Innovation and Practice of MOOC System Construction in Meteorological Industry

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Abstract. China Meteorological Administration-Massive Open Online Course, CMA-MOOC is an industry-oriented, international-oriented and public-oriented networked learning system of China Meteorological Distance Education Platform, which is hosted by the China Meteorological Administration Training Center of China Meteorological Administration. The CMATC provides technical support throughout the long-range international training on national observation equipment support along the "Belt and Road" and the demonstration training on nowcasting techniques for severe convective weather in ASEAN countries, successful completion of the first online cross-border training for meteorological distance education. The World Meteorological Organization, WMO Education and Training Office, appreciates this new initiative and shares within WMO innovative practices in international training for cadre colleges.

Keywords: MOOC System in Meteorological Industry, Network Learning, China Meteorological Distance Education Network, International Training

1. Background and Meaning
Massive Open Online Courses, MOOC, originated as an open course based on connectionism. It is not only the gathering of learning content and learners, but also a way to connect teachers and learners through common topics or discussions in a certain field. The year 2012 was what the New York Times called the first year of MOOCs and its "three platforms" (Udacity, Coursera, EDX) were formed. In October 2013, Tsinghua University launched the world's first Chinese-language version of its MOOC platform, Xuetang Online. Since then, Super Star MOOC, Wisdom Tree, Fruit Shell Net, C20 MOOC Alliance and other platforms have been established in China, which also means that MOOC has gradually matured in China. At present, many well-known universities, international organizations, multinational companies have begun to use MOOCs as a new training channel.

In recent years, the cadre college devotes itself to setting up the meteorological distance education training system and enriching the educational resources[1]. With the rapid development of the meteorological education cloud platform, the meteorological distance education is becoming more and more accessible[2]. In order to improve the training ability of meteorological distance education and resource sharing platform, a MOOC system for meteorological industry is developed based on the existing platform.

The MOOC system for meteorological industry is an online teaching platform for industry, public
and international of China Meteorological Distance Education Network. It is an open course teaching platform based on the "WMO Global Campus", which is based on the training of domestic meteorological personnel and takes into account the educational and training needs of domestic and international aviation, water conservancy, state farms, salt industry, forestry and other industries as well as universities to attract meteorological and related industries along with the public to participate in learning, curriculum development, sharing learning resources and learning results.

The MOOC system has the core functions of course management, teaching management, learning quality control management, course certification management, etc., which ensures the quality of the construction and teaching of Network Open Courses. By sublimating the traditional courseware learning to the level of course learning, the network of teaching class is realized. Relying on the advantages of the Cadre Academy's Training Resources, MOOC system shares the self-developed network courseware, broadens the coverage of meteorological training, and effectively plays the role of the Cadre Academy as the WMO Regional Training Center (Beijing), WMO RTC Beijing, China.

2. System design and implementation

2.1. Design philosophy

Based on the theory of constructivism, the system adopts the teaching mode of turning over the classroom, stresses the teacher's guiding role, and realizes the student-centered teaching organization. In the process of constructing meaning, students are required to collect and analyze relevant information, put forward various hypotheses and try to verify them. "Connection" and "Thinking" are the key to the construction of meaning. If the process of association and thinking can be combined with the process of consultation in collaborative learning, the efficiency and quality of students' meaning construction will be better. The system provides two traditional social learning tools: real-time chat room and discussion area. And customized the development of VIKI function that can achieve co-editing, modify the work of the function, which can also reflect the collaborative online learning features.

2.2. System architecture design

A large number of universities and social organizations are using open-source platforms such as CANVAS, Sakai and moodle. Meanwhile, expensive learning platforms such as Blackboard and Vipkid are widely used. Learning from the advantages of various learning platforms and combined with mature functional modules, we use "micro-service" architecture and make the following system architecture design.

(a) Business logic architecture

The system business logic architecture is composed of 4 layers, including system user access layer, content service layer, basic service layer and data layer.

System user access layer: resource entry and course entry are two parts. Support for both desktop and mobile devices.

Content Service Layer: based on the management of learning content, it provides the functions of making teacher's courseware, learning and testing, communication and interaction, analyzing and monitoring learning behavior, analyzing data visually, and paying interface.

Basic Service Layer: through the service supported by third party data access, data service, load balancing, components, platform monitoring, cache and API interface are composed.

Data Processing Layer: it provides data interface, data acquisition and data processing and other data-related functions. The third-party data includes training system, file management, examination system and mobile learning data layer processing is divided into six aspects such as client upload data, course resources, business data, access data, historical data and data acquisition.

(b) System functional architecture

The system functional architecture includes five layers. The top layer is media database, broadcast control and user center, the middle layer is big database background service whose background
interface service is RedisDB and Memcache. Moreover, the bottom layer is CND cluster and DB cluster. They're all connected and attached to each other.

(c) Interface function design

The system realizes the Chinese and English language support function based on the browser automatic matching, and reserve the interface of the third language. The sharing and interaction of data and resources between the system and the third-party system are the realization of user information registration, user login and their sub-functions[8]. The design is characterized by non-resident memory without other requirements, which achieves concurrent processing. Three main interfaces are provided: unified authentication interface, resource interface and file interface.

2.3. basic functional design of the system

The design of the system fully integrates advanced technologies such as virtual reality and big data, from classroom teaching management, course resource management, learning quality monitoring, course evaluation, social learning platform, data monitoring, data collection, Hadoop big data analysis, data visualization to other functional modules. Through the open interface to China Meteorological Distance Education Network System, the existing information system can be used to achieve data exchange and sharing.

At present, the MOOC system in the meteorological industry has the initial ability to carry out MOOC teaching, with the following three main features:

(a) A well-developed curriculum structure and its functions. The system is based on the constructivist teaching model, emphasizing the initiative of learners and integrating the process of learning and understanding into the teaching interaction. The curriculum structure supports themes, weeks, communities, activities, etc. According to the needs, the course can flexibly add many modular links, such as tutorial, handout, tutorial, self-discussion, supervising and promoting learning, correcting homework, glossary, learning activities, etc., which is convenient for the research, design and optimization of teaching courses.

(b) Flexible support for multiple courseware resource formats. The system cuts the traditional long course resources into independent study units according to the knowledge point and each unit can flexibly add, edit, delete audio and video, virtual reality, picture, document, hypertext and other formats of teaching materials. Among them, the virtual simulation courseware provides better interaction, experience and fun, showing a good course design and production. In addition, the system can also adapt courseware resources to mobile terminals.

(c) Users are classified and scalable. The system is not only open to register, but also realizes the integration with the existing system users through the single sign-on module. By default, you can have user roles and permissions for administrators, teachers, students, visitors, and so on. You can also define special user permissions as needed. The system also provides a convenient and easy-to-use grouping tool to coordinate with the teaching function module setting and teaching activities.

2.4. Functional design for system innovation

(a) Visualization of teaching "big data" analysis. The system integrates learning behavior data monitoring, big data processing, and data visualization functions, according to the system overview data analysis, curriculum group data analysis, curriculum individual detailed analysis, student group data analysis and individual detailed analysis of five levels show. The system can automatically record every student in the whole learning process, such as: browsing content, browsing time of each knowledge point, passing the test, and so on. The annual statistics on the number of new courses offered, the number of participants in training and the number of certificates obtained can reflect the benefits of the system; the total number of students, courses and teachers as well as the growth can reflect the development of the scale of the system; Traffic time distribution, user language distribution and device type are the portraits of user groups while the number of people online reflects the current operation of the system, including the number of people, language, student list, and etc.. Through the collection and analysis of these data, we can better optimize the allocation of teaching resources and
improve the accuracy of teaching services.

(b) Mobile synchronization learning. Free from the constraints of time and space, students can use mobile devices to access various learning resources and take the initiative to learn at their own pace without being confined to a fixed place such as a classroom or a computer screen, which makes mobile learning highly flexible. The mobile terminal of the MOOC system in the meteorological industry is compatible with both Android and iOS systems. It is convenient for the students to use the fragment time to study, and it effectively promotes the students' independent study anytime and anywhere, and the teachers give guidance and feedback anytime and anywhere.

(c) Online learning for virtual reality training courses. The system is mainly designed to provide the introduction interface for virtual simulation training courses developed by Unity3D, WebGl and other 3D engines. According to the prescribed template to make courseware package, the system can automatically configure the course teaching, training, examination and other modules. Students can get the same real experience as in the actual business operation and help them practice fully in the simulated intelligent learning environment, thus enriching their perceptual knowledge and deepening their understanding of the teaching contents [9-10]. It can effectively improve work efficiency and business ability. Through the three-dimensional simulation of the operation process of various kinds of precision, complex and high-risk instruments and equipment, the restriction of traditional teaching is solved because of the problems of experimental equipment, experimental site and teaching funds. The space and time of teaching activities have been infinitely expanded.

3. Application of "Belt and Road" international training

From May to July, 2018, the system was used for the first time in the Distance Learning Course on the Maintenance of Meteorological Observation Instruments for the long-distance International Training Course on national observation equipment support along the Belt and Road, providing technical support for online teaching and Learning. Based on the course design and teaching module of MOOC system, this training has 5 topics: course guidance, online autonomous learning, online synchronous teaching, summary communication, and technical support. The goal of the training was achieved through the functions of demand survey, message notification, forum communication, counseling and answering questions, self-test for students, learning tracking statistics and teaching evaluation, which is recognized by the WMO office of Education and Training and international participants. Training thematic webpage and training activities is shown as figure 1.

![Training thematic webpage and training activities](image)

Figure 1. Training thematic webpage and training activities

274 participants from 55 countries and territories who participated in the training completed the login through the system, which provided strict authentication and access rights for the logged-in users. 116 participants completed all the training courses provided by the MOOC system online using the grouping tool and the teaching function module provided by the system.
4. Application of model training in ASEAN countries

From August to September 2018, MOOC once again provided technical support for the International Course on Nowcasting Techniques on Severe Convection Weather for ASEAN Countries. The online training is a pre training session for face-to-face learners; There are 25 learners from four countries -- Indonesia, Malaysia, the Philippines and Thailand - who are enrolled in MOOCs. Through the MOOC system, participants participate in pre-training in the form of self-learning courseware and forum topic exchange. The contents of the courseware include introduction of strong convection weather, basic principle of doppler weather radar, introduction of wind and cloud series weather satellite and products, numerical forecast and its products etc. (see Figure 2).

![Training website and teaching resources](image)

**Figure 2.** Training website and teaching resources

The pre-training courseware provided by the MOOC complements the necessary knowledge for participants to attend face-to-face training, enhances the exchange and interaction between the trainers and the participants, and shortens the training period, as well as the adaptation period of the students' integration into the later face-to-face training course, which has been unanimously approved by the teachers and students.

The curriculum structure of this training period adopts the theme mode, which integrates the process of learning and understanding into the teaching interaction and flexibly adds various modular links such as tutorial, handout, tutorial, self-discussion, supervision and promotion of learning, etc., In this training, MOOCs offer the flexibility to support a variety of courseware resources, cutting course content into individual learning units based on knowledge points and to add editing units, virtual reality, documents, hypertext and other formats of teaching materials. In addition, MOOCs offer courseware adaptive mobile terminals to facilitate students' fragmented learning.

5. Conclusion and Outlook

The innovation and practice of the MOOC system in the meteorological industry have promoted the opening and sharing of China's meteorological education and training resources outside the meteorological departments, which enables students to always learn the best quality courses and provides innovation in the mode of industry training. International students directly participate in the international training organized by the cadre college through the MOOC system, so the joint of meteorological education and training in China and WMO education and training has been realized. Looking ahead, the MOOC system in the meteorological industry will be guided by advanced teaching design concepts and methods and by training needs, and constantly improve its functions to achieve the meteorological education and training network, industry, international development and make new and greater contributions.
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