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# Teaching Method and Systematic Course Monitoring System for "Introduction to Water Resources and Hydropower Engineering"

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**Abstract:** This paper introduces a teaching method and a systematic course monitoring system for the "Introduction to Water Resources and Hydropower Engineering" course at the School of Water Resources and Environment, China University of Geosciences (Beijing). The method allows students to self-evaluate and self-score their learning, tracks and analyzes data over years, and aims to explore factors affecting student development and improve teaching quality. In the teaching process, teachers use three evaluation methods: standardized fill-in-the-blank questions, subjective evaluations by students, and an anonymous evaluation system to evaluate the teaching effect. Analysis shows that the pandemic has had less impact on students' psychology but significantly affected their knowledge acquisition. Before the pandemic, teaching effectiveness was improved, while during the pandemic, it decreased.

**Keywords:** Introduction to Water Resources and Hydropower Engineering; Teaching Method; Systematic Course Monitoring System; Self-Evaluation; COVID

## 1. Background and Introduction

Current research<sup>[1]</sup> has recognized the important value of self-evaluation in learning, and student self-assessment is an extremely important aspect of formative assessment, which is the process of students' self-reflection and self-adjustment in learning. It also proves that student self-assessment plays an important role in university English teaching, not only conducive to promoting students' autonomous learning ability and improving students' comprehensive application ability of English, but also beneficial to the improvement of college students' lifelong learning ability. Taking quantitative research methods to study the impact of self-evaluation on

students' self-regulated learning and self-efficacy beliefs is an inevitable direction for research<sup>[2]</sup>. The literature adopts four meta-analyses and finds significant moderating effects of gender (girls benefit more) and certain components of self-assessment (such as self-monitoring) on self-efficacy beliefs. The research reaches a high level.

Core self-evaluations are a latent, broad personality structure defined as individuals' basic evaluations and estimates of their own abilities and values<sup>[3, 4]</sup>. The paper <sup>[5]</sup> uses teacher grading, student self-assessment, peer review to carry out the research, most students believe that peer review is a valuable activity, not only helps their learning, but also helps student motivation to learn. Analyzing students' performance in exams, after practice, it was found that most students considered evaluation a valuable activity that helped both their learning and students' motivation to learn. After practice, analysis of students' performance in exams found that almost all students did better than other students on problems related to practice.

Under the influence of COVID-19, domestic universities in China have implemented online teaching and gradually moved towards normality <sup>[6]</sup>. The COVID-19 pandemic has had an impact on higher education teaching, requiring analysis and research into the extent of this impact. There is a need for quality monitoring and evaluation of online teaching and corresponding influencing factors<sup>[3]</sup> to enhance learning outcomes.

Since its establishment in 2012, "Introduction to Hydraulic Engineering" at China University of Geosciences (Beijing) has been led by the author. From the very beginning, the author insisted on doing one thing - having students evaluate and score their own learning performance in this course. This practice has continued for 11 years now.

## **2. Objectives and Methods**

Since the author started teaching "Introduction to Hydraulic Engineering" at China University of Geosciences (Beijing), he had always harbored an idea to conduct long-term observation and monitoring of his students. Moreover, he had a grander notion to conduct a comprehensive longitudinal study on his students for 20 to 30 years or even longer, tracking their growth and development from college to graduate school to employment over an extended period. He sought to investigate the relationship between the eventual differences in students' professional development and various factors during their college years. Additionally, he aimed to determine which aspects of classroom teaching and learning affected and facilitated the path of talent growth, or more precisely, which traits could be identified early on in classroom instruction that could predict students' potential for success.

To achieve these objectives, the author asked his students to self-evaluate their performances in three areas: the instructor's teaching, the scores they received on their exams, and their final grade in the course. During exams, students were required to write down their self-evaluated scores in the left, middle, and right positions below the first page of their answer sheet in percentage terms.

For their final grade in the course, students were asked to give themselves a composite score based on their exam marks, attendance, and homework assignments throughout the semester.

### **3. Implementation Status**

For many years, the author has consistently required students to write down three ratings on their exam papers (a rating for the teacher, a rating for their own exam scores, and a rating for their own final overall score in the course). Section 3 presents scanned copies of one such rating each year from 2017 to 2022, as depicted in Fig. 1.

It has been going on continuously since 2012. As the teacher of this course, in the teaching project, the author is conscientious, put forward challenging ideas and methods, and constantly polish the teaching details. (1) At the end of each class, after the completion of the exam, I carefully thought about it and wrote a summary of thousands of words in each closing section, which is far ahead of other teachers in the closing summary of the school. (2) After each class, the author will scan all the papers and keep them for later summary, so as to further improve the teaching level, enhance the teaching research ability and explore the talent growth mechanism. (3) Actively care for ethnic minority students, sports students with special abilities, students majoring in transfer, and students who are lagging behind in their studies, and carry out discussions and exchanges in various ways to win their love. (4) In the first class of each year, explain the research content and future development direction of hydraulic engineering and civil engineering in all directions. At the same time, fully mobilize the enthusiasm of students who are good at learning, put forward new challenges, so that they fully understand and master the overall situation of the subject.

### **4. Self-rated scores of 2017-2022**

Since every year after the exam papers, the authors are all scanned and archived, so these data can be retained, so that I can continue to study.

The previous data are summarized and listed in Table 1. The scores used are the average scores, and the scores of the anonymous evaluation system developed by the author and the blank filling of the test paper are also listed.

#### **4.1 Objective evaluation of standardized fill-in-the-blank composition**

Due to some requirements of students in schools and colleges, scores need to be raised to a certain extent, which leads to a great discount in the actual effect of using scores to evaluate lectures, so the author thought of this problem many years ago. It is necessary to think of a method that not only meets the requirements of students' scores, but also has a more objective index to measure the teaching effect more accurately.

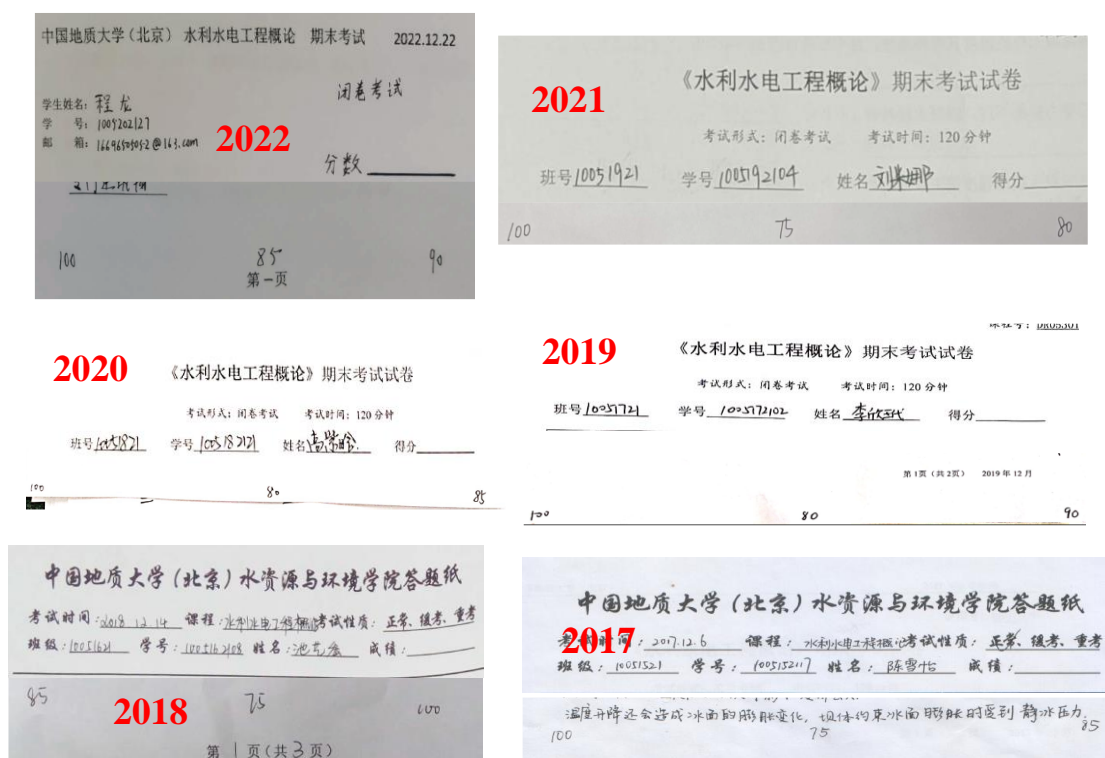


Fig. 1 Excerpts of the three scores of the students' self-assessment in the six years 2017-2022

The authors have been insisting on standardized fill-in-the-blanks for many years to solve this problem. And strictly stressed before the exam, "the heart of the confident fill in the blank, you can fill in, not sure, do not fill in; Can not guess, blind, bump ", from the examination, the examination paper, the students are strictly in accordance with this principle. This problem is solved for the author's teaching. Objective evaluation of real reaction teaching effect.

#### 4.2 Students' subjective evaluation of teaching

At the same time, I also received positive subjective responses from students, many students in the exam paper, some in the homework, and some left messages to me, expressing the true feelings of the course, teaching methods, teachers, authors, majors, future plans, innovative thinking, etc., and showing a positive attitude. The expression of these words is a subjective evaluation of the course teaching.

#### 4.3 Auxiliary evaluation system composed of anonymous evaluation system

Over the course of many years, it is necessary to know the mentality and state of the students in real time so that adjustments can be made. Although there are various auxiliary means such as wechat mini programs, these apps and mini programs were not developed in 2012. Therefore, the author independently developed the "Introduction to Water Conservancy and Hydropower Engineering" course anonymous evaluation system at that time, which is

simple and easy to use, can be activated at any time, and has played a positive effect.

The anonymous evaluation system developed by the author was used to score the course in three stages: the middle of the course, before the exam and after the exam. It also constitutes an objective auxiliary evaluation.

In the teaching of this course, the above three evaluation methods are used: standardized objective evaluation, students' subjective evaluation structure and anonymous evaluation system are the evaluation subjects of this course.

#### 4.4 Relationship analysis of several curves

Several of the data in Table 1 are listed in Fig. 2, 3, and 4.

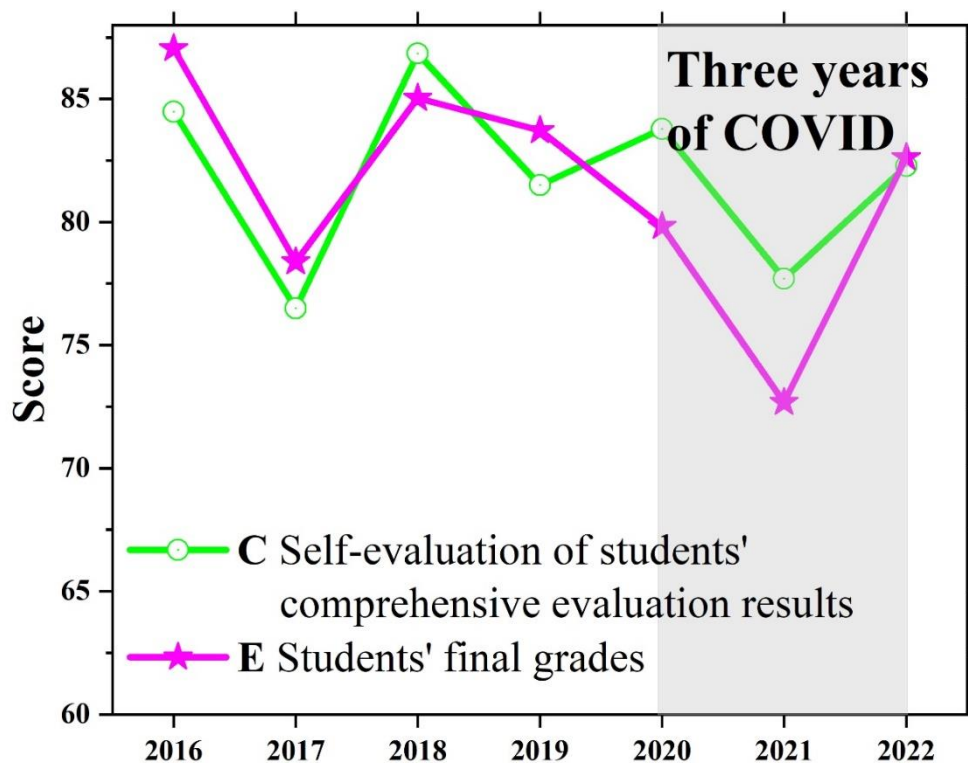


Fig. 2 Relationship between student evaluation and final grades

Table 1 Summary of students' fill-in-the-blank scores, self-rated scores, final total scores and anonymous scores from 2015 to 2022

Year	Number of examinees	Number of students enrolled	Gap filling	A Fill in the blank percentage conversion	B Students' self-assessment of test scores	C Self-evaluation of students' comprehensive evaluation results	D Final exam scores	E Students' final grades	Mid-term anonymous score	Midterm turnout	Final anonymous score	Final turnout	After the score anonymous score	Turnout after the score
2015	38	40					74.38	78.35						
2016	41	41			76.78	84.48	79.10	87.05						
2017	37	37	22.89	57.23	65.86	76.49	70.27	78.38	5	72.97	4.74	62.16	4.14	59.46
2018	38	38	26.37	65.92	73.13	86.85	76.03	85.03	5	89.47	4.81	84.21	4.25	73.68
2019	34	35	29.47	73.68	71.41	81.50	75.79	83.71	5	91.18	4.86	85.29	4.54	76.47
2020	33	33	27.06	67.65	73.79	83.78	70.52	79.82	5	100.00	4.71	84.85	4.56	75.76
2021	33	33	17.24	43.10	68.44	77.69	65.67	72.68	5	100.00	4.78	81.82	4.62	78.79
2022	*37	*37	*15.15	*75.75	77.24	82.27	74.21	82.62	5	100.00	4.79	82.86	The epidemic had just ended and the students were not in good health	

Note: The above scores are average. The anonymous rating system was only partially implemented in 2015 and 2016 but not fully implemented so there are no statistics. Fill-in-the-blank scores were not counted in 2015 and 2016. Student self-assessment scores for 2015 are not available. Voter turnout is the ratio of the actual number of people who participated in the anonymous scoring to the actual number of people who took the exam. \* In 2022, two students are selected as open books, and these two students are not considered in the calculation. For other students, the full score is 20 points, and the full score is 40 points in other years.

Fig. 2 reflects the relationship between students' overall rating and final score, that is, students think they have finished the course. The final practical grade E and self-evaluation grade C of the course can be obtained. Grade C not only reflects the expected grade of students, but also reflects students' self-positioning of their own performance and their own performance in the performance of all classmates. The average score of this item reflects the overall status of the class. A high score indicates that the class has higher expectations and better self-performance, reflecting the positive attitude of the students. Grade E is the grade the student actually gets.

From Fig. 2, it can be seen that from 2016 to 2019, the price ratio of the two curves is close, and there are certain fluctuations, and the volatility of the two curves is consistent. It indicates that the grades given by the teachers are in line with the students' expectations.

In the phase of the epidemic (2020-2022), this course is taught in the autumn of each year (September to December of each year), and almost every year is affected by the epidemic. In Fig. 2, it is obvious that there is a large decline in the two curves. Especially in 2021, the worst year of the epidemic, the two curves slipped seriously. There will be a rebound in 2022, but it has not recovered to the status of 2019 (it is closer).

Given an impact level, the actual impact level index of the epidemic in 2021 is:

$$\eta_f = \frac{E_{2019} - E_{2021}}{E_{2019}} = \frac{83.71 - 72.68}{83.71} = 13.2\%$$

In the formula,  $h_f$  is the actual impact degree index of the epidemic in 2021, and  $E_{2019}$ ,  $E_{2021}$  is the final score of students' courses in 2019 and 2021.

The degree of psychological impact on students is as follows:

$$\eta_f = \frac{E'_{2019} - E'_{2021}}{E'_{2019}} = \frac{81.50 - 77.69}{81.50} = 4.9\%$$

Where,  $h_h$  is the index of the psychological impact of the epidemic on students in 2021,  $E'_{2019}$ ,  $E'_{2021}$  is the self-assessment score of students in 2019 and 2021.

As can be seen from the above two indexes, from the actual impact degree index, the actual impact is greater than the psychological impact of students. In terms of the psychological impact index of students, students are not affected by the epidemic, mainly because of the extensive care and concern of the country, society and college teachers, which is directly related to the positive attitude of college students themselves.

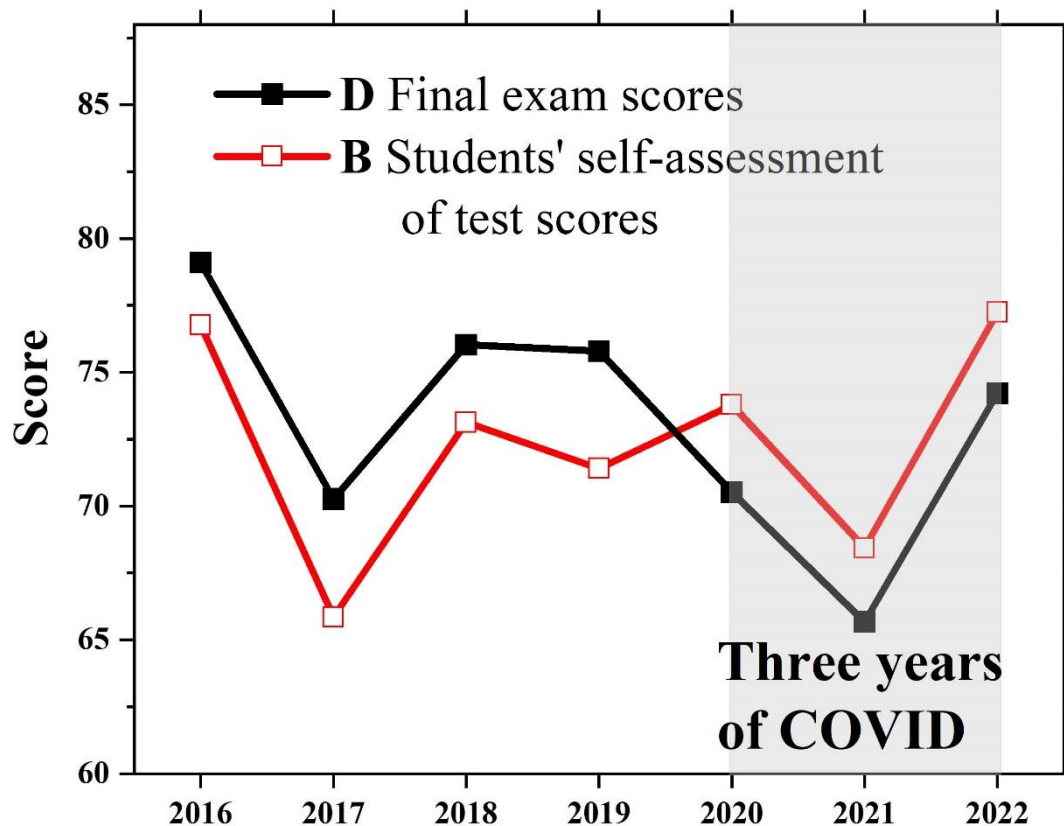


Fig. 3 Relationship between students' self-assessment of test papers and actual test scores

The relationship between student self-assessment and actual test scores is shown in Fig. 3. Curve B is the self-grading of the students' papers, and D is the actual score of the students' papers at the end of the semester. Before the epidemic, the two curves were basically D higher than B, and maintained a good fluctuation consistency. It shows that although there is a little gap between the score given by the teacher and the student's expectation, it is basically the same.

During the pandemic, this pattern changed, with curve D lower than curve B, but the fluctuation remained consistent.

It shows that the psychological impact of the epidemic on students is weaker than the actual impact, or students underestimate the actual impact of the epidemic on virtual learning. This point is also consistent in Fig. 2.



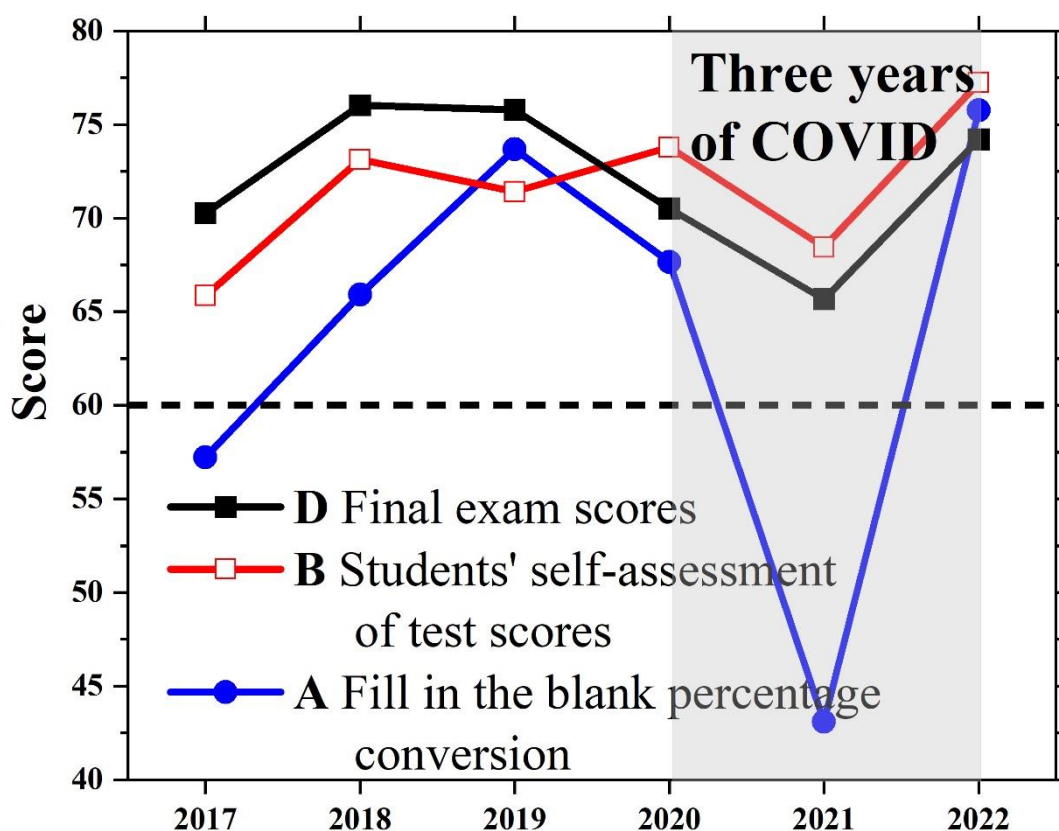


Fig. 4 The relationship between the standard score of filling in the blank, the students' self-assessment of the test paper and the actual score of the test paper

The relationship between the standard score of filling in the blank, the self-assessment of students' examination papers and the actual score of the examination papers is listed in Fig. 4. Curve A is the actual score of standardized filling in the blank, curve B is the self-rating of students' examination papers, and curve D is the actual score of students' examination papers at the end of the term. Grade A is an indicator that actually reflects the real learning situation of students.

Before the epidemic, from the three years of 2017, 2018 and 2019, it can be seen that the A-curve rose linearly, and it can be seen that students' scores in this course improved significantly, and this teaching concept, method and system significantly improved their teaching scores with excellent results.

During the epidemic period, the results of the three years of 2020, 2021 and 2022 declined, indicating that the epidemic has a great impact on students, which may be directly related to online teaching, the overall society and the school's anti-epidemic.

If standard scores are used to create the epidemic Impact Index, the calculation is as follows:

$$\eta_{fs} = \frac{S_{2019} - S_{2021}}{S_{2019}} = \frac{73.68 - 43.10}{73.68} = 41.5\%$$

Where,  $\eta_{fs}$  is the standardized actual impact degree index of the epidemic in 2021, and  $S_{2019}$ ,  $S_{2021}$  is the standardized score of students' courses in 2019 and 2021.

The pre-epidemic standardized data adopted in the formula did not take into account the hidden growth brought about by this teaching concept. From the calculation results of this index, it can be seen that the epidemic has a great impact on college students' knowledge mastery, far exceeding the previous two indicators.

## 5. Conclusion

Through the three evaluations established by the students themselves: the objective evaluation composed of standardized blank filling, the subjective evaluation of students' teaching, and the auxiliary evaluation system evaluation composed of anonymous evaluation system, the course realized the continuous teaching monitoring of the Introduction to Water Conservancy and Hydropower Engineering of China University of Geosciences (Beijing) for 11 years, and established the evaluation curve and the epidemic impact index. In particular, the data from 2017-2019 show that the teaching concept, method and system of this course have achieved good teaching results, and the impact of the epidemic on this course has been well monitored: the psychological impact on students is 4.9%, the comprehensive impact of the course is 13.2%, and the impact on students' knowledge mastery is 41.5%. It has little influence on students' psychological state, but the greatest influence on students' knowledge mastery. The state, society, schools and teachers have played a very good buffer role in this epidemic and have given students the greatest tolerance.

Some influencing factors affect the course teaching industry, this study provides a good calculation model and calculation method. Through the research of this method and this model, the research in this paper can well evaluate these influencing factors [2], and then take necessary measures to improve students' performance. The method and model in this paper provide a good method and path that can be operated, and have good value of popularization.

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