

Original Paper

Research on the Cultivation Path of Digital Literacy and Skills for College Students

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Abstract

Generally speaking, the old way of evaluating college students' digital literacy is to separate knowledge, skills and values, and therefore fails to consider their combined impact in cultivation plans. A new general framework for building a three-dimensional evaluation model of digital knowledge, digital skills and digital values has been put forward in this paper, and based on the theories of all-round human development and digital education, a tiered cultivation path will also be systematically presented. Based on the above, the current digital literacy status of university students has been determined through literature analysis, other methods and questionnaires. Most people have an average level of ability, and there are deficiencies in new-thinking practice, cyber security awareness and large-scale digital literacy. Therefore, the proposed cultivation path will be flexible and cooperative, have a hierarchy of training modules, address the deficiencies mentioned above, and stay in line with the current trend of digital transformation. Compared with the previous way, this framework is more all-encompassing and practical for teaching digital literacy at the university level; therefore, both the quality of teaching and the cultivation of digital talents will be improved.

Keywords

digital literacy, college students, evaluation model, cultivation system, empirical research

With the rapid spread of intelligent technology in both industry and higher education, digital literacy has become an essential quality that students need for their careers and is now a focus of digital education at universities. The digital economy requires all sorts of talented people who are good at technology and aware of cyber ethics. However, there is a large difference in the students' level of digital literacy; most students lack systematic training in skills, information discrimination, cybersecurity, digital innovation, etc. Algorithmic information cocoons, online rumours and data breaches are also problems that have increased the demand for digital literacy training among college

students.

According to the literature, the comprehensive assessment system for operational, critical and creative levels has been established by the international framework DigComp. However, these models focus too much on learning instrumental skills and give less weight to digital literacy and values; thus, they fail to achieve the goal of cultivating morality and talent in Chinese education. Most of the domestic studies have adopted foreign standards but have failed to localise them and place less emphasis on value education. Cultivation activities are still mainly confined to the classroom and lack continuous cooperation from all sides. Therefore, the current body of research is small in scale, lacks empirical evidence, and there is no unified cultivation system.

Therefore, the following are the theoretical and practical contributions of this paper. Theoretically, it is an analysis system composed of three dimensions: digital knowledge, digital skills and digital values; it aims to solve the problem of technological bias and provide a theoretical basis for fostering digital literacy in higher education. Based on the above empirical study, we will determine the current situation and group differences in the application of digital literacy among college students, and then, according to the results, propose a joint cultivation plan to promote the effective implementation of digital education initiatives.

Methodologically, the study has followed the logical order of “theoretical basis - connotation analysis - questionnaire distribution - problem diagnosis - countermeasure construction”, and the main research methods employed are literature analysis, interdisciplinary studies and questionnaires. SPSS 26.0 will be used for the statistics and tests to ensure the accuracy of the results. In the face of real-world problems and research deficiencies, this paper will provide some theoretical support and practical suggestions for improving the system of digital literacy education at universities.

1. Core Concepts and Theoretical Foundations of Digital Literacy

1.1 Definition of Core Concepts of Digital Literacy

Digital literacy education for college students is the process of nurturing students' skills and abilities in using digital technology at higher education institutions through all kinds of formal and informal educational activities (Geng, 2020). The above idea refers to the all-around literacy that people need to study, work and live in the digital age. It is not only about the operation of digital devices; rather, it is a whole-system ability set that supports people's digital life and development. The three levels of the main ideas are: the fundamental theoretical knowledge of digital technology, practical digital application skills, and positive value cognition of digital participation.

Digital literacy refers to people's practical use of digital tools, how to process information online, cyber protection skills, digital ethics and innovation, etc. Given that the subjects are college students and the goals of higher education institutions, this paper puts forward a three-dimensional closed-loop model of digital knowledge, digital skills and digital values. Digital knowledge provides the theoretical basis for teaching students their knowledge of hardware, software, information and security; digital skills aim to

develop practical application abilities by teaching students how to cooperate in learning, solve problems and create content; digital values guide students to have a sense of network responsibility and ethical awareness, regulate their behaviour in cyberspace, and promote all-round development of digital literacy.

1.2 Theoretical Foundations for Digital Literacy Research

The theory of all-around development aims to promote the all-round development of individuals in all aspects and is a basic theoretical foundation for university education. Cultivation of digital literacy can expand students' knowledge, strengthen their innovative and practical abilities, promote all-around development of students, and meet the educational needs of the new era. Digital Education Theory proposes to modify teaching modes with the help of digital technology. Therefore, digital literacy education has introduced online courses and practical platforms to overcome the problems of time and place in traditional classrooms, effectively carry out differentiated instruction, and meet the general direction of educational digital transformation. Cyberethics theory provides moral norms for behaviour on the Internet, and the theory of information literacy refers to one's ability to find and use information. The above theories together can help students develop good digital literacy, be more conscious of cybersecurity and information security, and thus avoid problems such as poor online behaviour and a lack of critical thinking.

2. NECESSITY AND CONTEMPORARY VALUE OF DIGITAL LITERACY CULTIVATION

2.1 Intrinsic Necessity of Cultivating Digital Literacy among College Students

Now that society has fully entered the era of digital development, many areas of life are supported by various digital technologies. Therefore, digital existence has become the main way of life for young people now. As the core force of future social construction, college students need to have sufficient digital literacy in order to adapt to life in the digital age, learn digitally, work digitally, seize the opportunities and deal with the problems of the digital society effectively, and avoid cyber risks. Therefore, adapting to the development needs of the digital era and accelerating the enhancement of college students' digital literacy are both internal requirements for improving the quality of talent cultivation in the new era and practical necessities for nurturing a new generation that can carry out the great rejuvenation of the Chinese nation (Wang & Chen, 2021). Digital literacy is an essential part of the new generation's general ability in recent years and has changed the way young people study, learn and work. All-round Digital Literacy promotes the development of education, science and technology, and life for all. With the continuous development of digital transformation in higher education, the construction of a digital literacy education system will help improve the design of courses and teaching methods, drive the digital transformation of universities, and promote all-round high-quality development of education.

2.2 Contemporary Value of Cultivating Digital Literacy among College Students

College students are a pool of young people for the development of the digital economy. Systematic

cultivation of their digital literacy promotes the development of the productive forces and changes in the relations of production and forms of production (Li, 2024). All sectors are changing digitally now, and many places need to train new young digital talents. Systematic cultivation of digital literacy for college students can provide multidisciplinary talents with the necessary technical skills and ethical awareness to promote industrial innovation and quality improvement. At the same time, this cultivation process will help students better distinguish between correct and incorrect information online and learn to use the Internet safely and responsibly. With the increasing intensity of global competition for digital talents, strengthening the digital literacy and cyber ethics of college students can help China's young people stand out on the international stage and contribute to the joint construction and shared enjoyment of world digital civilisation.

3. EMPIRICAL INVESTIGATION OF DIGITAL LITERACY AND ANALYSIS OF PROBLEMS AND CAUSES

3.1 Survey Design and Implementation

Based on the above, this paper will use literature review, interdisciplinary research and questionnaires to explore how to study, assess and understand college students' digital literacy systematically. First, based on the method of literature review, the main frameworks of classic digital literacy assessment, such as DigComp and domestic policies for national digital literacy, along with other studies on digital education at the university level, will be systematically reviewed. At the same time, supported by several theoretical systems, such as Marx's theory of all-round human development, the Digital China strategy and concepts of ideological and political education, this study is based on the developmental characteristics of contemporary college students and the fundamental educational task of cultivating virtue and nurturing talent; thus, it can address the shortcomings of foreign assessment systems that place too much emphasis on technology and give less weight to values. According to the three Design Principles of scientific rigour, relevance and systemisation, a logical framework of three levels has been established: digital knowledge, digital skills and digital values. The three levels in this framework are the three main indicators, and there are 11 secondary indicators and 39 tertiary indicators; together, they cover the core literacy areas of digital learning, online social interaction, information discrimination, digital innovation, cyber ethics and privacy protection.

At the time of developing the questionnaire, it was strictly in line with the three-level index system mentioned above. The four modules of the questionnaire are as follows: Module 1 is basic demographic information; there are five items in total that cover gender, institutional level, major category, grade level and whether one has taken digital literacy training. Module 2 is the scale of digital knowledge, and among the total of 15 items in this module, four sub-indicators are computer hardware, network information, security and privacy, and software engineering. Module 3 is the scale of digital skills, and among the 15 items in this module are digital social interaction, problem-solving, digital learning and content creation. Finally, Module 4 is the scale of digital values, which consists of three sub-indicators:

digital ethos, digital responsibility and digital civilisation, with a total of 9 items. All the literacy measurement items are in a five-point Likert scale; that is, scores range from 5 to 1, corresponding to “strongly agree”, “agree”, “neutral”, “disagree” and “strongly disagree”, respectively, and can be used to quantify all aspects of college students’ digital literacy.

Stratified Sampling was used to distribute the questionnaire via the online platform Wenjuanxing to all levels of institutions (double first-class universities, ordinary undergraduate colleges, and vocational schools), all departments (Science, Engineering, Agriculture, Medicine, Humanities and Social Sciences), and students at different stages (freshmen to seniors) to increase the sample size and improve the generalizability of the data. Based on the above survey, invalid questionnaires that were either too short or had contradictory response logic have been excluded, and finally, there are 402 valid responses. The sample structure is relatively balanced; there are approximately the same number of male and female respondents, and the distribution across institution type, grade and major is reasonable, so it can represent the general situation of digital literacy among domestic college students objectively.

SPSS 26.0 statistical software was used to perform all the reliability and validity tests, descriptive statistics and differential analyses of the data in the processing stage. Based on the results of the reliability test, the overall Cronbach’s α coefficient for the questionnaire is 0.949; the α coefficients for the three dimensions of digital knowledge, digital skills, and digital values are 0.957, 0.958, and 0.936, respectively, and all these values exceed the excellent threshold of 0.9, indicating very good internal consistency and stability of the item settings. Exploratory factor analysis was carried out to verify the validity, and the total KMO measure of sampling adequacy is 0.967 and Bartlett’s test of sphericity is significant at $p=0.000$. All the KMO values for the dimensions exceed 0.9, and all the factor loading coefficients are greater than 0.5; therefore, the scale structure is good, the division of indicators is scientifically sound, and the construct validity is excellent.

According to the results of the descriptive statistics, the overall mean score for college students’ digital literacy on a full-score basis of 5 points is in the middle range and needs to be improved. Dimension-wise comparison shows that the digital values dimension has the highest mean score; therefore, most current college students have a basic awareness of cyber ethics and digital responsibility. However, the dimensions of digital skills and digital knowledge are relatively low and represent the main weaknesses in the cultivation at present. Among the particular indices, those related to the innovation of digital content, application of new digital tools, protection of personal privacy, and awareness of anti-fraud had the lowest mean scores; thus, there are serious deficiencies in students’ innovative practical abilities and cybersecurity knowledge reserves.

Further independent samples t-tests and one-way ANOVAs were conducted to determine if there were any differences among groups, and the independent variables were gender, grade level, type of institution, background in major, and years of training; the dependent variables were the mean literacy scores of the three dimensions. According to the test results, there is no significant difference in scores among men and women or among different years of study; however, there are distinctions in the types

of institutions, college departments and participation in digital training. Students from double first-class universities scored higher than those at ordinary undergraduate and vocational colleges in all three areas, students majoring in science and engineering, agriculture and medicine achieved better results than students majoring in humanities and social sciences in terms of digital knowledge and skills, and students who have taken part in systematic cultivation, such as digital lectures and practical training courses, scored higher in digital knowledge, skills and values compared to those who have not participated in such education. This shows that systematic digital education activities have positively affected the all-around digital literacy of young people.

3.2 Existing Core Problems and Cause Analysis

Both the EU Digital Competence Framework and the ALA framework pay considerable attention to digital security literacy and the ability to protect one's own privacy in their "critical cognitive abilities", but many problems still exist in the form of digital security awareness among highly educated Chinese college students (Ling, 2020). Based on the above survey and analysis, the main problems that currently exist are as follows. First, Distributed Digital Knowledge Systems. Most students only have basic skills in recreational digital operation; they do not know about professional digital tools, cybersecurity, data processing, etc., and their channels for obtaining information are narrow; consequently, they are unable to use specialised digital resources effectively. Second, no knowledge of digital innovation. Students have achieved the basic operating skills; however, they generally lack the ability for independent creation, digital innovation and application of digital technology in problem-solving, and weak practical transformation skills. Third, poor cybersecurity and ethics awareness. Most students are not well-aware of the importance of privacy protection, cannot identify risks online, and lack self-discipline. Fourth, there is one-sided digital value cognition that gives more weight to technology and entertainment than to learning and norms.

According to the reasons for the above phenomena, four reasons have been identified. At the institutional level, the digital literacy curriculum system is still lacking, mainly consisting of basic computer courses; there are no tiered, specialised or innovative digital courses, insufficient practical training platforms, and teachers' own digital teaching skills also need improvement. At the level of society, there is a strong online entertainment environment; short-video and entertainment platforms have taken up a considerable amount of students' time, and positive digital practice resources are relatively scarce. At the level of individual students, self-directed digital learning awareness is weak; their use of the Internet is mainly for practical purposes and entertainment, and they lack the motivation to improve their own digital innovation and digital literacy proactively. At the level of the cultivation mechanism, the multi-party collaborative education system has not been well-established; linkages among universities, enterprises and society are weak, and the cultivation model is still relatively singular.

4. SYSTEMATIC CULTIVATION PATHWAYS FOR COLLEGE STUDENTS' DIGITAL LITERACY

4.1 Fundamental Principles of Digital Literacy Cultivation

To cultivate all-round digitally literate people in the new era, the first step is to close the gap between theoretical teaching and practical application and promote deep integration. On the one hand, systematic digital theory teaching should be continuously strengthened to consolidate basic knowledge, technical ideas and data thinking, build a progressive classroom teaching system in line with the changes of the industry, and enhance students' theoretical foundation. At the same time, various digital practice platforms should be built with professional training goals. Based on the training bases for the campus, science and technology innovation competitions, university-enterprise cooperation projects and real-scenario task exercises, various levels of practical tasks need to be designed to enable students to apply theoretical knowledge in actual situations, internalise the knowledge through project implementation and problem-solving, and thus develop abilities in using digital tools, innovative thinking and real-world problem-solving. Thus, it can be seen that the problem of excessive theoretical teaching and insufficient practical training will be addressed, and both goals will be achieved.

Based on the above, external guidance should be combined with students' own development to build a cooperative internal and external education model. Resources from universities, society and enterprises need to be combined: universities should optimise training programmes and provide high-quality teachers and facilities; society should spread digital literacy among all sectors and carry out public welfare activities; and enterprises should offer real-world projects, technical norms and internships. All sides will cooperate to build an all-encompassing digital education system and growth environment. At the same time, we will also pay attention to students' course status and provide motivation for them to proactively learn about digital technology and participate in practical training through individualised learning plans, innovation incentive policies and achievement recognition. By combining the external resource guarantee and the students' own desire to learn, their all-round digital skills will be constantly improved, and thus the quality of talent cultivation will be enhanced.

4.2 Multi-Stakeholder Collaborative Cultivation Mechanism

Building the cultivation mechanism should first strengthen the basic position of universities in education. The tiered curriculum system needs to be improved; general courses in digital fundamentals, information retrieval and cybersecurity should be offered for younger grades, and advanced courses in digital innovation and professional digital applications should be provided for older grades. Differentiation of teaching content should be based on the disciplinary differences between the arts and sciences majors, so that schools can not only transmit knowledge and teach students how to learn, but also guide students to process large amounts of information and communicate and collaborate with others using digital tools to achieve ubiquitous learning (Huang , 2015). At the same time, to increase the level of digital teaching, regular training for teachers on new digital teaching tools will also be organised. Establish digital innovation platforms, training bases and innovation competition platforms

in the school to give students more practical experience.

Strengthen cooperation between the industry and universities to improve the quality of teaching, promote joint development of digital training projects, internships and advanced digital resources for universities, and jointly build digital innovation laboratories and practice bases with other universities and enterprises. Universities should adjust the content of their courses according to the needs of the industry for talent and cultivate interdisciplinary digital talents focused on industrial development to meet the demands of the workplace.

At the level of society, a good digital education environment should be created to filter the online ecosystem, regulate content released by network platforms, and reduce the spread of vulgar and entertainment-oriented information. Media and social organisations need to actively spread information on digital security, digital ethics and digital innovation to create a good environment for digital learning and inspire more people to innovate digitally, thus providing strong support for enhancing the digital literacy of young people.

Given that students are the subjects of this work, self-cultivation awareness should be promoted by guiding them to learn about lifelong digital learning, proactively use online courses, academic resources and innovation platforms to expand their digital knowledge and skills, be mindful of their own behaviour online, avoid internet addiction and fake news, pay attention to privacy protection and ethical self-discipline, actively take part in digital innovation activities, and continuously improve themselves.

4.3 Comprehensive Tiered Cultivation System

First strengthen the foundation of digital knowledge for students in the work of cultivating digital talents. By adding all kinds of high-quality digital teaching materials and building a new teaching model that is partly online and partly offline, deficiencies in cybersecurity, data processing and the use of professional digital tools can be corrected. At the same time, in coordination with the university library, special training courses will be organised to teach students how to use digital libraries, obtain academic materials online and conduct some basic data analysis effectively in their studies and research.

Second, we need to strengthen the students' skills in digital innovation practice. Digital innovation competitions, digital design contests and other kinds of digital implementation projects should be organised regularly, and students should be actively encouraged to participate in practical work such as science and technology innovation research and grassroots digital volunteer services. Through all kinds of university-enterprise cooperation channels, students should be involved in the whole process of practical operation for real-industry digital projects and exercise their digital innovative thinking, complex problem-solving and digital content creation abilities in actual situations.

Finally, we should promote the cultivation of positive digital ethics. Integrate the rules of digital ethics, cyber laws and regulations, and new-era digital social responsibility into daily teaching in the classroom and the construction of campus culture. Regularly organise themed educational activities

such as cybersecurity popularisation and cyber civilisation construction to guide students in using the Internet reasonably, in accordance with the law, and to develop correct concepts of utilising digital technology for development; at the same time, be mindful of all kinds of improper online behaviour to comprehensively foster well-rounded and standardised digital civilisation literacy.

5. CONCLUSIONS AND PROSPECTS

5.1 Overall Conclusions

In light of the changes in society and the demand for digital literacy at present, this paper explores the main direction of college students' digital literacy cultivation in light of the goals of the current era, and uses various methods such as literature analysis, cross-disciplinary study and questionnaires to conduct this investigation. The first part of this paper is to introduce the current research on digital literacy at home and abroad, and some research deficiencies have been identified, such as placing too much emphasis on the technical attributes of foreign evaluation systems, lacking localisation in domestic studies, and having scattered cultivation paths for digital literacy. Based on the above, the compound meaning of digital literacy is presented. Based on the theoretical foundation of the theory of all-round development of individuals, the theory of digital education and cyber ethics, a three-dimensional closed-loop evaluation model consisting of digital knowledge, digital skills and digital values is built, and a hierarchical assessment system with 3 primary indicators, 11 secondary indicators and 39 tertiary indicators is developed.

Based on the above model, a five-point Likert scale questionnaire was developed and distributed to students at all levels and in various departments of various types of higher education institutions. A total of 402 good responses were finally obtained. Reliability and Validity Tests, Descriptive Statistics and Differential Analysis were all carried out in SPSS 26.0. Based on the above empirical results, college students generally have a good level of digital literacy and are relatively strong in the area of digital values; however, there are serious deficiencies in the integrity of their digital knowledge system, practical ability in digital innovation, and cybersecurity protection ability. The factors affecting students' literacy are the level of the institution, the main subject, and previous participation in digital training; however, there is no statistical difference based on gender or grade level. This paper will also examine the reasons for the above problems in terms of university curriculum construction, the social network environment, integration of enterprise-industry education, students' sense of initiative, and multi-stakeholder cultivation models.

Based on the shortcomings mentioned above, the systematic cultivation path put forward in this paper is as follows: Establish the two basic principles of integrating theory and practice and balancing external guidance with internal motivation; build a multi-stakeholder collaborative mechanism that includes universities, enterprises, society and students; and design an integrated cultivation plan of tiered digital classes, practical training and value education to comprehensively address the consolidation of knowledge, improvement of skills and shaping of digital values. Finally, the

deficiencies of this study are mentioned; that is, the coverage of the sample is relatively small and only cross-sectional data have been collected. In the future, research will expand the scope of the survey, conduct long-term panel studies, and enhance all kinds of cultivation programs. In short, this paper has made some contributions to the theoretical foundation of digital literacy for indigenous college students and offers both theoretical support and practical reference for the reform of digital education and the cultivation of interdisciplinary digital talents at the higher education level.

5.2 Limitations and Prospects

The sample coverage of this study is relatively small; only students from a few higher education institutions participated in the cross-sectional survey, so it cannot fully represent the changes in the development characteristics of college students' digital literacy at the national or even global level. Future research will increase the number of samples, carry out cross-regional and long-term longitudinal studies, develop different cultivation plans for students at various stages of education and in different major areas, and continually improve the dynamic cultivation and evaluation system for college students' digital literacy.

To cultivate the digital literacy of college students, various parties, such as universities, enterprises, society and the students themselves, need to cooperate and work together continuously. In the future, the three-dimensional theoretical and practical system of digital knowledge, digital skills and digital values should be continuously strengthened to form an individual cultivation model in line with the educational needs of local universities; at the same time, technical ability should be balanced with digital values to foster a new generation of young talents with all-round digital literacy and support the high-quality development of the digital industry and the great rejuvenation of the Chinese nation.

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