# Construction and Application of College Students' Online Learning Ability Scale from the Perspective of Digital Literacy

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**Abstract.** The internet and digital technologies have brought opportunities for college students to have richer online educational resources. However, the students' lack of digital literacy for learning also makes a large number of "online courses" fail to achieve the expected effect. With the literature review of Chinese college students' digital literacy, there are few empirical studies on analyzing the application of digital literacy in the process of online learning specifically. This study uses the questionnaire survey to investigate the main difficulties faced by Chinese college students in online learning, focusing on the digital literacy and skills that college students should have. Based on literature review and in-depth interviews, this study constructs the online learning ability scale from the perspective of digital literacy. A sample covers the first to fourth grade undergraduates of 63 majors in 13 schools in Xiamen University of Technology, by stratified sampling (N = 507). The results showed the development of Chinese college students' online learning ability as five dimensions: Cognition of online learning, Acquisition of online education resources, Selection of online education resources, Application of online education resources, and Evaluation of online learning. It can provide new support for promoting the effect of online education in Chinese colleges and universities.

**Keywords:** Online Learning · College Students · Digital Literacy · Scale Construction

## 1 Introduction

The network and digital technologies represented by "big data, cloud computing, artificial intelligence" are rapidly transforming people's learning, living and working styles. The coexistence between human being and computer has become one of the most important relationships. For the college students, online learning has been a necessary way of learning in the new era, and will also be the basis of lifelong learning in the future.

New technologies have brought new opportunities for college students to enjoy more high-quality resources. However, students' lack of concentration, self-control and information literacy also make a large number of "online courses" fail to achieve the expected effect. How to build a positive relationship between self and online learning,


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and grow into a qualified digital citizen with "online wisdom", which is urgent for the contemporary college students.

### 1.1 Overview of the Online Education in Chinese Universities

Since the president of Tsinghua University, Academician Wang Dazhong, first proposed the idea of "Modern Distance Education" in March 1996, online education in Chinese universities has gone through nearly 25 years. In December, 1998, the Ministry of Education in China announced Plan for Revitalizing Education in the 21st Century, which proposed the "modern distance education project" to form an open education network, and build a lifelong learning system. In 2013, known as "the first year of online education in China", with the launch of many MOOC platforms, more than 750 colleges and universities have participated in the construction of online courses, and a total of 3909 high-quality courses have been online. The outbreak of COVID-19 also has accelerated the expansion of online education across the country. According to IResearch (2021) [1], in China more than 950,000 teachers from 1454 colleges and universities have opened online courses, accounting for 54.09%; and 1.18 billion students have participated in online learning by the end of 2021.

More and more Chinese college students adopt the online learning style, but some problems also follow. Rushen (2020) pointed out that the development of online education in colleges and universities in China is still facing problems [2], such as the need to improve teachers' online teaching literacy, to strengthen students' online learning ability, to innovate the construction of online courses. Teachers' qualifications, and platforms' technology are important factors to ensure the effect of online education, but the ability of students' online learning is determinant. Gu (2021) found that the problems in traditional classroom, such as students' lack of interest in learning, lack of participation, low degree of achievement of teaching goals, are more obvious in the current online teaching [3].

### 1.2 College Students' Online Learning Ability Needs to Be Improved

Yang & Lei (2020), Rao & Wan (2020), and Xu (2021) proposed the main problems of college students in the process of online learning include [4–6]: first, many students have biases in their cognition of online education. They are used to the traditional offline learning, and regard the online platform as a social and entertainment platform, so they think online education as an informal education mode. Secondly, some students are not ready for online learning. They did not clearly understand the necessity of online education, and were unwilling to change their offline learning habits; What's more, they have not mastered the skills of using hardware or software required for online education. There are low class participation, insufficient learning atmosphere in online learning. And the existing of "one screen" gap reduces interaction, and online courses often become teachers' "one-way input". Students' initiative to share learning resources is also low.

### 1.3 Online Learning Ability is Determined by the Digital Literacy

Online learning ability is the application and embodiment of students' digital literacy in learning activities. Professor Alkalai Y. (2004) put forward the concept of digital literacy as early as 1994 [7]. European Union has issued several versions of digital literacy, pointing out that "the core of digital literacy is to use digital technology to serve work, study and life in a confident and safe way". Gu Tianlong, Director of Computer Major Education Committee of the Ministry of Education in China, proposed that in the era of digital economy, digital literacy is an important goal and content of talent training, including the ability to use and develop digital resources.

Although the concept of digital literacy will be dynamic, the core of its definition--"using digital technology to serve work, study and life", "the ability to use and develop digital resources", can make it clear that online learning ability is an important branch of digital literacy. Online learning ability is "using digital technology for learning", including "the use and development of online educational resources". The level of digital literacy determines the level of online learning ability.

### 1.4 Research Questions

In the relevant research of online education in colleges and universities in China, most of the topics are from the perspective of organizers, such as universities, teachers and platforms, mainly including online education theory, online teaching methods, platform configuration and so on. There are also some investigations from the perspective of college students, studying the situation, personality demands and influencing factors. These studies have helped us understand the process of online education and the basic status of all parts, but there is a lack of exploration of the root causes of the problems are faced by college students, such as why they do not give high evaluation to online education, how they choose and apply online education resources, and how they participate and interact in the process of online learning.

Similarly, through the literature review of Chinese college students' digital literacy, most of the research topics focus on the current situation and the improvement path of college students' digital literacy. Few scholars have focused on the special topic of "online learning", and specifically analyze the application of digital literacy in the process of online learning.

This study will investigate the main difficulties faced by college students in online learning, focusing on the digital literacy and skills that college students should have in this special field of online learning, and find a new breakthrough to maximize the effect of online education.

## 2 Methods

Based on literature review and in-depth interviews, this study constructs the online learning ability scale from the perspective of college students, and takes the undergraduates in Xiamen University of Technology as the questionnaire participants, so as to investigate the contemporary college students' online learning ability and digital literacy and the relationship between them.

### 2.1 Scale of College Students' Online Learning Ability

In 2018, on the basis of analyzing the existing digital literacy frameworks in European Union and countries around the world, UNESCO (2018) formed the global framework for digital literacy [8], which includes 7 dimensions and 26 specific indicators, which can be sorted into two areas--"digital technology literacy" and "digital citizenship literacy". "Digital technology literacy" focuses on the acquisition and use of information technology and information resources, while "digital citizenship literacy" focuses on the construction of citizenship in the digital environment, the protection of privacy and security, and the ability to solve social problems and develop professional skills. Applying the above digital literacy dimensions and indicators into the online learning field of college students, which will focus on the dimension of "digital technology literacy" in the learning process, include:

1) *Digital devices operation ability of online learning: hardware use and software operation of digital devices in the process of online learning;*
2) *Information literacy ability of online learning: browse, search, evaluate and manage data, information and resources in the process of online learning;*
3) *Communication and cooperation ability of online learning: use digital technology to interact, share and cooperate in the process of online learning;*
4) *Content creation and share ability in online learning: produce, integrate and share digital content in the process of online learning.*

Based on the framework, combined with the in-depth interviews on college students, this study defines "College Students' Online Learning Ability" as five dimensions: Cognition of online learning, Acquisition of online education resources, Selection of online education resources, Application of online education resources, and Evaluation of online learning (see Table 1).

### 2.2 Population and Sampling

Due to the impact of local epidemic prevention and control regulations, this survey chooses the college students of Xiamen University of Technology as the participants. The survey uses the stratified sampling method, and the sample covers the first to fourth grade undergraduates of 63 majors in 13 schools in Xiamen University of Technology. The questionnaire was distributed and collected through the professional survey platform named "Wenjuanxing". A total of 507 questionnaires were distributed, and 498 effective questionnaires were returned, with an rate of 98.4%. The sample composition is shown in Table 2.

## 3 Results

According to the survey results, 61.21% of college students spend 4–8 h online every day, and about 22.42% of college students even spend more than 8 h online, which has exceeded the average level of ordinary netizen. According to CNNIC (2021), Chinese netizen spend about 28 h online every week, an average of 4 h a day. The network has been deeply involved in college students' study, life and work [9].

**Table 1.** "College Students' Online Learning Ability" Scale

| Dimensions | Indicators |
|---|---|
| Cognition of online learning | Duration of daily network usage |
| | Operation of network hardware and software |
| | Understanding and willingness to use online education |
| | Acceptance of online education resources |
| Acquisition of online education resources | Access to online education resource |
| | Search methods of online education resources |
| Selection of online education resources | Selection of the form and attribute of online education resources |
| | Purpose and personalized needs of online learning |
| Application of online education resources | Application of terminals and platforms in the process of online learning |
| | Interaction and communication in the process of online learning |
| | Content production and sharing in the process of online learning |
| Evaluation of online learning | Evaluation of students in the process of online learning |
| | Evaluation of educational resources in the process of online learning |
| | Evaluation of educational platform in the process of online learning |

Further ranking the degree of network applications used by college students, the most frequently used applications are the social APP, and the second, third, fourth and fifth are shopping, entertainment and news APP respectively. In addition to the above four major applications, that are consistent with other netizen, Learning APP rank fifth and become one of the most important online applications for college students.

### 3.1 Cognition of Online Learning

As the original and main force of netizen, digital life, study and work have become a common existence for the contemporary college students. In this survey, a total of 83.04% of college students have known and used online education resources, of which 17.36% of students are very familiar with online education, but there are also basically the same proportion of students (16.96%) who do not know online education resources. At the same time, although online education has a high awareness among college students, more than 50% of students are more willing to accept the combination of traditional

**Table 2.** The Sample Composed in this Survey

| Sample Category | | Frequency | Percent |
|---|---|---|---|
| Gender | Male | 219 | 44% |
| | Female | 279 | 56% |
| Grade | Freshman | 72 | 14% |
| | Sophomore | 125 | 25% |
| | Junior | 225 | 45% |
| | Senior | 76 | 15% |
| Major | Literature and History | 95 | 19% |
| | Science and Engineering | 199 | 40% |
| | Arts and Designing | 66 | 13% |
| | Economic and Management | 115 | 24% |
| | Other | 23 | 4% |
| Average Monthly Expense (RMB) | Less than 1000 yuan | 29 | 6% |
| | 1000–2000 yuan | 312 | 63% |
| | 2001–3000 yuan | 127 | 26% |
| | 3001–5000 yuan | 17 | 3% |
| | More than 5000 yuan | 13 | 3% |

learning and online learning. Only 17.16% of students choose online learning as their first choice, lower than 25.25% of those who choose traditional online learning as their first choice.

Analyzing the reasons why college students have a positive attitude towards online learning, we can see that "learning anytime and anywhere, various forms of presentation, novelty and variety of optional content" are the four reasons for choosing the most, accounting for 55.5%, 48.33%, 46.41% and 42.58% respectively. The next reasons also include convenient knowledge reception (37.8%), simple and easy operation (33.01%), and rich functions (32.54%), which reflect the main attributes and advantages of the Internet.

Correspondingly, analyzing the reasons why college students hold a conservative or even negative attitude towards online learning, although the proportion of these students is not high, the reasons are very prominent, and the proportion of "unable to guarantee the learning effect" has reached 68.97%, which reflects that the essential demands of students on online learning are actually consistent with traditional learning, that all depends on the learning effect. The detailed reasons also include: first, the "online teaching quality problems" (34.48%) and "weak online education teachers" (20.69%); Second, at the level of learning platforms and tools, "unstable network access" (27.59%), "complex operation" (13.79%), and "multi pop-up advertising and interference factors" (10.34%). Although the above detailed reasons account for a small proportion, they also remind

that online education is a process in which all parts participate. In addition to students, educators, technology, institutions and platforms also have an impact.

### 3.2 Ability to Access to Online Education Resources

56.55% of students "can use simple and convenient information platforms to obtain resources", 31.35% of students "can skillfully use various ways to collect and obtain resources", and 12.1% of students "can accurately and effectively find resources with certain difficulties". Generally, college students with high educational level basically have certain information collection ability and can use the network platform to find the information resources they need. However, the information collection ability of college students needs to be improved. More than half of students just have a single way to obtain information, and nearly four fifths of students lack the ability to effectively grasp authoritative and professional information resources.

In the way of searching online educational resources, the majority of students are used to "using search engines to input keywords", accounting for 76.59%; The second is "using the portal website that provides classified navigation", accounting for 59.92%, and some students choose to "download relevant software in APP Store" (49.8%). Students who have the needs of taking examination will also "find digital information provided by training institutions" (21.63%). However, in more professional resource fields, "using the digital resources of the school's online library" or "digital resources attached to paper books" account for only about 40%.

### 3.3 Ability to Choose Online Education Resources

Online education is becoming more and more diverse, which not only gives college students more opportunities to choose, but also requires college students to improve their ability to evaluate online education resources. In terms of resource form, most students choose the form of live teaching, accounting for 67.46%. The choice of examination question bank and vocabulary bank accounts for 58.73%. Few students will adopt the one-to-one teaching mode. In terms of the media for content, more than half of college students are more inclined to video. Video is more vivid, and can also convey information to learners more interestingly. In terms of resource types, those who choose examination and professional skills account for 67.26% and 61.31% respectively, followed by hobbies and academic knowledge, accounting for 52.78% and 52.38% respectively. School courses are also selected by the students who have professional training needs. The above shows that the standard for college students to choose online education resources is still to give priority to living forms that can attract attention better, and "knowledge and skills" is the core purpose.

Further analyze what kinds of needs online education can meet for college students. College students said that online education can meet their needs of "expanding their knowledge", accounting for 77.38%, followed by "improving their professional skills and experience", accounting for 75.4%. At the same time, it also meets the needs of students in "communicating learning experience with others, self-satisfaction and cultivating sentiment". It can be seen that online education provides good opportunities for contemporary learners to acquire knowledge and improve skills.

### 3.4 Ability to Apply Online Education Resources

According to the preliminary investigation of the online education platform used frequently by college students, five main types and their representatives are sorted out. Among them, the integrated platforms for comprehensive courses, such as China University MOOC, Smart Tree MOOC, CNKI, BiliBili, and YouDao have the highest frequency of use; Then there are the instrumental platforms for assisting students in learning (BaiCiZan APP, Youdao Dictionary, Zhihu, XueXiaoYi, etc.), and the tutoring platforms for online teaching (Tencent Classroom, New Oriental Online, NetEase Open Class, Youdao School, etc.), whose frequency of use is also higher. The utilization rate of online school platforms (Hujiang Online School, Spark Online School, Website of Chinese Postgraduate Entrance Examination, etc.) and foreign online education platforms (Khan Academy, Coursera, Udacity, EDX, etc.) is lower. As we can see from Fig. 1, college students rely on domestic comprehensive resource platforms with rich courses, and then choose the corresponding platform according to their own needs. However, they do not know enough about foreign online education resource platforms.

In the process of online learning, 58.13% of college students said they had actively participated in online learning interaction, such as "raising hands to speak", "screen sharing", "creating live subtitles", accounting for 65.53%, followed by the interactive

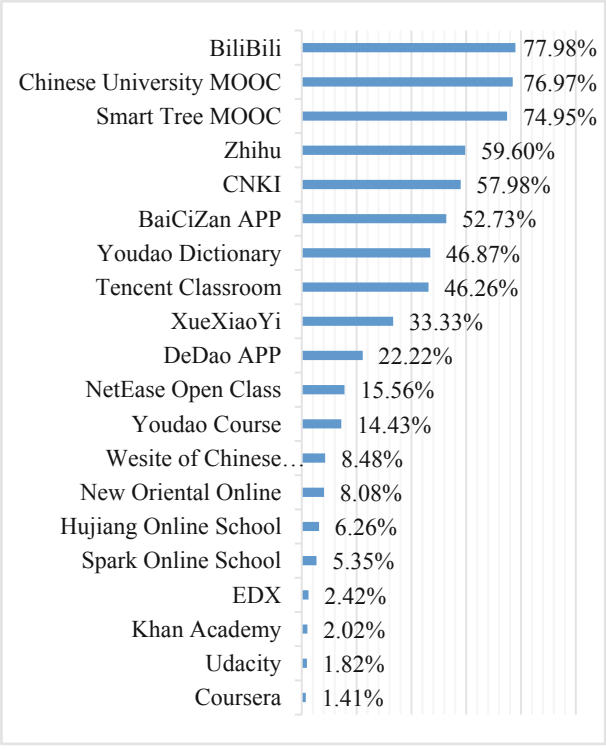


**Fig. 1.** Percentage of Usage Online Education Platforms for College Students

behavior of "sending messages in the comment area" and "posting posts in the comment area for help". The reasons for participation and interaction are that they can better "share experience and gain satisfaction", "expand knowledge and enrich insight" and "check deficiencies and improve themselves", accounting for 76.79%, 75.09% and 65.19% respectively. Among the college students who "have not actively participated in the interaction", accounting for 41.87%, the reason given is that the interaction in online learning "takes a long time to wait for reply ", "the quality of answer is low, and the value of reference is small", "the answers are diverse, and it is difficult to find a correct solution". Some students (35.55%) directly said they did not like sharing and communication.

### 3.5 Evaluation of Online Learning

According to the parts involved in online education, the survey divided college students' evaluation of online learning into personal level, resource level and platform level. At personal level, "in line with personal learning mode and high efficiency" is the most important factor for students to identify with online learning, reaching 63.29%; At resource level, the "rich and comprehensive" and "reusable" advantages of online education resources accounted for 65.48% and 59.33% respectively; At platform level, college students say that online learning can be convenient is the most attractive reason.

The main problems faced by college students are "lack of real-time supervision, learning effect is not good enough", "they can't concentrate for a long time ", which have reached about 60%; The second is "lack of operation skills, and failure to give full play to the advantages of online learning", " lack of classroom atmosphere". Being asked whether students will reply to messages during learning online, 26.06% will reply immediately, exceeding the proportion of replying after all learning (16.16%), indicating some students are difficult to resist the interference factors from Internet.

## 4 Conclusion

As the original and main force of netizen, it is necessary to accept and control online learning for college students. The cultivation and improvement of digital literacy can ensure the online learning effect of college students from long-term impact.

### 4.1 Cultivate Collection and Analysis Skills of Digital Information

An important point in the original intention of online education is opening the access of high-quality education resources. However, the utilization of professional resource is low, such as authoritative and scientific digital resources of university libraries. The acquisition of online educational resources reflects the backward literacy and skills of college students in digital information collection and analysis. Many college students said in in-depth interviews that they usually search for information through search engines such as Baidu and Google, and few search in databases such as Zhihu, Wanfang and CNKI. When asked whether they can quickly find the information they want on the network, nearly half of the respondents "lack a certain efficiency in searching ". In the

Internet era, information is diverse and complex. Whether we can have the ability to obtain valuable information directly determines the quality of information we can use and affects other digital literacy and skills.

### 4.2 Optimize Choice and Evaluation Skills of Digital Information

Online education not only breaks the restrictions of time and space, provides the expansion of information and resources, but also realizes the diversification of content. Online learning gives college students more opportunities to choose, but requires them to improve their ability of information evaluation to ensure higher quality. The standard for college students to choose online education resources is to give priority to the living form and the purpose also takes knowledge and skills as the core theme, reflecting college students have better digital information evaluation skills. But college students' dependence on domestic platforms, and the lack of foreign online education resource also remind they must broaden their horizons and deepen their cognition in order to have accurate standards.

### 4.3 Upgrade Exchange and Creation Skills of Digital Information

The college students' participation in the online learning process is not high. In the In-depth interviews, they are asked whether they will express their views on topics of interest on the online education platform and whether they will answer others' questions on the platform, the answers are basically occasional or never. Although they are used to the social APP, their awareness and ability to exchange views and share content with others online need to be improved. At the same time, in terms of information creation, college students show the advantages of its network natives, most college students have the ability to create digital content through the new network tools, which is a positive trend to better integrate with the Internet and the intelligent era. Whether we can use network knowledge and skills to create digital content is a high-level stage of digital literacy, which requires persistent training and practice.

With the rapid development of Internet and digital technology, "online learning" has gradually become the necessity, which has a profound impact on the college students' thinking ways and learning methods. It is inevitable to cultivate digital literacy and skills to constantly optimize their lives and learning. We all need to think and practice how to survive in the digital era and improve the quality of personal livings and professional development, learn and grow into a digital citizen with both "digital skills" and "online wisdom".

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