

## Study on the Online Learning Outcomes for College Students during the COVID-19 Epidemic

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### Abstract

**Objective** To analyze the overall characteristics of college students' online learning behaviors, explore the online learning outcomes of college students, and propose strategies to promote the online learning outcomes of college students based on the research results. **Methods** A questionnaire survey was conducted on students who participated in online learning during the NCP epidemic using a self-administered online learning outcomes scale, and the data were processed using SPSS 23.0 and Mplus 7.0 software. **Results** 1. The online learning outcomes of students during the epidemic was at a moderate level, but there were significant differences with the offline learning outcomes in the post-epidemic period, and the learning outcomes in the post-epidemic period was better. 2. The total mean score of learning outcomes was not significantly different from the median, while the self-assessment of learning outcomes, learning engagement and learning satisfaction were significantly different from the median. Among them, the scores of self-assessment of learning outcomes were significantly lower than the median, and the scores of learning engagement and learning satisfaction were significantly higher than the median; 3. The total mean scores of learning outcomes and the scores of each dimension were not significantly different from the median in terms of gender and grade. In the professional dimension, the self-assessment scores of learning outcomes of liberal arts students were higher than those of science students. **Conclusion** The offline learning outcomes is better than the online learning outcomes, and compared with the liberal arts majors, the online learning outcomes of science majors is worse.

### Keywords

Novel Coronavirus Pneumonia Epidemic; Online Learning; Learning Outcomes; University Students.

### 1. Introduction

Since the outbreak of the novel coronavirus pneumonia epidemic (the epidemic), China's education administrative departments and universities at all levels have rapidly launched teaching preparations and large-scale online classes for students in accordance with the policy guidance of the Ministry of Education (MOE) and the educational decision-making framework. In the context of the emergency prevention and control environment, online teaching activities are both an important emergency response and an important historical opportunity for us to continuously change the teaching concepts of school teachers and promote a technological revolution in the school classroom teaching process. In this particular context, students' online learning outcomes have attracted much attention.

## 1.1. Current Status of Research on Online Learning Behaviors

### 1.1.1. Definition of Learning Outcomes

Learning outcomes refer to the results of learning activities, which are the changes of individual ability after a period of learning[1]. The traditional teaching method has been the main choice of classroom teaching for college students in China, and practice shows that this "Duck-stuffing" teaching method still has obvious disadvantages. On the one hand, students are always in a passive and receptive state in the process of classroom teaching, and it is difficult to give full play to their own learning autonomy, creativity and enthusiasm[2], and teachers often just focus on instilling knowledge into students themselves in the classroom, and some students have stereotyped knowledge learning, lack of adaptability and lack of communication. This not only reduces students' interest and enthusiasm in learning, but also is not conducive to promoting the establishment of good interaction between teachers and students and between students; on the other hand, it does harm to the cultivation of students' knowledge application ability and independent innovation ability, and students' learning process is full of test-taking characteristics, which shackles the cultivation and development of most students' abilities of thinking and independent innovation, and is not conducive to the cultivation of college students. This is not conducive to the cultivation of comprehensive quality of college students and affects the development of China's cultural and educational undertakings [3]. Therefore, online learning can make up for many limitations of traditional classrooms. Online learning after the epidemic has been widely used and promoted in school teaching. Especially for students in remote areas, increasingly sophisticated online courses can provide them with better access to equal learning opportunities compared to students in developed areas.

### 1.1.2. Status of Overseas Research

Numerous universities and researchers abroad have also conducted studies on the completion of online learning courses and the evaluation of online learning outcomes. Most studies have attempted to study the development of learners' learning outcomes and the factors influencing online learning outcomes by analyzing the text and content data generated by learners' online learning. For example, Cho (2007) et al. explored the existence of relationships between social networks and the communication styles of groups of learners and their online learning performance [4]. Some scholars have conducted studies based on MOOC online learning environments and analyzed the factors influencing learners' MOOC learning performance as well as course completion. For example, Pursel (2016) and others applied logistic regression analysis to analyze how each variable affects online learning completion [5]. Barba (2016) found that online course participation factors such as learner's interest-based motivation, number of video viewing clicks, and number of test submissions can effectively predict their learning performance and learning outcomes through an empirical study [6].

Looking at the existing relevant studies, it is easy to find that most of the studies in the field of online teaching and learning abroad are focused on online learning on some platforms such as MOOC and Coursera [7], and data analysis is conducted on various behaviors generated during the learning process of learners, and this is used to explore the internal and external factors that directly affect the online learning results and learning success or failure of the course, and to analyze the academic effectiveness of each learner in order to predict the online academic performance of learners or the passing rate of online courses.

### 1.1.3. Current Status of Domestic Research

The domestic studies related to the establishment of learning performance system have different views on the evaluation index, and each study assesses the learning outcomes from different dimensions. Some studies consider that learning outcomes contains four dimensions of learners' knowledge and skill application, learning attitude, learning style and overall ability [8]. There are also studies that evaluate learning outcomes in terms of learners' learning

outcomes, satisfaction, and changes in learning behaviors [9]. Liang Wenli (2015) proposed that online distance learning outcomes evaluation can be conducted in terms of distance learners' learning behavior, online course satisfaction, and distance platform satisfaction [10]. Zhang Tao (2016) proposed a four-level model for evaluating the learning outcomes of learners in online teaching mode: perceptual expression layer, information processing layer, learning transfer layer, and reflection and enhancement layer [11].

## **1.2. Studies Related to Factors Affecting the Effectiveness of Online Learning**

### **1.2.1. External Environmental Factors**

Based on an in-depth elaboration of the blended learning model, Liu Fanhua (2009) argued that the disconnection between theory and practice, unreasonable course content and teaching methods, and weak learning ability of students all affect students' learning outcomes in the blended learning model [12]. Wei Shunping (2011) conducted a study on open online courses and analyzed two external factors that influence learners' online learning engagement, namely module access preference and learning time preference [13]. Using experimental and field survey methods, Zhao Yuqing (2012) explored the influence of factors such as the degree of matching educational objectives and online media on the effectiveness of online learning [14]. Peng Lei (2016) proposed that the characteristics and functional attributes of the learning space in the online teaching environment affect the learning outcomes of learners [15].

### **1.2.2. Internal Factors**

On the other hand, learners' subjective experience of online learning has been attached more and more attention and importance. Internal factors such as learners' motivation, independent learning ability, and tacit knowledge presented during learners' engagement in online learning have received more and more attention from researchers to explore the possible effects of learners' internal psychological factors on the effectiveness of online learning. For example, Hao (2005) used multiple regression analysis to explore the effects of learners' own learning satisfaction, negative emotions, and learning stress on learning outcomes [16]. Pan Qiaoming (2014) analyzed the possible effects of tacit knowledge on learning outcomes by creating various online learning contexts [17].

### **1.2.3. Combination of Internal and External Factors**

Some researchers have integrated the influence of external environmental factors and learners' internal psychological factors on the effectiveness of online learning. For example, Pi Zhongling (2014) proposed that learners' learning outcomes would be directly influenced by the video presentation format, and explained that learners' cognitive characteristics and attention allocation would affect the learning outcomes of video learning using a psychological perspective [18]. Li Manli (2015) explored in depth some factors that may affect learners' MOOC task completion rate and found that the intrinsic factors that affect MOOC learning outcomes are learners' motivation and course participation, and the extrinsic factors are the registration time of online courses and whether they are university students [19].

## **1.3. Research Significance**

In summary, there is a lack of research on the issue of "online learning outcomes" during the epidemic in China, and the existing research on online learning outcomes covers a variety of disciplines. However, the special background of the new corona pneumonia epidemic may present different characteristics of learners' online learning, and the online teaching plan under the epidemic is developed under the emergency situation, which is challenging for most teachers to carry out online teaching. The study of special learning behaviors and learning outcomes during the epidemic carries a certain degree of topicality and specificity; therefore, the analysis and evaluation of online learning behaviors and effects during the epidemic has strong practical significance and application value.

## 2. Research Objects and Methods

### 2.1. Research Objects

The objects of this study are undergraduate students and the 12th grade students (now the freshmen of college) who participated in online learning during the epidemic. In the survey, we interviewed some undergraduate students of different majors in different universities and issued questionnaires through the questionnaire web platform. A total of 984 questionnaires were collected, 604 of which were valid, with an effective rate of 61.4%. Among the survey sample, 267 freshmen, accounting for 44.21%; 109 sophomores, accounting for 18.05%; 150 juniors, accounting for 24.83%; 78 seniors, accounting for 12.91%, of which, 30.79% were male and 69.21% were female. The students of different majors were divided into two major categories of arts and sciences, including 265 students of arts and 339 students of science.

### 2.2. Research Instruments

Self-administered scale of learning outcomes

The sources of the questions of the learning outcomes self-curated scale included: ① By searching the relevant literature at home and abroad, the questions that conformed to the theoretical model were modified, and finally some of Wang Caihua's dimensions for mixed learning outcomes were selected for reference. ② Interviews were conducted with some college students and the 12th grade students (now the freshmen of college) who participated in online learning during the epidemic, and the items were determined based on the content of the interviews, from which the first draft of the scale was composed, with a total of 34 items and three dimensions: self-assessment of learning outcomes, learning engagement, and learning satisfaction. The higher the total score, the better the online learning outcomes of the individual.

### 2.3. Research Procedure

This study used SPSS 23.0 computing software to input the data, and also used Mplus software to conduct statistical analysis, and analyzed the psychometric indicators of the questionnaire and the results of statistical analysis.

## 3. Results

### 3.1. Analysis of the Characteristics of Online Learning Outcomes

The means and standard deviations of the online learning outcomes scale means and the means of each dimension are shown in Table 1.

**Table 1.** Comparison of total mean and factor mean scores of learning outcomes with median values (n=604)

	M±SD	Significance (two-tailed)
Total mean score of learning outcomes	3.04±0.82	0.25
Self-assessment of learning outcomes	2.73±0.94	0.00
Learning engagement	3.43±0.88	0.00
Learning satisfaction	3.26±0.92	0.00

From the above table, it can be seen that the mean score of online learning outcomes scale for college students is 3.04, and the mean values of three dimensions are 2.73, 3.43 and 3.26 respectively, and the mean values of total score and each dimension are in the middle level. The

scale was scored on a five-point scale, and a median score of 3 was taken for the one-sample t-experience. The results showed that there was no significant difference between the total mean score of learning outcomes and the median, while there were significant differences between the self-assessment of learning outcomes, learning engagement and learning satisfaction and the median. Among them, self-assessment of learning outcomes scores were significantly lower than the median, and learning engagement and learning satisfaction scores were significantly higher than the median.

### 3.2. Statistical Analysis of College Students' Online Learning Outcomess on Different Demographic Variables

#### 3.2.1. Comparison of Differences in Online Learning Outcomess on Subjects of Different Genders

Comparing the online learning outcomess of male and female students during the epidemic, the results showed that there were no significant differences in the total mean and factor scores of online learning outcomess among college students of different genders.

#### 3.2.2. Comparison of Differences in Online Learning Outcomess among Students of Different Majors

An independent sample t-test was conducted on the online learning outcomess of students of different majors during the epidemic, and the results are shown in Table 2: there were significant differences in the self-rated dimensions of learning outcomess among college students of different majors, and the differences in the total mean value of learning outcomess, learning engagement and learning satisfaction were not significant.

**Table 2.** Comparison of differences in online learning outcomes among students of different majors

	Major	Mean	Standard deviation	t	Significance (two-tailed)
Total mean of learning outcomes	Science	3.00	0.80	-1.37	0.17
	Liberal Arts	3.09	0.86		
Self-assessment mean of learning outcomes	Science	2.66	0.93	-2.30	0.02
	Liberal Arts	2.83	0.95		
Mean value of study engagement	Science	3.47	0.84	1.30	0.19
	Liberal Arts	3.38	0.93		
Mean value of learning satisfaction	Science	3.21	0.92	-1.44	0.15
	Liberal Arts	3.32	0.92		

#### 3.2.3. Comparison of Differences in Online Learning Outcomess among Students of Different Grades

The results of ANOVA on the online learning outcomess of students in different grades during the epidemic showed that there was no significant difference in the average score and factor score of online learning among different grades.

### 3.3. Analysis of Learning Outcomess of Different Teaching Modes

In this survey, learners were invited to self-assess their learning outcomess in the first and second half of the 2020 epidemic period, and the scores were taken as 1 to 10, with higher

scores representing better learning outcomes. A score of 6 and above was chosen for the study to represent the subjects' basic satisfaction with their learning outcomes. The results showed that 43.1% of the students were basically satisfied with online learning and 65.87% of the students were basically satisfied with offline learning.

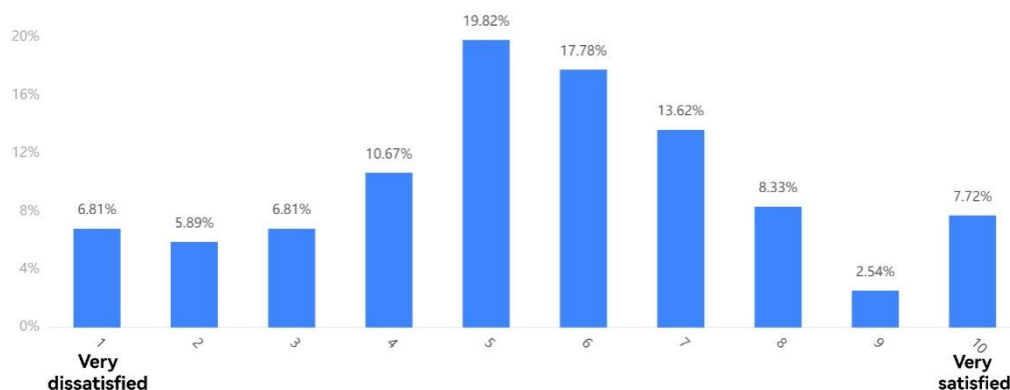


Figure 1. Self-assessment of learning outcomes in the first half of 2020

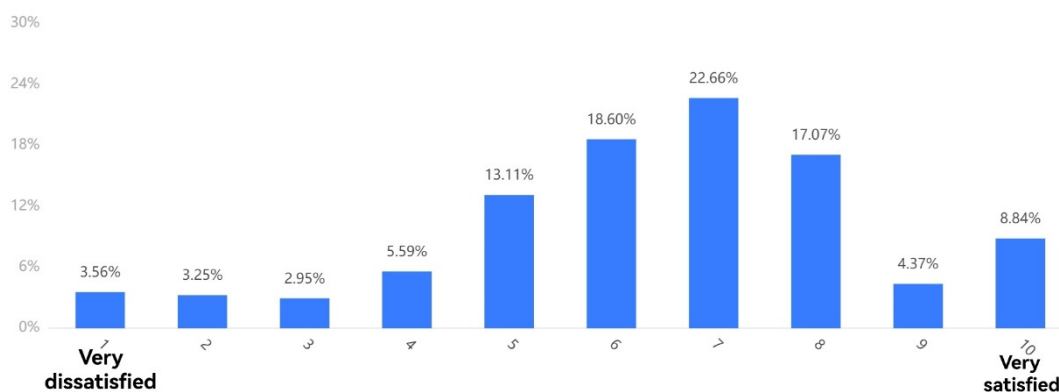


Figure 2. Self-assessment of learning outcomes in the second half of 2020

Table 3. Comparison of the differences in the learning outcomes of different teaching modes

	Mean	Standard deviation	t	Significance (two-tailed)
Self-assessment of the learning outcomes of online classes in the first half of the year during the 2020 epidemic	5.42	2.30	-12.35	0.00
Self-assessment of the learning outcomes of online classes in the second half of the year during the 2020 epidemic	6.49	2.03		

A paired-samples t-test was conducted to compare the differences in learning outcomes between the first half and the second half of the epidemic period for students who participated in online learning under different teaching modes during the epidemic, and the results of the mean comparison are shown in Table 3, which showed that there were significant differences between the learning outcomes in the first half and the second half of the epidemic, and

students' self-ratings of offline learning outcomes in the second half of the epidemic were significantly higher than those in the first half.

## **4. Discussions**

### **4.1. Analysis and Discussion of the Characteristics of Online Learning Outcomes**

Investigating the online learning outcomes of students during the epidemic, the results showed that the mean value of self-assessment of learning outcomes was significantly lower than the median value, and the mean value of learning engagement and learning satisfaction were significantly higher than the median value, and this result was consistent with the findings of Song et al. (2020), where the online interaction between teachers and students, the supervision of the course management platform, and the flexibility of online learning of college students led to higher levels of learning engagement and learning satisfaction. In addition, because college students have the need for interpersonal interaction, the need for personal practice improvement, and the value placed on the learning atmosphere [20], learning at home may face the challenges of decreasing learning self-discipline and increasing randomness, leading many students to be dissatisfied with their self-assessment of their learning outcomes.

### **4.2. Discussion of the Analysis of College Students' Online Learning Outcomes on Different Demographic Variables**

In this study, we examined the differences of college students' online learning outcomes on demographic variables, and the results showed that there was no significant difference in the total mean score and each dimension of learning outcomes in terms of gender and grade, and this result was consistent with the findings of Yang and Mei (2020) [21]. In terms of major dimension, there is a significant difference between liberal arts students and science students in the self-assessment dimension of learning outcomes, and this result is consistent with the findings of Hu, Satellite et al. (2008), that science students need more logical thinking and practical operation, and there is a difference in metacognitive level between liberal arts students and science students, and thus different online learning strategies [22], so we predict that the students majoring in liberal arts may be more adaptable in online learning and feel better than the students majoring in science and engineering disciplines about online learning outcomes.

### **4.3. Discussion about the Analysis of Learning Outcomes of Different Teaching Modes**

On the whole, students think that offline learning is more effective than online learning, with 43.1% of students being basically satisfied with online learning and 65.87% of students being basically satisfied with offline learning. Obviously, the proportion of students who were more than basically satisfied with offline learning was significantly higher than the proportion of students who were satisfied with the effectiveness of online learning. This was also confirmed by the results of a paired-samples t-test on students' self-ratings of learning outcomes in different teaching modes during the epidemic, where students' self-ratings of offline learning outcomes were significantly higher in the second half of the year than in the first half. This may be due to the fact that students tend to show low self-discipline when studying online[23], unable to resist the various temptations around them and easily get distracted. Moreover, the variety of online courses does not guarantee good learning outcomes, such as online sports courses, and lazy students are most likely to obtain low learning outcomes as a result.

## 5. Suggestions

### 5.1. Keep up with the Education Trend in the Post-Epidemic Era and Promote the Gradual Development of Multiple Learning Modes

With the sudden outbreak of the novel coronavirus epidemic, many colleges and universities responded hastily and online teaching was fully implemented in a short period of time. In this special environment, large-scale online learning is a brand new attempt to practice new forms of education in the information age, and all kinds of colleges and universities across the country are standing on the same starting line. Students and faculty will have new thoughts and insights about this learning method after experiencing this special period of scaled-up online learning. In the post-epidemic period, we can get a glimpse of the impact that online learning in this particular context will have on teaching and learning models, and see how scaled-up online learning will change educational trends and therefore likely produce a new learning ecology. In the information age, new technologies such as artificial intelligence likewise provide new directions and requirements for education[24], giving more life and possibilities to online learning. Therefore, the future teaching model needs to adapt to the development of the times, and the future classroom will definitely change from "teacher-centered" to "student-centered"; the roles of teachers and students will change from "teachers are actors and students are listeners" to "teachers are listeners". The roles of teachers and students will change from "teachers are actors and students are listeners" to "teachers are directors and students are actors". The teaching process will change from "teachers teach to the end" to "teachers and students participate together"; the learning form of students will inevitably change from "mainly offline classroom" to "online and offline integrated learning". Students' learning will inevitably change from "offline classroom-based" to "online and offline integrated learning".

### 5.2. Consolidate and Enhance the Campus Network to Realize the Organic Integration of Information and Education

For online learning, campus network plays an undeniable influence, and if schools want to survive and develop, they must build a good campus network and make it run efficiently. The construction of digital wisdom campus must be strengthened, while the core technology is transferred to computer network, and the big data platform is used to mine the data and jointly create a new education platform for digital information processing[25], so that information technology and education teaching can be perfectly and organically integrated.

### 5.3. Strengthen Hardware Construction to Solidify Online Learning Benefits

Effective hardware support is an important guarantee to ensure the benefits of online learning for students. Cell phones have brought great convenience to mobile learning, but relying on them alone to complete online learning tasks has certain shortcomings and may be greatly restricted. One survey found that 17.9% of students can only use their cell phones to access online classes. The smoothness of the Internet connection can affect the student learning experience. Delayed network will consume students' patience and students will stop further exploration of learning because they are worried about insufficient traffic, so good hardware support and sufficient traffic will largely ensure students' online learning outcomes.

### 5.4. Pay Attention to the Construction of Online Teaching Resources and Optimize Online Teaching Resources

Although online teaching resources are constantly improved by teachers' active efforts, there is still much room for improvement in quality. Online teaching resource library is a teaching resource that every university should vigorously build and devote to producing high-quality online teaching contents[26]. The corresponding incentive mechanism and operation methods can be used to mobilize the teaching and research departments and teaching backbone of each



major, strengthen audit and management, and impose strict requirements on course leaders to ensure the continuity of teaching resource construction, so that online teaching requirements can be met and the teaching implementation process can be continuously improved.

### **5.5. Strengthen Teachers' Technical Training and Enhance Their Ability to Use Online Classroom**

Online teaching has existed for a long time, but with the sudden outbreak of the epidemic and the instruction of "stopping classes without stopping learning", some teachers seem to be a bit frazzled. It is not difficult to get used to online teaching technology, but to use it well and fully demonstrate the advantages of online teaching technology, teachers need to conduct in-depth study. Online teaching is a teaching method that integrates multimedia and Internet technologies through multilateral and multi-directional interaction among teachers, students and media and the collection, delivery, processing and sharing of teaching materials in a variety of multimedia courses to accomplish its teaching objectives. In order to achieve more satisfying teaching results, teachers must find the best match of teaching contents and methods from them, carefully consider online teaching purposes, online teaching courses, online teaching tests, and coordinate and optimize all aspects of online teaching[27]. Teaching in the Internet environment should fully reflect the students' self-subject position in order to facilitate their interest, inspire guidance and induce, and thus truly mobilize students' motivation, initiative and creativity in learning. At the same time, we should also pay full attention to personalized teaching, completely change the previous single "assembly hall listening to reports" type of classroom teaching methods, so that its teaching better adapt to the laws of the education classroom, more to meet the different learning scenarios and various types of students.

### **5.6. Promote Classroom Interaction and Enhance Students' Online Learning Experience**

Online teaching, teachers should always adhere to the majority of the student body as the center, and strive to completely eliminate the feeling of being isolated by the cold screen, and adhere to the principle of network interaction in the live classroom, interspersed with screen sharing, video playback, and topic discussion together, so that all students can freely express their opinions in the discussion area at any time, and make suggestions about the situation in the classroom, and the teacher responds to each student's speech in a timely manner feedback was given. Although the teachers of online lecture classes are thousands of miles away from the campuses of other students, not as good as our traditional classroom to be able to have deep contact with other students, but through various forms of online teacher-student interaction, it can also promote teaching and learning to make up for the shortcomings of online teaching.

### **5.7. Focus on Guidance to Improve Student Engagement in Online Classes**

Online teaching is a common practice in epidemic prevention, but students are still unfamiliar with online courses and feel powerless and passive. The survey found that students in online classes have little interaction, low learning participation, few speeches, short online learning time, and are unable to expand in terms of breadth and depth of learning. To motivate students and increase their engagement in online learning, teacher guidance plays a critical role. Before the class, teachers can carefully design the course flow and inform students of the online course flow in advance, and make appropriate learning plans after students are clear about their learning tasks and goals. In the classroom, teachers should use more suggested language, refrain from using an imperative tone, guide students to ask questions, encourage students to ask questions to the teacher and evaluate students positively, and stimulate students to speak up; after class, teachers can design reflection questions based on the knowledge points in the class; after class, teachers and students can have in-depth discussions with the help of the

online platform[28]. In this way, not only can students have a more thorough understanding of knowledge, but also help them stay actively engaged in class.

### **5.8. Improve Students' Online Self-learning Ability and Adapt to the General Trend of Online Learning**

Compared with the offline classroom, online learning offers different learning modes such as synchronous and asynchronous to the majority of students, breaking the time limitation of online learning activities and making learning more personalized. Due to the lack of continuous care and supervision of teachers, students' independent learning ability has become a top priority that directly affects the effectiveness of online learning. In order to comply with the current trend of normalizing online teaching, teachers need to consciously lead students to take mobile Internet technology as an important learning tool, gradually improve their communication media literacy, and eventually be able to land on the traditional media for independent learning habits and ability development[29]. Teachers can also encourage them to make active learning plans on their own, to explore and learn with actual problems, and to plan, step by step, evaluate and reflect on each learning session.

Online teaching provides a good platform and opportunity for the development of students' independent learning skills. Teachers can also take advantage of the big data technology of online learning to record students' learning behavior and reflect various situations in the process of online learning (including the time, place, path and interaction with other users, etc.), so as to help students understand their learning process clearly, reflect, evaluate and adjust in time, and enhance their independent learning ability.

### **5.9. Pay Attention to Science Students' Online Learning Satisfaction and Enhance Online Classroom Adaptability**

Due to the factor of science major, there are more logical thinking and experimental operation in science students' learning content. Compared with liberal arts students who have a wide range of interests and rich imagination in the online environment, science students may not be good at communicating with their teachers and classmates in the online classroom, so that their self-evaluation of learning outcomes in the online classroom is lower. Therefore, colleges and universities should develop online classroom learning strategies that are suitable for different disciplines according to the differences of arts and sciences and disciplines of college students' online learning. Secondly, to cultivate the communication and interaction ability and personal comprehensive ability of college students in online classroom. Finally, the university students should be guided to combine the characteristics of their own disciplines with the online classroom to develop learning strategies suitable for their personal characteristics and to inspire them to deepen their learning of their professional knowledge with the help of the online classroom.

## **6. Conclusion**

Offline learning is more effective than online learning; compared with the students majoring in liberal arts, online learning is less effective for the students majoring in science and technology.

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