

Research on College Students' Online Deep Learning in the Epidemic Situation of Corona Virus Disease

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Abstract: In the epidemic situation of the corona virus disease, starting from the concept of deep learning, based on online learning experience, learning motivation and learning input and other variables, an influencing factor analysis framework, theoretical assumptions and corresponding measures of deep learning for college students were constructed. A one-stage survey was conducted on college students who conducted online learning at home during the epidemic to understand the situation of college students studying online at home and students' evaluation of online classrooms, and then a two-stage survey was conducted on students who will actively study online at the first stage Empirical analysis of influencing factors of college students' deep learning using structural equation model. The results prove that online learning experience, learning motivation and learning input all have a significant positive effect on deep learning. Therefore, colleges and universities need to continue to strengthen the construction of educational information infrastructure, integrate online education and teaching resources, improve teachers' ability to apply information technology, set up rich teaching classrooms, increase teacher-student interaction, strengthen student participation in online classrooms, and strive to stimulate student learning Motivation, enhance students' learning motivation, and cultivate students' deep learning ability.

1. Introduction

The outbreak of COVID-19 epidemic has made the education and teaching work in colleges and universities face great challenges. According to the decision-making arrangements of the Party Central Committee to prevent and control COVID-19 epidemic. Colleges and universities put the prevention and control of epidemic situation in the first place, and put the health and safety of teachers and students in the first place. In order not to drop the education for thousands of students, colleges and universities choose not to return to school at the beginning of school, organize online education and teaching activities in an all-round way, change offline classes to online classes, and truly stop studying. Under the implementation of online classroom teaching mode, the school organizes various online classroom trainings, teachers take part in the training and study hard, master the use of related online teaching equipment in a short time, and actively think about improving the attraction of online classroom. However, online learning puts forward higher requirements for students' learning initiative and deep learning ability.

Online learning is definitely not a simple way for students to cope with it, simply completing

learning tasks by memorizing, nor can it be because teachers can't supervise students' learning face to face. Therefore, students can choose one that doesn't need too much effort, analysis or integration of learning content, and only needs to complete the homework assigned by teachers. So how can online learning cultivate high-quality and high-quality students? How can we really cultivate college students' online deep learning ability? On the basis of constructing the index system of influencing factors of college students' online deep learning and various research hypotheses, this paper makes a survey of college students' online learning initiative and deep learning, and makes an empirical study with SEM, in order to reveal the formation reasons and influencing factors of college students' online deep learning.

2. Theoretical Analysis and Model Design

Starting from the concept of deep learning, deep learning is to be able to think critically on the basis of summing up previous experience, to deeply integrate innovative knowledge with original knowledge, to form a new cognitive system through criticism, summary and thinking, and then to transfer and apply it. During the epidemic period, students who don't return to school are separated from the school schedule, and lack the teacher's management and restraint. Students should arrange their time reasonably, study related courses independently, develop the good habit of reading more, thinking deeply, being good at asking questions and practicing diligently, and cultivate their ability of online deep learning. This is the teaching goal of online education during the epidemic, and it is also the requirement of higher education personnel training. Therefore, combining with the current reality, studying the factors that affect college students' online deep learning can explore ways to promote and realize college students' online deep learning.

(1) Research hypothesis

In this paper, based on the related research results at home and abroad, 12 specific micro-indicators are constructed based on four variables of online learning experience, learning motivation, learning input and online deep learning, and the factor analysis index system of online deep learning for college students is constructed (see Table 1).

Table 1 The Factor Analysis Index System of Online Deep Learning for College Students

Variable	Measurable variable	Meaning of measurable variable
Online learning experience	TY1: learning environment	Learning environment comfort, network fluency, etc.
	TY2: Data acquisition	Ease of learning data collection and acquisition
	TY3: Teacher-student interaction	Learn the degree of interaction and communication between teachers and students online
Learning motivation	DJ1: Like learning	Like online learning and can actively participate in online classroom learning
	DJ2: Autonomous learning	Take yourself as the master of learning and learn independently
	DJ3: Learn to think	Have a strong curiosity, thirst for knowledge and desire to explore knowledge
Learning engagement	TR1: Vitality	Have full learning energy and good resilience
	TR2: Absorbed	Putting your energy into study is not easy to be disturbed by the outside world
	TR3: Dedication	Study with all your heart and soul and accept the challenge bravely
Online deep learning	XX1: Reflective learning	Understand a certain point of view, train of thought, and deeply reflect on the analysis
	XX2: Deep understanding	Through learning, we have changed our understanding of a certain problem or concept
	XX3: Practical innovation	Apply what you have learned to practical problems or new situations

① Online learning experience

As we all know, experience refers to an experience and feeling after experiencing something personally. Learning experience is the concretization of experience. It is the unique feeling generated by the learner's interaction with the teaching environment during the learning process. The learning experience will be different when the environment is different. In the context of the current epidemic, colleges and universities have started the learning mode of online learning. Teachers use Tencent classrooms, QQ group classrooms, Tencent meetings, etc. to conduct voice lectures, video lectures, and exchange learning materials with students. Students can also use related teaching platforms. Watch the teacher's video and PPT to learn more about the teaching content of the course. A good learning experience can effectively stimulate students' learning motivation, make students more engaged in learning, and encourage students to consciously enter deep learning. Regarding the research on the constituent elements of learning experience, Mi Gaolei [1] and others believe that learning environment, curriculum learning experience, and learning effect feedback will affect learning experience. Hu Yongbin [2] and others focused on the influencing factors on the physical environment of learning, the acquisition of resource information, and the interaction of the teaching process. Udo G.J [3] and others pointed out that the structure of course content, teacher-student interaction, and individual learning will affect the learning experience of students. Based on this, the learning environment, complete learning content, and teacher-student interaction are selected as the influencing factors.

H1: Online learning experience has a significant positive impact on learning motivation

H2: Online learning experience has a significant positive impact on learning engagement

H3: Online learning experience has a significant positive impact on online in-depth learning

② Learning motivation

Learning motivation refers to a dynamic tendency that initiates and maintains students' learning actions and makes them point to certain academic goals. Learning motivation comes from one's own learning interest and thirst for knowledge, which is often manifested in students' willingness to learn and active learning. Generally speaking, when students realize that learning is in line with their own interests and hobbies in the learning experience, and can play an important role in their own growth, students' learning motivation will be highlighted and become the inexhaustible motive force of the whole learning process. On the study of the elements of learning motivation, Liu Zhongyu and others [4] focused the influencing factors on students' active learning and active participation in classroom learning. Chen Yi [5] thinks that students should be curious about knowledge, actively study and learn to think. Li Yajiao and others [6] also believe that students should study independently and study hard to acquire new knowledge. Accordingly, there are three influences of the choice here. First, students like online classroom learning and can learn independently. Second, online classroom is very interesting and willing to actively participate in classroom learning. Third, the purpose of students' study is to learn to think and have a strong curiosity and exploration desire for knowledge.

H4: Learning motivation has a significant positive impact on learning engagement

H5: Learning motivation has a significant positive impact on online in-depth learning

③ Learning input

Learning engagement is the degree of students' efforts in learning and mastering knowledge, or the degree of studying hard to get better grades. Students' learning engagement has a profound impact on students' online deep learning ability and future achievements. Freds [7] and others think that learning engagement includes three independent dimensions: behavior, emotion and cognition. Zhang Qi [8] thinks that learning input is a unity of mutual influence and interaction among cognitive input, behavioral input and emotional input. Schaufeli[9] divides learning input into three dimensions: vitality, concentration and energy. Accordingly, vitality, dedication and concentration

are chosen as influencing factors here.

H6: Learning engagement has a significant positive impact on online in-depth learning

(2) Research model

Structural equation model is a confirmatory statistical method to quantitatively measure the degree of influence of related influencing factors on a certain variable. The goal of this paper is to verify the theoretical hypothesis of the influencing factors of online deep learning for college students, so we use structural equation model for empirical analysis, and verify the causal relationship between variables through quantitative estimation of the model. Based on the above analysis of influencing factors of college students' online deep learning, a theoretical model of influencing factors of college students' online deep learning is constructed (see Figure 1). The theoretical hypothesis model is the initial structural equation model.

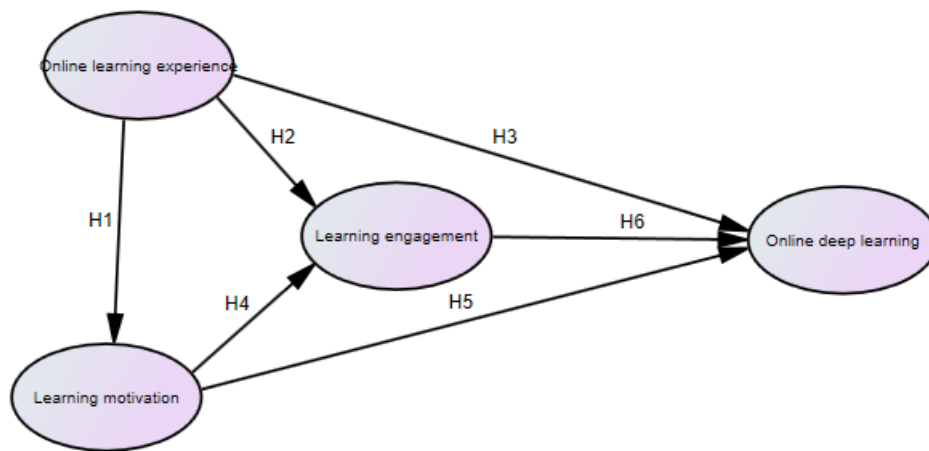


Fig.1 Theoretical Hypothesis Model of Influencing Factors of College Students' Online Deep Learning

3. Online Learning Status and Data Analysis of College Students under Epidemic Situation

(1) Data sources

This study carried out a two-stage questionnaire survey. In the first stage, a questionnaire was designed to investigate the situation of college students' online learning at home during the epidemic and the evaluation of online classroom by students. The survey object was mainly aimed at college students who were online learning at home during the epidemic. The survey was carried out in March 2021, and questionnaires were distributed online, with 1,500 questionnaires and 1,180 valid questionnaires, with an effective rate of 78.7%. In the effective questionnaire, male students account for 45% and female students account for 55%, and the proportion of male and female students is equal, which will not interfere with the analysis of the questionnaire results. On the initiative of online learning: 60% of students think that they will not take the initiative in online learning, 35% think that they will take the initiative in online learning, and 5% hold the attitude of Buddhism. As to whether online learning is focused or not: 8% students will concentrate on class 100% of the time, 20% students will concentrate on class 80% of the time, 52% students will choose 50%, and 20% students will choose less than 50%. About what students will do after the online class (multiple choices): 100% of students choose to finish the homework assigned by the teacher, 20% choose to review carefully to consolidate relevant knowledge, 9% choose to search for

relevant online learning materials to continue learning, and 2% choose to broaden and think about relevant knowledge points. Evaluation of online classroom (free play): Students think that online classroom is not limited by space, online learning lacks learning atmosphere, there is a sense of distance between teachers and students in online classroom, problems can't be communicated with teachers in time, network and teaching equipment are limited, and practical teaching is difficult.

In the second paragraph, a questionnaire is designed, which is mainly aimed at the 35% students who can take the initiative to learn online in the first stage. The contents of the questionnaire mainly include online learning experience, learning motivation and learning engagement, and other online deep learning influencing factors. For each measure item, Likert five-point scale is used to score, including totally disagree, disagree, uncertainty, agree and totally agree, which are expressed by 1-5 respectively. The survey mainly adopted direct E-mail questionnaires and telephone interviews, with 380 questionnaires and 334 valid questionnaires, with an effective rate of 85.6%.

(2) Measurement model analysis

① Reliability and convergent validity analysis

In this study, the measurement model is used to verify the Factor loading of various factors, and the factor loading studied by the measurement model must be greater than 0.6. If the factor load of a measure fails to reach this value, the measure is not representative and should be deleted [10]. Otherwise, the measure must be retained. The suggested value of the combined reliability CR for the factors is 0.6 [10]. The results show that the combined reliability of each factor reaches 0.6, and the average extraction variance (AVE) of each factor must be greater than 0.5, so that the measurement model has the required reliability (see Table 2). From the statistical analysis results, it can be seen that the structures of online learning experience, learning motivation, learning engagement and online deep learning meet the convergence validity conditions of Fornell and Larcker [12], so these results support the convergence validity of each factor.

Table 2 Analysis of Reliability and Convergence Validity

Variable	Measurable variable	Factor loading	CR	AVE
Online learning experience	TY1	0.958	0.814	0.601
	TY2	0.669		
	TY3	0.661		
Learning motivation	DJ1	0.861	0.919	0.791
	DJ2	0.980		
	DJ3	0.820		
Learning input	TR1	0.730	0.750	0.502
	TR2	0.775		
	TR3	0.610		
Online deep learning	XX1	0.867	0.821	0.656
	XX2	0.774		
	XX3	0.684		

② Discriminant validity analysis

With regard to the differential validity test of these four factors, in this study, the correlation coefficient between every two SEM verification factors is set to 1, and if it is rejected, it means that there is differential validity (see Table 3). If the D.F. in Table 3 is increased by one unit, CMIN will expand by tens or hundreds of times, which indicates that the test is rejected and the factor has differential validity.

Table 3 Analysis of Discriminative Validity

Original model CMIN=237.11 (d.f.=48)	Detection model CMIN(d.f.=49)	Δ CMIN
Online learning experience-learning engagement	454.067	216.96
Online Learning Experience-Online Deep Learning	371.826	134.72
Online Learning Experience-Learning Motivation	369.886	132.78
Learning motivation-Learning engagement	357.801	120.69
Involvement-Online Deep Learning	352.059	114.95
Learning Motivation-Online Deep Learning	303.28	66.172

③ Fitting degree analysis

In this study, 12 fitting indexes are adopted, which are as follows: (1) the ratio of chi-square value to degree of freedom (χ^2/df); (2) goodness of fit index (GFI); (3) The adjusted goodness of fit index (AGFI); (4) Comparative Fit Index (CFI); (5) Normative Fitting Index (NFI); (6) Incremental fitting index (IFI); (7) Relative Fit Index (RFI); (8) Simple goodness of fit index (PGFI); (9) Simplicity Fit Index (PCFI); (10) Simple norm fitting index (PNFI); (11) root mean square residual (RMR); (12) approximate root mean square error (RMSEA). Specific values (see Table 4). AMOS program is used to analyze the structural model of this study. χ^2/df is 4.94, GFI is 0.902, AGFI is 0.841, NFI is 0.9, CFI is 0.918, IFI is 0.918, RFI is 0.862, PGFI is 0.555, PCFI is 0.667, PNFI is 0.654, RMR is 0.04 and RMSEA is 0.01. The results of the structural model support this association of all models.

Table 4 Analysis of Fit

Index	Evaluation criterion	Index value	Evaluation result
X ² /df	1~5	4.94	Good
GFI	>0.8	0.902	Good
AGFI	>0.8	0.841	Good
NFI	>0.8	0.900	Good
CFI	>0.8	0.918	Good
IFI	>0.8	0.918	Good
RFI	>0.8	0.862	Good
PGFI	>0.5	0.555	Good
PCFI	>0.5	0.667	Good
PNFI	>0.5	0.654	Good
RMR	<0.08	0.04	Good
RMSEA	<0.08	0.01	Good

4. Analysis of Model Estimation Results

(1) Research hypothesis results

Based on the structural equation model, the whole path is simulated and tested by using amos statistical analysis software, and the empirical results of influencing factors of college students' online deep learning under the epidemic background are obtained (see Figure 2). In addition, this study uses SEM to test six hypotheses, which are very important for the hypothetical paths of online learning experience, learning motivation, learning engagement and online deep learning that have an impact on college students' online deep learning, and the path coefficient must support the relationship of all hypotheses. Table 5 lists the main path coefficients, significance and conclusions in the model.

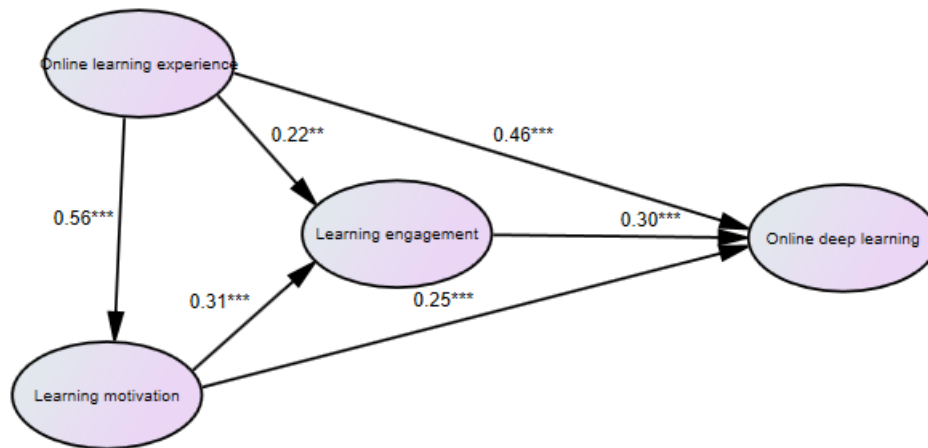


Fig.2 Test Results of Factors Affecting College Students' Online Deep Learning

Table 5 Main Path Coefficients and Significance

Symbol	Hypothetical conditions	Standardized coefficient	Result
H1	Online learning experience - learning motivation	0.56***	Support
H2	Online learning experience - Learning Engagement	0.22**	Support
H3	Online learning experience - online deep learning	0.46***	Support
H4	Learning motivation - Learning Engagement	0.31***	Support
H5	Learning motivation - Online deep learning	0.25***	Support
H6	Learning engagement - Online deep learning	0.30***	Support

* p-value <0.05; ** p-value <0.01; *** p-value <0.001

(2) Analysis of research conclusions

The results show that the model constructed in this paper is suitable for the study of influencing factors of college students' online deep learning. According to the above specific data analysis results, the following conclusions can be drawn:

① During the epidemic, online learning experience has a significant positive impact on college students' online deep learning. The path from online learning experience to online deep learning is 0.46, which shows that the improvement of students' learning experience can affect the improvement of online deep learning. Open online class, students are happy to accept it, because it is easy to operate and flexible in time and space. However, online learning is also limited by space and facilities. Students can't make eye contact with teachers in class, and classroom interaction becomes less. Even some students are lying in bed to receive online classes, and their learning status is not good. In this case, they can't talk about deep learning of knowledge. In addition, in order to prevent students from coping with class and not thinking and reviewing, teachers will assign corresponding homework and thinking development questions. However, if homework can easily collect relevant learning materials on the network, students do not need to think too much independently, which will deeply hinder the progress of online in-depth learning and keep learning in the shallow stage. Moreover, the online classroom organized by teachers has rich and interesting classroom contents, teachers and students can realize interactive communication, and the knowledge points of learning can attract students' high attention, which can also introduce students into the state of online in-depth learning. It can be seen that if we need to improve the online in-depth learning level of college students, we must improve the degree of students' learning experience. During the epidemic period, students accept online learning at home. The family environment is different, and there is no way to create a good learning environment for all students.

However, teachers need to work hard in online classroom design. The designed teaching links need to effectively mobilize students' enthusiasm and give full play to students' subjective initiative to think and analyze problems, so as to lead students' learning to the depths and improve their online in-depth learning ability.

② Online learning experience has a significant positive impact on college students' learning motivation and learning engagement. The research shows that the paths of learning motivation and learning input in online learning experience are 0.56 and 0.22 respectively, which shows that the effect of students' learning experience will be improved by one unit, and the learning motivation and learning input of students will be improved by 0.56 and 0.22 units respectively. The data analysis shows that if the learning objectives of students are not clear, they only go through the learning process, do not establish their own clear learning plan before learning, and lack corresponding supervision during learning, so they can't form good learning motivation and really get involved in learning. Only when students feel the fun and necessity of learning in the online learning experience can they have full energy and good resilience. Even if he encounters difficulties and setbacks, he can bravely accept challenges and devote himself to his studies. Moreover, a good learning experience can bring students a sense of pleasure and pride in learning, so as to stimulate students to have a strong learning motivation and invest more actively in learning. In the online classroom, teachers throw out a challenging topic. Students quickly accumulate relevant learning materials through the knowledge they have learned and through the network, and then get their own original analysis results and recognized through their own sorting, classification and analysis of knowledge. The pride that students get will make them willing to take themselves as the master of learning and study independently. In addition, in the online classroom, teachers guide the interaction between teachers and students, and students actively express their ideas, so that students in all directions can feel a warm classroom atmosphere, so that they can actively participate in classroom learning, rather than as a task they have to complete. The interaction between teachers and students creates a scene in which different people have different opinions. Students will naturally think and learn to think, and have a strong curiosity, thirst for knowledge and desire to explore knowledge. This is the key for students to form deep learning motivation, devote themselves to learning and move towards online deep learning.

③ Learning motivation has a significant positive impact on learning engagement and online deep learning. The research shows that the paths from learning motivation to learning engagement and online deep learning are 0.31 and 0.25, respectively, which shows that students' learning motivation will affect learning engagement and finally the improvement of online deep learning ability. The research divides the investigation of students' learning motivation into three dimensions: autonomy, initiative and strong thirst for knowledge. The research results show that the factor load of these three dimensions is greater than 0.6, which proves that they can well explain the learning motivation of learning. 74% students who can study independently choose to focus on their studies and regard themselves as the masters of their studies. 96% of students who actively participate in classroom learning will be full of vitality for learning, and 67% of students who have a strong thirst for knowledge and inquiry will contribute to learning, that is, good learning motivation will play an important role in learning input, thus affecting the cultivation of online deep learning habits. Thus, the further improvement of learning motivation will improve students' learning engagement, thus contributing to online deep learning.

④ Learning engagement has a significant positive impact on online deep learning. It shows that the path of learning input to online deep learning is 0.3, indicating that students' learning input will affect the improvement of online deep learning ability. The research divides the investigation of students' learning input into three dimensions: vitality, dedication and concentration. The research results show that the factor load of these three dimensions is greater than 0.6, which proves that

they can explain learning input well. 53% of the students fully agree that they will have full energy and good resilience when they are aware of the value of learning. 60% of the students fully agree that they will devote themselves to learning and accept challenges bravely. 37% of the students fully agree that they will put their energy into their study without external interference, and they will eventually check fully agree with the survey dimensions of online deep learning, including reflective learning, deep understanding and time innovation. It can be seen that the further improvement of learning input will promote online deep learning.

5. Strategic Enlightenment

(1) Take learning investment as the foothold and enrich the teaching content

The focus of college students' online deep learning needs to pay attention to the quality and quantity of learning input, so as to form continuous and voluntary learning input. Colleges and universities need to train students in a planned way to promote their development. The first thing in college education is to set up rich teaching classrooms and teaching contents. Teachers need to invest more time and energy in preparing online classes, and they must never deal with lectures just to complete their performance. In the whole process of teaching preparation, in addition to designing the teaching content with complete structure and rich content, it is also necessary to design some cases that are close to life and reflect the real world by combining the existing knowledge, experience and ability level of students, so as to arouse the resonance of students' learning, make them realize the value of learning and be willing to devote all their energy to learning. Teachers can't judge the satisfaction of teaching content by students' expressions and behaviors in online class, but teachers actively explore and construct attractive teaching content, so that students can not only increase their knowledge and experience, but also think and discuss deeply. In addition to the holistic and prescriptive teaching content, the course should also have certain expansibility, so that students can use their existing knowledge to "build" the unknown world with "known", cultivate students' strong learning input and learning attitude to accept challenges, stimulate students' high-level development and guide students' deep learning.

(2) Strengthen the interaction between teachers and students and strengthen students' participation in online classes

This study found that rich online classes and good teacher-student interaction can improve students' learning experience. Therefore, in order to improve students' learning experience, form a good learning motivation, promote students' learning input and promote students' in-depth online learning, it is necessary to strengthen the interaction between teachers and students and let students participate in online classes. During the epidemic, students can't go back to school to study, and colleges and universities set up online learning. However, teachers can't be reluctant to conduct online classes, just to complete the teaching tasks, and teachers should intensify the preparation of lessons in online classes. The design of online classroom teaching should fully consider all kinds of convenient conditions in the network age, and design teaching links that can interact with students. In the whole teaching process, teachers should not only teach knowledge. Teachers can learn about students' learning situation through teacher-student interaction, including notes, comprehension and mastery. Only by learning about students' learning situation can teachers promote their own teaching plans and ensure classroom teaching effect. In addition, the current rich network technology and equipment provide a variety of interactive platforms for online teaching, such as voting, chat opening, group competition, etc. When students attend classes, it is inevitable that they will be absent-minded and absent-minded, and timely and appropriate interaction can quickly pull students back and make them re-concentrate. Furthermore, modern college students are full of personal ideas, and they prefer to discuss and analyze hot and challenging issues. Teachers should

grasp students' psychology, throw out interactive topics, fully mobilize students' learning enthusiasm, let students learn actively, and then promote online deep learning.

(3) Stimulate learning motivation and enhance learning motivation

For students with strong learning motivation, their learning behavior is based on personal thinking development and knowledge mastery. The online deep learning of these students is generally very good. Therefore, schools and teachers should pay attention to students' learning trends according to students' personal characteristics, help students establish a correct learning view and personal values, and cultivate students' attention to knowledge and ability learning, so as to promote students' learning motivation. In the teaching process, teachers create problem situations and put forward some difficult problems, so that students feel familiar and can not simply use their existing knowledge to solve them. At this time, it will stimulate the students' enthusiasm of thinking and desire for knowledge, and make the students enter the realm of “heart seeking communication but not communication, mouth wanting to speak but not communication”. When students are actively thinking in their minds, but can not reach the mental state of thinking, or have a new understanding of this problem, but can not accurately express it, and are actively organizing and clarifying their language or ideas. If teachers inspire and induce students in time, they can improve students' learning enthusiasm, stimulate students' need for knowledge and enhance their learning motivation. In addition, the current online learning can properly carry out some competition activities, because in the process of competition, students' curiosity and desire to explore will be stronger, and their interest in learning and perseverance to overcome difficulties will be greatly enhanced. The competition can be conducted in groups and take turns to speak and show, so that more students can have the joy of success and experience success. Of course, they should often encourage students to compete themselves and encourage students to improve their learning enthusiasm.

6. Conclusions

Under the epidemic situation in COVID-19, the construction of online classroom has been promoted. Online teaching and diversified teaching are the requirements of the development of the times, the need of personnel training in colleges and universities, and the teaching guarantee under the emergency situation in colleges and universities in the future. Therefore, in addition to continuously strengthening the construction of educational information infrastructure and integrating online education and teaching resources, it is more important for colleges and universities to improve teachers' ability to apply information technology, set up rich teaching classrooms, increase the interaction between teachers and students, strengthen students' participation in online classes, strive to stimulate students' learning motivation, enhance students' learning motivation and cultivate students' ability to integrate innovative knowledge with original knowledge. So that students can form their own new cognitive system through criticism, summary and thinking, so as to meet the ever-changing social demand and talent demand.

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