Research on the Construction Mode of MOOCs in Higher Vocational Colleges in the Present Integration Situation of Science and Education

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DOI: 10.32629/jher.v5i6.3384

Abstract: The rapid development of MOOC construction has brought a teaching reform to both higher vocational education and general higher education. However, the construction practice of MOOC for higher vocational colleges is different from that of general universities due to their different types of personnel training. On the basis of an investigation of MOOC and a survey of the participants of MOOC, this paper points out that MOOC construction in higher vocational colleges should take into consideration of the characteristics and realities of higher vocational education and have its own uniqueness. The characteristic of MOOC in higher vocational education is analyzed and some suggestions for MOOC construction are proposed. The construction mode of MOOC is also studied taking a professional core course — Construction and Maintenance of Railway Subgrade in the program of Railway Engineering Technology as an example so as to provide some reference for the current MOOC construction.
***Keywords*:** characteristics of MOOC, construction principles, construction mode integration of science and education

1. Introduction

The concept of MOOC (Massive Online Open Courses) is proposed by Dave Cormier and Bryan Alexander [1] in 2008. MOOC emphasizes the characteristics of open and online, which can realize the sharing of high-quality learning resources. This allows students to schedule their online learning time flexibly according to their individual needs, widens the learning channels, and makes up for some short board problems in the current high education. MOOC has initiated a teaching revolution as the integration of information technology and education[2]. "In the face of global high-quality education resources and strong cultural impact, Chinese universities must speed up education reform and improve teaching quality. Otherwise there will be the risk of becoming the teaching laboratory and tutoring classroom of world-class universities" [3].

It is an indispensable choice to carry forward the construction of MOOC to adapt to the new teaching reform for higher vocational colleges and general universities in China [4]. However, some researchers selected 76 MOOC courses randomly for analysis and found that although most MOOCs are well-packaged (most MOOCs scored highly on organization and presentation of course material), their instructional design quality is low [5]. In addition, the effects of MOOC application practice are not ideal especially for high vocational students. Many researches indicate that the main reasons are as following: the low completion rate of MOOC learning, most students having low capacity for self-discipline, and some teachers not having grasped related developing technology well etc.[6]. We, as a research group, have investigated the MOOCs for higher vocational colleges on the present popular platforms such as https://www.icourse163.org, https://open.163.com, and https://next.xuetangx.com. We also have conducted a questionnaire survey as well as an interview study on the current MOOC developing condition for higher vocational education in China. We distributed questionnaires to 8900 students concerning the MOOC learning motivation, and then collected 8516 valid questionnaires to arrange and analyze the data, which indicates that many students lost interest in MOOC learning because the design of current MOOCs in higher vocational colleges cannot satisfy their demands. And the interview with 25 professional teachers shows that the biggest current challenge for the development of MOOC is that it doesn't take into consideration of the characteristics and realities of higher vocational education and lacks of features. In essence, both the results of the questionnaire survey and the interview with the teachers indicate that the MOOC development doesn't fully consider the actual situation of higher vocational education.

Higher vocational education, definitely belonging to high education system, is characterized by its principles for the establishment of majors and the training objects of talents. The principles should demonstrate features of direction, adaptability, and practicality vocational posts. Specifically, the establishment of majors should be occupation oriented, the training goal should be talents with high practical ability, and the corresponding teaching process should strengthen practice and cultivate students' abilities of practical operation, analyzing problem and solving problem. All these make the

construction, development, and application of MOOCs in higher vocational education unique and characteristic. Therefore, it is undoubtedly important to analyze the characteristics of MOOCs for the higher vocational education and to explore the construction correspondingly.

2. Analysis of the Characteristics of MOOCs in Higher Vocational Education

Higher Vocational Education is a type of higher education in Chinese education system. It combines certain higher education foundation with vocational education characteristics and is different from general undergraduate education [7]. The undergraduate education lays more emphasis on its disciplinary system, explanation of the horizontal relationship between different disciplines and the deep development of disciplines. And the higher vocational education, based on the specific classifications of professional posts and the actual scope requirements of business activities, shoulders the fundamental task to cultivate the high-skilled special talents. Much more attention is paid to the cultivation of the abilities to analyze and solve technical problems in the production line. More emphasis is put on the cultivation of professional ability and professional quality. Because of the different training goals, MOOC for higher vocational education has to be vocationalized in order to innovate teaching reform and to help cultivate the talents based on the teaching law and reality of higher vocational education in China. Therefore, besides its common characteristics of being large-scale and open, MOOC for high vocational education should have its unique features which are located in its design ideas and content presentation. Contrary to the MOOCs in the universities which are basically a disciplinary system and the content is theoretical explanation, MOOCs in higher vocational education should pay less attention on the systematicness and integrity of traditional disciplines based on an overall optimization and application orientation, meet the demand of repeated skill training such as equipment operation, fault maintenance, safety education, skill upgrading, and professional quality cultivating. The vocational education courses should embody its professionalism and skill operability, thus helping students learn skills and arouse their consciousness of safety and mental health.

Meanwhile, as an online learning mode, the effect of MOOC application practice mainly depends on students' self-study and active learning. The fact is that the knowledge foundation for most higher vocational college students is weaker than that of the general university students which are indicated by their lower admission score. Most of the students in higher vocational colleges lack of good study habits and have lower autonomy of learning. Based on this reality, it is also necessary to redesign the MOOCs and reorganize the content of MOOCs for better achieving the educational goal other than the current state of simply following the general universities.

3. Suggestions on the construction of MOOCs for Higher Vocational Education

Some researchers put forward five principles of MOOC design and construction: meaningful, attractive, evaluable, accessible, and extensible [8]. These are general principles suitable for MOOC design. In addition, based on the analysis of characteristics of MOOCs in higher vocational education, some suggestions for MOOC design and construction for higher vocational colleges are proposed as follows:

3.1 Design and develop MOOC according to the students' learning characteristics and the teaching law of higher vocational education

To make the students learning more effectively, the design of MOOC should take the students' learning characteristics and the teaching law of higher vocational education into account. According to the questionnaire survey we have conducted on the higher vocational students, the motivation of MOOC learning can be summarized as the following three main factors: helpful for the specialized study, meeting the perceptual demand, and satisfying the interests. The survey results also show that most students like intuitive, concrete, vivid, and interesting learning. Meanwhile, the teaching law of vocational education is "learning by doing" because most students are better at operation and thinking in image [9]. Then, the presentation form and teaching design need fully consider the students' learning characteristics and the teaching law of higher vocational education. For example: VR, AR, flash, 3D, video, game, and other forms can be used to organize teaching in the development of MOOC, which determines the students' acceptance and learning effect of new knowledge in the learning process. The teaching content of some courses need to be reorganized by taking real typical engineering projects as learning units and the students' learning process follows the working process. This may support higher vocational college students' autonomous learning and collaborative exploration, and help inspire their intelligence.

3.2 Make an overall plan for MOOC construction for higher vocational colleges

As a new form of online learning, MOOC is different from traditional course and has its own innovation and advantages. But MOOC is not all-inclusive. Some courses are suitable for it while others not. For each higher vocational major, it

should choose its own proper courses for would-be MOOCs through investigation, analysis, and discussion. For each higher vocational college, MOOC construction should be overall planned. The overall plan could include but not limited to: encouraging the construction team to explore actively other learning forms of MOOC besides micro videos to help improve the students' reflective learning, inquiry learning, and cooperative learning; encouraging to research teaching strategies and methods suitable for MOOCs to enhance interaction and personalized communication between teachers and students and to arouse students' learning interests and effectiveness; encouraging to update the resource of MOOC timely and share or exchange the experience and achievements obtained in the process of use and construction.

3.3 Design teaching according to the Five Star Teaching Method by M. David Merrill

Design teaching according to M. David Merrill's Five Star Teaching Method. The core of the Five-Star Teaching Method [10] is that detailed teaching tasks to be fulfilled such as facts, concepts, procedures, principles, etc. should be put into the step-by-step real problem-solving situations. That is, first present problems to students, guide and help them to actively think, and then conduct teachings according to specific tasks to show students how to apply specific knowledge to solving problems or fulfill the overall task. This kind of effective teaching (achieve better teaching results with less teachers 'and students' time and energy) proposed by M. David Merrill is based on the two principles of reasonable course content and appropriate learning activities [11] , reflecting the two elements of online courses [12].

4. The Construction Mode of MOOC in Higher Vocational Colleges

According to the teaching objectives, the courses in higher vocational colleges in China can be roughly divided into four categories. The first category is to impart theoretical knowledge; the second one is to help students acquire basic operation skills; the third one is to cultivate students' professional quality and innovation ability; the last one is to cultivate students' core professional skills. In fact, those teaching objectives are integrated with each other. According to the courses with different teaching objectives, the construction ideas and presentation forms should be different.

For the first category, there are many courses on MOOC platforms, uploaded by prestigious universities. Most of them are theoretical teaching video clips and the quality can be guaranteed. Each major can selectively recognize the course credits according to the needs of its own talent training orientation. Students are allowed to choose certain MOOCs according to their own knowledge structure and interest needs. Concerning the first category, there is no need for higher vocational colleges to construct the courses. But, when guiding students to use MOOCs for fragmented learning and mobile learning, teachers are required to pay attention to the content selection of MOOCs and sort out the key and difficult points and prioritize those curriculum contents with "task-driven" course design concept as the core of Blended Teaching method (a teaching method combining the advantages of online teaching and traditional teaching) so as to obtain better teaching effect.

For the second category, a question-oriented MOOC design and development mode is proposed, including the following steps — presenting problems, explaining the fundamental theory, demonstrating practical operation, working through a task, developing the application, which can be abbreviated as PTPTA (problem-theory-practical operation-task-application) design and development mode. When learning resources are designed, first, a practical problem that students can possibly solve is put forward. Then, its theoretical basis and feasible solutions are explained, and practical operation demonstration is conducted. In the process of solving problems, students are guided to apply theories to practices, to master fundamental theoretical knowledge, to exercise basic operation skills, and gradually develop their problem-solving abilities. Furthermore, according to the teaching objectives, MOOC teachers create vivid learning task situations, increase the degree of task difficulties gradually, ask students to improve their levels by working through tasks, and guide students to solve problems using knowledge acquired online in order to improve their participation. As far as the expansion of application is concerned, it is through BBS (Bulletin Board System) — which is a course forum that facilitates interaction and exchange between participants and each learner can air their ideas freely, answers their peers' questions, and comments on others' views on it.

The key to PTPTA Mode is that the construction team can reasonably break up the course content into different knowledge points and skill points, elaborately design and raise questions, and create learning tasks. The development of video resources should be focused on visualizing the abstract concepts and rules. When tools and operating objects are arranged and examples of excellent employees in enterprises are set, much professional quality can be integrated into education to improve students' basic operation skills and to internalize their professional quality.

The PTPTA Mode can be shown as Figure 1.

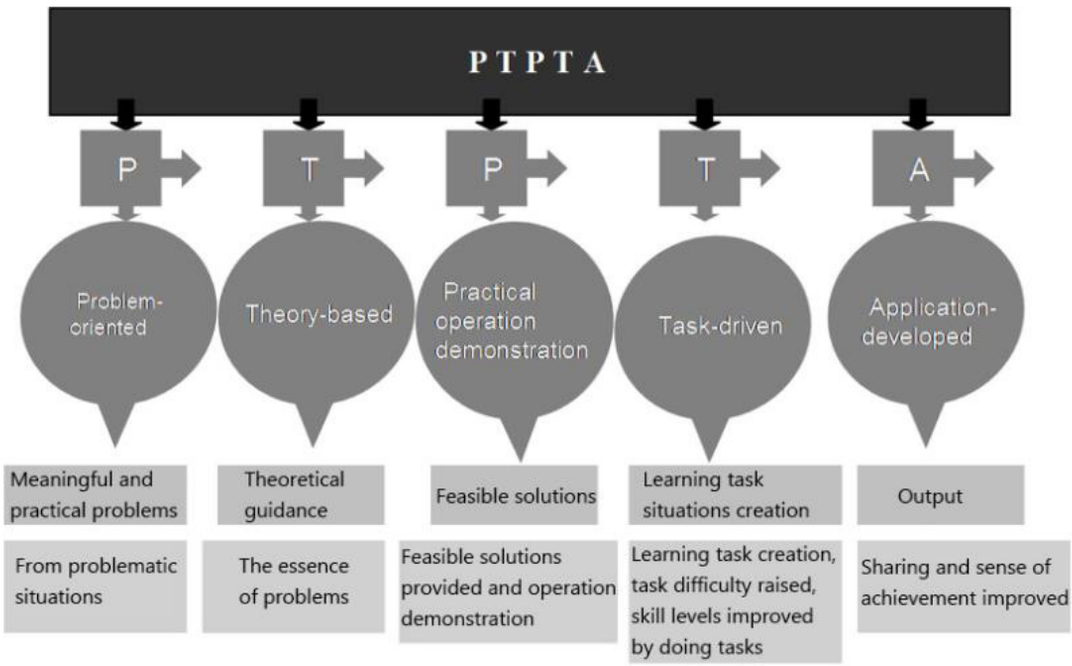

Figure 1. Graphical Representation of PTPTA Mode

The third category refers to the courses for the cultivation of professional and innovative quality which is a long-term and comprehensive process. It requires the participation of skilled workers, experts, especially successful entrepreneurs in every industry. But it is virtually impossible to invite all of them to teach students in classrooms. In regard to these courses, new solutions are put forward under the background of MOOC. The solutions are: inviting experts, educators, leading and well-known entrepreneurs to develop and open MOOCs on innovation theory, research methods, technology frontline, entrepreneurship foundation, employment guidance or in the form of college-enterprise cooperation development; digging up and enriching the innovation and entrepreneurship education resources to set up a sharing platform to provide open free education resources and learning experience, which can help students understand industry policies and information in time, to learn and accumulate industry experience, even to find partners or venture investors; inviting education experts of innovation or well-known entrepreneurs to give high-level innovation and entrepreneur lectures. The solutions can be combined with flipped classroom (Flipped classroom teaching mode refers to that students learn online independently before or after class, and the classroom has become a place for interaction, including answering questions, cooperative exploration, and completing their studies, etc.) or blended teaching to cultivate students' critical and creative thinking and to stimulate their innovation and entrepreneurship inspiration.

The last category refers to the courses which cultivate students' core professional competencies. Because the core professional competencies can only be cultivated in the complete process of work, we follow the principle of working process oriented, real project as medium, and docking with professional standards in MOOC construction of these courses. To be specific, the MOOC construction mode can be described as "Working Process+Real Project+Professional Standard". The higher vocational colleges and enterprises cooperate to develop MOOCs for the last category courses guided by orienting specific working process, selecting enterprise real projects, restoring real work scenes, adhering to relevant professional standards, emphasizing practicality and foresight. The action field of work process is transformed into the learning field of curriculum and the completion of independent typical work tasks can improve various professional abilities. The instructors of MOOCs cannot be confined to higher vocational college teachers. The enterprise employees with expertise in certain business or knowledge field can play the role too. Through the construction of MOOCs, the resources sharing between higher vocational colleges and enterprises can be realized.

We take a professional core course - Construction and Maintenance of Railway Subgrade in the major of Railway Engineering Technology as an example. It trains higher vocational college students to use the norms and standards of railway construction and maintenance and engages in subgrade construction and maintenance technology and management. This course plays a major supporting role in training higher vocational college students' abilities of railway engineering construction and maintenance and engineering management. This course is also in the core position in the whole curriculum system.

The employment posts of this major mainly are construction workers, quality inspectors, and railway line workers. When MOOC for the course - Construction and Maintenance of Railway Subgrade is developed, the main tasks of these key positions are firstly analyzed concerning preliminary work of subgrade construction, subgrade construction, its operation, and maintenance. Then we select certain typical engineering projects (by "typical engineering projects", we mean that most of the above working tasks are needed to complete in the projects) and design teaching modules based on the analysis of the working process required to complete the engineering projects. For example: we select the construction and maintenance of railway subgrade in mountainous area as a typical engineering project and design 7 teaching modules shown in Table 1. It is important to note that we integrate the requirements of foundation treatment construction process and quality acceptance method in Technical Guide for Subgrade Construction of Railway Line for Passenger Traffic and Acceptance Standards for Construction Quality of Subgrade Works of Railway Line for Passenger Traffic in the teaching modules. The teaching contents of this MOOC are designed and organized based on the subgrade working process in order to reach the goals of acquiring skills, knowledge and quality those projects require.

Table 1. MOOC Development Strategy for Railway Subgrade Construction and Maintenance Course

Analyze employment positions	Select certain typical engineering projects	Main tasks required to complete the projects	Teaching modules	Incorporated professional standards
Construction worker Quality inspector Railway line worker	Taking the following project as an example: the construction and maintenance of railway subgrade in mountainous area	Preliminary work of subgrade construction	Reading of an engineering geological investigation report	Technical Guide for Subgrade Construction of Railway Line for Passenger Traffic Acceptance Standards for Construction Quality of Subgrade Works of Railway Line for Passenger Traffic
			Preparation of a section of subgrade construction	
		Subgrade construction	Subgrade treatment of section of high-speed railway	
			Roadbed filling construction of a section of high-speed railway	
			Cutting construction of a section of high-speed railway	
		Subgrade management and maintenance	Subgrade disease treatment of a section of railway	
			Overhaul and maintenance of a section of railway subgrade	

Subgrade working process: geological investigation, construction preparation, foundation treatment, subgrade construction, disease treatment and subgrade maintenance.

The video resource development of this MOOC, based on the detailed teaching contents of each project, can be in the forms of field shooting or 3D animation or a combination of both by collaborating with enterprises. For difficult knowledge points and error-prone operation skill points, with the help of various media forms such as pictures, audios, videos, 3D animations, their abstract concepts and rules can be visualized and specified, and their operation processes can be visualized with vivid language expressions. When tools and operating objects are arranged and good examples in enterprises are set, much professional quality can be integrated into education. Efforts should be made to create real working situations so that students can not only improve their professional ability, but their basic professional qualities can be constantly internalized. The ultimate effect is that as long as students log in to their MOOCs, they can consolidate their learning contents, simulate their operation of training equipment, and conduct their self-assessment and knowledge expansion at any time and any place.

5. Conclusions

The construction of MOOC not only brings good opportunities but also challenges to higher vocational education. Higher vocational colleges must lay emphasis on the study of the connotation of MOOC combining the characteristics of higher vocational education. The courses with different teaching objectives require different MOOC construction modes, which can bring the role of MOOC to its fullest, thus make it an indispensable way to improve the education and teaching quality.

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