The Construction and Practice of Mixed Teaching Mode of Software Engineering for New Engineering

Mengzi Zhang
Anhui Xinhua University
No.555 Wangjiang West Road
Hefei, Anhui, China
coolkeke168@163.com

Shaowei Zhang*
Anhui Wenda University of Information
No.3, Linlin Avenue
Hefei, Anhui, China
Corresponding author : Shaowei Zhang
573163645@qq.com

Xiande HU
Anhui Xinhua University
No.555 Wangjiang West Road
Hefei, Anhui, China
119182904@qq.com

Shuying Liu
Anhui Xinhua University
No.555 Wangjiang West Road
Hefei, Anhui, China
2539214487@qq.com

Abstract—Since the Ministry of education put forward the construction of national top-quality online open courses, the mixed teaching mode has been widely used in the process of professional education, indicating a new direction for the development of college teaching. Based on the analysis of the gap between the traditional teaching mode and the cultivation of the comprehensive innovation ability of software engineering talents, this paper proposes to combine the national excellent online open courses with the intelligent classroom teaching, introduce it into the teaching process of software engineering, and implement "1 + n". It also introduces the application process of the mixed teaching mode in the course of "software design and architecture". This paper explores the overall construction process of the mixed teaching mode, runs the new engineering education concept through the software engineering professional training and teaching process, and trains the new software engineering talents to adapt to the industrial upgrading and the development of the software industry. This kind of teaching mode plays an important role in improving students' practical ability, strengthening the interaction between teachers and students, promoting teaching reform, and adapting to the needs of social development.

Keywords—New engineering; software engineering; mixed teaching mode; national top online open Courses

I. INTRODUCTION

With the emerging Internet information technology constantly penetrating into the education industry, especially the proposal of "national long-term education reform and development plan outline", the process of education informatization has been accelerated. As of February 2, 2020, the Ministry of education has organized 22 online course platforms to develop diversified online teaching solutions. During the period of epidemic prevention and control, the Ministry of education requires colleges and universities to formulate online teaching implementation plan, make full use of the advantages of online teaching, promote the reform and innovation of teaching and learning with the deep integration of information technology and education and teaching, promote the reform of learning methods, improve teaching efficiency, ensure teaching quality and complete teaching tasks.[1] Colleges and universities should guide teachers to choose appropriate online courses, apply online course service platform, carry out online teaching, organize online discussion, question answering and guidance, arrange online homework, conduct online tests, etc. Teachers should make full use of learning behavior analysis data to understand students' online learning.[2] The construction of various online teaching platforms and online courses provides a variety of teaching methods with greater flexibility for the teaching of colleges and universities, puts forward new ideas and methods for the development of computer education, and provides a good opportunity for educators to change their teaching concepts and methods, from knowledge imparters to supervisors, guides and supervisors of students' learning. How to establish a set of rich, multi-level, multi perspective and strong compatibility teaching mode, realize the cross complementation of various teaching forms, get through the online and offline modes, and ensure that the practice curriculum can meet the needs of students at different levels, all of which bring new challenges to the curriculum construction. Hybrid Teaching solves the problem that face-to-face interaction between teachers and students in the offline classroom is not enough, especially in the classroom with a large number of students. It is difficult for teachers to answer all the questions raised by students.[3] Online teaching breaks the limitation of time and space of communication between teachers and students. Teachers can throw out different topics to discuss with students through multiple time periods before, during and after class. In such an interactive process, each student's learning effect can be judged by data such as speech frequency and speech quality.

Hybrid teaching integrates the advantages of online learning and classroom teaching. It can make full use of the characteristics of online and offline teaching, take students as the center, actively guide students to actively participate in online learning, make good use of online teacher-student interaction, use the collection and analysis of various interactive data in online teaching and learning, understand the learning effect of students, and stimulate students through scientific and effective process evaluation, encourage and guide students to learn, use online data to understand and judge students' learning effect, and adjust teaching content and methods in time according to students' learning situation. [4-5]

II. PRINCIPLES AND METHODS OF THE CONSTRUCTION OF MIXED TEACHING MODE

The hybrid teaching mode combines the network with the classroom, so that its advantages are complementary and the teaching effect is better than the simple classroom teaching. It pays more attention to students' growth and learning process, facilitates the creation of virtual and reality, facilitates teachers' combination and selection of teaching elements, and facilitates students' assistance in teaching. Based on the cognitive theory of multimedia learning, Richard E. Mayer summed up three levels of learning cognition: unrelated cognition, basic cognition and generative cognition[6]. Irrelevant cognitive processing is ineffective cognition caused by unreasonable teaching design or bad learning strategies. Basic cognition is caused by the complexity of learning content itself, which requires learners to choose and organize the relevant information presented by materials. Generative cognition is caused by learners' learning motivation, which requires learners to complete knowledge construction by selecting relevant information for further processing, organizing the selected knowledge into orderly psychological representation, and integrating the new learning content with the original knowledge. In order to avoid the cognitive processing required by learning tasks beyond the scope of learners' cognitive capacity, the most simple and direct way is to help students reduce irrelevant cognitive processing that has little to do with teaching purposes. [7]

A. Construction Principles of Mixed Teaching Mode

First, teachers should guide students to actively participate in teaching evaluation. In the process of mixed teaching, teachers should guide students to participate in the evaluation of teaching process and teaching effect. In the process of participating in the evaluation, students can effectively enhance their learning effect and sense of responsibility, so that they can change from passive learning to active exploration. The purpose of evaluation is to promote teaching, students' participation in the formulation of evaluation standards, evaluation of other people's works and self-evaluation, so that students can understand their own shortcomings and areas to be improved from multiple perspectives, and then under the function of feedback mechanism, teachers can fully realize the effectiveness and effectiveness of the existing teaching mode, effectively

improve the quality and efficiency of teaching, and meet the needs of talents in Colleges and universities Development requirements of training mechanism.[8]

Second, teachers should guide students to reflect on the teaching process. Teaching reflection includes reflection on the teaching process, teaching content and objectives, challenges encountered, personal acquisition and the process of receiving teachers' guidance. The purpose of reflection is to guide students to analyze the causes of the problems, find ways to solve the problems, and correct the ideas and problems in time.

Third, the curriculum content design should highlight the key points and remove unnecessary interference. That is, focus on the main idea, remove the interesting but not relevant text or charts, and highlight the key materials. As you learn the text, list the text outline and the subtitles for each part. Inform the learning purpose and evaluation method in advance, for example, ask the students to give examples after learning a certain part. The learning effect will be better if the voice explanation and the picture are presented at the same time instead of one after another.

B. The construction method of mixed teaching mode

The mixed teaching mode extends the teaching tentacles from inside to outside the classroom and from offline teaching to online teaching. The specific construction process includes pre class preparation, online teaching, offline teaching and evaluation feedback.[9]

1) Preparation before class

The pre class preparation stage is the first step to develop the online and offline hybrid teaching mode. Before class, teachers need to conduct a comprehensive investigation and analysis of the teaching environment, teaching objects, teaching content and other factors, design a teaching design that conforms to the characteristics of the course and learning situation, and make a micro class or MOOC class that matches the teaching content. It includes:

Investigation and analysis. In the preparation stage, teachers should investigate and analyze the teaching environment, teaching objects, teaching contents and other factors, be familiar with the multimedia equipment in the classroom, investigate and analyze the knowledge level, learning ability and learning habits of students, and organize students to hold many pre class symposiums to fully understand the students' Mastery of basic knowledge, so as to formulate the corresponding teaching design.

Teaching design. On the basis of investigation and analysis, combined with the content of teaching materials, determine the teaching objectives and teaching methods. In the specific teaching links, there should be pre class preparation, problem introduction, in class experience, class summary, after class promotion, after class reflection and other links. Compared with the traditional classroom teaching mode, the online and offline hybrid teaching mode pays more attention to the pre

472

class preparation, which includes both teachers' pre class preparation and students' pre class preparation.

Micro class production or MOOC selection. Micro class can present profound and complex knowledge points in an intuitive and image way, stimulate students' interest in learning and improve students' learning efficiency. Teachers combine the teaching content, collect pictures, videos and other information through the network, books and other channels, and design micro class teaching programs. The forms of micro class are rich and diverse, which can be lecture type, drill type, scenario drama type, etc. Teachers can also choose a MOOC video that matches the current learning situation.[10]

2) Online teaching

The online teaching stage is an important part of the online and offline hybrid teaching mode, which is also different from the traditional teaching mode. This link needs teachers and students to cooperate with each other to complete the teaching task together. The teacher uploads the prepared micro class to the class QQ group, wechat group, Tencent class, super star learning link or other network platforms, and according to the micro class teaching scheme, develops learning tasks or online tests. The students learn independently on the network platform, complete the tasks assigned by the teacher, and ask the teacher questions online about the difficult problems in the process of self-learning. The teacher can arrange real-time discussion or non Discuss in real time and answer questions online for students' doubts. Before class, teachers collect and sort out the related problems discussed by students in online teaching, and sort them into two parts. One part can be solved by students themselves after watching the video of micro class or MOOC class, and the other part can not be solved by students themselves, so they summarize them in the subsequent offline teaching. Online teaching has the characteristics of flexibility and efficiency, which highlights the main position of students. Students need more autonomy to arrange their own online learning. Online teaching is uncontrollable, and there is inevitably a phenomenon of students making up the wrong number in the specific implementation. Therefore, teachers must formulate appropriate learning requirements according to the individual needs of students, guide all students to actively participate in it. By setting task points and background data to monitor students' learning progress in real time, students can also supervise each other's learning.[11]

3) Offline Teaching

Offline teaching is face-to-face teaching. Its essence is the process of knowledge transfer, application, deep processing and output of students' online learning. It is also a kind of practice-based inquiry learning. Compared with the traditional teaching mode, offline teaching in the hybrid teaching mode is a further deepening of online teaching, including the following four aspects:

● Problem import.

The teacher will quickly review the contents of the micro class or MOOC video, highlight the key points, strengthen the memory, and show the online discussion, and show the problems that students can solve by themselves after watching the micro class or MOOC video, and can't solve by themselves, so that students can think again.

● In class experience.

According to the difficulty degree of knowledge and students' acceptability, there are several links in class experience, from simple to deep, from easy to difficult. For the part that students can solve by themselves in the problem introduction stage, teachers can directly summarize; for the part that students can't solve by themselves, teachers can carry out guided teaching, guide students to think, and summarize the correct answers. On the basis of students' autonomous micro class or MOOC video learning before class, teachers should extend knowledge points horizontally and vertically, increase the depth of knowledge points, increase professional frontier knowledge, and stimulate students' autonomous learning interest and exploration spirit; if it is a practical operation course, teachers can demonstrate and let students try to summarize key points. Finally, the teacher can use the task-based teaching method to arrange a number of cases or practical questions, and let students discuss the exercises in groups. After the specified time, each group will send a member to report or drill, and the teacher will give comments.

● Teacher summary.

Teachers sort out knowledge points according to online discussion and offline practice, deepen students' memory, promote knowledge internalization, and comment on students' online and offline performance.

● Improve after class.

After class, teachers can arrange offline and online homework according to the teaching objectives and students' learning conditions. Offline homework is traditional paper homework. Online homework is the homework that students need to complete on the network teaching platform. Students review their knowledge according to the requirements, submit the answers within the specified time. Later, teachers will comment and upload the answers and analysis.

4) Evaluation feedback

Evaluation feedback stage is an indispensable part of the online and offline hybrid teaching mode, which can be combined online and offline in a complementary way. Online evaluation feedback can be completed online with the help of online teaching platform, and offline evaluation feedback can be conducted through questionnaire survey, individual interview and other ways. Evaluation feedback includes two levels: Teacher's evaluation feedback to students and student's evaluation feedback to teachers. Through the evaluation feedback, we can know the actual application effect of online and offline hybrid teaching mode. In the future exploration, we can make up for the shortcomings, carry forward the advantages, pave the way for the next teaching and promote the development of the new teaching mode.

It is worth noting that online teaching and offline teaching are not two independent parts of each other. On the contrary, the two parts integrate and echo each other. On the one hand, online teaching, as a front link, paves the way for the effective development of offline teaching. Through online teaching, students have a certain understanding of knowledge points, and teachers have a clearer understanding of students' mastery. Therefore, offline teaching will be more efficient. On the other hand, offline teaching is the premise and further extension of online teaching. Students enter the classroom with problems, which can cultivate students' exploration spirit of knowledge and improve students' interest in learning. After offline teaching, students can log in to the platform, continue to watch micro class or MOOC video, conduct online learning, strengthen understanding and consolidate new knowledge.

III. MIXED TEACHING COMBINATION

How to establish a set of rich, multi-level, multi perspective, strong compatibility hybrid teaching mode model, realize the cross complementation of various teaching forms, get through the online and offline modes, and ensure that the curriculum can meet the needs of students at different levels, all these bring new challenges to the curriculum construction. Scholars have discussed the combination of mixed teaching methods from different perspectives, and combined with various programs, established the following four ways. [12]

A. MOOC and Case Analysis Mode

On the one hand, this mode provides MOOC intensive lecture of basic knowledge points in programming, on the other hand, it helps learners to strengthen engineering application ability by using case analysis, which unifies large-scale teaching and personalized learning. The model is flexible and suitable for anyone who is interested in the course of programming.

B. MOOC and Offline Classroom Mode

Students use online MOOC to learn and master basic knowledge points, and then consolidate the understanding of knowledge points through offline learning reports, group project practice, classroom discussion and other modes to further improve students' ability to analyze and solve problems. The learning process of the basic knowledge points of the model is free and flexible, and the offline classroom needs less centralized teaching time, which is suitable for a small number of students who are actually registered in non related majors.

C. Online Course and Case Analysis and Offline Classroom Mode

Online course provides detailed explanation and analysis of knowledge points of programming and the realization of abstract data types. The case analysis platform provides the analysis of specific cases and the platform for students to realize. Offline classroom provides opportunities for students to answer questions and solve doubts and project cooperation and exchange. This model solves the contradiction between the serious shortage of offline class hours and the requirements of in-depth learning, and is suitable for a few students who are actually registered in similar majors.

D. Offline Classroom and Online Course Mode

The mode combining offline classroom and online course gives consideration to knowledge explanation and ability cultivation, which not only gives full play to the enthusiasm and initiative of students' independent learning, but also has the guidance of teachers and the management of learning process.

IV. THE MIXED TEACHING MODE PRACTICE OF "1+N PRACTICE" COURSE

In order to meet the requirements of the construction objectives of our university's high-level application-oriented universities, we should actively make use of the excellence of national top-quality online open courses Resources, carry out the mixed teaching of "software design and architecture" in the school practice course, combine the online "C/C++ language programming" and "Research on software engineering talents training mode upgrading to industry under the background of new engineering" to carry out "1+N" The MOOC/SPOC hybrid teaching mode practice of the practical course is to realize the cultivation of students' interest and comprehensive ability in the field of program design, software engineering through one basic course and n software engineering courses. The MOOC/SPOC hybrid teaching mode of "1+N practical" course refers to making full use of multiple excellent online course resources to carry out MOOC/SPOC Hybrid Teaching in the form of flipped classroom. The MOOC/SPOC flipped classroom mixed teaching mode of "one basic" excellent course shares the course content and teaching resources carefully prepared and taught by the national excellent teachers. The MOOC/SPOC flipped classroom mixed teaching mode of "N software engineering professional courses". During the practical teaching time, students have the choice to take a specific software engineering professional course in combination with their own field interests, and encourage energetic students to carry out multiple professional courses.[13]The "1+N practical" MOOC/SPOC hybrid teaching mode is shown in Fig. 1.
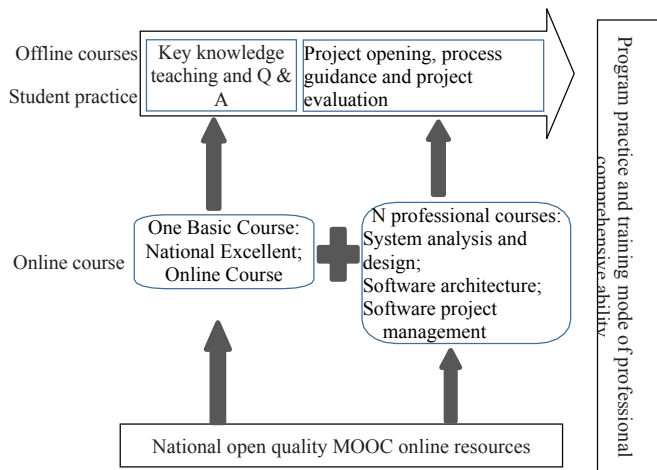
Offline courses — Student practice | Online course

| Key knowledge teaching and Q & A | Project opening, process guidance and project evaluation |

One Basic Course: National Excellent; Online Course ＋ N professional courses: System analysis and design; Software architecture; Software project management

National open quality MOOC online resources

Program practice and training mode of professional comprehensive ability

Fig. 1. MOOC/SPOC hybrid teaching mode of "1+N practice"

"Software design and architecture" as a practical course, as a typical student of program design, has already possessed the foundation of program design, but lacks the ability of application development. For students who have mastered a programming language, the "1+N" MOOC/SPOC hybrid teaching mode can be used as a practical teaching method. Taking 2018 students as an example, this paper introduces the teaching development of the three-stage curriculum. The first stage is grammar learning week. By focusing on the basic grammar of "C/C++ Programming" in the classroom, and by learning the national online course "C/C++ Programming", students can basically master the grammar knowledge of C/C++ programming. At the end of the first stage, through the online evaluation system, online evaluation of students' learning effect. The second stage is software engineering practice. Teachers encourage students to study online courses such as "advanced development of C++ language program" and "Introduction to C++ game development" of MOOC online courses in China University, and plan software engineering projects of their own interest in groups of 2-3 people. The course consists of 85 development groups, including 34 game development groups, 23 graphic drawing projects and 28 network projects, involving handwriting recognition, drawing board, license plate recognition, wechat robot, web crawler, etc. Students' topics fully reflect the diversity of students' interests. The third stage is the main coding and question answering stage of the project. Through many discussions and exchanges organized by teachers, students complete the planned software engineering project at the end of the course, and submit project document reports and project codes. According to the statistics of students' self-evaluation, the completion degree of teaching project goal is 94%.

V. CONCLUSION

Hybrid teaching mode is an important means to improve students' practical ability, gain practical experience and deepen theoretical understanding. In the new era, colleges and universities should combine the current characteristics of science and technology, make use of online teaching auxiliary platform, and realize a diversified, three-dimensional, classroom and network education mode, so as to promote the healthy and long-term development of colleges and universities. Good education is the intersection of curriculum content, curiosity and teacher-student relationship. Only through the guidance of correct teaching concept, detailed analysis of learning situation, full respect for individual differences in curriculum design, and comprehensive use of a variety of teaching methods and models can we achieve ideal teaching results. The MOOC / SPOC hybrid teaching mode of "1 + n practice" course provides an overall solution, promotes the integration and sharing of teaching resources, and realizes the maximum utilization of teaching resources. Through the combination of "C / C + + language programming" online open course and "Research on software engineering talents training mode upgraded to industry under the background of new engineering", the research on the teaching content and teaching method of "software design and architecture" hybrid teaching mode is carried out. The teaching reform and practice show that the teaching content of the course is reasonable and attractive, which achieves the training purpose of the students' program foundation, professional course interest and comprehensive ability.

REFERENCE

[1] Liou W K, Bhagat K K, Chang C Y. Beyond the flipped classroom: A highly interactive cloud-classroom (HIC) embedded into basic materials science courses. J. Journal of Science Education and Technology, 2016, 25(3), 460-473.

[2] Dicheva D, Hodge A. Active learning through game play in a data structures course[EB/OL]. [2019-12-13]. https://www.researchgate.net/publication/323328846_Active_Learning_through_Game_Play_in_a_Data_Structures_Course. 2018: 834-839.

[3] Zhou Y, Grygorash O, Hain T F, et al. Clustering with Minimum spanning trees. J. International Journal on Artificial Intelligence Tools, 2011, 20(1): 139-177.

[4] MICHEAL G. Engineering trends and the future of making structural things [EB/OL] . [2017-03-27]. http://blogs.autodesk.com/bim-and-beam /2016 /08 /30 /.

[5] MICHELLE R E. Competency models: a review of the literature and the role of the Employment and Training Adminis-tration (ETA)[EB/OL].[2017-03-28].https: //www.careeronestop.org/competencymodel/Info_Documents/OPDRLite rature Review.pdf.

[6] Arne J B, Huang S H, Murad H , et al. Teaching modelling for requirements engineering and model-driven software development courses[J]. Computer Science Education, 2018, 28(1): 42-64.

[7] Lars Gehrke and Arnot HN. A discussion of qualifications and skills in the factory of the future [EB/OL].[2017-03-20].

https://www.researchgat.net/publication/279201790_A_Discussion_of_Qualifications_and_Skills_in_the_Factory_of_the_Future.

[8] KERRYS. Higher education for sustainability seeking affective learning outcomes. J. International journal of sustain-ability in higher education, 2013,9(1) : 87-98.

[9] KATHARINA S,KERSTIN G, RENE V, et al. Preparing for industry 4.0-collaborative virtual learning environments in engineering education: automation, communication and cybernetics in science and engineering 2015/2016. M. New York: Springer International Publishing , 2015:417-427.

[10] Singh H , Reed C , Software C . A white paper: Achieving success with blended learning . J. Centra Software Retrieved, 2001,12 (3): 206-207.

[11] Wang cuie, Wang Yan. Teaching research of data structure on MOOC platform. J. Journal of culture, 2019 (3): 185-186.

[12] Xu Xin. Research on teaching method of data structure course based on case driven . J. Computer education, 2019 (3): 44-47.

[13] Du Shichun, Fu Zetian. Hybrid learning inquiry. J. China higher education research, 2016 (10): 52-55.