The Need and Strategies for Digital Literacy Development of Elementary and Middle School Students

NIE Lingping[1]，LUO Ziyan[1]，GAO Xiaojie[1,2,3*]

1 School of Life Sciences, Qinghai Normal University, Qinghai Province Xining 810016（China）

2 Institute of Plateau Science and Sustainable Development, Qinghai Province Xining 810016（China）

3 Key Laboratory of biodiversity Formation Mechanism and Comprehensive Utilization of Qinghai Plateau, Qinghai Province Xining 810016（China）

Abstract: Digital literacy serves as an important component of core literacy in biology. It is both an important foundation for lifelong learning and digital survival of primary and secondary school students, as well as the core of today's skills. The article firstly overviews the concept and composition of digital literacy, and then analyzes the digital literacy policies in China as well as in the United States, Australia, the Netherlands and other countries. It also analyzes and summarizes the necessity of cultivating digital literacy for primary and secondary school students and the strategy of cultivating digital literacy for primary and secondary school students in the light of China's policy and existing literature. It provides reference for China to carry out digital literacy curriculum reform and cultivate digital literacy of primary and secondary school students.

Keywords: primary and secondary school students; digital literacy cultivation

Networking, digitalization and intelligence-based information technology has become a major feature of the 21st century, profoundly affecting people's work, learning, life and way of thinking. Digital literacy is not

only an important part of information technology, but also an important part of core literacy, and it is also an important embodiment of digitalization and informatization of education[1]. It aims to equip students with the knowledge, skills, and attitudes of how to handle information efficiently, and then to promote the society towards a healthier informatization society[2]. Moreover, countries have begun to focus on the development of digital literacy and launched a series of related policies to achieve the educational goal of equipping all citizens with the ability to apply digital skills[3]. In this situation, in 2020, China's "14th Five-Year Plan" put forward the implementation of "universal digital literacy and skills enhancement program", which emphasizes the need to accelerate the construction and development of digital education, enhance the digital literacy capacity of the whole population and prioritize the program as an action[4]. In 2021, the Central Internet Information Committee issued the "Action Program for Enhancing Digital Literacy and Skills of the Whole Population", which emphasizes the need to accelerate the construction and development of education digitization, enhance the digital literacy capacity of the whole population, and prioritize the program[5]. Teachers, as an important driver of digitalization and informatization of education, bear the mission and task of cultivating high-quality digital talents. In November 2022, the Ministry of Education of China issued the "Teachers' Digital Literacy" standard, which clearly points out that today's teachers should have the ability of digital literacy in the five dimensions of "digital awareness, knowledge and skills of digital technology, digital application, digital social responsibility, and professional development"[6]. Enhancing the digital literacy of primary and secondary school students has become an internal need for cultivating digital talents in this era, and the digital literacy level of teachers directly affects the quality of students' digital literacy. Both of them are also related to the realization of China's education digitalization, informatization and the strategy of a strong education country[7]. Therefore, cultivating the digital literacy of primary and secondary school students in China has become an urgent matter. To this end, this paper will analyze the concept and composition of digital literacy, combine relevant policies and literature, and analyze the necessity and strategy of cultivating digital literacy among primary and secondary school students.

I. The concept and composition of digital literacy.

In 1994, Israeli scholar Yoram Eshet-Alkalai first proposed the term "Digital Literacy" and suggested that the broad framework of digital literacy includes "Picture-image literacy, reproduction literacy, branching literacy, information literacy, and social-emotional literacy"[8]. In 1998, American scholar Paul Gilster also introduced the concept of digital literacy in his book Digital Literacy. It is understood as accessing online resources through the Internet or computers and understanding and applying the resources[9]. In contrast, the digital literacy and framework proposed by Yoram Eshet-Alkalai is one of the more comprehensive models in relation to other claims and is included in the Encyclopedia of Distance Education[10].

The proposal of digital literacy has also created a wave of research in the international arena. In 2012, the American Library Association defined the term digital literacy as "the ability to use Internet technologies to access digital information, as well as the ability to comprehend and apply digital information", and it was recognized by the library community[11].At the beginning of the 21st century, member states of the European Union (EU) undertook a curricular change, which was dominated by the adoption of "Core Literacy" replaces "reading, writing and arithmetic" with "core literacy", which is the sum of knowledge, skills and attitudes necessary for an individual to be able to survive in society, with a framework of includes information literacy, communication literacy, digital literacy, content creation literacy, security awareness literacy, and problem solving literacy[12]. China in 2016, Shi Ge to Yoram Eshet-Alkalai and the European Union's core literacy framework as the basis and combined with the characteristics of China's basic education informatization. Summarized the framework of digital literacy for primary and secondary school students in China, which mainly includes information processing literacy, communication literacy, content construction literacy, problem solving literacy, information security literacy, and cyber ethics literacy[13].

II. Development of digital literacy at home and abroad.

The strength of a country's comprehensive national power is inextricably linked to the country's science and technology and the level of national digital literacy. China's cultivation of digital literacy for primary and secondary school students started late compared to developed countries. China began to pay attention to the theoretical research on digital literacy since 2006, and the research at this stage mainly focused on the interpretation of the concept and connotation of digital literacy[14]. However, from 2012, when the Ministry

of Education issued the Ten-Year Development Plan for Education Informatization (2011-2020), China began to pay attention to cultivating students' ability to use information technology to learn[15]. By 2018, China issued the Education Informatization 2.0 Action Plan, which states, "Develop an evaluation index system for students' information literacy, and implement targeted cultivation and training"[16].In 2020, the issued Statistical Indicator System for Testing and Evaluation of China's Education (2020 Edition) for the first time included students' information literacy attainment rate into the indicator system[17]; in 2021, the "Outline of Action for Enhancing Digital Literacy and Skills of the Whole Population" issued pointed out that enhancing the digital literacy and skills of the whole population is an important task for realizing a digital China, and is an important measure for realizing the common wealth[5].In 2022, the "Compulsory Education Information Technology Curriculum Standards (2022 Edition)" issued pointed out that it is important to separate the information technology course out and enhance students' learning of the course, thus promoting the development of digital literacy among primary and secondary school students[18].

All along, the United States has been vigorously promoting and implementing the construction of digital infrastructure and carrying out digital skills development programs covering various fields within the United States, so that the whole society can support the programs from all aspects, thus forming a model of digital literacy education for all[19]. Australia, Singapore and other countries in the country's digital strategy specifically formulate digital skills development goals, while carrying out digital skills courses to implement and promote digital literacy education[20].In 2006, the European Union, in order to enable European citizens to better base on the society, put forward the integration of digital literacy into all stages of education[21].In 2010, the European Union, in the proposed Europe 2020 Development Strategy pointed out the need to increase and popularize the use of digital tools for all European citizens[22]. To better implement digital literacy education for European citizens, the EU has issued the Digital Literacy Framework 1.0[23], the Digital Literacy Framework 2.0[24], the Digital Literacy Framework 2.1[25], and the Digital Literacy Framework 2.2[26], starting in 2014 and up to the present. Canada, the Netherlands, and Norway have included digital literacy in their basic education curriculum reforms by establishing relevant courses, while integrating digital literacy into other courses[27]. Among them, the Committee on Computer Science in Secondary Education of the Royal Netherlands Academy of Sciences stated in Digital Literacy in Secondary Education: 21st Century Skills and Attitudes, published in 2012, that the curricula of primary and secondary education should be updated to develop digital literacy among primary and secondary school students[28].

III. The necessity of cultivating digital literacy among primary and secondary school students.

(i) Primary and secondary school students are "big users" of the Internet.

In 2020, the China Internet Information Center released the "2020 National Minors' Internet Use Research Report", which shows that the scale of China's underage Internet users has reached 183 million people, with a penetration rate as high as 94.9%[29]. In the same year, Eurostat released the Digital World of European Youth, which showed that the number of EU teenagers using the Internet every day was as high as 91% during the period of 2011-2016[30].In 2018, E-Marketer, a market research organization in the United States, surveyed the number of U.S. elementary and middle school students owning a smartphone in that year, and found that 81% of them owned a smartphone and expected the ratio will reach 85% by 2022[31]. From the above data, primary and secondary school students have become "big users" of the Internet. While the Internet as a "double-edged sword" can bring more resources to primary and secondary school students' learning and entertainment, it may also bring various threats and hazards to them. Therefore, it is urgent to cultivate the digital literacy of primary and secondary school students.

(ii) Digital literacy is an important part of core literacy.

Core literacy has become an important direction of China's curriculum reform. In 2014, China's Ministry of Education issued the Opinions on Comprehensively Deepening Curriculum Reform and Implementing the Fundamental Task of Literacy (hereinafter referred to as "Opinions"). The Opinions put forward the meaning of "core literacy", meaning that primary and secondary school students should have the character and abilities needed for lifelong development and social development[32]. In 2016, the official issuance of the "Core Literacy of China's Student Development", the content of which consists of three main aspects: cultural foundation, independent development, and social participation[33]. Digital literacy, as an important part of the core literacy, is both an important foundation for lifelong learning and digital survival of primary and secondary school students, as well as the core of today's skills. The development of digital technology gives every primary and secondary school student the opportunity to acquire knowledge and share information, but this must be done based on primary and secondary school students having a certain degree of digital literacy.

(iii) Primary and secondary school students have low discrimination and security awareness of digital information.

Digital literacy focuses on primary and secondary school students' retrieval, judgment, application and management of the information they need. With the development of information technology, a wide variety of information content has emerged, and while students have access to more content, they are also easily attracted to all kinds of content. Primary and secondary school students are unable to retrieve and manage information correctly due to their lack of ability and immature values. At the same time, they are also unable to judge the authenticity of some information. This in turn causes some negative effects on primary and secondary school students. Li Xiaojing[34] and others found that students have some awareness of privacy protection. However, this awareness only stays in the protection of basic personal information and lacks the awareness of data security protection. At the same time, the awareness of prevention of network fraud, rumors and information theft and other illegal acts is not strong.

IV. Strategies for Cultivating Digital Literacy in Primary and Secondary School Students.

(i) Improve the construction of China's digital literacy curriculum system.

At present, China's digital literacy curriculum system compared to the European Union and so on there is still a lot of room for progress. Teachers and students do not pay enough attention to the digital literacy curriculum, and most schools are only stuck in the application of basic digital equipment for education digitization and informatization. For this reason, China's Minister of Education Chen Zhili held in 2000, "the national primary and secondary school information technology education work conference", to "seize the opportunity to accelerate the development of primary and secondary schools to vigorously popularize information technology education" as the title of a series of reports. Information technology courses were included in the compulsory curriculum for primary and secondary schools, and relevant documents such as the Guidelines for Information Technology Courses in Primary and Secondary Schools (for Trial Implementation) were issued at the same time. All over the country, to promote and implement the policies of the Ministry of Education, etc., they formulated IT syllabi and plans and prepared new teaching materials in accordance with the Guideline for Primary and Secondary School Information Technology Courses (for Trial Implementation) and the actual situation in their localities[35]. China's State Council emphasized in the 2017

Development Plan for a New Generation of Artificial Intelligence that relevant courses about AI should be offered in primary and secondary schools, and programming courses should be gradually promoted to primary and secondary school curricula[36]. At the same time, it is also proposed in the 2020 Key Points of Education Informatization and Network Security Work in 2020 that the establishment and application of AI courses will be continuously promoted in primary and secondary education[37]. From this, China is improving the system of digital literacy courses step by step. In addition, the digital literacy curriculum should not be independent, but should be integrated into basic subjects such as language, mathematics and foreign languages, and then realize the integration of digital literacy education with other subjects.

(ii) Emphasize the comprehensive training of the teaching force and strengthen the training of teachers in digital literacy.

The rapid development of the Internet has brought new changes to the training of teachers[38]. At present, many IT teachers in primary and secondary schools rarely receive training in digital basic knowledge, skills, and specialized knowledge of digital literacy. Therefore, it is necessary to start with the existing teaching force, emphasize the cultivation of digital literacy in the teaching force, strengthen the relevant training of teachers, and make up for the short board. In the 1.0 stage of education informatization in China, the training and practice of teachers' IT competence is carried out in accordance with the Standards for Educational Technology Competence of Primary and Secondary School Teachers (Trial) and Standards for Information Technology Application Competence of Primary and Secondary School Teachers (Trial) to improve the IT competence of primary and secondary school teachers[39].The National Primary and Secondary Smart Education Platform (NSSEP), which will be put into trial operation in April 2022, is a platform for the development of digital literacy in primary and secondary schools by the National Primary and Secondary Smart Education Platform. The "National Intelligent Education Platform for Primary and Secondary Schools", which was launched on a trial basis in April 2022, is an educational platform developed by the Ministry of Education of China, which provides a wealth of learning resources and educational resources, and the Ministry of Education relied on the platform to carry out the "National Summer Teachers' Seminar" in July the same year, which stipulates that teachers should participate in the study on a regular basis, and the content of the teachers' training topic includes The content of the teacher training program includes a module

on "Digital Literacy Improvement", which implements teachers' learning of the Digital Literacy Standards for Teachers and promotes the development of teachers' digital literacy[40]. At the same time, schools in China regularly carry out a series of activities such as teacher skills competitions and teaching seminars to create a digital and informatized teaching atmosphere and encourage teachers of all subjects to integrate digital teaching tools into their daily teaching.

(iii) Comprehensively cultivate students' digital literacy.

The digital environment is ever-changing and easily mixed with undesirable information. As "big users" of digital information, students should have the basic ability to identify, apply and master the use of digital technology, which has become an indispensable element in the digital era. To cultivate the digital literacy of primary and secondary school students, it is necessary to start from the following aspects: first, providing a good learning environment. A good digital education environment is the basis for ensuring the development of students' digital literacy. Since 2000, China has implemented a series of nationwide programs such as "School-to-School", "Class-to-Class" and "Three Passes and Two Platforms" to increase the construction of basic education facilities. The plan to achieve full coverage of digital campuses by 2022 has also been completed[16], which lays the foundation for the cultivation and development of digital literacy among primary and secondary school students. Second, cultivate good digital and informational learning habits among primary and secondary school students. Choose appropriate learning content in combination with their interests and the resources provided by the digital platform. Before using digital devices, they should learn in advance how to protect the security of personal information and the security of the devices and learn the necessary measures to take when encountering security threats and other problems, so as to ensure their own network security. Third, providing abundant resources. In recent years, the Ministry of Education has provided primary and secondary school students with a wealth of information technology resources through various Internet platforms. One of the best platforms is the "National Wisdom Education Platform for Primary and Secondary Schools" developed by the Ministry of Education, which provides primary and secondary school students with information technology courses and sufficient learning resources to cultivate their digital literacy. Fourth, provide a platform for practice and innovation. Give students a platform to apply and practice digital technologies. For example, platforms for digital innovation activities, robotics, code

writing and other scientific and creative research and competitions are set up to strengthen information technology education, exercise primary and secondary school students' ability to use information technology to solve practical problems and allow primary and secondary school students to give full play to their information technology skills.

In conclusion, in today's information technology era, having digital literacy has become a basic ability and attitude for all primary and secondary school students. Digital literacy is an important part of the curriculum reform of basic education, a necessary skill for primary and secondary students to improve their learning efficiency, and an immediate need for building education models such as digitization and lifelong learning, as well as for cultivating innovative talents.

References

[1] WU MAI, ZHU SHA, WANG MEIQIAN (2022). The integrated construction of students' digital literacy cultivation system:challenges, principles and paths[J]. China Electrochemical Education, (7):43-49,63.

[2] KNAW.Digitale Geletterdheid in het Voortgezet Onderwijs:Vaardigheden en Attitudes voor de 21st e eeuw[R].Amsterdam:KNAW,2012.

[3] Lan, G.S., Guo, Q., Zhang, Y. et al. (2020). Digital Literacy Framework for Educators in the E uropean Union:Interpretation of Key Points and Implications[J]. Modern Distance Education Rese arch,32(6):23-32.

[4] Compilation of Documents of the Fifth Plenary Session of the 19th Central Committee of the C ommunist Party of China[M]. Beijing: People's Publishing House, 2020:34-35.

[5] Central Internet Information Office (2021). Outline of action to enhance the digital literacy and skills of all people [EB/OL]. [2023-01-21]. http://www.cac.gov.cn/2021-11/05/c_163770886775430 5.htm.

[6] Textbook Letter [2022] No. 58, Notice of the Ministry of Education on the Release of the Educ ational Industry Standard on Digital Literacy for Teachers [Z].

[7] Wu Main,Li Huan,Yang Shan et al. Research on the evaluation index system of digital literacy of primary and secondary school students in the context of digital transformation of education[J] . Chinese Journal of Education,2023(07):28-33.

[8] Xiao Junhong. Digital literacy[J]. China Distance Education,2006(05):32-33.

[9] Gilster P. Digital Literacy[M]. New York:Wiley,1997:25-48.

[10] Wang Yumei,Yang Xiaolan,Hu Wei,Wang Juan. From Digital Literacy to Digital Competence:Co nceptual Flux, Constituent Elements and Integration Model[J]. Journal of Distance Education,201 3,31(03):24-29.

[11] Morgan, Kendra, Chesemore, et al. State library guidebook:support for digital literacy in public libraries[J]. 17(3):82-84.

[12] Liu XY, Pei XN. Policy Opportunities and Challenges in the Period of Educational Reform--Im plementation and Evaluation of Core Literacy in the European Union[J]. Global Education Prosp ects,2014(4):75-85.

[13] Shi Ge. The Connotation and Cultivation of Digital Literacy in Elementary and Middle School Students[J]. Curriculum. Teaching Materials. Teaching method,2016,36(07):69-75.

[14] Dong Yuping. Development pulse and hotspot analysis of domestic digital literacy[J]. Journal of Library Science,2022,44(07):99-105.

[15] Kong Xiangyu. Analysis of Information Technology Curriculum for Elementary and Middle Sch ool Students Based on Digital Literacy[J]. Science and Education Wenhui (Lower Decade),2018(06):138-139.

[16] Ministry of Education of the People's Republic of China. Notice of the Ministry of Education on the issuance of the Education Informatization 2.0 Action Plan [EB/OL]. (2018-04-23) http:// www.moe.gov.cn/srcsite/A16/s3342/201804/t20180425_334188.html.

[17] General Office of the Ministry of Education (2020). Circular of the General Office of the Mini stry of Education on the Issuance of the Key Points of Educational Informatization and Networ k Security Work in 2020 [Z].

[18] Ministry of Education of the People's Republic of China (2022). Compulsory Education IT Curriculum Standards (2022 Edition) [EB/OL]. [2023-01-21]. http://www.moe.gov.cn/srcsite/A26/s8001/202204/W020220420582361024968.pdf.

[19] Du Xilin,Sun Peng. Research on Digital Literacy Education in China's Public Libraries--Based on the Perspective of Digital Literacy Education for All People in the Digital Era[J]. Library Work and Research,2022, (7):19-26+53.

[20] He Chun. International Digital Literacy Research Evolution, Hot Spots and Implications--Visualization Analysis Based on Knowledge Mapping[J]. World Education Information,2022,35(1):10-21.

[21] European Commission.Proposal for a Council Recommendation on Key Competences for Lifelong Learning[R].Brussels:European Commission,2018.

[22] European Commission.Europe 2020, A European Strategy for Smart,Sustainable and Inclusive Growth[R].Brussels:European Commission,2010.

[23] Punie Y,Brecko B,Ferrari A.DigComp:A Framework for Developing and Understanding Digital Competence in Europe[J].2013,38:3-17

[24] Vuorikari R,Punie Y,Gomez C,et al.DigComp2.0:The Digital Competence Framework for Citizens.Update Phase 1:The Conceptual Reference Model[M]. Luxembourg Publication Office of the European Union,2016.

[25] Carretero S,Vuroikari R,Punie Y.DigComp2.1:The Digital Competence Framework for Citizens with eight proficiency levels and examples of use[M]. Luxembourg Publication Office of the European Union,2017.

[26] Qingyi Wang. On the enhancement of digital literacy for all from the EU digital literacy framework (DigComp2.2) [J]. Library Journal,2023,42(03):97-106.

[27] Zhu Hongyan,Jiang Xin. A review of domestic digital literacy research[J]. Library Work and Research,2019, (8):52-59.

[28] Wei Xiaomei. Digital literacy learning framework and implementation path for primary and secondary school students in the Netherlands[J]. Comparative Education Research,2020,42(12):71-77.

[29] Research Report on National Minors' Internet Use in 2020[J]. National Library Journal,2021,30(04):13.

[30] Eurostat-Being young in Europe today-digital world. [EB/OL]. [2019-01-04]. https://ec.europa.eu/ eurostat/statistics explained/index.php?title=Being_young_in_Europe_today_-_digital_world

[31] E-Marketer. us millennials 2020. [EB/OL]. [2020-02-25]. https://www.emarketer.com/content/us-mi llennials-2020

[32] Ministry of Education. Opinions on Comprehensively Deepening Curriculum Reform to Impleme nt the Fundamental Task of Establishing Moral Education [OL]. <http://old.moe.gov.cn/publicfiles /business/htmlfiles/moe/s7054/201404/xxgk_167226.html>

[33] People's Daily Online. China's student development core literacy released [OL]. <http://edu.peopl e.com.cn/n1/2016/0914/c1053-28714231.html>

[34] Li Xiaojing,Liu Yining,Feng Ziwei. The current situation of China's youth digital literacy educat ion problems and enhancement path based on the NVivo analysis of in-depth interviews with se condary school students in East, Central and West China[J]. China Electrochemical Education,20 23(04):32-41.

[35] Zhang Lu. Research on the content and system construction of high school information technol ogy courses [D]. Nanjing Normal University,2006.

[36] State Council. A new generation of artificial intelligence development plan [EB/OL]. http://www. gov.cn/zhengce/content/2017-07/20/content_5211996.htm,2017-08-24.

[37] ZHANG Zhixin,DU Hui,GAO Lu et al. Status quo, problems and countermeasures of artificial i ntelligence curriculum construction in primary and secondary schools in developed regions--Taki ng a "new first-tier" city as an example[J]. China Electrochemical Education,2020(09):40-49.

[38] Wang ZZ. Digital research and training: a new paradigm for teachers' professional growth[J]. S hanghai Education Research, 2021(5):75-77.

[39] Wang Wei,Yan Hanbing. Practice-oriented research on teachers' digital literacy enhancement path s - A multi-case study based on international programs[J/OL]. Modern Distance Education:1-12[2023-11-14]. https://doi.org/10.13927/j.cnki.yuan.20231008.001.

[40] FENG Xiaoying,HE Chun,GUO Luwen et al. A study on the construction and application of a five-category assessment framework for teacher training--an example of the National Summer Te acher Training in 2022[J]. China Distance Education,2023,43(01):59-69.