Online Education of Atomic Physics based on MOOC Platform

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Abstract. With the rapid development of the Internet, online education (e-Learning) has gradually become an important form of education. Traditional education has many shortcomings, and the e-Learning can overcome these shortcomings well. Massive Open Online Course (MOOC) is an online education model that anyone can use for free. China University MOOC is an e-Learning platform launched by NetEase and Higher Education Press in China. The MOOC has developed rapidly in China in recent years. The MOOC provides students with courses from well-known universities in China. There are many course resources on the MOOC platform, and students can choose the right course according to their own situation. In this paper, based on the teaching process of Atomic Physics course using the MOOC platform, we share some experiences for the teaching process, and we will explain how to use the MOOC platform to better improve the teaching.

Keywords: MOOC Platform, E-Learning, Atomic Physics

1. Introduction

1.1. Shortcomings of Traditional Education Methods
Different from traditional education methods, E-Learning is a method of knowledge and learning by using information technology and Internet technology [1, 2, 3, 4, 5]. At present, traditional education methods have many shortcomings: (1) Many teachers in traditional education methods just repeat the content on the slides, which is not as lively and interesting as teachers in e-learning. Moreover, new knowledge and new technology are not as good as e-learning. (2) There are not many courses in traditional education methods, and teachers need a longer time to complete the education of the course. Furthermore, the courses in traditional education methods cannot meet the learning requirements of students. (3) Traditional education methods need to study at a fixed time, and the flexibility of study is poor. In addition, students cannot arrange time freely, and traditional education methods are difficult to stimulate students' interest in learning.
1.2. Advantages of Education Methods Using the E-Learning

The e-learning is a teaching method based on the Internet [6]. Especially during the COVID-19 last year, e-learning played an important role [7, 8, 9, 10]. Students and teachers can carry out teaching activities by using the Internet even if they are far away from each other. In addition, with the help of online courseware, students can also learn in any time and space. The e-learning is the most convenient way of learning for employees with busy work and irregular study time. There are many forms of the e-learning. Some e-learning is for students at school, and some are for company employees. Some companies have replaced the traditional education methods with the e-learning. At present, about 60% of companies train their employees by using the e-learning.

The advantages of the e-learning are as follows: (1) The e-learning time is flexible and the e-learning method is more efficient compared to the traditional education method. Students can study online at any time according to their own time. (2) Students do not need to go to school and they can only study at home. Students only need a computer or a mobile phone to study on the Internet. (3) There are more options for the e-learning courses, and students can freely choose their own courses. Moreover, the e-learning method costs less, but more benefits.

2. The Main Features of MOOC Courses

2.1. The History of the MOOC

Massive Open Online Course (MOOC) is concepts developed after 2000 [11,12,13,14,15]. In 2007, David Wyley taught an early open online course at Utah State University. A postgraduate course open to people all over the world who are interested in learning. Before it became an open online course, this course had only 5 graduate students, but later became 50 students from 8 countries. The first MOOC platform appeared in 2011. Stanford University professor Sebastian Sloan put his artificial intelligence courses on the Internet, which attracted 160,000 students from more than 190 different countries. In 2012, top universities in the United States successively established online learning platforms to provide free courses online. Later, the three major course providers Coursera, Udacity, and edX provided more students with the possibility of systematic learning. In 2013, the National University of Singapore cooperated with the American company Coursera to establish a large open online course platform. In 2014, they announced courses on quantum physics through the Coursera's platform.

2.2. The Main Features of the MOOC

Because the MOOC often have a large number of learners, it requires instructional design that can promote a large number of responses and interactions. Teachers often use objective and automated online evaluation systems, such as quizzes, exams, etc. Colleges and universities create the course and designate teachers in charge of the course. Teachers can publish the courses on the MOOC platform in two ways: the first is the SPOC teaching mode. The SPOC teaching mode uses the finished course resources of other university to conduct teaching activities, which is an important teaching method. If another university has already opened a good course, and this course fits our own teaching plan, we can use this resource. Teachers can modify the original knowledge and add new knowledge according to their actual teaching situation. In the teaching process, the homework, answering questions, and standard setting are freely set according to the teaching plan of your department.

The second method is for teachers to create a new MOOC course. The production of a MOOC course includes course topic selection, knowledge design, course recording and editing, etc. Some well-known universities spend a lot of time and money to create a course, and then provide this course for everyone to learn for free. For some courses, students may need to pay some money. After the course is published, the teacher needs to participate in online guidance such as answering questions and correcting homework.
2.3. The MOOC in China

Since 2011, the international online courses of many famous universities have quickly landed in China by main websites. From 2012 to 2013, the number of open courses in NetEase has doubled to 12,000. There are approximately 4.6 million users a day, and there are approximately 1 million students access these courses by using computers and smartphones. In 2014, the largest Chinese MOOC platform was launched by the NetEase and Higher Education Press. The MOOC platform provides free courses from famous universities in China such as Peking University, Zhejiang University and Fudan University.

3. Introduction to Atomic Physics Course Knowledge

Generally speaking, the main content of atomic physics includes [16,17,18] (1) the difficulties of classical physics, for example, the typical difficulties are the black body radiation, photoelectric effect, atomic spectrum. These difficulties led to the discovery of quantum theory. (2) Thomson discovered the electron and provided a assumption of the atomic structure model. Rutherford’s α particle scattering experiment and the establishment of the atomic structure model. (3) Bohr proposed a quantum atom model, which has achieved great success in explaining the spectrum of hydrogen atoms. However, it has not been able to explain the spectrum of multi-electron atoms. (4) For the multi-electron atom problem, the theoretical explanation of the multi-electron atom spectrum requires the calculation of the coupling between electrons. (5) In the magnetic field, the energy and spectrum of the atom will change. We must explain why the energy and spectrum change in the magnetic field. (6) The distribution of electrons satisfies the Pauli Exclusion Principle, and the Pauli Exclusion Principle can explain the electronic distribution of elements well. Thus, atomic physics is not only the basic requirement of physics students, but it also plays an important role in chemistry, biology, materials science, etc.

4. Teaching of Atomic Physics on the MOOC Platform

We use the SPOC model to teach the Atomic Physics course. (1) Teachers use the China University MOOC platform website http://www.icourse163.org/ to apply for registration of their own account. The MOOC platform supports multiple registration methods. Teachers can register with mobile phone number, email and other registration methods. (2) After completing the registration, teachers can set their own profile and choose a different login method. (3) Entering the MOOC platform again, finding the position of the avatar, teachers can then enter the course management. (4) Selecting the SPOC course and semester, teachers edit and copy the course content, and publish the course content after confirmation. (5) Choosing the grading method, teachers confirm whether the grading standard meets their own teaching requirements, if not, they can change it. Teacher set the ratio of grades, save and publish it after confirming that it is correct. (6) Setting teaching content and chapter tests and homework. Teachers choose their own teaching content according to the curriculum plan and the actual situation of the students. Teachers can also choose to post the homework at the right time.

5. Conclusions

Online education has gradually become an important form of education. In this paper, we introduced the shortcomings of traditional education methods and the advantages of the E-Learning. The MOOC platform is an important online education in colleges and universities. We introduced the development history of the MOOC and the main features of the MOOC courses. We also analyzed the characteristics of atomic physics curriculum knowledge. We use the MOOC platform to teach atomic physics courses, and we have achieved very good teaching results. We introduced our experience and how to use the MOOC platform.

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References

[1] Henderson, CL: The browsable classroom: An introduction to e-learning for librarians. JOURNAL OF THE MEDICAL LIBRARY ASSOCIATION 90, 481-482 (2002).

[2] Stahr, B: The browsable classroom: An introduction to e-learning for librarians. LIBRARY JOURNAL 127, 223-223 (2002).

[3] Fay, NL: The browsable classroom: An introduction to E-learning for librarians. JOURNAL OF ACADEMIC LIBRARIANSHIP 28, 259-259 (2002).

[4] Blair, Jim: E-learning: a virtual challenge for educators. Nursing times 98, 34-5 (2002).

[5] Pantazis, C: Maximizing E-learning to train the 21st century workforce. PUBLIC PERSONNEL MANAGEMENT 31, 21-26 (2002).

[6] Hoyle, Robin: The benefits of e-learning. British journal of perioperative nursing: the journal of the National Association of Theatre Nurses 12, 298-9 (2002).

[7] McMahon, Colin J; Tretter, Justin T; Faulkner, Theresa; Krishna Kumar, R; Redington, Andrew N; Windram, Jonathan D: Are e-learning Webinars the future of medical education? An exploratory study of a disruptive innovation in the COVID-19 era. Cardiology in the young 1-10 (2020).

[8] Alqahtani, Naji; Innab, Adnan; Bahari, Ghareeb: Virtual Education During COVID-19: Exploring Factors Associated With E-Learning Satisfaction Among Saudi Nursing Students. Nurse educator (2020).

[9] Sukendoro, Sukendoro; Habibi, Akhmad; Khaeruddin, Khaeruddin; Indrayana, Boy; Syahrudin, Syahrudin; Makadada, Fredrik Alfrets; Hakim, Hikmad: Using an extended Technology Acceptance Model to understand students' use of e-learning during Covid-19: Indonesian sport science education context. Heliyon 6, e05410 (2020).

[10] Eltayeb Lienda Bashier, Alharthi Nahed Sail, Elmosaad Yousif Mohammed, Wagqiallah Hisham Ali: Students' perception on E. Learning and Remote Exams during COVID 19 Outbreak 2020. INTERNATIONAL JOURNAL OF PHARMACEUTICAL AND PHYTOPHARMACOLOGICAL RESEARCH 10, 142-148 (2020).

[11] Aguaded-Gomez, J. Ignacio: The MOOC Revolution: A new form of education from the technological paradigm? COMUNICAR 21, 7-8 (2013).

[12] Gyles, Carlton: Is there a MOOC in your future? CANADIAN VETERINARY JOURNAL-REVUE VETERINAIRE CANADIENNE 54, 721-722 (2013).

[13] Kellogg, Sarah: Online learning: how to make a MOOC. Nature 499, 369-71 (2013).

[14] Rice, Jeff: What I Learned in MOOC. COLLEGE COMPOSITION AND COMMUNICATION 64, 695-703 (2013).

[15] Mackness Jenny, Waite Marion, Roberts, George, Lovegrove, Elizabeth: Learning in a Small, Task-Oriented, Connectivist MOOC: Pedagogical Issues and Implications for Higher Education. INTERNATIONAL REVIEW OF RESEARCH IN OPEN AND DISTRIBUTED LEARNING 14, 140-159 (2013).

[16] Budker, D: Atomic physics - A new spin on magnetometry. NATURE 422, 574-575 (2003).

[17] Stohler T, Bucke H, Beyer HF, Bosch F, Brauning-Demian A, Hagemann S, Ionescu DC, Jungmann K, Kluge HJ, Kozhuharov C, Kuhl T, Liesen D, Mann R, Mokler PH, Quint W: Status and perspectives of atomic physics research at GSI: The new GSI accelerator project. 11th International Conference on the Physics of Highly Charged Ions (HCI 2002), CAEN, FRANCE, NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS 205, 156-161 (2003).

[18] Dyugaev, A. M.; Lebedeva, E. V: Rules of Correspondence in Atomic Physics. JETP LETTERS
103, 57-61 (2016).