Analysis of Online Teaching of Applied Undergraduate Courses in Engineering

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ABSTRACT
During the COVID-19, many universities use online teaching methods to ensure the normal operation of the teaching., the traditional teaching experience has been unable to meet the needs of online teaching, This paper takes the 1-4 weeks online teaching at Harbin Institute of Technology as an example to analyze and summarize, discusses the online classroom design method of application-oriented undergraduate course, which is based on engineering courses. Analyze common problems encountered. According to the characteristics of the applied undergraduate engineering courses constantly excavate resources, reform the curriculum construction, class design, information fusion technology and summarize the solution. At last, the teaching effect was investigated and evaluated and data analyzed by means of supervision and lectures, platform data statistics, and student questionnaires, so as to realize real-time supervision and all-around management of students' learning process.
Keywords*: Applied undergraduate, Engineering courses, Online teaching, Evaluation of teaching effectiveness*

1. INTRODUCTION

In the spring of 2020, the whole nation is fighting the epidemic and implementing the requirement of "stop teaching without stopping" during the epidemic prevention and control period, many colleges and universities have implemented online teaching. The School of Technology of Harbin University has also responded positively by changing the traditional classroom teaching method and adopting online teaching method. Lack of experience in online teaching traditional classroom experience has been unable to meet the needs of online teaching, and there are some problems, such as network congestion instability and lack of control of students, etc., so the beginning of the online teaching of teaching mode selection and classroom design, active use of online teaching resources, improve the teaching quality of online monitoring, teaching work smooth and orderly, ensure the quality of online teaching.
Based on this, this paper takes 1-4 weeks of online teaching the School of Technology of Harbin University as an example to analyze and summarize the online teaching of application-oriented undergraduate courses focusing on engineering.

2. GENERAL SITUATION OF ONLINE TEACHING

Harbin University aims at cultivating application-oriented undergraduate talents. the School of Technology mainly offers majors and courses in engineering. There are five majors in the School of Technology, namely, urban underground Space Engineering, Electronic Information Engineering, Architectural Electrical and Intelligent Engineering, Civil Engineering and Physics. In the spring semester of 2020, there are 73 online courses, with 63 teachers and 1,183 students participating in online teaching. There are 211 online courses in a single week, and the attendance of students is about 11,250. Table 1 shows the statistics of online teaching data of each major for 1-4 weeks.

Table 1. Sensor network experimental results

Professional	Number of lecturers	Course gate number	Class number	Number of live classes	Should be to the student	Actually realized student	Attendance
Urban underground space project	11	12	153	153	7884	7880	99.9%
Electronic information engineering	15	14	181	181	6914	6908	99.9%
Building electrical and engineering	16	16	166	166	6991	6988	99.9%
Civil engineering	16	16	211	211	12422	12422	99.9%
Physics	9	17	104	104	7764	7758	99.9%
A combined	67	75	815	815	41985	41956	99.9%

According to the course characteristics and learning situation analysis, teachers choose the corresponding live broadcast interactive platform and teaching platform, and generally choose two or more platforms, such as "Tencent Conference +PPT explanation + Learning Interaction", "Tencent Classroom + learning Channel +QQ group + wisdom tree", "Tencent Conference + China University MOOC+ Learning Channel" and other teaching modes. Live streaming platforms mainly include Tencent conference, Tencent classroom, super star learning channel, WeChat group chat, QQ group chat, and enterprise WeChat. Figure 1 shows the use of live streaming platforms.

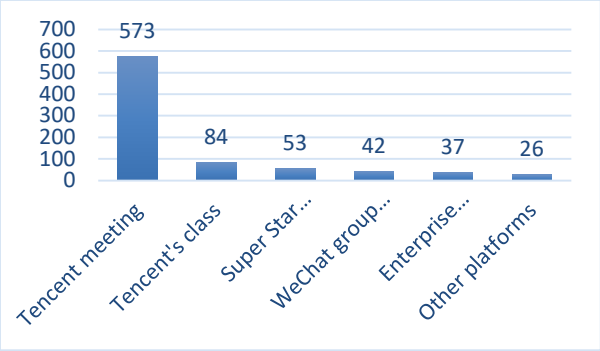

Figure 1. Usage of online live streaming platform

The teaching platform mainly includes MOOCS of China University, Super Star Learning Access, Wisdom Tree, Rain Classroom and our course platform. Figure 2 shows the use of online course platform.

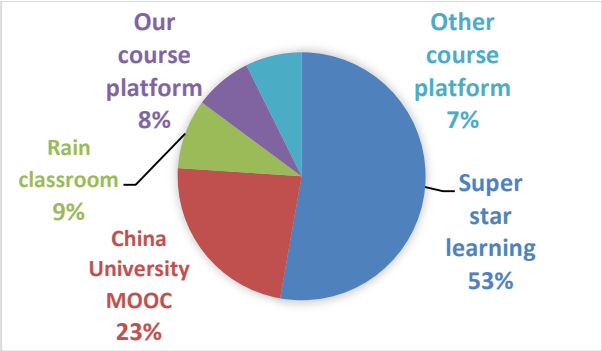

Figure 2. Usage of online course platform

In terms of teaching methods, all courses are provided with live lecture, PPT, recorded broadcast, MOOC or SPOC according to course characteristics, PPT courseware accounts for 72.73%, recorded broadcast lecture accounts for 45.45%, MOOC or SPOC accounts for 27.27%, and online real-time interaction accounts for 63.64%.

In terms of the selection of teaching hardware tools, computers are used as teaching tools, mobile phones as communication and interaction tools, and writing boards can be used as demonstration tools for calculation derivation of engineering courses. A variety of tools are designed to assist in sign-in, exam questions and other background operations do not affect the normal effect of class.

3. ONLINE TEACHING CLASSROOM DESIGN

Online teaching is different from face-to-face teaching, so it is necessary to pay attention to inspiration and guidance in classroom design, so as to arouse students' enthusiasm and attention, so that students can better participate in classroom learning and discussion, and achieve better teaching effect. Online classes are divided into three parts: preparation before class, lecturing in class and tutoring after class.

3.1. Preparation before Class

Let the students preview before class, which is helpful for the students to keep up with the ideas of the class and get ready to mobilize the students to answer questions in the following class. In terms of preview, MOOC interception, video recording, electronic textbooks, test questions and other methods can be selected to fully motivate students to enter the learning state in advance.

There are several ways to preview the material:

(1) MOOC can be used as preview materials for students, and the most suitable part can be intercepted for students to watch.

(2) The course platform can be used for video recording and uploading.

(3) The electronic version of the textbook should be sent to students in advance for reference, so as to facilitate preview before class.

(4) For some engineering applied courses, the tool software can be distributed to students in advance, and the students can be guided to complete the installation and use, so as to provide students with a platform for experiments.

After all the materials are distributed to students, it is necessary to track students' preview progress and preview quality, make full use of the course platform to see whether students have read all the preview materials and how correct the preview test rate is, and collect feedback information through chat software and other tools. By making students familiar with the classroom content in advance through preview, it can make it easier for students to follow the teacher's thoughts in class, and at the same time give the teacher more time to explain the key points and difficult points. It is more conducive to the application of classroom design such as flipped classroom, so that students can exercise their ability and put what they have learned into practice.

3.2. Teaching in Class

Due to the different emphasis of each course, teachers and students have different ways to integrate into the classroom, and other factors, there will be some deviation in classroom design. Therefore, different teachers should seek for methods for each course and choose the most suitable online teaching methods and means according to the characteristics of the course and students. As for engineering courses for application-oriented undergraduates, in terms of the overall teaching method, there are mainly the following links: sign-in, classroom introduction, classroom explanation, interactive questioning and classroom test[1].

(1) Sign-in. Multiple platforms and software can realize the online check-in, quick learn sign in comparative, and be clear at a glance, the most teachers choose, for a large amount of first class can be at a meeting in tencent gestures, to learn through window, so that both sides of both methods can avoid learning to check in and class number of tencent the meeting.

(2) Classroom introduction. Class introduction can arouse students' curiosity and drive the rhythm of the class. It can be explained through live PPT or arranged for students to listen to a short video of the resource-sharing class and then return to the live platform to ask questions, summarize and answer questions. Engineering majors can stimulate students' interest in courses by combining engineering practice and guiding students to look up materials by themselves.

(3) Classroom explanation. Live presentation +PPT is the most common and most effective way. Is given priority to with PPT lecture way, extensions to the content of the text, images, video, through case analysis to illustrate the point of view, and to demonstrate the way to enhance the students' intuitive feelings, played by video image can enhance classroom interesting, also can use a stylus sketch, especially for the parts need to deduce demonstration engineering course, may be derived by hand through tablets manner, have the effect of blackboard writing, is more advantageous to the student to keep up with the teacher's ideas. For experimental courses, virtual simulation experiments can be set up to explain experimental principles through live broadcast and share experimental feedback.

(4) Interactive questions. To mobilize the enthusiasm of students through interaction, questions can be asked through the group chat dialog, roll call, learning through the platform of random backstage selection. In terms of the selection of interactive content, a random question can be asked according to the classroom explanation, or a flipped class can be used to explain a preview problem, and then the teacher can make supplements, so that students can keep up with the teacher's teaching ideas at any time, so as to have a more solid grasp of knowledge[2].

(5) Classroom test. Periodic classroom quizzes and chapter tests can be conducted to grasp students' mastery of the teaching content. Can through Super Star Learning Access or WeChat platform (because of network problems such as instability, can backup multiple platforms) to make good questions to students in advance, timing recovery, timely find the answer by means of data query error of students, timely one-to-one tutoring or is the unity of the universal problem answer, classroom test result can be used as a normal result, forming process inspection records.

For example, some teachers require all students to open the mic to prevent students from doing things unrelated to study. They can also ask questions that they do not understand at any time to restore the face-to-face atmosphere to the greatest extent.

3.3. After-school Tutoring

After class, communication and interaction with students should be strengthened through homework and tutoring. Homework can be assigned through platforms such as Learning Pass, which can be collected regularly and corrected uniformly, and tutoring can be conducted according to homework correction. The teaching platform can record the homework of theory class or experiment class. The homework can help the teacher master the knowledge of the students and facilitate the students to check and review the learned knowledge[3]. It can also serve as the basis for process assessment. There are many ways of tutoring. Take the following three as examples:

(1) One-to-one communication. As for the grading of students' homework, I can have some understanding of each student's master situation, so that I can have one-to-one communication. Students with good master skills can be encouraged, while students with poor master skills can find out the reasons and solve them, and explain the specific reasons for mistakes.
(2) Communication and interaction in chat groups. Answering questions about common problems in the chat group is conducive to the mobilization of students' learning atmosphere. Students can ask questions at any time and teachers and students can solve them together through interaction.
(3) Recording screen explanation. For some important knowledge points or difficult points with common mistakes, they can be explained by video recording, and then uploaded to chat groups or learning channels for students to watch repeatedly, which is easier to master.

4. EXISTING PROBLEMS AND EXPERIENCE SUMMARY

There are some problems in online teaching compared with physical teaching. The following are four common problems.
(1) The network state is unstable. Due to the sharp increase in the number of online learners during the epidemic, the stability of major platforms has been greatly tested. Objective factors such as network congestion sometimes cause some teachers and students to have voice jams, interactive interface delays and dropped lines during the teaching process.
(2) Lack of online teaching experience. Before that, only mixed teaching would adopt part of online teaching. Most courses are physical teaching, so there is not much experience in online teaching, which is a new learning and new challenge for all teachers.
(3) The learning atmosphere of students is not as good as the physical classroom. Because students have a relaxed learning environment at home and there is no face-to-face communication between teachers and students, teachers cannot observe the feedback of students' listening expressions in real time. Therefore, students will wander off and lose their concentration more frequently during class, and teachers cannot timely control and stop them.
(4) Teachers' classroom control becomes more difficult. In the case of no face-to-face contact with students, the teaching quality and teaching effect should be ensured, and the test for teachers should be increased. Teachers should not only control the teaching progress and classroom content, but also the real-time learning dynamics of students, which is a very difficult classroom construction.
Make some corresponding experience summary for the above problems.
(1) Adopt multiple platforms and multiple plans. Multi-platform is adopted in order to avoid the unexpected situation of a single platform, which results in the course being unable to proceed normally. The purpose of adopting multiple plans is to ensure that students can switch to the commonly used platforms immediately in case of problems with the common platforms, without affecting the normal teaching. However, multiple platforms should choose the most suitable one by taking advantage of the advantages and disadvantages of each platform. Other platforms can only supplement the main platform, or it will lead to the problems of dispersing teaching materials and archiving.
(2) In order to achieve a better teaching effect, during the epidemic, teachers used three to four times of the original lesson preparation time to choose the platform, learn the software, prepare the plan, research and teaching, and timely adjust the teaching method according to the curriculum, students and the network platform.
(3) Increase the frequency of teacher-student interaction and master students' ideological dynamics. In the course of the class, the use of multi-frequency questions to prevent students from listening attention; At the same time, targeted preview before class is strengthened. Flipped classroom teaching mode of "asking questions - students' explanation - teachers' supplement" is adopted in class to increase students' participation in class. You can also intersperse the class with exams and quizzes to keep the students focused[4].
Students are the main body of the classroom, so that students can fully participate in the course construction and teaching, and grasp the students' learning intention and situation by issuing questionnaires, so that students can truly participate in the teaching.
(4) Build the course content, use high-quality MOOC resources to establish the online teaching system most suitable for your own classroom, and improve and modify the teaching content and process according to the actual situation of students during the teaching process.
A complete teaching process is also a guarantee of teaching quality. Preview before class and supervise students according to their learning data. In class, master the rhythm and timely interact with students, intersperse exams to divide class stages; Answer questions and give feedback after class, master students' learning situation and give targeted guidance.

5. EVALUATION OF ONLINE TEACHING EFFECTIVENESS

For the online teaching work, the effectiveness was evaluated by means of supervision and lectures, platform data statistics, and student questionnaires.

(1) Supervision. Through the three levels of leadership of school, college and department, the two levels of supervision of school and college, peer comprehensive lectures, to achieve the full coverage of teachers, classes, courses, different periods of time. A total of 637 lectures and class visits were conducted during 1-4 weeks, accounting for 78.16% of the total courses, which effectively guaranteed the teaching quality and order of the Engineering school. The supervisors also gave high comments on the online classes of the Engineering school.

Table 2. The situation of receiving lectures and visiting classes in 1-4 weeks

Department/School of Technology	1-4weeks total number of courses	Number of courses attended and toured	Proportion of courses attended and toured
Urban underground space project	153	121	79.08%
Electronic information engineering	181	141	77.90%
Building electrical and engineering	166	129	77.71%
Civil engineering	211	166	78.67%
Physics	104	80	76.92%
A combined	815	637	78.16%

(2) Platform data statistics. Due to the isolation of online teaching, students' learning status cannot be captured in real time, while the student data of online platform can reflect students' learning status. The backstage data statistical analysis function of live teaching platform can be used to reflect and master the operation of various teaching links and students' learning dynamics.

(3) Student questionnaire. Students' satisfaction, opinions and Suggestions are investigated through various channels such as questionnaire function of teaching platform and chat tool interaction, and students' feedback and Suggestions are listened to promote teachers' improvement of teaching methods.

Through the above methods, data analysis and effect evaluation are carried out for various situations including the use of online learning platform, online learning effect, concentration of live class, learning atmosphere of live class, preview and homework completion.48.82% of online learning platforms are very good, 33.18% are good, 16.11% are generally good, 0.47% are poor, and 1.42% are very bad.38.39% of students think online learning effect is very good, 29.86% is good, 24.64% is general, 3.32% is poor and 3.79% is very bad. Students' feedback on online class concentration accounted for 40.28%, 30.81%, 25.59%, 1.42 and 1.9% respectively. Compared with the actual classroom, the study atmosphere in the live classroom is very active (32.7%), more active (30.81%), general (30.33%), very dull (3.32%) and very bad (2.84%).The proportion of students who can preview before class is 82.94%, and the proportion of students who finish homework on time after class is 97.63%. Figure 3 is the feedback chart of students' learning effect.

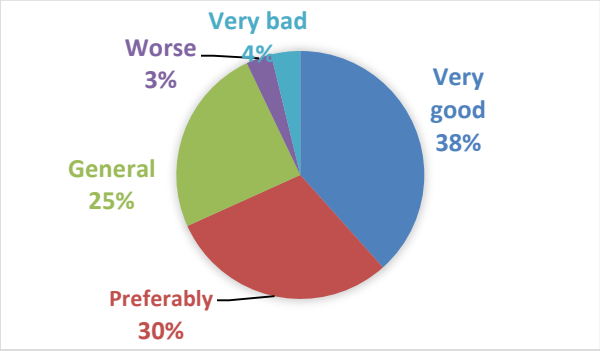

Figure 3. Feedback diagram of students' learning effect

From the overall feedback information, students have been able to master various learning platforms proficiently, with good attendance, concentration and interactive participation. Has formed a positive interaction and urged preview before class, class assignments, mentoring virtuous cycle mode, students in class can orderly, positive self-study under the lesson, for applied type knowledge and solve engineering problems also emphasize the cultivation of, realized with the real-time monitoring and comprehensive management in the process of students' learning.

6. CONCLUSION

Because outbreak made originally as auxiliary teaching means online lecture came to the front desk, became the main way of teaching, the teachers and students according to the characteristics of the applied undergraduate engineering courses constantly excavate resources, reform the curriculum construction, class design, information fusion technology and the depth of the classroom teaching, construction of network teaching resources, for the subsequent offline courses broaden the train of thought, combining online and offline, build first-class courses integration pattern.

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REFERENCES

[1] Linhong Qian, Xingzhu Zhang. Reform and innovation of computer curriculum examination course [J]. Software Guide. Educational Technology, 2018,17(1).

[2] Dongen Guo, Xuwan Wang. Teaching Reform and Exploration of Computer Software Examination Class [J]. Value Engineering,.2018(27)

[3] Xiaoli Lei. Thoughts on Enhancing the Teaching Effect of Professional Examination Class [J]. Examination Weekly, 2013(31).

[4] Yuna Pan. Practice and Thinking of Course Process Assessment in colleges and universities [J]. Research on Course Education. 2018,(50).