

Research on the Current Situation and Cultivation Path of Digital Literacy of Normal Students in Border Ethnic Areas

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Abstract: The digital literacy of normal students in border ethnic areas is crucial to promoting the development of basic education in these regions. Improving the digital literacy of normal students is an important means to enhance education quality and promote educational equity. Based on the "Teachers' Digital Literacy Framework" and the characteristics of normal students in border ethnic areas, this study prepared a questionnaire and distributed it to normal students in three normal universities in Province Y. The results show that there are significant differences in the digital literacy levels of normal students of different grades; significant differences exist among liberal arts, science, and arts and sports students in their digital literacy levels; there is no significant difference in the digital literacy levels of normal students from different places of origin such as urban areas (including county towns), towns, and rural areas; the digital literacy level of normal students is correlated with family economic conditions; curriculum teaching is the main channel for improving the digital skills of normal students, among others. Based on this, it is proposed: first, to create comprehensive digital education and teaching scenarios for normal students; second, to integrate digital literacy cultivation into various courses for normal students; third, to coordinate among families, schools, and communities to expand the educational field of digital literacy for normal students; fourth, to strengthen normal students' digital social responsibility and digital citizenship literacy; fifth, to fundamentally enhance normal students' digital literacy and innovative application ability.

Keywords: digital literacy; normal students; border ethnic areas; cultivation path

1. Introduction

The cultivation of digital literacy among normal students is a key support for realizing the digital transformation of education in China. The Overall Layout Plan for Digital China Construction proposes to "vigorously implement the national education digitalization strategic action." On November 30, 2022, the Ministry of Education officially released the industry standard Teachers' Digital Literacy, which points out the direction for the development of teachers' digital literacy. In May 2023, during a collective study session, the leader emphasized that "education digitalization is an important breakthrough point for China to open up new tracks for educational development and shape new advantages in educational development." The quality of education and cultivation of normal students in border ethnic areas is related to the quality of basic education in these regions. As the reserve force of the teaching team, the improvement of normal students' digital literacy is not only a key support for education digital transformation but also an essential path to realizing education modernization [1], as well as a key measure to narrow regional education gaps [2]. To strengthen education, it is necessary to first strengthen teachers. Improving the digital literacy of normal students is an important foundation for promoting education digitalization. Cultivating a team of normal students with solid digital literacy can not only improve their professional skills and enable them to adapt to the demands of the education market, but also plays a vital role in helping teachers adapt to the development of the digital era and educational innovation and reform.

2. Literature Review

The concept of digital literacy was first proposed in 1994 by Israeli scholar Yoram Eshet-Alkalai. Eshet-Alkalai believed that digital literacy is an essential skill for humans in the digital age, consisting

of graphic-visual literacy, reproduction literacy, branching literacy, information literacy, and socio-emotional literacy. In 1997, American technology journalist Paul Gilster defined "digital literacy" as the key ability to understand and use complex information presented by computers. With further social development and changes in digital technology, digital literacy has far exceeded basic skills in handling computers. It includes the use and production of digital media, information processing and retrieval, participation in social networks for creating and sharing knowledge, as well as a wide range of professional computing skills (UNESCO, 2011). It is the basic capability required in the digital society (JISC, 2014). In March 2023, the World Summit on the Information Society (WSIS) emphasized that building an inclusive digital society must be supported by a nationwide digital literacy program. At present, foreign research on digital literacy includes interpretative studies on important documents issued by certain international organizations in the field of digital literacy and skills improvement, flagship projects launched, and various practical activities. However, it lacks an overall insight into the full picture of practical progress in the field of digital literacy and skills.

The earliest domestic literature is the 2006 article Revolution and Conflict — Pedagogical Thinking of Educational Informatization by Wang Xiaohui [3], which first proposed "digital literacy." In China, the number of publications has gradually increased since 2012, with sustained growth in attention to digital literacy in the past three years. For example, Ma Xing [4] et al. (2011) believed that college students' digital literacy is one of the important components of 21st-century core literacy, and preliminarily determined a college students' digital literacy evaluation index system consisting of four dimensions and seventeen secondary indicators. In November 2022, the Ministry of Education issued the industry standard Teachers' Digital Literacy, which clearly defines teachers' digital literacy as the awareness, ability, and responsibility to appropriately use digital technology to acquire, process, use, manage, and evaluate digital information and resources; discover, analyze, and solve educational and teaching problems; and optimize, innovate, and transform educational and teaching activities. The Teachers' Digital Literacy framework includes five primary dimensions, thirteen secondary dimensions, and thirty-three tertiary dimensions.

As of 2023, research on digital literacy in China has involved disciplines such as education, information science, and computer science. The research focus is mainly on the connotation, characteristics, cultivation, and evaluation of digital literacy, with research objects concentrated on students, teachers, libraries, and other groups or departments. However, there has been little attention to the digital literacy of normal students. Since 2024, scholars have begun to focus their research on the group of normal students. Su Linmeng [5] et al., from the perspective of the philosophy of educational technology, condensed the practical connotation of digital literacy education for normal students into three dimensions: subjectivity, qualification, and socialization. Yang Xiaohong [6] et al., aiming at the Teachers' Digital Literacy standard, constructed a digital literacy framework for normal students. Based on distinguishing the differences between the digital literacy of normal students and that of teachers, they built a framework for normal students' digital literacy, including five primary dimensions, thirteen secondary dimensions, and twenty-eight tertiary dimensions.

The cultivation of digital literacy among normal students in border ethnic areas is an important means to effectively bridge the regional digital divide and promote educational equity. It is urgently necessary to carry out in-depth research on the current situation of digital literacy cultivation among normal students in this region and explore cultivation paths that reflect the characteristics of border ethnic areas.

3. Basic Information of the Questionnaire

3.1. Survey Subjects and Distribution of Samples

The subjects of this survey are normal students from three normal universities in Province Y, a border ethnic area. Referring to the Normal Students' Digital Literacy Framework (Yang Xiaohong, 2024), the questionnaire was designed in accordance with the "1-5-13-28" four-level dimensions of normal students' digital literacy, with a total of 32 questions. In June 2025, the online questionnaire was distributed through the Wenjuanxing mini program. The questionnaire adopted a five-point Likert scale ("strongly disagree" = 1, "strongly agree" = 5). A total of 720 questionnaires were collected, with 687 valid questionnaires, resulting in an effective rate of 95.42%. The distribution of the survey sample is shown in *Table 1* below:

Table 1 Distribution of Survey Samples

Variable	Option	Frequency	Percentage (%)	Mean	Standard Deviation
Gender	Male	108	15.7	1.84	0.364
	Female	579	84.3		
Grade	Freshman	244	35.5	2.05	0.982
	Sophomore	233	33.9		
	Junior	140	20.4		
	Senior	70	10.2		
Discipline	Liberal Arts	544	79.2	1.28	0.596
	Science	91	13.2		
	Arts and Sports	52	7.6		
Place of Origin	Urban (including county town)	196	28.5	2.27	0.876
	Town	112	16.3		
	Rural	379	55.2		
Device Ownership	Computer + Tablet + Mobile Phone	254	37	1.69	0.578
	Computer + Mobile Phone only	392	57		
	Mobile Phone only	41	6		

3.2. Reliability and Validity Test

To ensure measurement validity, the author conducted reliability and validity tests on the questionnaire results. Using SPSS 27 for data testing, the overall Cronbach's α of the scale was 0.922, and the Cronbach's α values of each dimension were between 0.7 and 0.9. Through KMO and Bartlett's sphericity tests, the overall KMO value of the questionnaire was 0.947, and the approximate chi-square significance of Bartlett's sphericity test was infinitely close to 0. The KMO values of each dimension were between 0.74 and 0.91, and the approximate chi-square significance of Bartlett's sphericity test was $p < 0.001$. The items of the scale had good correlations with each other. The questionnaire demonstrated good reliability and validity.

4. Survey and Analysis of the Current Situation of Digital Literacy of Normal Students in Border Areas

4.1. Overall Performance of Digital Literacy

The data show that the overall digital literacy score of normal students in border ethnic areas is at an average level (3.15 ± 0.54), with the highest score in "digital application" (3.23 ± 0.66) and the lowest score in "digital awareness" (3.02 ± 0.63).

Digital application [6] includes four modules: digital teaching design, digital teaching implementation, digital academic evaluation, and digital collaborative education. Students can proficiently use online documents (such as Tencent Docs, Kingsoft Docs) to carry out collaborative revision of group assignments and collaborative education between home and school ($M = 3.34$). They can also use common mind mapping software, such as XMind and Muboo, to design unit knowledge maps, and complete teaching design and implementation with the help of digital tools ($M = 3.26$). They are proficient in using teaching platforms, such as DingTalk and Chaoxing Learning, to assign layered tasks ($M = 3.27$).

Digital awareness includes three aspects: digital cognition, digital willingness, and digital determination, in which students' performance is generally unsatisfactory. Most students occasionally take the initiative to observe high-quality lesson examples from the National Primary and Secondary School Smart Education Platform ($M = 3.05$), rarely persist in using platforms such as "Rain Classroom" for teaching practice ($M = 2.83$), and some students do not have the habit of backing up courseware to deal with sudden network lag ($M = 2.95$). Students generally lack the willingness and determination for digital learning.

4.2. Analysis by Demographic Variables

When designing the questionnaire, information such as gender, place of origin, grade, discipline, device ownership, and source of digital skills of the students was collected. Using independent samples

t-test, analysis of variance, and multiple response analysis, the following results were obtained:

In terms of grade, the total digital literacy scores of freshmen, sophomores, juniors, and seniors were 68.05 ± 12.19 , 68.22 ± 10.98 , 71.81 ± 12.24 , and 71.61 ± 12.00 , respectively. The total score of digital literacy showed significant differences among grades ($p < 0.01$), and the three dimensions of digital awareness, digital technology knowledge and skills, and digital application also showed significant differences among grades. Post-hoc tests revealed that the digital literacy levels of freshmen and sophomores were lower than those of juniors and seniors.

Taking School S in Province Y as an example, normal students in the freshman year take the Fundamentals of University Computer course, focusing mainly on basic operations of the Office software suite. In the sophomore year, they study Information-based Teaching Design and Application, focusing on innovative application of PowerPoint and AI-empowered teaching design. In the junior and senior years, students participate in practical activities such as simulated teaching and teaching competitions, combining theoretical knowledge with practical teaching design and course organization through a series of hands-on teaching activities, thereby further improving their digital technology capabilities and digital teaching application skills.

In November 2024, the General Office of the Ministry of Education issued the Notice on Strengthening Artificial Intelligence Education in Primary and Secondary Schools [7], which proposed to "integrate the actual situation of primary and secondary school education and teaching with the current development of artificial intelligence, strengthen top-level design and departmental coordination, coordinate the efforts of universities, teaching and research institutions, high-tech enterprises, and primary and secondary schools, and jointly promote the integrated development of AI education in primary and secondary schools and universities" and to "basically popularize AI education in primary and secondary schools by 2030." This sets new requirements for the digital technology capability and digital application ability of normal students, making the strengthening and improvement of digital literacy cultivation for normal students an urgent task.

In terms of discipline, the total digital literacy scores of normal students in liberal arts, science, and arts and sports were 68.61 ± 11.57 , 70.00 ± 12.79 , and 74.40 ± 12.27 , respectively. There were significant differences in the total score of digital literacy across disciplines ($p < 0.01$), and the three dimensions of digital awareness, digital technology knowledge and ability, and digital application also showed significant differences across disciplines ($p < 0.01$). Post-hoc tests showed that in terms of digital literacy, arts and sports students > science students > liberal arts students. Taking School S in Province Y as an example, liberal arts and science normal students focus mainly on specialized courses of their respective disciplines in their professional studies, and public courses offer computer- and AI-related courses. Digital technology ability is mainly improved through public courses, teaching practice activities, personal interests, and other aspects. Due to the professional characteristics and college background of arts and sports students, taking art students as an example, the college offers professional or elective courses such as film and television editing, UI design, and layout design. Some students engage in related work such as photography and videography, video editing, and platform hosting after graduation. Whether in professional study or in personal career intentions, arts and sports students have better digital literacy than those in liberal arts and science. Compared with liberal arts, most science normal majors study digital technologies with higher technical content, such as software use, artificial intelligence, and big data, while liberal arts students are less sensitive to data technology. At the same time, science students have higher self-efficacy in technology than liberal arts students, and their problem-solving approaches tend to be more technology-oriented [8]. The above reasons have led to differences in digital literacy among normal students of different disciplines.

In terms of place of origin, regarding whether students are from within or outside Province Y, the total digital literacy scores of normal students from within the province and from outside the province were 69.18 ± 11.54 and 69.65 ± 14.27 , respectively, and there were no significant differences in any dimension of digital literacy based on whether the place of origin was within the province ($p > 0.05$). The total digital literacy scores of normal students from urban areas (including county towns), towns, and rural areas were 70.55 ± 12.69 , 67.92 ± 12.17 , and 68.94 ± 11.31 , respectively. There was no significant difference in the total score of digital literacy based on place of origin, but there was a significant difference in the dimension of digital technology knowledge and ability based on place of origin ($p < 0.05$). Post-hoc tests showed that students from urban areas (including county towns) had higher digital technology knowledge and ability than students from towns and rural areas. This shows that the level of economic development, quality of education, and construction of digital resources in different regions affect normal students' understanding and mastery of digital technology concepts and principles, as well as their choice and use of digital technology resources.

In terms of device ownership, the total digital literacy scores of normal students using computer + tablet + mobile phone, computer + mobile phone, and mobile phone were 71.97 ± 12.05 , 67.79 ± 11.13 , and 66.07 ± 14.60 , respectively, and there were extremely significant differences in the total score of digital literacy based on device ownership ($p < 0.001$). At the same time, the three dimensions of digital technology ability, digital teaching application, and digital social responsibility and digital professional development also showed significant differences based on device ownership. Since the results of Levene's test for homogeneity of variances based on the mean value of each dimension were not significant, the study used Welch's ANOVA to further explore the differences between groups. The results showed that university students with different device ownership had significant differences in scores in the dimensions of digital technology knowledge and ability, digital application, and digital social responsibility and digital professional development ($p < 0.05$). Among them, students whose device ownership was computer + tablet + mobile phone had higher digital literacy than students whose device ownership was only computer + mobile phone. It can be seen that device ownership has a relatively large impact on the digital literacy of normal students, and normal students with multiple electronic devices are better in all dimensions of digital literacy than those using two or one device. For normal students, the source of electronic devices mainly comes from family economic support, which is closely related to family economic capacity. Family economic capacity provides positive support for the digital literacy of normal students.

The sources of digital skills are mainly concentrated in teacher education courses, self-study, club activities, and family education. A multiple response analysis of the sources of digital skills in the questionnaire results showed that the case percentage for "teacher education courses" was 83.40%, followed by "self-study" at 56%, "club activities" at 40%, and "family education" at 15.1%. It can be seen that teacher education courses are the main source of digital skills for normal students. Interviews with normal students revealed that, in addition to teacher education courses, most normal students learn to use teaching software such as "Rain Classroom," learn to use Seewo Whiteboard, use mind mapping software such as XMind to draw course knowledge maps, and use AI to produce courseware or teaching videos during teaching practice activities such as simulated teaching competitions and lecture competitions. It can be seen that teacher education activities promote students' improvement of digital literacy and support teaching design and practice.

4.3. Aspects of Digital Literacy Cultivation That Need Strengthening

The questionnaire included the question "Which aspects of the cultivation of digital literacy for normal students do you think need to be strengthened the most?" Normal students generally believed that the cultivation of digital literacy should start from the following three aspects: first, strengthen the learning and application of AI-assisted teaching skills. Schools should offer AI-assisted teaching-related courses, carry out systematic teaching, and closely integrate theory and practice through a series of teaching practices and teaching competitions to help normal students become proficient in the use of AI-assisted teaching skills; second, guide normal students to use digital products and services reasonably, especially regarding copyright issues and ethical issues in the use of AI and software; third, in the process of using AI-assisted teaching, guide normal students to enhance their independent thinking ability and autonomous innovation ability, so that AI truly plays an auxiliary role in teaching rather than being used "for the sake of using it."

5. Cultivation Path of Digital Literacy of Normal Students in Border Ethnic Areas

Based on the analysis results of the questionnaire data, the current development status of digital literacy among normal students in border ethnic areas shows a multidimensional need for improvement, and it is urgent to construct a systematic cultivation path. Specifically, this is mainly reflected in the following five logically progressive aspects:

5.1. Strengthening the Construction of Digital Infrastructure for Teacher Education in Universities

The construction of digital infrastructure in universities is the foundation. The construction of digital hardware in universities in border ethnic areas still needs improvement, and the coverage and advancement of the technical support system need to be enhanced. For normal students, creating an all-encompassing digital education and teaching environment is conducive to improving their digital literacy. The construction of smart universities can provide normal students with an immersive digital environment [9]. From the stages of freshmen enrollment, student management, social practice, scientific

research competitions, to smart classrooms, laboratories, and online course learning platforms, the construction of smart universities should be strengthened. Through immersive environments and seamless intelligent learning experiences, the digital literacy of normal students can be subtly influenced, promoted, and improved, helping students to quickly adapt to and master various digital tools when they enter basic education teaching scenarios in the future.

For primary and secondary schools, in 2018, the Ministry of Education issued the national standard Overall Framework for Smart Campus, which proposed adaptive schemes with gradients for schools at different levels [10]. However, in actual application, the development of smart classrooms and personal terminals in primary and secondary schools at all levels is relatively weak. Among the various types of student terminals, including intelligent learning companions, tablet computers, dot matrix pens, answer devices, smart wristbands, VR glasses, etc., both the per capita configuration and the group configuration ratio are below 10% [11]. The digital environment of primary and secondary schools in border ethnic areas is weaker than that in the eastern and central regions. The construction of both smart universities and smart primary and secondary schools needs to continue to be promoted to prevent the improvement of normal students' digital literacy and the development of teachers' digital ability from becoming "water without a source."

5.2. Strengthening the Construction of the Digital Literacy Curriculum System for Normal Students

Curriculum construction is the core of digital literacy education for normal students, and the training program for normal students needs systematic optimization, with digital literacy courses and practice links deeply integrated. At present, digital literacy courses for normal students in universities still remain at the level of information technology courses, and only a small number of universities offer AI-related courses, but the depth and breadth of the teaching content are still insufficient.

Each university should integrate digital literacy cultivation into the construction of training programs for normal students according to actual conditions, focusing on the five dimensions of digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and digital learning, and carry out a series of compulsory and elective courses, increase the practical credits of digital literacy, and offer a series of lectures and practical activities on digital literacy. At the same time, digital literacy cultivation also needs to be integrated into various courses, student union and league activities, and subject competitions, so that the cultivation of digital literacy is not an isolated individual process but is all-round, whole-process, and participated in by all members, jointly promoting students' improvement in digital literacy and enhancing normal students' practical ability, teaching ability, and problem-solving ability.

5.3. Improving the Collaborative Education Mechanism of Family–School–Society for Digital Literacy

The collaborative education mechanism of family–school–society is a guarantee. At present, the three-in-one education network of family–school–society needs to be improved, and the resource integration ability of multiple entities still needs to be strengthened. In 1987, Professor Epstein proposed the theory of overlapping spheres of influence, advocating that family, school, and community are the three main entities influencing student development, and the three, through synergy, form overlapping influences and jointly act on the growth process of students.

Through collaborative education among family, school, and society, the responsibilities of families and society can be strengthened, and cooperation among multiple educational entities can be realized, effectively making up for the deficiencies in the content and methods of traditional classroom teaching, and promoting the comprehensive development of normal students' digital literacy through collective intelligence co-creation [12]. At the family level, personalized educational support can be provided based on normal students' interests, strengths, and family economic capacity, to cultivate their digital awareness, help them improve their digital technology ability, and enhance their digital social responsibility. At the social level, it is necessary to fully utilize practical education capabilities and provide technical resources and practice bases. With the collaboration of these three aspects, the educational field of digital literacy for normal students can be jointly expanded, and the overall function of education can be brought into play.

5.4. Paying Attention to Ethics Education in the Digital Literacy Education of Normal Students

At present, the digital ethics education of normal students in universities in border ethnic areas is relatively weak, and the digital social responsibility and digital citizenship literacy of normal students need to be strengthened. Normal students have a dual role as current students and future teachers. This special attribute requires normal students to abide by relevant laws and regulations on digital ethics, and to recognize the importance of digital ethics in teaching, cultivating a sense of digital responsibility and moral judgment [13]. Normal students need to distinguish online rumors, reject cyberbullying, pay attention to information security, and actively create a safe, harmonious, and orderly digital ethics environment. The education of normal students' digital ethics awareness needs to be integrated into student management regulations and moral education links. At the same time, with the help of extracurricular activities, the standardization and safety of normal students' use of digital tools should be regulated, guiding normal students to clarify the "permissible" and "impermissible" behaviors in the digital environment.

5.5. Promoting the Cognitive Transformation of Normal Students' Digital Literacy

The cultivation of digital awareness still needs to be deepened, and the digital thinking and innovative application ability of normal students need to be fundamentally improved. The questionnaire shows that normal students scored the lowest in digital awareness, and they have problems such as insufficient digital cognition, weak digital willingness, and weak digital determination. Specifically, normal students have not realized the importance of education digitalization and the key role of digital empowerment in education, their willingness to actively learn and use digital technology resources is not strong, and they do not have enough confidence and determination to overcome the difficulties encountered in the practice of education digitalization. However, in the context of the general trend of education digitalization, the requirements for normal students' digital literacy are more urgent. As the main body of digital literacy cultivation, normal students need to fundamentally recognize the importance of improving digital literacy, actively participate in all links of digital literacy cultivation, systematically master digital technology knowledge and skills, be proficient in using digital applications, and improve their self-efficacy in cultivating digital literacy, so that the assistance from all sides will not become "a castle in the air."

6. Conclusion

With the iterative rise of generative artificial intelligence, the connotation of digital literacy is constantly enriched, and the requirements for the digital literacy of normal students are also constantly updated. In particular, the cultivation of digital literacy in border ethnic areas has its regional characteristics and practical difficulties. This study is based on the analysis and conclusions of questionnaires from three normal universities in Province Y, and there are still some limitations. It is expected to increase research dimensions, expand the distribution scope, and improve the scientific nature of the research in future studies.

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