

Design and Construction of MT SPOC Intelligent Teaching Service Platform

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Abstract

With the development of MOOCs and intelligent teaching technology, the integration of them is a research trend to optimize teaching and improve learning effects. Aiming at the problems existing in OER and MS SPOC platform, this paper analyzes the requirements of interdisciplinary research and teaching optimization, and puts forward the design of physical architecture, software structure and technical scheme of MT SPOC intelligent teaching service platform. MT SPOC platform introduces EDM and LA technologies into its construction by learning data collecting, sharing and analysis to obtain a comprehensive profile of students, and provide intelligent teaching support for teachers to optimize their teaching resource designing and strategies making. Finally, with the help of MT SPOC platform, the appropriate long term development goals for education will be made.

Keywords

MT SPOC, intelligent teaching service platform, Education Data Mining, Learning Analytics

1. Introduction

Since The MIT Open Course Ware (OCW) project demonstrating the power of high-quality Open Educational Resources (OER) successfully, Massive Open Online Courses (MOOCs) were proposed to build a learning network by connecting, collaborative learning and knowledge spreading through online courses which can meet the concept of Connectivism[2]. After then, Armand Fox from UC Berkeley, proposed a Small Private Online Course (SPOC) which was used as not just a supplement but also a replacement in classroom teaching to meet the requirements of higher education.[7] It was called "MOOC for School" (MS SPOC). However, in the practice of MS SPOC platform, some defects are emerging and considered not the best structure for higher education, such as barriers in data collecting and sharing, barriers in interdisciplinary research and lack of feedback channels for teaching needs.

This paper believes that "MOOC for Teaching" (MT SPOC) platform, constructed and operated by universities with intelligent teaching technology, can avoid those shortcomings and meet the requirements of higher education[4]. This paper consists of three parts. Firstly, the author demonstrates the development of teaching service under the background of information technology, and makes an analysis on the key elements in intelligent teaching service system; Secondly, this paper makes a description about the structure of MS SPOC teaching service platform as well as their shortcomings. Finally, this paper puts forward the design of physical architecture, software structure and technical scheme of MT SPOC intelligent teaching service platform.

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2. Intelligent Teaching Service System

Intelligent teaching service system is defined to collect and analyze learning data with the help of intelligent teaching technology, and finally realizes the optimization of teaching effect and efficiency.

2.1. Intelligent teaching service technology

At present, the hot topic of teaching research turns to explore effective teaching mode blending with intelligent teaching technology based on MOOC/SPOC [3][4]. Intelligent teaching technology refers to the application of Artificial Intelligence (AI) and Big Data technology in the field of education, such as Educational Data Mining and Learning Analytics.

2.1.1. Education data mining (EDM)

EDM is determined to analyze the learner's behavioral tendency and identify the problems in learning, by the data generated in online or offline teaching activities, with data processing technologies such as prediction, clustering, association mining, decision support and model discovery [5][6].

2.1.2. Learning analytics (LA)

LA is an emerging application based on a variety of data mining and analysis technologies. In February 2011, The International Conference on Learning Analytics and Knowledge (LAKI), defined learning analysis as "The measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" [5].

2.2. Key elements of intelligent teaching service system

In order to play a positive role, intelligent teaching service system carry out its functions by integrating all elements of teaching, which includes teaching team, system developers, comprehensive display platform, data collecting and analyzing platforms.

2.2.1. Intelligent teaching platform

Intelligent teaching platform generally refer to a rendezvous point where learners find the learning resources what they need or the people whose they want to consult. This platform should be able to record every single trail of users' activities.

2.2.2. Data collecting and analyzing platform

This platform will collect learning data collected from intelligent teaching platform through VPN or telecommunication public network. Intelligent teaching technology integrated in the platform, such as EDM or LA, will be used to analyze those learning data and give a comprehensive profile of users.

2.2.3. Comprehensive display platform

A profile of learner, a behavior description of groups or a development tendency out of higher education should be directly shown to those would like to study on it in all kinds of demonstrate ways, such as comprehensive text descriptions, dynamic diagrams or statistics report.

2.2.4. Corporation between system developers and educators

Intelligent teaching technology relies on the convergence, connection and collaboration of multiple disciplines such as pedagogy, sociology, computer science, psychology and statistics to carry out research and solve the problem in teaching. This determines that the whole related system should run by the corporation between system developers and educators. The architecture of the system is shown in Figure 1.

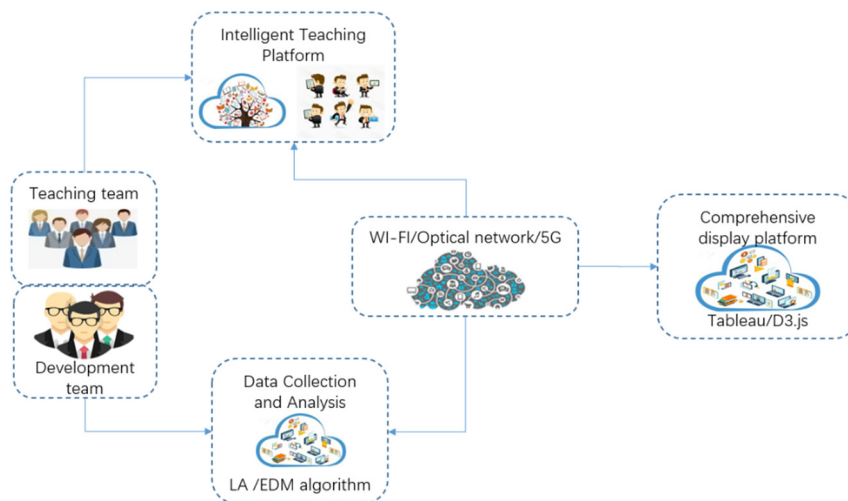


Figure 1: Intelligent Teaching Service System

3. MS SPOC teaching service system

MS SPOC Teaching service system contains the framework and the procedures supporting all teaching activities, in which the framework highlights teaching-related entities such as equipment, tools and network devices, while the procedure highlights standards, process and data flows.

3.1. MS SPOC teaching service structure

MOOCs, since their origin in OER, have constantly changed their teaching service structures along with their motivation.

3.1.1. The structure of OER teaching service platform

Since MIT launched OCW program in 2001, a total number of 2,000 free high-quality courses has been provided for students and teachers around the world by 2010 [8]. OER's structure is quite simple and those functions focus on how to download more easily. Massive storage devices, high bandwidth download network, document retrieval system, User Interface (UI) and management interface. The structure of the OER service platform is shown in Figure 2.

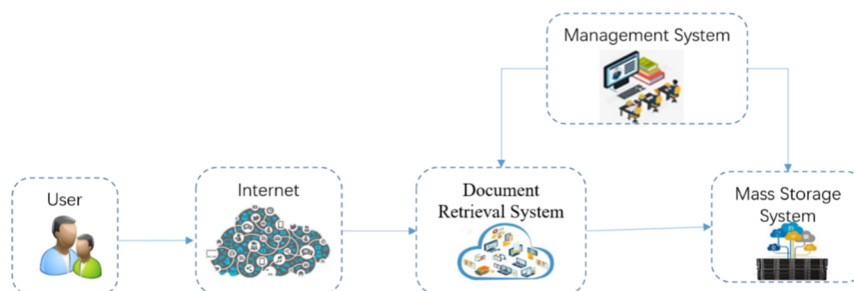


Figure 2: The Structure of OER Teaching Service Platform

3.1.2. The structure of MOOC's teaching service platform

MS MOOC platform make steady profits by licensing MOOCs to the public or universities, so the platform relies on their accurate accounting system and well-designing teaching resources. The whole platform mainly contains those components, such as teaching resources repository system, teaching resource OTT module, accounting module, behavioral statistics module, management module and UI. The structure of MOOC's teaching service platform is shown in Figure 3.

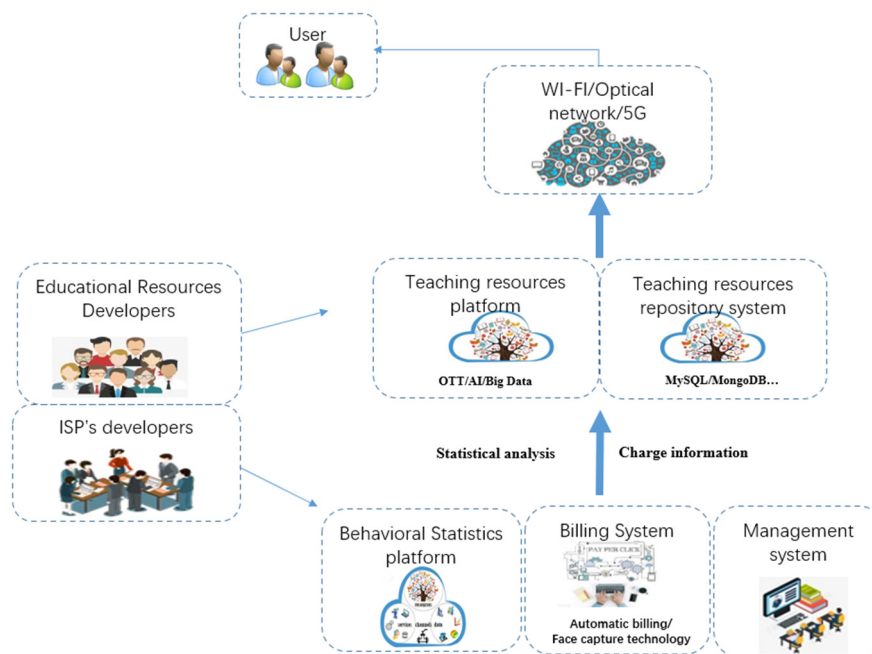


Figure 3: The Structure of MS SPOC's Teaching Service Platform

3.2. Shortcomings of MS SPOC teaching service platform

By analyzing those shortcomings in MS SPOC, it will be helpful to build MT SPOC intelligent teaching service platform in which internal and external teaching elements are fully connected to serve us well.

3.2.1. Barriers in data collecting and sharing

Learning data, including online and offline, build the basis for the research and application of intelligent teaching technology, and so it has the characteristics of multi-source and distribution. The public MOOC platforms collect students' online learning data within its cyberspace, and usually, they have no obligation or willing to share their own data asset with third party educational researchers. It will come to a result that learning data scatter around and learning behavioral research can't be fulfilled.

3.2.2. Barriers in interdisciplinary research

Intelligent teaching service requires interdisciplinary research, such as data mining and machine learning combined with pedagogy, sociology, psychology, and statistics. At the present stage, computer technology practitioners are the main force engaged in the research and development of MS SPOC, and studying educational issues is not their priorities. Therefore, they do not have the will to carry out the exploration of educational issues.

3.2.3. Lack of feedback channels for teaching needs

A teaching process forms by three steps of teaching service in MS SPOC: micro-class video pushing, checking online homework and Q&A in learning forum. The whole process above can be automatically generated and managed by "machines", and learners' demands for improving effects of teaching are ignored, or even left behind. As a result, Internet Service Providers (ISP), the non-professional educational institutions, play a one-man show in teaching services.

4. Structure of intelligent teaching service platform based on MT-SPOC

With the Study of MOOC/SPOC platform, this paper believes that the MOOC platform should be MT SPOC model and will be more efficient than the previous one.

4.1. Advantages of MT SPOC teaching service platform

The purposes of establishing MT SPOC platform is to play full advantages of MS SPOC, while avoids its shortcomings. Therefore, MT SPOC should lay emphasis on delicate design of inter-module collaboration and establish an intelligent environment to carry out empirical exploration for teaching optimization [1].

4.1.1. Collecting learning data

The ownership of MT SPOC belongs to the school, so as the learning data collected from it. Communication mechanisms should be established by inter-school's consultation to complete data collecting, centralized storage and sharing. The larger the amount of data, the more comprehensive results will come out of teaching objects by EDM or LA technology, and the adjustment of teaching strategies will be more accurate.

4.1.2. Interdisciplinary research based on intelligent teaching technology

Intelligent teaching technology needs convergence, intersection, connection and collaboration of various related-disciplines to identify and solve problems in teaching practice. MT SPOC platform, running by colleges and universities, open channels to share learning data and support more interdisciplinary research in teaching projects. More interdisciplinary research, more learning data will generate during research and application to support further research as a return.

4.1.3. Learning assessment

Learning assessments is an indispensable part of teaching quality supervision and feedback. With the help of EDM/LA technology, MT SPOC platform can provide dynamic learning assessment function to gain a comprehensive evaluation of learners' personality, characteristics and cooperation abilities. Teachers take those assessment results as the guidelines of adjustment for teaching strategy, and serve the purpose of imparting knowledge and cultivating intelligence well.

4.2. The Architecture of MT SPOC teaching service platform

In order to achieving those advantages mentioned above, MT SPOC platform should be designed under the concept of intelligent teaching service and based on the framework of MS SPOC platform. New technologies and components introduced into this architecture to solve the problems existing in MS SPOC platform. This paper puts forward suggestions on the structure for MT SPOC teaching service platform which includes "Teaching resources and design platform", "Date collecting platform",

“Data Center”, “LA algorithm platform”, “Teaching decision support platform” and so on. The architecture of the MT SPOC teaching service platform is shown in Figure 4.

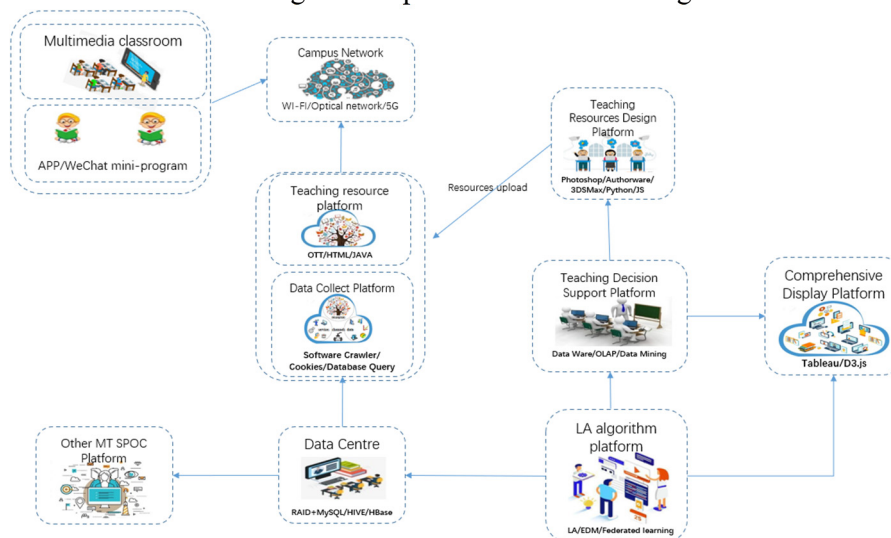


Figure 4: The Architecture of MT SPOC Teaching Service Platform

4.2.1. Teaching resources and design platform

This platform will be divided into two parts: Teaching resources module and Resources design module. The first part will allow students access the delicate teaching resources by campus optical network in Multimedia classroom, or by campus WI-FI network in WeChat mini programs. The second part will allow teaching personnel to upload teaching resources according to the Analysis reports or suggestions from Teaching Decision Support system.

4.2.2. Date collecting platform

When students browse micro-video course, complete the assigned homework and question or consult with learning activity module of the platform, their learning data and behavior trails will be collected by Data Collecting platform by means of Software crawler, webpage cookies and database query. This platform also connects Educational administration system to collect the final result for further data collaboration analyzing. No matter of online or offline learning data, Data collecting platform should support various interfaces for data active collecting, automatic data upload and bulk import.

4.2.3. Date center

Learning data will be stored in Data Center after deduplication, structure regulation and transition. Considering the various structure of data, Data Center will deploy various Database for structured data and semi-structured data in Mass Storage Device. Data Center also support high-traffic query interaction capability and high bandwidth ports for other MT SPOC platform’s data exchange.

4.2.4. LA algorithm platform

This system is the key core of MT SPOC structure. It selects required learning data from data center and feeds into LA algorithm software. After measurement, analysis and reporting of data about learners and their contexts, those results will sent to teaching decision support platform for purposes of optimizing teaching strategy and environments in which data comes from. This platform should contain other important function in which learning data should be desensitized and shared through Federated learning technology for Data Center when other MT SPOC platform makes a data sharing request.

4.2.5. Teaching decision support platform

The implementation of teaching decision support platform is quite complicated. Because it relies on the convergence, intersection, connection and collaboration of multiple disciplines such as pedagogy, sociology, computer science, psychology and statistics to carry out research and provide comprehensive profiles of students. It will not only provide automatic statistics summary function, automatic report generation function and intelligent decision-making suggestion function, but also a flexible man-machine interface should be provided to facilitate educational experts to manually correct the analysis results and suggestion output.

4.2.6. Comprehensive display platform

The platform will provide the authority level with a display of comprehensive educational achievements of university, so that the long term development goals and top-level design will be made accurately by fully understanding of the overall teaching and learning situation of the school. At the same time, it also serves as a platform for external experience sharing and communication.

4.3. The software structure of MT SPOC teaching service platform

MT SPOC teaching service platform will be run by the authority of university, so the low cost and simplicity of system structure will be the most considered elements. At the time of fulfilling the requirement of teaching, it should be easy to deploy and the concept of microservice will be introduced into the implementation of platform. Microservice is to split an application into a set of small services which run in the way of independent process. Those microservices use lightweight communication mechanisms and achieve coordination among them to easy deploying in the level of functions. Also considering the cost, MT SPOC should make advantages of distributed storage system to deploy great amounts of learning data collected. The general software architecture of MT SPOC teaching service platform should be divided into five layers which includes foundation layer, storage layer, data process layer, management layer and application layer. Each layer will follow the security authentication mechanism and make sure that all information exchange is conducted under a secure and trusted network. The general software architecture is shown in Figure 5.

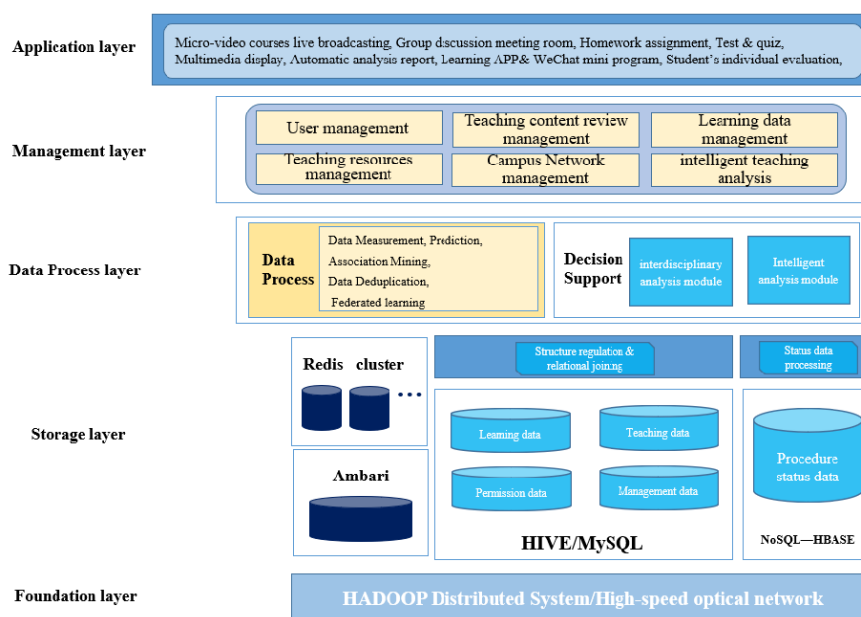


Figure 5: The Software Structure of MT SPOC Teaching Service Platform

4.3.1. Foundation layer

Considering the requirement of lower cost, mature open-source distributed operation system should be the first choice such as Apache HADOOP distributed system. HADOOP Distributed File System (HDFS) allow learning data will be stored in a high reliability and availability environment with low storage cost and maintain expansion. The Cloud and virtualization technology will be considered for flexible deployment of fundamental Operation System such as WINDOWS or Linux. At the same time, high-speed bandwidth network will be constructed on campus network, by using optical fiber to expand the visiting bandwidth of Data Center. The balance between cost and reliability should be the priority to consider.

4.3.2. Storage layer

All the data should be stored after structure regulating and relational joining so as to make sure that data would be organized and relevant for further processing. Considering various structures of data, relational database, such as HIVE/MySQL, and non-relational database, such as HBase/MongoDB, will be adopted depending on what kinds of data collected. Storage layer will be the busiest layer in this architecture for a lot of query operations, so Redis database will be used to improve the query speed for its high performance in large data interaction and scalable data structure. Ambari management tool is used to make sure Storage layer and foundation layer function well, and provide a convenient system operation and maintenance tool for the maintenance team.

4.3.3. Data process layer

This layer is the core of MT SPOC teaching service platform, in which all the EDM/LA technology such as data Measurement, prediction and association mining will be used to find out the individual or general learning effects behind the learning data. Federated learning technology also will be used to share the data or modes coming from different MT SPOC platform and at the same time protect study objects' privacy. Decision support function is another important part of this layer, in which interdisciplinary analysis module give a full profile of study object after the data processing by EDM/LA technology and intelligent analysis module will automatically provide the analysis report for teaching team's further discussion. Those reports will give a total evaluation of study objects and cover their learning behavioral rules, courses' reference tendency, learning assessment results and so on. This layer is a demonstration of collaboration with pedagogy, sociology, psychology, AI and big data technology.

4.3.4. Management layer

The management layer provides comprehensive management functions for all users to access the MT SPOC teaching service platform. Students will visit all delicate teaching resources after identity authentication while teachers upload their wisdom efforts after teaching content's review, examination and censorship. This layer also provides visual interfaces for maintenance teams to check visiting traffic of campus network and integrity of data collection. Overview of educational outcomes will be shown in intelligent teaching analysis function so that the university's management level will receive a comprehensive analysis summary and help them to formulate appropriate long-term development strategies.

4.3.5. Application layer

Students in multimedia classrooms browse live broadcasting micro-video courses by an OTT platform through fiber optic, and participate in group discussions through WeChat mini program by their cell phone through campus WI-FI network or 4G/5G wireless communication network. They also

can finish their homework assigned, test & quiz through webpages in their lap-top accessing MT SPOC teaching service platform. While, teaching personnel can retrieve student's learning effect information and receive all analysis reports automatically from the system.

5. Conclusion

This paper demonstrates the development of the intelligent teaching system under the background of information technology. By identifying problems found in MS SPOC's operation, this paper proposes the architecture of MT SPOC teaching service platform well-designed to solve them. This platform should enable universities to break the barriers in learning data collection and provide a perfect learning analysis. Also taking advantages of universities' inherent conditions of interdisciplinary research, the platform can give a comprehensive and detail display of study objects and support teachers to optimize their teaching strategies, while students finish their curriculum. In the future, MT SPOC intelligent teaching service system should be paid by more attention and research, especially in friendly UI, connectivity between functions and appropriate learning data analysis models, so as to guarantee more simple operation, comprehensive student analysis profiles and high-quality teaching services.

6. Acknowledgement

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