectives. Vuorikari (2022) proposed that digital literacy skills, regarded as a fundamental "survival skill" for adapting to digital society, are also one of the key competences for lifelong learning, essential for

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personal fulfillment, employability, and active social participation. Wu et al (2022) further reinforced this perspective, highlighting the indispensable role of digital literacy in navigating the modern digital landscape. For college students, Luai (2024) verified that digital literacy is a foundational ability for academic growth, supporting adaptation to global digital development and effective navigation of modern educational and professional environments. Meanwhile, Caton (2024) argued that digital literacy is a critical competency for improving learning fluency and college readiness, underscoring its indispensability for higher education and career success.

Against this backdrop, researchers have developed several systematic theoretical frameworks for digital literacy. United Nations Educational, Scientific and Cultural Organization (UNESCO, 2022) established a global digital literacy framework focusing on equity and inclusiveness, covering five dimensions: digital technology application, information literacy, digital ethics and social responsibility, digital communication and participation, and digital problem-solving. This framework connects digital literacy with sustainable development, educational equity, and cross-cultural adaptation. However, it is too macro and general, with limited practical operability for direct implementation. Vuorikari et al. (2022) put forward the DigComp 2.2 framework, which consists of five components: information and data literacy, communication and collaboration, digital content creation, digital safety, and problem-solving. Supported by 21 detailed indicators and over 250 cases, it comprehensively covers the whole process of digital information processing. Nevertheless, this framework is based on the EU educational and cultural context, making it difficult to adapt to China's educational digitalization and local application in higher education.

However, studies on digital literacy dimensions for Chinese college students, especially those in local undergraduate universities, remain fragmented and require further refinement. Wang & Chen (2021) established a seven-dimensional framework covering digital information cognition, acquisition, communication, analysis, security, problem-solving, and ethics. Although this framework addresses cognitive, practical, and ethical aspects, its dimensions are scattered and lack focus on academic scenarios such as scholarly literature retrieval for application-oriented undergraduates. Kong (2023) proposed a five-dimensional framework for educators, including digital awareness, skills, application, social responsibility, and professional development, which ignores students' needs in academic research and local industrial problem-solving. Sun (2024) developed a five-dimensional framework for undergraduates involving information processing, communication, content creation, digital life, and learning development. However, it fails to reflect the talent cultivation goals of local application-oriented colleges and does not consider regional industrial demands, such as those in Hechi.

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Therefore, based on a comprehensive synthesis of existing studies on digital literacy, this study develops a targeted digital literacy framework tailored to the cultivation of application-oriented talents in local undergraduate institutions in China, which consists of five core components: 1) Information literacy skills: The ability to accurately locate, critically evaluate, scientifically organize, and ethically apply digital information using digital platforms and tools. 2) Communication skills: The ability to engage in respectful, efficient, and ethical information exchange and collaborative interaction via digital tools. 3) Cybersecurity skills: The ability to identify, prevent, and respond to digital risks, and safely protect personal data, devices, and privacy in digital environments. 4) Problem-solving skills: The ability to use digital tools and cognitive thinking to identify, analyze, and resolve practical challenges in digital contexts. 5) Digital technical skills: The ability to proficiently operate and apply digital tools, platforms, and technologies to complete learning, research, and daily tasks efficiently.

Conceptual Framework

This research focuses on digital literacy skills, aiming to clarify the current level of freshmen's digital literacy skills at Hechi University and provide targeted enhancement guidelines. Based on a systematic analysis of existing theories and research on digital literacy skills, five core components are synthesized and extracted from mainstream academic perspectives and component systems in this field to form the research framework, which is as follows:

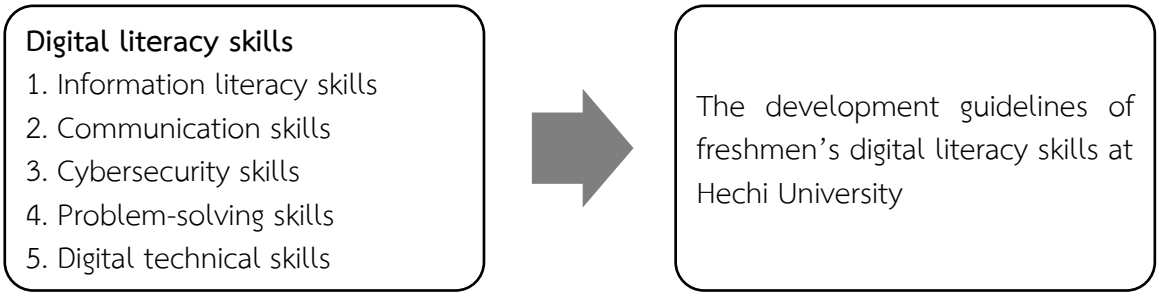


Figure 1 Research framework

Methodology

This study adopted a mixed-methods design. Quantitative data were first collected through a questionnaire to examine freshmen's digital literacy skills levels, followed by structured interviews to develop targeted enhancement strategies.

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Population and Sample

The population consisted of 4,695 freshmen enrolled at Hechi University during the 2025 academic year. Based on the Krejcie and Morgan sample size table (1970), a sample of 356 students was selected using simple random sampling.

Questionnaire

A self-developed questionnaire, Survey on the Current Status of Digital Literacy Skills among Freshmen at Hechi University, was used, employing a 5-point Likert scale. It assessed five dimensions: information literacy skills, communication skills, cybersecurity skills, problem-solving skills, and digital technical skills. Content validity was confirmed by three experts (IOC = 0.96). The questionnaire yielded a Cronbach's alpha of 0.983, indicating high reliability. All participants provided informed consent, and data confidentiality was ensured.

Structured Interview

Five university experts with relevant experience participated in structured interviews. An interview guide was developed based on the questionnaire results. With informed consent, one-on-one interviews were conducted, each lasting 30–40 minutes, focusing on improvement strategies across the five dimensions.

Data Collection and Analysis

Data were collected via an online survey platform in 2025, yielding 356 valid responses, and five experts were interviewed online in February 2026. Quantitative data were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation. Mean scores were interpreted according to Likert's (1932) five-level criteria (4.50–5.00 = highest; 3.50–4.49 = high; 2.50–3.49 = medium; 1.50–2.49 = low; 1.00–1.49 = lowest). Qualitative data from the interviews were analyzed using content analysis.

Results

Objective 1: To study the current situation of digital literacy skills of freshmen in Hechi University.

Table 1 Mean and standard deviation of digital literacy skills of freshmen in five aspects (n=356)

	Digital literacy skills	Mean	S.D.	Min	Max	Level	Ranking
1	Information literacy skills	3.32	0.62	1.33	5.00	medium	3
2	Communication skills	3.38	0.62	1.92	5.00	medium	2
3	Cybersecurity skills	3.64	0.71	1.92	5.00	high	1
4	Problem-solving skills	3.29	0.64	1.25	5.00	medium	4
5	Digital technical skills	3.16	0.72	1.00	5.00	medium	5

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Digital literacy skills	Mean	S.D.	Min	Max	Level	Ranking
Total	3.36	0.58	1.62	5.00	medium	

According to Table 1, the overall digital literacy skills level of freshmen across the five dimensions was at a medium level (M = 3.36, SD = 0.58). Among the dimensions, cybersecurity skills had the highest mean score (M = 3.64, SD = 0.71), reaching a high level, while the remaining four dimensions, communication skills (M = 3.38, SD = 0.62), information literacy skills (M = 3.32, SD = 0.62), problem-solving skills (M = 3.29, SD = 0.64), and digital technical skills (M = 3.16, SD = 0.72), were all at a medium level. The standard deviations ranged from 0.62 to 0.72, indicating a relatively consistent distribution of scores across dimensions. However, the minimum scores (1.00–1.92) and maximum scores (5.00) suggest the presence of individual differences among students.

Objective 2: To propose the enhancement guidelines of freshmen's digital literacy skills at Hechi University.

Based on the statistical results and expert consultation, the enhancement guidelines for freshmen's digital literacy skills at Hechi University are proposed. Prioritization is based on the mean scores of each dimension, with lower-scoring areas given higher priority. The specific guidelines are as follows: 1) Digital technical skills. As the lowest-scoring dimension, this area is identified as the top priority. Universities should strengthen training in digital tools and data awareness, while teachers should integrate software application tasks into disciplinary courses to enhance practical use. 2) Problem-solving skills. As another relatively low-performing dimension, universities should implement problem-based projects, scaffolded tasks, and innovative activities. Teachers are encouraged to guide students in digital content creation and structured thinking to support active learning. 3) Information literacy skills. Universities should embed relevant curriculum modules and provide training on library resources. Teachers should support academic database use, academic writing, and project-based learning to improve information evaluation skills. 4) Communication skills. Universities should promote collaborative activities and online communication scenarios. Teachers should guide students in digital communication norms and the use of collaboration tools. 5) Cybersecurity skills. As a relatively higher-performing dimension, this area should be further consolidated through continuous training. Universities should offer cybersecurity courses and awareness activities, while teachers should provide training on privacy protection and risk identification.

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Overall, these guidelines are derived from empirical findings and align with student-centered learning principles in higher education, emphasizing practice-oriented and competency-based development to support systematic improvement.

Discussion

The discussion is organized into two parts, as follows:

Objective 1: To study the current situation of digital literacy skills of freshmen in Hechi University.

The results indicate that freshmen's overall digital literacy skills are at a moderate level across all five dimensions, reflecting a transitional stage between basic education and higher education, where students move from foundational digital exposure to more advanced, discipline-oriented digital competence development. This finding is consistent with previous studies showing that freshmen often experience a gap between prior digital learning experiences and the more complex digital demands of higher education (Sun, 2024; Xu et al, 2024). While freshmen have developed basic digital competencies, they have not yet reached the level of independent and critical digital engagement required in higher education contexts. Similar patterns have been reported in other universities, where first-year students typically demonstrate functional digital skills but lack higher-order competencies such as critical thinking, creative problem-solving, and academic digital practices (Vuorikari, 2022; Singh, 2022). This indicates that the "moderate but balanced" level observed in this study may represent a common phenomenon among freshmen rather than an isolated case. A detailed analysis of each dimension further reveals an imbalance in the development of digital literacy skills.

First, cybersecurity skills achieved the highest mean score. This can be explained by the increasing emphasis on digital safety education in basic education and national policy guidance, such as initiatives promoting digital literacy among the general population (The State Council of the People's Republic of China, 2024). In addition, students' frequent exposure to real-life online risks enables them to accumulate experiential knowledge. From the perspective of constructivist learning theory, learners construct knowledge through interaction with authentic environments, which strengthens their ability to identify online risks and apply privacy protection strategies (Almulla, 2023).

Second, communication skills ranked relatively high. This is largely due to students' extensive use of social media and online collaboration tools in daily life and learning contexts (Boro et al., 2024). Such continuous informal digital engagement facilitates the natural development of communication competence. In line with constructivist principles, these skills

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are developed through repeated participation in meaningful social interactions within digital environments (Almulla, 2023).

Third, information literacy skills were at a moderate level. Although freshmen are capable of basic information retrieval through digital platforms (Singh, 2022), they lack systematic training in critical evaluation, academic information filtering, and knowledge organization required in higher education. This finding aligns with previous studies emphasizing that higher-order information literacy requires structured instruction and academic guidance (Wu et al., 2022; Yang et al., 2024).

Fourth, problem-solving skills scored relatively low. This can be attributed to the lack of opportunities in basic education to engage in complex, technology-integrated problem-solving tasks (Wang & Chen, 2021; Caton, 2024). From the perspective of curriculum articulation theory, there exists a misalignment between secondary education and higher education in terms of digital competence requirements (Xu et al., 2024). As a result, students are not adequately prepared to apply digital tools in solving real-world academic and practical problems.

Finally, digital technical skills had the lowest mean score. This finding highlights a structural gap between the basic operational skills emphasized in secondary education and the more advanced, discipline-specific digital skills required in higher education (Tinmaz et al., 2022). The insufficient alignment between different educational stages creates challenges for students in adapting to university-level digital learning environments. This imbalance is also noted in studies on digital literacy development, which emphasize the need for systematic and progressive skill training across educational stages (Zhu & Jiang, 2019; Zhang et al, 2025).

These findings have important implications for technology education management in local application-oriented universities. They suggest that the development of digital literacy should not only focus on skill acquisition but also address systemic issues such as curriculum alignment, instructional design, and the creation of authentic learning environments (Wu et al., 2022; Xu et al., 2024). Guided by student-centered and constructivist approaches, universities should facilitate the transition from passive use of digital tools to active and meaningful digital competence construction, thereby supporting students' long-term academic development and digital adaptability (Almulla, 2023; UNESCO, 2022).

Objective 2: To propose the enhancement guidelines of freshmen's digital literacy skills at Hechi University.

Based on empirical findings and supported by existing literature, this study proposes a systematic, student-centered, and competency-based framework for developing freshmen's digital literacy skills at Hechi University. The framework comprises four interrelated dimensions, namely, curriculum integration, pedagogical innovation, practice-oriented support, and assessment and sustainability mechanisms, which collectively promote the coordinated

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development of five core dimensions of digital literacy. The specific components are detailed as follows.

1. Curriculum integration: Information literacy skills serve as the foundational component. The university should embed information literacy modules into formal curricula and provide systematic training on library resources and academic databases. This approach aligns with the European Digital Competence Framework for Citizens (DigComp), which identifies information and data literacy as a core competence area (Vuorikari et al., 2022). In addition, integrating AI-related instruction and academic writing courses further supports students' ability to process, evaluate, and produce academic information (Zhang et al., 2025; Singh, 2022).

2. Pedagogical innovation: This model emphasizes student-centered and constructivist learning approaches. Strategies such as project-based learning, scaffolded tasks, and digital problem-solving projects enable students to actively construct knowledge through authentic tasks. This is consistent with constructivist learning theory, which highlights meaningful learning contexts and learner autonomy (Almulla, 2023). These approaches enhance problem-solving skills and facilitate the transformation of basic digital knowledge into higher-order competencies such as critical thinking and creativity (Sun, 2024; Caton, 2024).

3. Practice-oriented support: This model highlights the importance of continuous and authentic digital engagement. Activities such as discipline forums, cross-major collaboration, themed online communication, and simulated cybersecurity exercises provide real-world scenarios for applying digital skills. This reflects the principle that digital competence develops through participation in authentic environments (Tinmaz et al., 2022; Boro et al., 2024). Cybersecurity training that combines theory with practice strengthens responsible and safe digital behavior (Olalere & Soyemi, 2022; Wang & Chen, 2021).

4. Assessment and sustainability mechanisms: This model emphasizes long-term implementation and institutional support. Universities should establish multidimensional evaluation systems to monitor students' digital literacy development and ensure alignment between curriculum, teaching, and practice. In addition, continuous support mechanisms, such as curriculum articulation across educational stages, ongoing teacher professional development, and policy support, are essential for sustaining digital literacy development (Wu et al., 2022; Xu et al., 2024).

Across these four dimensions, the five components of digital literacy skills, namely information literacy skills, communication skills, cybersecurity skills, problem-solving skills, and digital technical skills, interact dynamically rather than developing in isolation. This interconnected structure reflects a competency-based approach, as emphasized in international frameworks such as UNESCO's digital competence standards (UNESCO, 2022).

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In summary, by integrating theoretical frameworks, empirical findings, and institutional strategies, this study proposes a coherent and scalable model for freshmen's digital literacy development. This model not only responds to the specific needs identified in this study but also provides a reference for technology education management in similar local application-oriented universities. Furthermore, these findings underscore the critical role of institutional and teacher-level digital empowerment in supporting students' digital literacy development (Chen, 2023; Guo, 2023; Zhang et al, 2025).

Recommendation

For university administrators: University administrators should promote the systematic integration of digital literacy modules into the formal curriculum and urge the university to offer compulsory cybersecurity courses. They should coordinate and organize a variety of activities, including discipline forums, cross-major and cross-grade collaborative tasks, themed online communication activities, campus cybersecurity promotion, themed class meetings, simulated network security exercises, digital problem-solving practice projects, and digital innovation competitions. Meanwhile, university administrators should take the lead in providing progressive training, such as library resource guidance, workshops on office and image-editing software, and micro-lessons on digital tools, and push for the regular release of safety reminders to build a supportive and well-structured digital learning environment.

For Teachers: teachers should deliver targeted training on academic databases, digital communication etiquette, privacy protection, and network risk identification. They should integrate digital content into professional teaching by offering AI and academic writing courses, designing project-based learning tasks and progressive scaffolded activities, and guiding students to use professional collaboration tools, mind mapping, and digital content creation software. Teachers are also expected to embed software application tasks into disciplinary courses and encourage students to use digital tools in presentations and assignments, linking technical skills with disciplinary practice.

For Students: students should actively participate in curriculum learning, library training, cybersecurity drills, digital innovation competitions, and cross-major collaborative activities to improve their information acquisition, critical thinking, and academic expression abilities. They should consciously learn and practice office software, digital creation tools, and online collaboration platforms, follow norms of digital communication and online safety, protect personal privacy, and identify network risks. By applying digital skills in project tasks, course

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presentations, and practical problem-solving, students can turn basic technical knowledge into comprehensive digital competence for academic and future professional development.

For future research: studies can be further expanded in two key directions: first, conduct a longitudinal tracking study on the development of digital literacy skills among Hechi University freshmen, collect dynamic data across different grade stages to explore developmental patterns, and revise relevant guidelines adaptively; second, explore the correlation between teachers' digital literacy and students' digital skill development, and clarify the driving role of teachers' digital competence in promoting students' digital literacy and learning engagement.

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