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# Digital Literacy Education Among Students: Status, Pathways, and Implications in the Current Digital Era

**Wang Yi[1]*, Wang Siqian[1]**
Institute of Education, Guizhou Normal University, Guiyang, China

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***Correspondence Author:**
Wyah1999@126.com

**Abstract:** This research aims to analyze in depth the digital literacy of students, which refers to their ability to effectively find, evaluate, create and communicate information using digital technology in the education and teaching process in higher education. In the digital age, digital literacy has become an essential and indispensable skill for personal, academic, and professional success. Cultivating digital literacy in university students is not only an important component of promoting the construction of higher education programs but also a crucial issue in facilitating the digital transformation of higher education. The study surveyed undergraduate students at Guizhou Normal University in Guiyang, China, using a structured questionnaire that covered six dimensions of digital literacy: information acquisition, communication and collaboration, digital content creation, security, privacy, and problem-solving. The results reveal that university students generally exhibit high levels of digital literacy, with no significant differences between genders. However, students from urban areas demonstrate significantly higher digital literacy levels compared to those from rural areas, particularly in security and privacy domains. The findings underscore the need for targeted interventions to enhance digital literacy in areas such as digital content creation and problem-solving. This study provides practical recommendations for higher education institutions to address these gaps and promote comprehensive digital literacy development among students especially in the fields of education and teaching.

## INTRODUCTION

The new wave of the digital technology revolution has become an important driving force for social progress (Jerbić & Švaco, 2023). Digital literacy is a key indicator of a country's international competitiveness and soft power. In the field of education, technology has become indispensable, revolutionizing traditional teaching and learning methods (Campisi, Forte, Carrillo, Vescan, & Brydges, 2018; Cremers, Wals, Wesselink, Nieveen, & Mulder, 2014). Innovative pedagogical approaches with digital enable educators to increase student engagement and accessibility (Pangrazio, Godhe, & Ledesma, 2020). Digital technology in education can develop critical thinking and problem-solving skills (Fitarahmawati & Suhartini, 2021; Lawson, Jordan-Fleming, & Bodle, 2015; Xu, Wang, & Wang, 2023). In addition, there is an urgent need to integrate

technology into education, especially distance learning appropriate for many institutions (Murtagh, Calderón, Scanlon, & Macphail, 2023; Timonen & Ruokamo, 2021)

Major countries and regions around the world have set enhancing the digital literacy and skills of their populations as a strategic goal, introducing plans and conducting digital skills training to improve the overall quality of their populations (Martínez-Bravo et al., 2022). Governments worldwide attach great importance to fostering citizens' digital literacy in order to build a digital talent system and ensure the sustainable and healthy development of the digital economy. Marc Prensky introduced the term "digital natives" in 2001 to describe the first generation of students who have been surrounded by and frequently use digital technology since birth (Prensky, 2001). As typical digital natives, university students are particularly crucial targets for cultivating digital literacy and skills (Blau, Shamir-Inbal, & Avdiel, 2020; Gyaurov, Fabricatore, & Bottino, 2022). Enhancing university students' adaptability, competence, and creativity in the digital age is key to building a "learning society where everyone learns, learning is everywhere, and learning is continuous" (Wu, 2024). This is of profound strategic significance and practical value for the sustainable development and progress of society in the digital era.

Technology has transformed the educational landscape by introducing tools and platforms that make learning more engaging, accessible, and effective. From online learning management systems to virtual classrooms, digital technologies have bridged the gap between educators and students, enabling knowledge exchange across geographical boundaries (Kirkwood & Price, 2013). In higher education, the integration of technology supports collaborative learning, personalized education, and interactive content delivery, which are critical in enhancing student engagement (Means et al., 2014). Furthermore, the development of digital competencies among university students is essential for ensuring that they can navigate and thrive in the modern workforce, where digital proficiency is increasingly a prerequisite (Van Laar et al., 2017).

The development of education in the digital era depends on the ability to utilize technology to create an inclusive and equitable learning environment. The use of technology in education can overcome various challenges, especially in urban and rural education systems (Kozma, 2005). Growing and providing insight into the current condition of digital literacy among students requires practical strategies to improve digital competence through targeted educational interventions, especially among students (Lahav, Talis, Gali, & Albert, 2019). Marc Prensky introduced the term "digital natives" in 2001 to describe the first generation of students who have been surrounded by and frequently use digital technology since birth (Prensky, 2001). As typical digital natives, university students are particularly crucial targets for cultivating digital literacy and skills. Enhancing university students' adaptability, competence, and creativity in the digital age is key to building a "learning society" where everyone learns, learning is everywhere, and learning is continuous (Karpudewan, Ponniah, & Ahmad, 2016).

Digital literacy has a real role in learning development (Audunson & Shuva, 2016; Hariharasudan & Kot, 2018; Zheng et al., 2024); although there are many studies that explore digital literacy, there is still fewer that focus on a comprehensive evaluation of digital literacy learning in higher education, specifically regarding geographic disparities

(urban vs. rural) in students' digital competence in problem-solving. Digital content is important in learning (Audunson & Shuva, 2016; Hariharasudan & Kot, 2018; Zheng et al., 2024). There is a need for targeted research to understand better and propose actionable actions and strategies to promote digital literacy in higher education and become a driver of improving the quality of learning, not the other way around (Derder et al., 2023; Punter, Meelissen, & Glas, 2017).

Digital developments can change a person's way of thinking and mindset when carrying out actions (Havenga, Olivier, & Bunt, 2023; Robinson, 2020). This study seeks to fill this gap by conducting an in-depth analysis of student digital literacy. This research aims to contribute practical insights in bridging the digital literacy gap and supporting the digital transformation of higher education for future use. Mastery and use of digital in the learning process is a necessity in creating a more effective and efficient learning process (Carte, Dharmasiri, & Perera, 2011; Ilin, 2022; Lewis, Pea, & Rosen, 2010). This research will provide an in-depth picture of the current state of students' digital literacy and actively seek effective ways to improve their digital literacy in learning so that they are able to respond effectively to the challenges of the digital era, adapt to the rapidly changing digital environment, and contribute to development high-quality education.

## THEORETICAL SUPPORT

### *The Concept of Digital Literacy*

The concept of "digital literacy" was formally introduced by Israeli scholar Y. Eshet-Alkalai in 1994 (Eshet-Alkalai, 2004), marking a new dimension of individual capabilities in the digital age. Following this, scholars like Paul Gilster contributed to further research and promotion of digital literacy, which gradually attracted significant attention from the library community. In August 2017, the International Federation of Library Associations and Institutions (IFLA) released the landmark "International Federation of Library Associations Digital Literacy Declaration." This declaration clearly defined the core value of digital literacy for personal growth and societal development, stating that digital literacy refers to the ability of individuals to effectively use digital tools and fully exploit their potential (Radovanović et al., 2020). In the digital age, the connotation of digital literacy has become increasingly rich and diverse. Its core aspects include the ability to acquire digital information, engage in digital communication, create digital content, enhance digital security, and solve digital problems (Huang, 2015).

### *Ability to acquire digital information*

The ability to acquire digital information refers to the skills required to efficiently browse, search, and evaluate digital resources.. According to Buckingham (2008), digital literacy involves the critical evaluation of online content to differentiate between credible sources and misinformation. In an era of information overload, individuals must develop these skills to make informed decisions and avoid falling victim to false narratives (Livingstone & Helsper, 2007). University students, as active participants in the digital

age, are expected to master these skills to engage effectively with academic and professional resources (Van Laar et al., 2017).

***Ability to engage in digital communication***

Engaging in digital communication entails effectively using digital platforms for interaction, collaboration, and information sharing. Platforms such as social media, email, and video conferencing have become essential tools for students to collaborate on academic tasks and maintain social connections. Helsper and Eynon (2013) argue that digital communication skills are fundamental in fostering collaborative learning environments and ensuring successful participation in professional networks. Additionally, understanding and adhering to online etiquette is crucial for maintaining constructive and respectful communication (Garcia, Argelogos, & Pivado, 2020).

***Ability to create digital content***

Creating digital content involves integrating existing knowledge with innovative thinking to produce unique and meaningful outputs. Ferrari (2012) emphasizes that content creation is not limited to technical skills but also includes the creative process of integrating multimedia elements such as text, images, and videos to communicate ideas effectively. This capability is essential for university students, who are often required to prepare presentations, design projects, and produce academic content. Moreover, digital content creation skills enhance employability by fostering innovation and adaptability in dynamic professional settings (Kozma, 2005).

***Ability to enhance digital security***

Digital security refers to the awareness and application of measures to protect personal and institutional data from unauthorized access, misuse, or cyber threats (Nykvist & Mukherjee, 2016; Zheng et al., 2024). Digital data security is very vulnerable if there is no awareness on the part of technology users in understanding and understanding how data security and privacy and also data quality are an important part. As cyberattacks become increasingly sophisticated, university students must understand best practices such as creating strong passwords, recognizing phishing attempts, and safeguarding sensitive information. Livingstone and Helsper (2007) note that digital literacy includes an understanding of cybersecurity risks and the ability to navigate the digital world safely.

***Ability to solve digital problems***

Problem-solving in digital contexts encompasses the ability to identify, analyze, and address challenges using appropriate digital tools and technologies. This includes troubleshooting technical issues, adapting to new software, and applying critical thinking to develop innovative solutions. Problem-solving is a key component of 21st-century skills, enabling individuals to thrive in a rapidly changing technological landscape (Van Laar et al., 2017). Students, as future professionals, must be able to adapt to global challenges. Digital mastery in learning requires these skills to adapt to ever-growing demands and maintain competitiveness in the global workforce (Kirkwood & Price, 2013).

### *Frameworks for Digital Literacy*

In the field of digital literacy, over 100 different models and frameworks have emerged (Brown & Xiao, 2018). However, up to this point, no widely recognized and universally accepted unified framework for defining and assessing digital literacy has been established. The creators of these frameworks often consider their respective political, economic, and social contexts, resulting in significant diversity and regional characteristics in the digital literacy frameworks (O'Neil et al., 2020). After introducing the concept of digital literacy, Y. Eshet-Alkalai further proposed an innovative digital literacy framework in 2004, which gained wide attention and recognition. Subsequently, organizations such as the American Library Association, the United States National Information Systems Committee, and the European Union also proposed their own digital literacy frameworks, as shown in Table 1.

**Table 1**. Major Framework Models of Digital Literacy

| No. | Framework Institution or Individual | Year | Main Content of the Framework |
|---|---|---|---|
| 1 | Y. Eshet-Alkalai (2004) | 2004 | (1) Visual Literacy: Ability to understand graphical information; (2) Recreational Literacy: Creative "copying" ability; (3) Branching Literacy: Mastery of hypermedia literacy; (4) Information Literacy: Ability to discern information; (5) Social-Emotional Literacy: Digital communication skills. |
| 2 | American Library Association (ALA) | 2012 | (1) Digital Device Operation Skills; (2) Cognitive and Technical Skills; (3) Digital Communication and Collaboration Skills; (4) Critical Thinking Skills; (5) Social Participation and Service Skills. |
| 3 | Joint Information Systems Committee (JISC) | 2013 | (1) Information and Communication Skills; (2) Learning and Thinking Skills; (3) Information and Media Skills. |
| 4 | European Union (EU) | 2013 | (1) Information Domain: Ability to judge information; (2) Communication Domain: Digital communication skills; (3) Content Creation Domain: Ability to integrate information; (4) Security Awareness Domain: Digital identity protection skills; (5) Problem Solving Domain: Ability to use digital means to solve problems. |
| 5 | New Media Consortium (NMC) | 2015 | (1) General Literacy: Ability to use digital tools; (2) Innovative Literacy: Innovation ability based on general literacy; (3) Interdisciplinary Literacy: Ability to integrate knowledge across disciplines. |
| 6 | UNESCO (United Nations Educational, Scientific and Cultural Organization) | 2017 | (1) Operational Domain: Digital device operation skills; (2) Information Domain: Digital content management skills; (3) Communication Domain: Digital communication skills; (4) Content Creation Domain: Digital content creation skills; (5) Security and Ethics Domain: Device, data, and privacy protection skills; (6) Problem Solving Domain: Ability to solve problems using digital technologies; (7) Professional Domain: Digital technology skills specific to professional fields. |

Table 1 provides a comprehensive comparison of key digital literacy frameworks proposed by various prominent organizations and scholars. Each framework reflects the evolving understanding of digital literacy over time, highlighting its multidimensional

nature and its relevance across educational, social, and professional contexts. These frameworks emphasize the essential skills and competencies required to navigate the increasingly complex digital environment. The table outlines contributions from notable researchers such as Eshet-Alkalai (2004), whose foundational framework identified five core literacies, including branching literacy and social-emotional literacy, which remain relevant today. It also includes institutional contributions, such as those from the American Library Association (ALA, 2012), which highlights cognitive and technical skills, and UNESCO (2017), which broadens the scope to include digital ethics and professional competence, especially in the world of education.

The frameworks are categorized based on their focal areas, such as: Information Skills The ability to locate, evaluate, and manage digital information effectively; Communication Skills Competence in digital collaboration and interpersonal interactions; Content Creation Skills in generating and sharing original digital content; Security Awareness Understanding and managing digital privacy and safety; Problem-Solving – The capacity to address challenges using digital tools. This table serves as a foundation for analyzing how different dimensions of digital literacy are prioritized across various contexts and highlights the shared and unique elements of each framework. Such insights provide a robust basis for developing tailored strategies to cultivate digital literacy among university students. Therefore, the frameworks presented in table 1, collectively demonstrate the multidimensionality of digital literacy. While there is a common emphasis on information management and communication, newer frameworks, such as UNESCO's (2017), introduce professional competencies and ethics to address emerging challenges in the digital landscape. This analysis provides a theoretical foundation for understanding how digital literacy can be cultivated effectively in higher education settings, ensuring that students are prepared for the demands of the digital era.

A comprehensive review of existing digital literacy frameworks shows that they generally focus on four core elements: technology and resources, information and culture, innovation and critical thinking, and security awareness and overall competence (Hanesová & Theodoulides, 2022). in the world of education, technological development is a necessity that must be followed in order to facilitate and also the effectiveness of the learning process, so that both students and teachers must be able to utilize and it would be better if they were able to develop technology that can be utilized in the learning process. Researchers strongly believe that a learning process if supported by an appropriate learning system will result in maximizing the ability and pattern of development of children's abilities in the learning process. Among these, particular emphasis is placed on interpersonal communication, participation, and service to society. This study, based on the EU's digital literacy framework, proposes that digital literacy should encompass the domains of information, communication and collaboration, digital content creation, security and privacy, and problem-solving. This research will try to focus on a questionnaire during the research process that was developed and used based on the domains that have become the focus of the research and can be explained in hypotheses about student digital literacy that the researchers have detailed. The hypotheses that researchers have developed are divided into 3 main parts.

***University students who own personal computers have significantly higher digital literacy than those who do not own personal computers ($H_1$)***

Ownership of a personal computer is directly related to increased exposure to digital tools and consistent opportunities for skill development in learning.. According to Venkatesh et al. (2003), the Technology Acceptance Model (TAM) posits that access to technology, combined with perceived ease of use and usefulness, significantly enhances digital proficiency. Students with personal computers are more likely to practice and apply digital literacy skills in academic and non-academic settings, leading to a measurable advantage. Research by Van Dijk (2005) further emphasizes that material access to technology—such as owning a personal computer is a critical factor in bridging the digital divide and promoting equitable skill development.

***Students in urban areas have much higher digital literacy than students in rural areas in the learning process ($H_2$)***

The disparity in digital literacy between urban and rural students can be attributed to differences in access to infrastructure, quality of education, and technological exposure. Urban environments typically provide better access to high-speed internet, digital tools, and training opportunities, fostering higher levels of digital competence. The Digital Inclusion Framework (Helsper, 2012) supports this notion, highlighting the role of socioeconomic and infrastructural factors in shaping digital skill acquisition. The role of social factors is as a tool or added value which greatly influences how digital facilities are obtained, so that equality must of course be done in realizing quality and competitive education. Furthermore, studies by UNESCO (2017) has shown that rural areas often face challenges such as limited internet access and fewer digital educational resources, which hinder the development of digital literacy among rural students in gaining knowledge.

***Digital literacy is significantly positively correlated with six domains: information, communication and collaboration, digital content creation, security and privacy, and problem solving especially in the education and teaching process ($H_3$)***

The digital world can be a source for children to be creative and more improvise their learning abilities to be better, the ability of students and teachers to develop more creative learning content can improve students' memory and enthusiasm in learning, so that students will be motivated and encouraged to understand learning better. Digital literacy is inherently multidimensional, with each domain contributing to a comprehensive skill set. For instance, the European Commission's DigComp Framework (Ferrari, 2013) outlines these domains as interdependent, suggesting that proficiency in one area often enhances capabilities in others. For example, students proficient in digital communication are better equipped to collaborate effectively, which also supports problem-solving in team settings. The concept of "transversal skills" (Voogt et al., 2013) further underscores the interconnection between these domains, emphasizing their collective role in fostering holistic digital competency. Empirical evidence from Huang (2015) also confirms significant correlations between these domains, reinforcing the idea that in learning digital literacy functions as an integrated framework and not an isolated skill.

## METHOD

This study employed a quantitative research design to investigate the digital literacy levels of university students and propose strategies for improvement. Quantitative research can provide a picture or data that is truly measurable clearly and the data argumentative skills can be seen in clearer and more comprehensive categories. Quantitative data will provide a picture in accordance with the hypothesis that the researcher has proposed (Jhon John W. Creswell, 2012). A structured questionnaire was developed based on the six dimensions of digital literacy: information acquisition, communication and collaboration, digital content creation, security, privacy, and problem-solving. The questionnaire was validated through a pilot study involving a small sample of students to ensure reliability and clarity of the items.

This study targeted undergraduate students at Guizhou Normal University, which has a total student population of approximately 20,000. A stratified random sampling technique was employed to ensure representativeness and diversity within the sample. A total of 119 students were selected, with the sampling process accounting for various demographic factors, such as gender, academic disciplines, year of study, and residence location (urban vs. rural). Sample selection is an important factor in supporting the truth of research results where the right sample will provide the right conclusion in a study. Sampling not only makes it easier for researchers to generalize research data but researchers also believe in building the effectiveness and credibility of research data, so that student answers that will be measured are truly representative of the entire research data or the research population that will be observed. This approach ensured that the selected sample reflected the overall characteristics of the university population.

The survey was distributed to the selected participants via an online platform to ensure accessibility and convenience. Student answers in the survey are an important factor and are a determinant in the integration of more accurate and comprehensive research results, so that in this study the researcher attempted to provide a questionnaire with clear rules or steps so that students can easily fill in the questionnaire answers and the results obtained are believed to be able to describe completely and maximally. Clear instructions were provided to encourage participants to respond truthfully to the questionnaire items based on their actual experiences and digital literacy practices. The anonymity and confidentiality of responses were strictly maintained throughout the study, which facilitated the collection of high-quality and reliable data.

The data collection process utilized a structured questionnaire based on well-established digital literacy frameworks, including the Digital Competence Framework for Citizens (European Union, 2017) and the Global Framework of Reference on Digital Literacy (UNESCO, 2023). The questionnaire was adapted to the study's specific research context, focusing on six dimensions of digital literacy: information acquisition, communication and collaboration, digital content creation, security, privacy, and problem-solving. To ensure clarity and relevance of the content, the questionnaire was refined through a pilot study involving 20 students from the target population, but it should be emphasized that the 20 students taken were representative of the entire research population, Consists of 31 items divided into six dimensions, as detailed in Table 2.

**Table 2.** Six Dimension Item Questionnaire

| Dimension | N0 | Item | Question |
|---|---|---|---|
| Information Domain | 1 | I can quickly and accurately obtain the information I need from the Internet. | How effectively can you search and retrieve information online? |
| | 2 | I can evaluate the reliability and relevance of information found online. | How well can you assess the quality of online information? |
| Communication and Collaboration | 1 | I can effectively collaborate with others using digital tools (e.g., video conferencing, shared documents). | How proficient are you in collaborating using digital platforms? |
| | 2 | I can actively participate in online discussions and share information appropriately. | How often do you engage in online discussions and share content responsibly? |
| Digital Content Creation | 1 | I can use digital tools to create content, such as writing documents or making presentations. | How skilled are you in creating digital content using various tools? |
| | 2 | I can adapt and repurpose existing digital content to meet my needs. | How capable are you of modifying existing content for different purposes? |
| Security Domain | 1 | I understand how to protect my devices from viruses and hackers. | What is your level of knowledge regarding device security? |
| | 2 | I regularly update software and use antivirus programs. | How frequently do you ensure your devices are secure? |
| Privacy Domain | 1 | I take great care to protect personal and other people's private information. | How aware are you of protecting personal and shared private information? |
| | 2 | I understand privacy settings on social media and other digital platforms. | How well do you manage privacy settings across digital platforms? |
| Problem-Solving Domain | 1 | I often use digital technology to solve general problems I encounter. | How frequently do you use digital tools to solve everyday problems? |
| | 2 | I can troubleshoot and resolve technical issues independently. | How confident are you in resolving technical issues without assistance? |

## RESULT AND DISCUSSION

The research that has been conducted and from the results of data analysis obtained in this research such as conducting reliability analysis on six dimensions of the questionnaire using SPSS software. The results are presented in Table 3 below:

**Table 3.** Reliability Analysis for Six Dimensions

| Dimension | Cronbach's Alpha | Number of Items |
|---|---|---|
| Information Domain | 0.865 | 4 |
| Communication and Collaboration Domain | 0.893 | 5 |
| Digital Content Creation Domain | 0.863 | 3 |
| Security Domain | 0.853 | 4 |
| Privacy Domain | 0.870 | 3 |
| Problem Solving Domain | 0.851 | 3 |

The research was conducted at Guizhou Normal University in Guiyang, China. The questionnaire was distributed to undergraduate students across multiple academic departments via an online platform. Specific measures were taken to ensure accessibility and engagement, including the use of email invitations and follow-up reminders to encourage participation. The online distribution method ensured a broad reach, accommodating students from urban and rural areas, as well as those with varying levels

of digital access. By focusing on this location, the study captured the digital literacy levels of a diverse group of students, reflective of the broader trends within higher education institutions in similar contexts.

The Cronbach's Alpha values indicate that the scale is reliable for evaluating digital literacy across all six dimensions. Among these, the Communication and Collaboration Domain exhibits the highest reliability ($\alpha = 0.893$), reflecting the clarity and coherence of the items measuring this domain. Other dimensions, such as the Information Domain ($\alpha = 0.865$) and the Privacy Domain ($\alpha = 0.870$), also demonstrate robust reliability, confirming that the items consistently capture the intended constructs. The high reliability scores across all domains suggest that the questionnaire is a reliable tool for assessing the digital literacy of university students. These results provide a strong foundation for further analysis and discussion of digital literacy competencies in higher education.

### *Basic Information of the Study Participants*

The core objective of this study is to gain an in-depth understanding of the digital literacy status of university students. To achieve this, a comprehensive and detailed analysis of students' digital literacy levels is necessary to reveal their actual conditions in areas such as digital skills, cognition, and attitudes. A score range from 1 (Strongly Disagree) to 5 (Strongly Agree) was assigned, with a mean score of 3 indicating an overall higher digital literacy level. The sample size of this study was 119. The average scores for each dimension of digital literacy were calculated and are presented in the Table 4.

**Table 4.** Descriptive Statistics for Six Dimensions

| Domain | N | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|---|
| Information | 119 | 1.00 | 5.00 | 4.0294 | 0.64946 |
| Communication and Collaboration | 119 | 1.00 | 5.00 | 3.8941 | 0.66883 |
| Digital Content Creation | 119 | 1.00 | 5.00 | 3.6134 | 0.86899 |
| Security | 119 | 2.00 | 5.00 | 4.1492 | 0.67829 |
| Privacy | 119 | 2.00 | 5.00 | 4.1989 | 0.69613 |
| Problem-Solving | 119 | 1.00 | 5.00 | 3.3417 | 0.99098 |

From Table 4, it can be concluded that the average scores for each dimension are all greater than 3, indicating that the overall digital literacy of university students is relatively high. Among the dimensions, the "Privacy Domain" (M = 4.20) scored the highest, followed by "Security Domain" (M = 4.15). On the other hand, the "Digital Content Creation Domain" (M = 3.61) and "Problem-Solving Domain" (M = 3.34) were weaker, with their standard deviations being noticeably higher than those of the other dimensions. This suggests that there is significant variation among the students in terms of digital content creation and problem-solving skills.

### *Analysis of Factors Influencing Digital Literacy in University Students*

A secondary test was conducted on the overall digital literacy and the six dimensions to check the homogeneity of variance. Since the variances were homogeneous, an independent samples t-test was conducted to examine gender differences in overall digital

literacy and each of the six dimensions. The results indicated that the p-values for all tests were greater than 0.05, meaning there is no significant gender difference in digital literacy. Researchers believe that digital literacy is greatly influenced by how long students spend using digital tools as a means of gaining knowledge and information.

**Table 5.** Independent Samples T-test for Ownership of Personal Computers

| Category | Personal computer | N | M | SD | t | P |
|---|---|---|---|---|---|---|
| Safety | Have | 109 | 4.1904 | .62998 | 2.224 | 0.028 |
| | Not | 10 | 3.7000 | 1.01242 | | |
| Privacy domain | Have | 109 | 4.2477 | .64375 | 2.586 | 0.011 |
| | Not | 10 | 3.6667 | 1.01835 | | |

An independent samples t-test was conducted on the ownership of personal computers, as shown in Table 5. The results indicate a significant difference between the ownership of a personal computer and the levels of digital literacy in the safety domain ($P = 0.028 < 0.05$) and the privacy domain ($P = 0.011 < 0.05$). This shows that students who have personal computers have a much better performance in the domain of safety and privacy compared to those who do not have personal computers. Students who have technology may have known the impact that will arise in, for example, interacting or communicating in the social world, because with computers they can more easily get the latest information that can be a driver and also increase their knowledge, especially in carrying out the learning process. No significant differences were found in the other domains related to personal computer ownership.

**Table 6.** One-Way ANOVA F-Test for Sample's Household Residence Area

| Category | Resident territory | N | M | SD | F |
|---|---|---|---|---|---|
| Safety | Township | 76 | 4.1480 | .62740 | 3.556* |
| | County/County-level City | 28 | 4.3661 | .70541 | |
| | Prefecture-level City | 13 | 3.8462 | .73271 | |
| | Provincial Capital/Direct-Controlled Municipality | 2 | 3.1250 | .53033 | |

Based on the above results, it can be concluded that there is a significant difference in the security domain level based on students' family residence. Based on the results above, it can be concluded that there is a significant difference in the level of security domain based on the student's family residence. Researchers argue that residence also has a significant difference in the digital utilization process, this could happen perhaps because of the ability to access different digital which occurs because the signal used or the understanding of the benefits of digital for the world of education has not been clearly and accurately described, so that students' digital literacy skills are still very low and have not been able to manage and utilize technology for good or the world of education. The low level of digital literacy is certainly an obstacle that must be overcome because it will make it difficult to obtain the latest information or knowledge and also mean that students will experience difficulties in dealing with a global landscape that is moving increasingly rapidly. Specifically, undergraduate students whose families reside in provincial capitals or municipalities under direct control have a much higher security domain than those

whose families reside in municipalities, county-level cities, or prefecture-level cities, and of course this needs to be further analyzed and verified.

### *Correlation Analysis*

The correlation between university students' digital literacy and its six dimensions was analyzed using Pearson correlation coefficients. The updated results, presented in the revised Table 7, demonstrate significant positive correlations between digital literacy and all six dimensions. The strength of these relationships varies, with the highest correlation observed in the Information Domain and Digital Content Creation Domain.

**Table 7.** Correlation Analysis of University Students' Digital Literacy and Six Dimensions

| Dimension | Pearson Correlation | Significance (p-value) | Number of Cases |
|---|---|---|---|
| Information Domain | 0.818** | <0.001 | 119 |
| Communication and Cooperation | 0.792** | <0.001 | 119 |
| Digital Content Creation | 0.817** | <0.001 | 119 |
| Security Domain | 0.747** | <0.001 | 119 |
| Privacy Domain | 0.774** | <0.001 | 119 |
| Problem-Solving | 0.651** | <0.001 | 119 |

Through bivariate correlation analysis, the results indicate that digital literacy is strongly correlated with all six dimensions. Among these, the Information Domain ($r = 0.818$) and the Digital Content Creation Domain ($r = 0.817$) exhibit the strongest associations, reflecting students' proficiency in these areas. The Problem-Solving Domain shows the lowest, yet still significant, correlation ($r = 0.651$), suggesting the need for targeted interventions to improve this skill. $p < 0.01$, indicating statistical significance for all correlations.These findings align with prior studies emphasizing the interconnected nature of digital competencies.

This study investigates the digital literacy levels of undergraduate students at Guizhou Normal University, located in Guiyang, China. As a comprehensive higher education institution, the university provides a unique context to examine digital literacy competencies, given its diverse student body from both urban and rural areas. The study assessed six dimensions of digital literacy information acquisition, communication and collaboration, digital content creation, security, privacy, and problem solving using a structured questionnaire distributed via an online platform. The findings indicate that university students generally exhibit high levels of digital literacy, particularly in the privacy and security domains. This can be attributed to increased societal awareness about online safety, reinforced by educational initiatives and media campaigns promoting responsible digital behavior. These results are in line with a broader trend observed in other research that emphasizes the growing importance of online privacy and security in the digital age both now and in the future.

However, students' performance in the digital content creation and problem-solving domains is comparatively weaker. This disparity may stem from the lack of emphasis on these skills in current academic curricula, as well as variations in students' personal experiences with technology. Rural students, in particular, may face additional barriers, such as limited access to advanced digital tools and training opportunities, which could

hinder their development in these areas. Future efforts should prioritize targeted interventions to address these gaps, focusing on hands-on training and curricular integration for digital content creation and problem-solving skills. This approach would foster a more comprehensive and balanced development of digital literacy among university students, enabling them to better meet the demands of a rapidly evolving digital world and enhance their competitiveness in the job market.

In the context of the digital age, university students generally exhibit high levels of digital literacy. This study found that students perform exceptionally well in the privacy and security domains, likely due to societal awareness, school education, and media promotion, which have strengthened students' consciousness of these issues. However, their performance in the digital content creation and problem-solving domains is relatively weaker, which may be influenced by differences in course focus and personal interests. Students' skills and experiences in these areas are uneven. Future efforts should focus on targeted training for these two domains to foster comprehensive and balanced development of digital literacy among university students, enabling them to better meet the demands of the times for talent.

There was no significant difference in digital literacy between genders. This suggests that, in cultivating digital literacy, there is no need to design specialized training strategies based on gender differences (Rizal et al., 2021). A unified and comprehensive educational approach should be implemented to promote the collective improvement of digital literacy among all students and The presence or absence of personal computers significantly impacts the security and privacy domains of digital literacy. Students who own personal computers tend to have more hands-on experience with practices like security measures and privacy settings (Yeşilyurt & Vezne, 2023). However, no significant differences were found in other domains, indicating that personal computers are not a key factor influencing other aspects of digital literacy.

The students' family residence location showed a significant correlation with the security domain. University students living in provincial capitals or directly governed municipalities exhibited higher levels of security literacy. This phenomenon can be attributed to the relatively abundant digital resources in large cities, as well as more extensive and in-depth network security training and awareness campaigns. In contrast, small cities and rural areas are relatively weaker in these areas. The findings reveal a significant correlation between students' family residence location and their proficiency in the security domain of digital literacy. Specifically, university students residing in provincial capitals or directly governed municipalities exhibited higher levels of security literacy compared to their peers from smaller cities and rural areas. This disparity can be explained using Van Dijk's Digital Divide Theory (2005), which emphasizes the role of material access, skills access, and usage access in creating inequalities in digital proficiency. Urban areas typically provide abundant digital resources, including advanced internet infrastructure and greater access to cybersecurity awareness programs, which enhance residents' digital security knowledge and practices.

In contrast, students from smaller cities and rural areas often face limited access to such resources and training opportunities, leading to lower levels of security literacy. These

findings align with Helsper's (2012) Corresponding Fields Model, which suggests that socioeconomic and infrastructural factors significantly influence digital skills development. To further explore the educational implications, the socio-geographic disparity in security literacy underscores the importance of integrating targeted cybersecurity education into university curricula. For instance, students from rural areas could benefit from tailored workshops or online training modules that focus on practical cybersecurity skills, bridging the gap created by infrastructural inequities.

Digital literacy is significantly correlated with all six dimensions, with a particularly strong positive correlation between digital literacy and the information domain and digital content creation domain. The correlation with the other domains is moderate. This result highlights the central importance of digital literacy within the broader system (Wuyckens et al., 2022). In educational practices, it is crucial to emphasize a multidimensional, collaborative cultivation model. By building a foundation in information literacy and enhancing digital content creation and problem-solving skills, the overall digital literacy level can be significantly improved (Park et al., 2020). This, in turn, enables students to better address the multifaceted challenges of the digital era, while equipping them with the necessary abilities and knowledge to effectively solve related problems and meet the comprehensive quality requirements for talent in the digital age.

Therefore,In the digital age, higher education has become the core force and solid foundation for driving the digital transformation of education (Khan et al., 2022). In response to the urgent demand for societal transformation and upgrading, cultivating professionals with strong digital literacy is not only a key indicator for defining talent cultivation standards and quality, but also a necessary path for the sustained and robust development of higher education. Through the analysis above, it is clear that university students generally exhibit high levels of digital literacy. However, there are differences between urban and rural students, with urban students demonstrating superior digital literacy (Afriliandhi et al., 2022). The cultivation of digital literacy among university students remains a long-term challenge.

### *Improving Teachers' Digital Literacy*

Teachers with strong digital awareness, rich digital knowledge, and ample digital skills are indispensable key strengths in leading the digital transformation of education. The level of teachers' digital literacy is crucial for enhancing teaching quality, building an outstanding educational system, and nurturing highly qualified talent. Universities should organize digital literacy training sessions for teachers, invite experts to give lectures or seminars, and systematically impart knowledge related to digital literacy (Sánchez-Cruzado et al., 2021). Universities should also encourage teachers to improve their digital self-efficacy. Only when teachers demonstrate a deep understanding and keen perception of digital technology will university students be more inclined to actively choose and apply appropriate digital technologies in educational activities. Furthermore, when teachers embrace digital technologies with enthusiasm and deep interest, students will be motivated to explore and learn various digital technologies, so that they are actively involved in an effective and efficient learning process.

### *Developing Digital Twin Courses*

With the rapid development of digital technologies, the digital classroom ecosystem is undergoing an unprecedented evolution (Hazrat et al., 2023). Currently, the application of digital technologies in teaching remains primarily at the tool level. In the face of the digital wave, universities must deepen the cultivation of students' diverse thinking skills, especially focusing on the development of digital divergent thinking, digital creative thinking, digital dynamic thinking, digital abstract thinking, and digital reverse thinking (Zhou & Zhu, 2023). Universities should keep pace with the times by adopting a twin-track approach, achieving in-depth integration and collaborative innovation between "digital" and professional courses. This would optimize talent cultivation quality and nurture new-era professionals who not only possess specialized knowledge but also strong digital literacy.

### *Optimizing the Digital Literacy Ecosystem in Higher Education*

The cultivation of digital literacy is undoubtedly a systematic project that requires joint efforts and collaboration from multiple parties. Its scope goes far beyond traditional classroom teaching and should permeate into the broader digital ecosystem closely related to students' campus life (Bojórquez-Roque et al., 2024). With the rapid advancement of technology, many daily academic tasks for university students can now be easily completed online, such as digital enrollment processes, online course selection, and the convenience of grade queries. These digital environments have subtly become effective tools for students' self-directed learning and inquiry, while also providing important platforms for collaboration, emotional experience, and knowledge internalization (Bautista,2024). In such a digital ecosystem, university students can not only access knowledge and information through online platforms, but also utilize digital tools for project collaboration, team discussions, and even emotional communication and psychological counseling. Therefore, the cultivation of digital literacy should be integrated into the entire campus life of students, allowing them to continuously improve their digital skills, digital thinking, and digital ethics through daily digital practices, thereby comprehensively enhancing their digital literacy.

In the end , to enhance their digital literacy, students should actively engage with available resources and opportunities both inside and outside the classroom. This includes participating in workshops and training programs focused on digital skills, exploring digital tools for academic and personal projects, and seeking guidance from teachers and peers when facing challenges. Additionally, students are encouraged to practice ethical digital behaviors, such as protecting their personal data, evaluating the credibility of online information, and using technology responsibly. Universities should also consider providing dedicated support services, such as digital literacy mentoring programs, access to advanced technologies, and online resources, to empower students in becoming proficient digital citizens. By taking ownership of their learning and using these recommendations, students can develop the competencies needed to thrive in the digital age so they can meet the global challenges of the future.

## CONCLUSION

This study provides valuable insight into students' digital literacy levels in the world of education, especially in the teaching and learning process, which consists of six main domains: information acquisition, communication and collaboration, digital content creation, security, privacy, and problem-solving. These findings highlight that although students in the educational process demonstrate strong competencies in security and privacy, there is still room for improvement in digital content creation and problem-solving skills. This research also highlights the impact of geographic mapping, with students in urban areas showing higher levels of digital literacy than students in rural areas. These findings align with existing theories regarding the digital divide and well-being to encourage educational institutions and policymakers to address this gap through tailored training programs, curriculum adjustments, and wider access to digital resources. By leveraging these insights, higher education institutions can play a critical role in cultivating comprehensive digital literacy among students, equipping them with the skills necessary to thrive in the future. Future research should explore additional factors that influence digital literacy, such as socio-economic status and access to advanced technology in the education and learning process so that the findings that researchers have obtained can be further refined to support a higher quality education world.

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