Analysis of the college students' online learning status and implementation strategies during the epidemic

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Abstract—**In order to promote high-quality online teaching and learning of Chinese colleges and universities during the COVID-19 pandemic. This study conducted an online questionnaire survey on college students in different universities in China, and analyzed the data collected from 155 valid questionnaires to gain an in-depth understanding of the status and the specific needs of online learning during the epidemic. According to the survey results, an online learning model during the epidemic was constructed based on mixed teaching theory and generative teaching theory, and the model for the proposed upgrade teaching and learning quality of implementation strategies.**

Keywords—COVID-19, college students, online learning, learning mode, implementation strategies

I. INTRODUCTION

When the coronavirus (COVID-19) spread rapidly around the world, many countries in the world have launched a variety of strategies to contain the virus, the key of which is to close schools [1]. UNESCO pointed out that as of March 12, 2019, 46 countries on five continents have announced school closures to curb the spread of COVID-19, affecting the learning of nearly 376.9 million children and youth. Another 20 countries/regions have partially closed schools (partially closed schools) to prevent or curb the spread of COVID-19 [2]. International organizations pay special attention to the issue of "crisis and educational countermeasures in crisis". During the epidemic, Chinese universities used online course teaching resources, and under the support services of resource platforms, course platforms, and online learning spaces, actively carried out online teaching activities such as online teaching and online learning to ensure the progress and quality of teaching during the epidemic prevention and control period. Online learning has gradually become an important way for people to learn, but there are also problems such as information overload and information trek [3]. This study focuses on undergraduates studying at home in the context of epidemic prevention and control, investigates the online learning status and learning needs of undergraduates, and based on data analysis results, proposes online teaching models and implementation strategies for colleges and universities.

II. ONLINE TEACHING AND ONLINE LEARNING MODE

A. Online learning

Online learning usually refers to the learning process of providing some or all teaching materials and activities through the Internet. Teachers facilitate online learning by structuring and sequencing online activities to help learners achieve defined objectives, these activities might include the presentation of instructional materials (e.g. online tutorials) [4], communication among learners (computer-supported collaborative learning) [5], and computer simulations of real-life situations [6]. At present, the speed and scale of online learning are surprising, especially MOOC online learning. Past research has found that more than 25% of students enrolled online in higher education from all over the world [7]. The number of students taking at least one online course has increased over the years as shown in a recent survey on online learning in US higher education which revealed growth rates for students taking at least one online course at 25.9% in 2012, at 27.1% in 2013, at 28.3% in 2014, and at 29.7% in 2015 [8]. This report also noted that online education is becoming an important long-term strategy for many postsecondary institutions. The online education market is also becoming more and more active in China. By 2019, the number of online education users in China has reached 261 million, it shows a trend of the increasing year by year, and it is predicted that the number of users will reach 309 million in 2020. It can be seen that online learning will become an important way for people to learn in the future.

Many educators and researchers are interested in online learning courses to enhance and improve student learning outcomes while battling the shortage in resources, facilities and equipment particularly in high education institutions. As early as 2001, the Massachusetts Institute of Technology in the United States pioneered the online launch of the Open Course Ware Project (OCW), and put more than 2400 courses in our school online through the Internet for learners to learn online, by 2019 OCW online courses had reached 2,472. The official platform supported by the Italian Government was launched Edu Open in April 2016. According to the statistics of Class Central International MOOC research data, the total number of MOOCs on overseas online learning platforms has grown to 13,500. In addition to using online integrated platforms to build learning courses, there are online learning courses were designed based on specific students' learning styles. The course is more personalized to serve students and helps teachers to evaluate students' preferences for relevant courses, in order to significantly improve teaching methods and improve student's evaluation effect. In addition, scholars have carried out related research on the learning process and learning effects in online learning courses. Hwang explored the application of self-assessment, logging, and peer sharing in online computer programming, and the results showed that the three evaluation methods complemented each other and all of them can promote the academic achievement of online courses [9]; Mary K. Wilhelm-Chapin et al. researched the resource interaction and participation behavior of graduate students in online learning courses, and further explored the relationship between learning resources and students' perceived value [10], these studies indicate that students who report high levels of satisfaction in online courses also have expressed higher levels of social-presence and teaching-

24

presence [11]. In addition, technology has a positive effect on student engagement [12].

B. Online Teaching Mode

The effectiveness of online learning varieties according to how the online course is designed and taken [13]. In order to promote the teaching and learning effect of online learning, it is necessary to develop an effective teaching model. The two most commonly used instructional design models are ADDIE models [14] and Dick and Carey models [15]. However, these two models are more used in the offline traditional curriculum guidance teaching, researchers based on the theoretical basis of the above model, designed five related teaching modes for online learning: (1) E-learning instruction mode, which is mainly a psychological teaching mode based on content structure, embodies the concept of information processing psychology and social constructivism [16]. (2) The instructional design model for online learning (IDOL), which is proposed for online courses of higher education, includes three main steps, analysis, strategy, and evaluation. In particular, it can only be used with other instructional design modes, because the teaching efficiency is low when it is used alone [17]. (3) Roblyer's online and blended learning design theory, which also draws on the ADDIE model and Dick and Carey model, based on the original traditional teaching design process, fully considers the characteristics of an online mixed learning environment [18].(4) Quality online learning and teaching, which provides a review and case study of MOOC provision. The review considers the current position of MOOCs as a change agent for higher education provision, and the case study considers lessons learned from a MOOC which uses the study platform [19]. (5) Quality Matters (QM) Publisher, a non-profit organization dedicated to assessing the quality of online and combined instruction. There are two sets of the rubric: one for higher education and the other one for K-12 education. The rubric was created to address the need for a design stand [20].

It can be seen that the main goal of the online teaching model is to help teachers better design online course activities, promote students to focus on online learning, and ultimately achieve a good situation of active teaching and learning. However, few teaching modes are designed for online learning courses, and it is an urgent need for educators, instructional designers and training developers to jointly discover adaptive online teaching modes. With the support of relevant online education theory and combining teaching environment, teaching methods and other elements, to build the online teaching mode adapted to different situations.

Under the new situation, new technologies have brought opportunities to solve online learning challenges. This research takes the online learning of university teachers and students as the cut-in perspective, focusing on the current learning situation and learning needs of college students, from the background information of the learners, the learners' choice and evaluation of MOOC teaching methods, arrangements and environments, and the performance and difficulties of postgraduate online learning , Learners' needs for learning time, interaction, learning support and learning goals, etc., design and implement a survey questionnaire on the status and needs of college students' online learning.

III. METHOD

A. Participants

Participants in this study included undergraduates and graduate students from different universities in China, with a total of 155 students. As shown in Table 1, among these students, 81 (52%) are undergraduates and 74 are postgraduates. 75 (48%) participants are majors in literature and history, and 80 participants are majors in science and engineering. The sample included 37 women (24%) and 118 men. On the whole, the discipline distribution of participants is relatively balanced. As shown in Table 2, 90 participants (58% of the sample) reported that they have completed more than 3 online courses in the past. Only 3 participants (1.94%) reported no online learning experience.

TABLE I. PROFESSIONAL DISTRIBUTION OF ONLINE LEARNING

Response Option		Number	Percentage (%)	Response Option	Number	Percentage (%)
Gender	Male	37	23.87	Undergraduate	81	52.26
	Female	118	76.13			
Profession	Liberal arts	75	48.0	Postgraduate	74	47.74
	Science	80	52			

TABLE II. COLLEGE STUDENTS' ONLINE LEARNING EXPERIENCE

Response Option	Number	Percentage (%)	behavior
No experience	3	1.94	Never participated in any live courses or online platform courses
Less experience	21	13.55	Have participated in some learning activities of live courses or online plat form courses
A little experience	41	26.45	Completely participated in 1 live course or online platform course learning activity
Very experienced	90	58.0	Completely participated in more than 3 live courses or online platform course learning activities

B. Instrument

By using the online survey service "Questionnaire Star", we have developed an online survey questionnaire as a tool for the survey. The questionnaire is composed of 23 questions and is divided into three parts, which are related to the status of online education in higher education and the needs of students. The first part includes three questions about the interviewee's demographics and background information. The second part includes 11 questions about the status of respondents' online learning. The third part includes 9 questions about online teaching needs. The survey used various types of questions, including multiple-choice questions, multiple-choice questions, and sorting questions.

C. Data Collection and Analysis

The survey was conducted from March 20 to April 1, 2020. Invitations were sent to learners from colleges and universities through online social platforms. The colleges and universities selected were random. The invitation contained information and background about the research, and 155 completed the survey. Participants responded anonymously to the survey, and the data was stored in a hosted online survey service. Use SPSS22.0 for descriptive data analysis (such as frequency).

IV. RESULTS

Our research confirmed some general beliefs about online education, refuted some other beliefs, and designed and constructed a model for online learning.

A. Online teaching methods and tools

Under the background of epidemic prevention and control, learning methods have changed, and the response rate and popularity of the use of live teaching, course groups and learning platforms are high, indicating that the mixed-use of these three teaching methods is the backbone of online teaching during the epidemic. As shown in Table 3, the two most popular teaching methods are:

★ The live broadcast is the main form, and interactive software is used to supplement the use of WeChat, QQ and other communication and discussion after class (77.42%).

★ Use the learning platform to strengthen Confucianism Cloud, MOOC, etc. to communicate and complete homework (76.77%).

In live teaching, teachers mainly complete the teaching content through shared screens and voice chat, and the usage rate of classroom activities such as interaction and on-site questions is low. Among them, the response rate and penetration rate of the shared screen were 30.21% and 85.16%, the response rate and penetration rate of the microphone were 30.66% and 86.45%, and the response rate and penetration rate of the interactive area were 17.85% and 50.32%. However, the response rate and penetration rate of classroom activities such as interaction are low. The response rate and penetration rate of random roll calls are 2.75% and 7.74%, respectively, and the response rate and penetration rate of on-site questioning are 0.69% and 1.94% respectively. Table 4 shows that the "teaching presence" of online teaching is indeed in a negative state.

TABLE III. TEACHING METHODS

Response Option	Response		Penetration
	n	Rate (%)	rate(%) (n=155)
Just live broadcast, no other software or platform to assist learning	19	5.61	12.86
Live broadcast is the main form, and interactive software is used to supplement after -class communication and discussion (such as WeChat, QQ, etc.)	120	35.61	77.42
Live broadcast is the main form, and the learning platform is used to complete communication and homework (such as MOOC)	119	35.31	76.77
Online learning platform focuses on self -directed learning, supplemented by live teacher broadcast	51	15.13	32.90
No live broadcast, mainly viewing micro -classes, supplemented by software and platform	23	6.82	14.84
No live broadcast and micro -teaching videos, just learn by completing the assigned tasks	5	1.48	3.23
Goodness-of-fit test	x2=234.104, ρ=0.000		

TABLE IV. LIVE BROADCAST FUNCTION

Response Option	Response		Penetration rate (%)
	n	Rate (%)	(n=155)
Cast screen	132	30.21	85.16
Camera	67	15.33	43.23
Microphone	134	30.66	86.45
Barrage	4	0.92	2.58
Comment area interaction	78	17.85	50.32
Like (Kudos to)	7	1.60	4.52
Voice Changer	0	0.00	0.00
Roll call	12	2.75	7.74
Issue on site	3	0.69	1.94
Goodness-of-fit test	x2=513.890, ρ=0.000		

B. Student performance and difficulties

Although college students have certain autonomous learning capabilities, online learning environment, course tasks, and effective interaction are still the biggest obstacles college students face in online learning. Therefore, how to adjust the difficulty according to the content of the course, under the existing conditions, to achieve effective interaction of teaching is a problem that efficient teachers need to seriously consider in the context of the epidemic situation.

College students encounter various difficulties in learning online, which can be analyzed through Pareto charts. Pareto's rule believes that a relatively small number of original causes usually cause most problems or defects. This rule is usually called the two-eighth rule, that is, 80% of the problems are caused by 20% of the reasons. As shown in Figure 1, according to statistics, the five factors of network speed, learning environment, homework, course difficulty and interaction account for 82.98 as the main influencing factors.
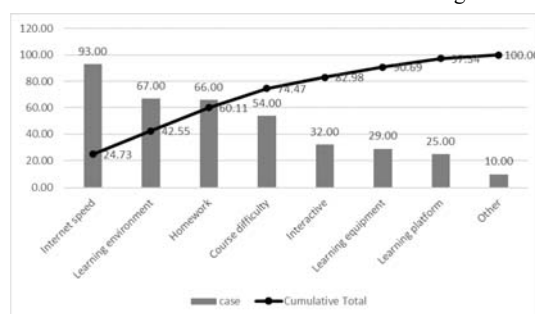

Fig.1. Online learning difficulties Pareto chart

C. Learning methods and duration

As shown in Figure 2, the questionnaire surveyed the length of live learning for college students and found that the length of learning affects students' concentration. The data shows that 50.32% of college students think that short breaks should be provided in the middle of the live broadcast class to improve the effectiveness of the class, and 10.32% of college students think that providing eye exercises in the live class can improve the class effect and improve the efficiency of the class. In terms of length of study, 44.52% of college students chose 30 minutes to 45 minutes for each live broadcast, 36.77% of college students chose 45 minutes to 60 minutes, and only 18.06% of college students thought that each live broadcast could be 60 to 90 minutes. It can be seen that when undergraduates are studying online, they need to reasonably control the length of learning to ensure the efficiency of learning.
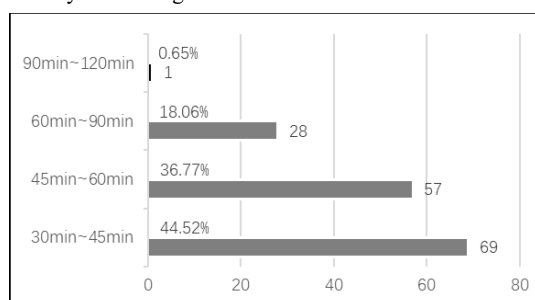

Fig.2. Online learning duration requirements

D. Learning interaction

During the online learning process, college students are unable to engage in more teacher-student interactions and

peer interactions, lack deep learning interactions, and are prone to learning loneliness, which has affected learning effectiveness and satisfaction to a certain extent. As shown in Table 5, the questionnaire surveyed the interaction of the discussion area of the online learning platform. In view of the fact that the relevant questions are sorting questions, it is necessary to process and re-encode the collected questionnaire data first, and then perform frequency analysis and descriptive analysis. Finally, sort the results. The data shows that the most important thing is to reply to the teacher's topic (the content of the reply is mainly for approval and encouragement) and put forward different opinions (for emotional responses such as approval, opposition and encouragement to other people's posts).

TABLE V.   SORTING THE IMPORTANCE OF DEMAND INDICATORS IN THE INTERACTIVE MODE OF THE DISCUSSION AREA

Response Option	Respond	Min	Max	Average	Standard	Median	So
Reply under the teacher's topic	138	1.000	6.000	4.413	1.182	3.000	1
Reply content is mainly to agree, encourage and put forward different opinions	125	1.000	6.000	4.336	1.459	5.000	2
The replies are sentimental (such as approval, opposition and encouragement)	119	1.000	6.000	4.151	1.650	4.000	3
Reply to the posts of classmates who can stimulate your thinking	133	1.000	6.000	3.391	1.966	4.000	4
The main content of the reply is clear	124	1.000	6.000	3.129	1.672	3.000	5
According to the teacher's question, open a new topic to answer	116	1.000	6.000	2.962	1.936	3.000	6

E. Learning support services

Learning support is a key factor in the success of online teaching and an effective guarantee for online learning during the outbreak. As shown in Table 6, the questionnaire surveyed the learning support services of the online learning platform. Statistics show that learning resources based on courseware, video, audio, and literature account for 90.32%, discussion areas account for 47.74%, and homework accounts for 29.03%. Learning resources, discussion areas, and homework are considered by most college students. The most effective learning support in online learning. At the same time, 65.17% of college students need an average of 1- 3 hours to complete each course every day. It can be seen that the amount of homework is also a consideration for teachers in online teaching. In addition, 47.74% of college students believe that the discussion and explanation of homework can better promote learning.

TABLE VI.   PLATFORM LEARNING SUPPORT DEMAND RESPONSE

Response Option	Response		Penetration rate(%) (n=155)
	n	Rate(%)	
Learning resources, courseware, video, audio, literature, etc.	140	35.81	90.32
Forum	74	18.93	47.74
Wiki	21	5.37	13.55
Homework	45	11.51	29.03
Teaching objectives	24	6.14	15.48
Online interactive courses	56	14.32	36.13
Vote	13	3.32	8.39
Questionnaire	18	4.60	11.61
Goodness-of-fit test	$x2=258.555$，$\rho=0.000$		

F. Learning goals and achievements

Compared with obtaining excellent grades, completing course tasks and learning skills are the main goals of online learning for college students. However, it should not be overlooked that, with the constant emphasis on the scientific research ability of talents, research knowledge has also become an essential skill for college students to learn online. Therefore, how to use online learning to cultivate the research literacy of college students is also the primary consideration for teachers in online teaching. In view of the fact that the objective of online learning is sorting, it is necessary to process and recode the collected questionnaire data first, then perform frequency analysis and descriptive analysis, and finally sort. As shown in Table 7, college students believe that the order of importance in the learning objectives is generally: complete tasks> learn to skills> obtain excellent results> obtain research knowledge.

TABLE VII.   PRIORITY RANKING OF LEARNING GOALS TO ACHIEVE DEMAND INDICATORS

Response Option	Respond	Min	Max	Average	Standard	Median	Sort
Basically complete daily courses	147	1.000	4.000	3.088	0.802	3.000	1
Learned skills	146	1.000	4.000	2.582	1.285	3.000	2
Get excellent results	141	1.000	4.000	2.340	1.133	2.000	3
Acquire research knowledge	136	1.000	4.000	2.213	1.007	2.000	4

V. DISCUSSION

A. Results analysis

Through the questionnaire survey, we can find that although home-based online learning has the flexibility and adaptability of self-regulation, it still faces many problems and challenges. First, the level of home online learning conditions is uneven. Online learning is generally restricted by objective conditions. For example, the smoothness of the network is the most basic condition for online learning. Since most students come from different provinces, cities, and regions, their community signals and family network conditions are different. The terminals most used by college students for home study are mobile phones and computers. Second, the multi-selectivity of learning resources and platforms. In order to make better use of the advantages of online teaching, teachers will provide students with rich and high-quality learning resources, but college students often have difficulty in making choices in the face of massive curriculum resources, resulting in increased learning time and increased learning pressure. Third, teaching presence [21] is at a shallow level. In order to increase the participation of college students in online learning and generate meaningful discussions, teachers need to create a positive atmosphere for discussion. Some existing online teaching lacks face-to-face communication and group interaction in traditional classrooms. The discussion and cognition between teachers and students and students are still at a relatively shallow level, and the learning situation is still mainly based on surface learning. Fourth, personalized learning needs are difficult to achieve. Students' personalized learning is currently more dependent on the support of online learning platform big data and personalized online education resources.

B. Mode construction

The construction is "synchronous live teaching, asynchronous self-learning" model. Based on the results of

the questionnaire survey, this study combined the mixed teaching concept and the generated teaching concept, and relied on platforms and tools to build the mode, which aims to provide personalized support for high-quality online teaching and learning platforms To meet students' learning needs and promote their personal growth. As shown in Figure 3, this model includes 3 major parts. These parts are closely linked, especially suitable for teachers' online teaching and students' online learning.

Asynchronous self-learning mainly occurs before and after class. Autonomous online learning mainly completes the learning of set goals by interacting with the digital learning content carefully prepared by the designer. Before class, teachers can publish the "Independent Learning List" through the learning platform, clarify the learning content, learning goals, classroom form notices and learning tasks, and share learning videos such as MOOC, micro class, etc. Students can also provide learning tools such as multimedia courseware, experiment tools and virtual simulation that are used for study preparation. After class, students need to complete homework, practical projects and quizzes through the learning platform.

Simultaneous live broadcast online teaching refers to teachers who can use Dingding, Tencent Classroom, Zoom, CCtalk and other platforms for live broadcast interaction in the class. Wheat, discussion area or course group and other ways to interact with students online in real-time to keep abreast of student dynamics.

The online learning environment covers the conditions of the entire learning preparation and learning process. Online support services such as network access conditions, learning platforms, and live broadcast tools provide technical support for online teaching methods. During the epidemic, students studying at home require students to be good at independent study. Students as the center of learning, teachers should formulate specific and appropriate learning goals based on the overall teaching goals, combined with the students' learning conditions and needs. Students need to master the use of multiple learning tools and have the ability to independently set learning goals, self-management, self-monitoring, and self-evaluation.

Task-driven, effective interaction, and multiple evaluations are required to promote students' deep learning before, during, and after class. Before the class, teachers release learning resources and tasks, students complete the tasks and reply to each other on the learning platform, raise questions and learning needs in learning, and teachers can improve teaching design through pre-class interaction. During the lesson, teachers can use the wiki and other online collaboration tools to guide students in online group cooperation to complete classroom exercises. Teachers and students can directly communicate through live broadcasts and discussion areas to ensure the timeliness of interaction. After the class, students need to complete assignments, online tests, and share their learning results on the learning platform. The entire process adopts an evaluation method that combines quantitative analysis and qualitative analysis. The platform tracks and records student learning process data, interaction data, and result data to make a quantitative analysis. Teachers can comprehensively evaluate students' learning achievements. Students can also conduct self-evaluation and mutual evaluation.
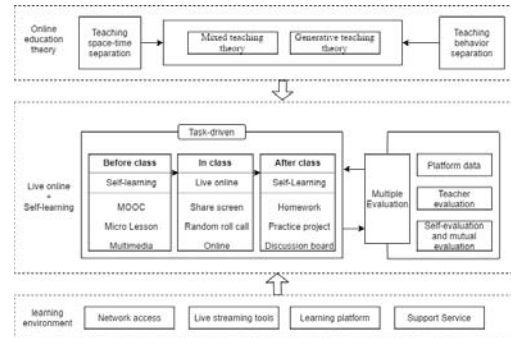

Fig.3. Online Teaching and Learning Model

C. Implementation strategies

The above model is a new teaching model in line with the online learning situation of colleges and universities, and requires multiple collaborations such as online learning environment, teacher instructional design, and learning platform. Based on the constructed online learning model, combined with the current status and needs of college students' online learning, this article puts forward four suggestions for the implementation of the model:

Follow the new form of the online learning environment and promote the development of personalized learning. Many researchers have tried to solve strategies, including the use of digital badges for online certification and course evaluation [22], and the realization of targeted teaching by building online learner portraits in the context of big data [23]. In addition, VR and AR can also achieve personalized recommendations of learning resources and learning paths and intelligent data analysis. Therefore, in order to better carry out online teaching and realize personalized learning, teachers should not be limited to a single online teaching platform, try to apply a new learning environment, start with teaching evaluation, stimulate students' learning motivation, and enhance students' learning concentration.

Guided by task-driven, reshape teaching goals. Online teaching during the epidemic should focus on the quality and effectiveness of talent training, and be task-driven. On the basis of adhering to the comprehensiveness of the teaching objectives, it must also ensure the ease of operation and comprehensiveness of the teaching objectives. It not only emphasizes the online learning network The mastery of basic knowledge and professional skills in the course puts more emphasis on the transfer and acquisition of research knowledge, appropriately increases the depth of learning of online courses, helps students improve research literacy as much as possible, and trains them to find problems, analyze problems and solve problems.

Innovate teaching design and explore diverse and mixed teaching. The survey found that teaching activities and homework represented by collaborative learning are one of the main factors that affect the quality and effectiveness of online deep learning. In terms of collaborative learning research, Park and others have built a model of "using the wiki for online collaborative knowledge construction" to achieve the continuous development of online deep collaborative knowledge construction [24]. In addition, online learning organizations cannot copy the normal class classroom teaching methods, duration and teaching arrangements. We should innovate and diversify teaching activities and

homework forms, as much as possible to reduce the burden of student work and maintain a pleasant Online learning atmosphere.

Optimize teaching support services and deepen interactive learning. Learning and analysis technologies such as artificial intelligence, 5G, and big data can empower teachers and students to achieve teacher-accurate teaching and student adaptive learning. Laato created a web-based learning platform UTUPS on the basis of analyzing the learning needs of college students, and integrated various components such as teacher-student interaction, content management, and learning evaluation to achieve organic teaching, learning, and testing activities. Integration [25]. These studies provide a variety of interactive forms for optimizing online teaching support services, and more emphasis on social presence.

VI. CONCLUSIONS AND LIMITATIONS

Online research tools and a wide range of social and learning platforms have provided effective technical and conditional support for this research organization. The purpose of this study is to help teachers integrate the short-term online teaching and long-term development of education informatization in the context of the epidemic, and promote the reform of online education and teaching. But this research is exploratory in nature, so there are some limitations that should be recognized. The research targets of this study include graduate students and undergraduates. The uneven development of education in different regions and the differences in the professional nature of students all have certain influences and restrictions on the results of the survey. In addition, gender and age factors are beyond the scope of the discussion. The online learning model constructed in this study is a new teaching model in line with the online learning situation in colleges and universities. Online learning in basic education is not applicable, but it has a certain reference value. This model has yet to be verified by the next application practice and effect to ensure its effectiveness.

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