Practice and Experience of Digital Open Course Construction

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Abstract: The digital open course is a form that integrates Internet technology and informatization courses. On the basis of formulating new curriculum system standards and changing traditional classroom teaching, it builds an interactive platform for real teachers and students through the Internet and big data technology. In terms of solving the shortcomings of the traditional course teaching methods, on the other hand, it expands the course service target, and at the same time responds to the national call, innovatively develops the "Internet +" education model, and builds "smart campus" and "smart classroom". It has played an important role in promoting education and teaching reform and innovation of educational system, improving the quality of education and teaching, and teaching the level of professional courses and enhancing learning effects. This paper is based on the "Mechanical Engineering Control Basis" national boutique online open course construction process, focusing on the analysis of the current development of the curriculum at home and abroad, discusses the curriculum construction objectives, construction content, key issues to be solved, etc., summed up the construction practice process experience and vision, to provide reference for those who need to carry out course construction.

Key-Words: *Digital open courses; Quality online open courses; MOOC; Online courses; Practice*

1. Introduction

In the process of educational informatization and network development, the traditional classroom teaching process is changing from text course classroom teaching to digital open course teaching with the support of network information technology [1,2]. Digital open course refers to the course construction in the modern education technology platform on the new idea and new forms [3], which based on the modern education technology and conditions, It integrates a variety of interactive, interconnected media and resources, and forms micro courses, knowledge unit teaching video, digital teaching materials and dynamic test question bank, etc. it also can provide a kind of teaching resources for the teaching of the overall

solution, and optimize allocation of teaching resources, and make the excellent teaching resources share, digital open course teaching promotes and improves the quality of teaching at the same times.

The basic content of digital open course construction includes micro-course construction with knowledge points as the content, dynamic test question bank construction, new form of digital teaching materials construction, etc. [4,5], and its forms include teaching videos, electronic publications, online course content and paper new form of teaching materials, etc. Based on this, how to teach reasonably, effectively and scientifically compile teaching materials, design network teaching platforms, actively and timely guide students to develop and utilize digital teaching resources, and enable them to cultivate students' ability to think, analyze and solve complex problems in the teaching

process is an urgent issue for college teachers [6].

Based on the national high-quality goods online open course "Fundamentals of Mechanical Engineering Control"(FMEC course) for the construction of the practice and experience [7], and based on existing Blackboard at Northeastern University network teaching platform, and the content of MOOC course construction as the foundation, to the teaching objects (students) as the main body, in the teaching process digitization construction as the gripper, cultivate students according to their existing knowledge accumulation and thinking structure, to meet the needs of academic, to choose their own courses focus and academic information, and construct their own knowledge system, cultivate the students' thinking, analysis and the ability to solve complex problems, explore and develop new engineering background, Research on the new teaching mode of university courses in the era of intelligent campus.

2. Analysis of the development status of curriculum at home and abroad

2.1 The development of relevant courses abroad

Taking the FMEC course as an example, the degree of digital openness in some developed countries is much more advanced than that in China. In the 1880s, the FMEC course has become a compulsory course for mechanical students in European and American countries, and some schools also set it as a basic course for engineering students. According to the survey statistics, university of Sheffield, Massachusetts Institute of Technology, Purdue University and University of Michigan and other institutions have opened relevant courses, and constantly reform and update. Especially in the last decade or so, in the field of digital open teaching and lecture notes construction, the materials are abundant, the ideas are novel and the content is advanced. Meanwhile, the experimental

subjects of design are constantly introduced from the industry and decomposed into the contents of a Team project.

2.2 The development of relevant courses in China

In China, the FMEC course originated from the first Chinese textbook "Engineering Cybernetics" compiled by Mr. Qian Xuesen in 1956. Since then, with the refinement of specialization and deepening of research, "Engineering Cybernetics" has been more and more refined according to professional objects. Among them, FMEC course is a basic control course for mechanical engineering. In recent years, on the basis of theoretical teaching, the experimental teaching situation of mechanical engineering control basic courses has also been greatly improved. The professional scope of the courses has also been expanded and the teaching reform has been continuously developed. A batch of higher education national planning textbooks and advanced experimental systems have been published. However, compared with the teaching mode of mechanical engineering control courses in advanced countries in the world, there is still a big gap.

In recent years, the Northeastern University "Fundamentals of Mechanical Engineering Control" curriculum group has undertaken a number of projects such as the Ministry of Education's Online Education Research Fund, the Liaoning Provincial Educational Reform Project and the Northeastern University Educational Reform Project. The main textbook, learning guidance textbook and experimental course compiled by the group constitute a complete teaching material system and have gradually become the best of similar textbooks. In particular, the third edition of the main textbook is the MOOC version of the new form of textbooks, which is welcomed by teachers and students. It also builds online courses based on the Blackboard network, and develops experimental teaching

equipment for trolley position control and a new industrial patch robot system with independent intellectual property rights, and develops virtual simulation teaching software. The curriculum group has been actively participating in the reform of education and teaching, constantly exploring new teaching modes and forging ahead towards its innovative direction.

3. Curriculum reform content

3.1 Reform goals

Taking the opportunity of adapting to the new university education and teaching model in the information age, aiming at cultivating and improving students' learning and innovation abilities, taking reform and innovation as the starting point, taking the digitalization of the teaching process as the core, on the basis of creating a three-dimensional textbook, relying on the international general online teaching software Blackboard and using the domestic largest MOOC network platform AiCur.net as a window, we construct digital open courses to stimulate students' learning interest and subjective initiative as much as possible, adapt to the times trend and advance with the times to promote the coordinated development of students' knowledge, abilities and qualities.

3.2 Content of curriculum reform

Taking the FMEC course as the construction object, it focuses on the following four aspects to carry out research: (1) The construction of the course content system is the leading factor--the construction of teaching materials. (2) Curriculum network assisted construction is a means--online resources. (3) The construction of curriculum teaching method is a breakthrough--flipped classroom. (4) The construction of curriculum teaching quality is the core-- quality evaluation. In this way, a complete closed loop is formed in the teaching process as shown in Fig.1.
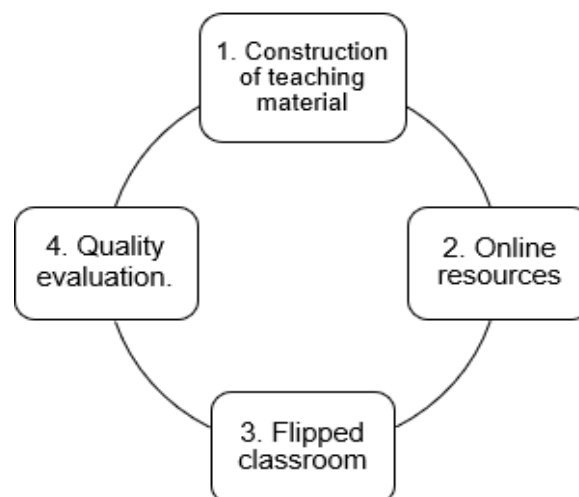

Fig.1 The closed loop

3.2.1 The construction of teaching material

The content of teaching materials is the leading part of curriculum construction and is always the primary work of educational reform and teaching research of course team. Our course team has published the "Fundamentals of Mechanical Engineering Control (third edition)", "Learning guidance and problem solutions of Fundamentals of Mechanical Engineering Control (second edition)" and "Fundamentals of Mechanical Engineering Control Experiment", the cover of the teaching materials are as shown in Fig.2 These three materials form the complete teaching material system, including the main teaching materials, learning tutorial materials and experimental materials. Among them, "Fundamentals of Mechanical Engineering Control (third edition)" is a new form textbook of MOOC. According to the statistics of Science Press, this set of textbooks has been used by more than 30 schools and units nationwide, and has gotten consistent recognition and praise by teachers, students and social readers.

(a) Main textbook (b) Tutorial material

(c) Experimental materials

Fig.2 Teaching material construction

Fig.3 Course Interface

3.2.2 Online resources

In order to adapt to the new learners of new generation, who growing up in the information society, in order to better promote the digital construction of the teaching process, and improve the efficiency of the networked process learning effectively, the scientific nature, frontier nature, accuracy and practicality of the network teaching content architecture is particular important. The course team has been building online courses based on the Blackboard teaching resource platform since 2008, mainly including five modules: basic course content, online test, course homework, course discussion, and teacher-student communication and interaction. It has become one of the best online courses of Northeastern University. On this basis, the construction of micro-course teaching video with knowledge points as the unit was carried out in 2015,

and the course was launched on MOOC officially in 2016, with nearly 30,000 people choosing this course. Since the opening of the course online, the course team has been summing up the experience and improving the methods constantly. And the course was rated as the national-level MOOC in 2018. The homepage of Web courseware is shown in Fig. 3.

3.2.3 Flipping the classroom

It is found that the biggest feature of MOOC courses is the fragmentation of knowledge units, which is convenient for learners to have a deeper understanding of a certain knowledge point, but it is also very important to grasp the whole curriculum system. So that guide students to return the fragmented knowledge points organically to the curriculum system also is a very important part. Especially in the Internet era, learners are no longer faced with the lack of era resources, but with the problem of resource trade-offs and organic integration. Traditionally, teachers are the primary providers of learning resources to students, they have more resources than students through years of accumulation and the superiority of their platforms. In the Internet era, in the face of massive resources, the teachers' more important task is to excavate the truly valuable and suitable resources for students' learning from the massive resources through his professionalism and professional judgment and guide students to learn correctly and efficiently. Therefore, breakthroughs must be made in teaching methods, so flipped classrooms are particularly important.

The flipped classroom teaching method refers to the teacher arranging tasks for students in the classroom, allowing students to learn network resources in a targeted and purposeful way after class, while class time is spent more on discussion, quizzes, and practical exercises [8]. It may seem that the teacher's workload is much lighter, but it is not, as the teacher must have real-time knowledge of student

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mastery and the ability to solve complex problems and prepare answers to all possible questions, thus placing much greater demands on the teacher. Northeastern University has carried out a lot of work on the construction of intelligent teaching resources such as smart classrooms, and it has been proven that flipped classroom teaching is much more effective than traditional methods. On the one hand, process learning enables students to have a deeper understanding of knowledge points. On the other hand, online course resources can free teachers from repetitive tasks and devote more time to developing students' ability to solve complex problems and innovation capabilities.

3.2.4 Quality evaluation

In traditional teaching, teachers are on the front line of the whole process from lesson planning, lectures to after-school tutoring and Q&A. So, students are very dependent on teachers and classrooms for their learning. With the introduction of online courses into course teaching, students through online courses can basically complete most of the course content learning. In the face of learning some of the difficulties, common problems, basically can be solved through the discussion from of online courses. Therefore, throughout the teaching process, the teacher mainly plays the role of an instructional organizer — organizing students' effective participation in the online course class, organizing group discussions for the course, giving timely feedback on learning outcomes.

In addition, in the traditional teaching model, teachers can only focus on the common problems of the majority of students to improve the overall effectiveness of teaching. In this model, the development of personalized education is hindered. In the context of online courses, teachers can get out of the repetitive teaching process and have more time to focus on individual students and promote personalized learning, such as paying attention to individual student differences, giving individual guidance to students, and solving individual student problems.

Since the beginning of the MOOC course, the course team has been summing up the experience and improving the methods. From the students' feedback, we know that most of the students prefer to take the interactive modules such as online tests. In terms of access to content and media format, the most desirable resources for students are core modules such as teaching plans, teaching courseware and exercises. The media format of resources tends to be video, documents and web video materials. The main reason for the popularity is that there is a large amount of information and all of it has been carefully designed and structured. In addition, through the research and analysis, it was found that the biggest feature of MOOC courses is the fragmentation of knowledge units, which is convenient for learners to have a deeper understanding of a certain knowledge point, but it is also very important to grasp the whole curriculum system, i.e. to guide students to return the fragmented knowledge points organically to the curriculum system.

3.3 Key issues to be addressed

Regardless of the traditional teaching or the new form of teaching under the "Internet+" mode, the leading person of the teaching activity is still the teacher [9]. Therefore, in order to develop digital teaching construction, the teacher is the key, and must deal with the following three aspects: (1) teachers' re-understanding and positioning of digital teaching; (2) digital-based teaching process design; (3) accumulation and update of digital resources. A description of the problem is shown in Fig.4.

3.3.1 Teachers' reconceptualization and repositioning of digital teaching

Relative to students, teachers experience not only convenience but also challenges when confronted with digital teaching resources [10,11]. First of all, teachers'

role concept must have a new understanding and orientation. With the advent of the information era, it poses a great challenge to the traditional teaching and learning structure model, and the learning knowledge channel and media are no longer single, not only the teaching materials and paper culture, but also the electronic media, especially the network of all kinds of digital knowledge and resources, which challenge the central position of teachers. Secondly, teachers must have a clear understanding of the situation and at the same time must think about and implement new strategies and methods. Faced with the new teaching situation and teaching conditions, teachers should, on the one hand, stimulate and cultivate students' interest in independent learning and creativity, and on the other hand, redefine the focus of education and teaching.

3.3.2 Teaching process design based on digitization

Training talents with practical ability and innovative ability has become the main goal of higher education, and the teaching of specialized basic courses plays an increasingly important role in ensuring the realization of this goal. With the development of science and technology, automatic control technology of mechanical engineering is the most widely applied professional technology in the field of modern mechanical engineering. The FMEC course has become a very important professional basic course in the mechanical engineering discipline and other similar disciplines. This course is an essential theoretical knowledge course for students to further study and solve practical problems. At the same time, it is directly related to the cultivation of students' innovative thinking ability and practical ability. Therefore, under the new situation of vigorously promoting education and teaching reform, how to build the teaching content of frontier system, the advanced and practical network teaching process design, the new and open teaching method and the scientific and reasonable examination method become the key.
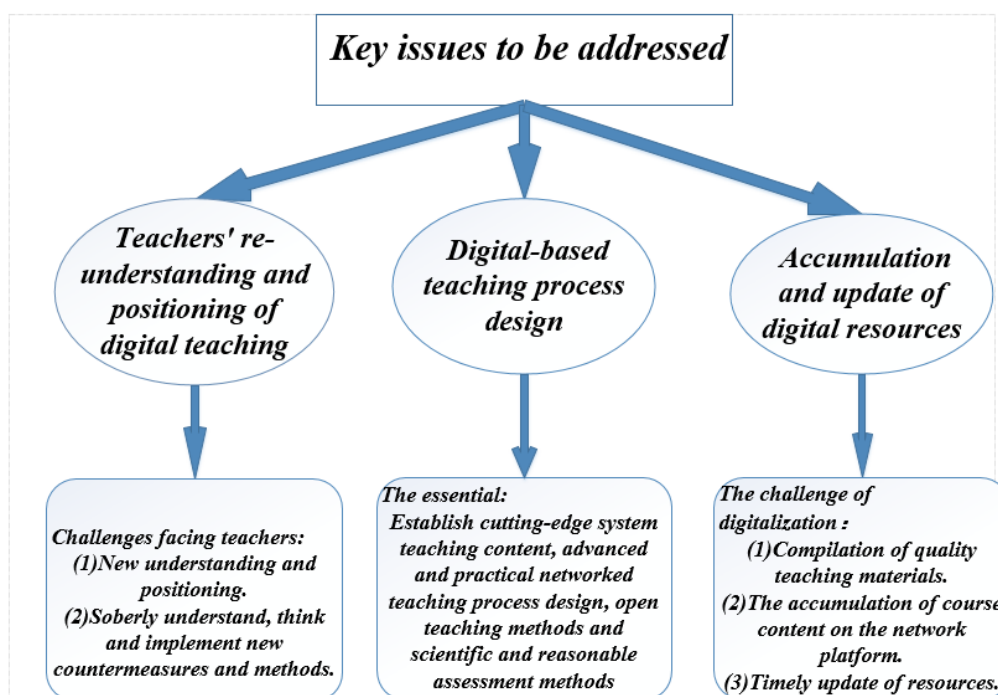

Fig.4 Key issues to be addressed

3.3.3 The accumulation and update of digital resources

To realize the digitalization of teaching process, the accumulation and renewal of teaching resources is undoubtedly one of the key problems to be solved. The main challenges lie in three aspects: on the one hand, the compilation of high-quality teaching materials and the leading role of teaching activities in the content of teaching materials need to consider the problems of knowledge quantity, readability and network; On the other hand, the course content accumulation for the network platform, such as the design of the question bank for testing and online examination, is very heavy. The third aspect is the timely update of resources. For the construction and maintenance of digital network platform, only timely update can stimulate students' interest in using and improve their innovation ability.

4. Practical experience and prospect

Contemporary college students teaching should focus on construction of teaching resources and teaching process, to change the previous to the last final grade level to assess the good condition of students, especially for the similar to the mechanical engineering control basis course, after many years of teaching experience, found that more solid learning process will help knowledge flexibly and effectively applied to work in practice. In the learning process, through digital teaching resources, students can not only acquire the ability to construct knowledge, but also flexibly communicate and interact with classmates and teachers. They are not limited by the class hours of previous classroom teaching, which is more conducive to strengthening the discussion of unfamiliar knowledge points. In addition, through to the digital instructional resource selection and use of practice, students' learning from the teachers on one-way instruction pattern into a constructive, discovery learning, change from passive learning to active learning, spreading knowledge by teachers to students themselves to create knowledge, is the inevitable development trend.

The digitization of teaching process is based on digital information and network. It is a virtual educational environment, which makes optimal use of digital resources. It is built on computer and network technology, is the collection, processing, integration, storage, transmission and application of teaching contents, multimedia courseware, teaching videos, references, experiments, discussions, learning experiences, online tests, online examinations and other information. By realizing the three-dimensional process from environment, resources to application, building a digital space on the basis of traditional teaching, in order to expand the time and space dimension of realistic learning, enhance the operational efficiency of traditional teaching mode, and ultimately realize the comprehensive network and informatization of the educational process, so as to achieve the purpose of improving the level and efficiency of teaching, is the inevitable direction of efforts. The practical experience and prospect is shown in Fig.5.
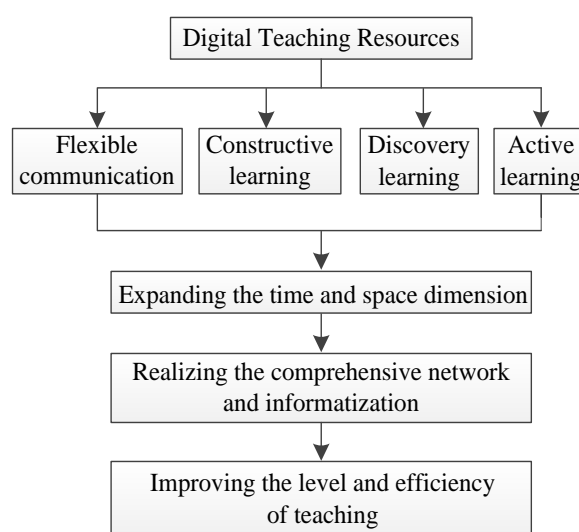

Fig.5 Practical experience and prospect

5. Conclusion

In recent years, the Curriculum Team has taken the cultivation of talents with innovation and practical application ability as its guide and the improvement of course teaching quality as its driving force and established a more complete course resource system from five aspects, such as the construction of teaching materials, Blackboard network platform, MOOC network course construction, multimedia course design and the establishment of experimental systems, in order to promote the learners to master knowledge, improve their ability, and improve the quality of teaching. It lays the foundation for the coordinated development of such qualities as outreach.

The digitalized FMEC course integrates video explanation of knowledge points, in-class tests and after-class exercises into one. Featured by inspiring and analyzing ingenious animations, it has been fully open for use. The construction and promotion of the MOOC FMEC course not only popularized the knowledge of this subject and relevant application principles, but also played a good guiding and promoting role in the further construction and development of the FMEC course.

Under the background of new engineering, learners are accepting and adapting to this advanced teaching method and mode, which cultivates learners' active learning habit and has great help to improve learning efficiency. In addition, the new situation also put forward new requirements for teachers, constantly explore, constantly innovate, constantly practice, and constantly develop. Therefore, the construction of the digital FMEC course is also a kind of improvement and progress for teachers themselves.

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