Construction and Application of MOOC Resources Database for Software Engineering Major Based on Integrable Ware

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Abstract. In recent years, the construction of MOOC (Massive Open Online Course) resources database has been paid more attention on MOOC research field. Based on the idea of integrable ware, MOOC elements are designed to form the corresponding MOOC learning knowledge points for some courses of software engineering major in a local university. They have the characteristics of openness, flexible and reusable. MOOC elements are fully applied in construction of the MOOC resources database on local campus for personalized learning effectively. The results show that teachers can select several different MOOC elements to form an important knowledge point for MOOC teaching process according to an actual course and reuse some existed MOOC elements to form another MOOC knowledge point for other courses. Different MOOC elements can be combined freely to form the related learning knowledge points for one course of software engineering major to stimulate and improve students' interests in personalized learning. Finally, further work is put forward. Firstly, compatible supported conditions on software and hardware are to be created based on big data. Secondly, capacities on integrating and reusing of various types of MOOC resources by teachers should be improved. Thirdly, more reusable MOOC elements based on integrable ware for the courses of other majors should be designed and constructed for personalized learning.

1. Introduction

Accelerating the process of education informatization, focusing on the development and application of high-quality education resources, constructing a modern network teaching resource system and introducing more high-quality teaching resources are effective ways to improve the quality of teaching level in universities and reduce the cost of higher education [1]. The improvement of construction of higher education teaching resources database have a direct impact on the formation and development of quality, healthy and comprehensive development of students after they participate in the work in the future.

MOOC (Massive Open Online Course) has been widely focused on in recent years. Unprecedented development and researches on MOOC in distance education field, and MOOC has played an active role in education fairness, teaching and learning at any time and any place, online interaction, and online evaluation [2]. Learning resources on MOOC are mostly designed according to the structure of the chapter (module)-section (unit), each section is connected with a complete knowledge point, and the whole of the MOOC resource is mostly concerned from the technical and application. MOOC is for the massive learning groups in society, which the contents of MOOC are complete and full opening, and it is difficult for MOOC resources to match the curriculum goals and the accumulation of existing knowledge of most social learners [3, 4]. Although construction activities on MOOCs are carried out in
many local universities in China, researches on designing and innovation of MOOC resources are
ignored. "Internet+" has provides much wider space for the construction of teaching resources on MOOC,
but basic theoretical research such as knowledge attributes of MOOC resources is not enough yet [5, 6].

In this paper, MOOC resources are designed that based on integrable ware for some courses of
software engineering, software testing, software architecture, object-oriented programming, and UML,
and are fully implemented for MOOC construction of the software engineering major in a local
university. The structure of the paper is organized as follows: Section 2 presents the relevant concepts
and technologies of integrable ware and resources database. Section 3 and section 4 describ the
construction and application of the MOOC resources database for the software engineering major.
Section 5 concludes the paper and puts forward the further work.

2. Relevant Concepts and Technologies

2.1. Integrable ware
Integrable ware is also called micro-courseware, and the major principle is to use the unified coding
standard to decompose the knowledge into tiny units [7]. These tiny units can be freely reorganized to
form a knowledge section (unit) according to the actual learning needs for learners, and they are not
limited to the contents of a particular course. Integrable ware has the characteristics of openness,
universality and flexibility. The idea of integrable ware emphasizes that students are the main body of
cognition, and the construction of the learning knowledge is completed by learners themselves finally.
When the idea of integrable ware is applied to the development of MOOC resources, the MOOC
resources can be minimized and integrable, thus fulfilling the requirements of MOOC's universality,
oneepness and flexibility, and new design ideas for MOOC resource development can be provided [6].

2.2. Technology of DHTML dynamic web
DHTML supports the development of dynamic Web systems for resources database in the form of
HTML and WWW access. It also supports Java, Script, CSS, DOM and other technologies for
cooperating with each other, and it has the advantages of dynamic style, dynamic content and dynamic
positioning [8]. DHTML can interact with the system for repository access through hardware devices
such as keyboard and mouse, and it can be responded accordingly. It can make the interface operation
by its own way or respond to the user's operation, and realize the movement of information such as text
and pictures on the page.

2.3. Technology of XML database
XML database is a data persistence software system that allows data to be specified, and sometimes
stored, in XML format [9]. This data can be queried, transformed, exported and returned to a calling
system [9]. Data processing requirements can be implemented by XML database directly, and it also
has a function of UI interface friendly. It provides a great convenience in designing, invocation,
modification, and combination of integrable ware of MOOC resource.

2.4. Technology of message push
Message push technology is a technology for the field of web application development, which means
that the server sends the information for the users' interests and purpose to the end users on time in an
active manner according to the needs of the user. It searches and filters information based on users’
interests and pushes them to users on regular time to help users to discovering valuable information
efficiently [10].

The message push function on the platform of PC or smart phone can be well implemented by some
network protocols of MQTT, RSMB, and XMPP and so on. Of course, there are also some third-party
push platforms in domestic that can provide the message push service by means of payment.
3. Construction of MOOC Resources Database

3.1. Design of integrable ware for MOOC resources

A knowledge point of MOOCs for learning is needed to be divided into several MOOC integrable wares. Integrable ware is the smallest unit on MOOC resources, which is also known as the MOOC element that cannot be decomposed [6]. Users can freely combine these MOOC elements to form the corresponding resources for one MOOC or several MOOCs according to the requirement for local learning. All MOOC elements will be coded uniformly and stored in the database of the MOOC platform by a certain file format to form a MOOC resources database.

Different from the idea on construction of traditional MOOC resources, flexible and reusable are the most characteristics on MOOC integrable ware.

For the MOOC integrable ware, each MOOC element should be followed the designing criteria for MOOC resources. The description of a MOOC element is allowed in the form of text, image, animation, video, and so on. Teachers can choose the most appropriate description form to design each MOOC element according to the actual teaching situation, but the picture and its accompanying essay for the description should be both excellent.

As a case of an important MOOC element of "Class Diagram" for software engineering major, the framework of the information on a MOOC element for designing is shown as Table 1.

Here, MOOC elements cover most of the important knowledge points on the courses of software engineering, software testing, software architecture, object-oriented programming, and UML for software engineering major. The list of the MOOC elements is shown as Table 2. Some new MOOC elements could be added during the learning process, and the list of the MOOC elements is often updated.

Table 1. Framework of the information on a MOOC element.

| No. | Name                | Text Description                                      | Image Description       | Animation Description | Video Description          | Others                        |
|-----|---------------------|-------------------------------------------------------|-------------------------|-----------------------|----------------------------|-------------------------------|
| 19  | Class Diagram       | *Describe the definition and characteristics of a class diagram (.PPT) | *Describe the relationships between classes (.JPG/.PNG) | *Describe the formation process of a class diagram (.SWF/.FLV) | *Describe the applications of class diagram (.MPG4<=5mins) |                               |

Table 2. The list of MOOC elements.

| No. | Name                | Knowledge Point | Comments                        |
|-----|---------------------|-----------------|---------------------------------|
| 19  | Class Diagram       | UML Diagram     |                                 |
| 20  | Sequence Diagram    | UML Diagram     |                                 |
| 250 | Code Review         | White Testing   | Unit Testing by Coders          |
| 489 | Boundary Value Analysis | Black Box Testing |                                    |
3.2. Development of subsystem for combination of MOOC integrable ware
The main function of the subsystem is to provide teachers with the ability to combine MOOC elements freely. For one hand, teachers can select the corresponding MOOC integrable wares to form a MOOC learning knowledge point according to the actual teaching of a course. On the other hand, learners can also combine the MOOC integrable wares freely according to the learning interests to complete the personalized MOOC learning.

The subsystem for combination of MOOC integrable ware is developed by JSP, which is based on MyEclipse 2015. SQL-Server 2010 is the database management tool. The interface on this subsystem is beautiful and easier to operate. Each MOOC element is stored in the database of the subsystem in the form of a standard encoded file, to convenient for users to export and retrieve by keywords. As the registered and authorized learners on local campus, the elements which are extracted by users can be displayed in the resource list, and they are free to be selected and combined for different learners. Then, a complete MOOC knowledge point is generated for displaying finally. Due to limits on length of the paper, here, only the functions of the subsystem are briefly described, but the development process is omitted.

3.3. Construction of MOOC resources database
The construction of MOOC resource database needs to be closely integrated with the daily teaching content to achieve integrated management [11]. On one hand, it is necessary to complete the functions of updating, accessing, and publishing of teaching resources in a unified system. On the other hand, openness, shareable, and usability are the guiding principle on construction of MOOC resource database.

The author's experimental university relies on a lightweight MOOC platform (abbreviated as E-MOOC platform) in domestic to construct of MOOC resources database for some courses of software engineering major, and organizes students on senior grades from the college of computer engineering on local campus to carry out learning activities on these MOOC courses actively, such as software engineering, software testing, software architecture, object oriented programming, and UML.

Technology of DHTML dynamic web, XML database, and message push are fully applied in E-MOOC platform, and enable to provide functions of MOOC course management, exam management, interactive topic management, score management, MOOC learning and management, participation in interaction, message push, and so on. As a new and important part, the subsystem for combination of MOOC integrable ware is integrated into the E-MOOC platform. The new function of MOOC integrable ware database is added to improve the function of MOOC course management. It provides great convenience on the generation, reorganization and reuse of MOOC resources on local campus.

4. Application of MOOC Resources Database
The application of MOOC resources construction based on integrable ware for actual teaching is also the driving force for the development of MOOC resources database on local universities. Development and construction of combinable and reusable MOOC resources, teaching method on network in the period of "Internet+" can be innovated, and a MOOC resources database is formed initially which is corresponding to the software engineering subject knowledge system.

Such as Table 1, more than five hundred MOOC elements has been designed that based on integrable ware are imported to the subsystem of E-MOOC platform for the last two years, and nearly two hundred learning knowledge points on about six to eight courses for software engineering major are covered. Different MOOC elements can be combined freely to form the related learning knowledge points for one course, and they are shown as Table 3 as a case. Teachers can select several different MOOC elements to form an important knowledge point for MOOC teaching process according to an actual course, and reuse some existed MOOC elements to form another MOOC knowledge point for other courses.

More than 80 percent of MOOC elements are provided with clear animation demos or videos for learners. More than four hundred students of computer and software major on local campus completed
learning process on MOOC by combining the MOOC elements freely and purposeful according to own interests in personalized learning.

Table 3. Learning knowledge points for MOOC elements combination.

| No. | MOOC Element     | Order of Comb. | Knowledge Point          | Course                      |
|-----|------------------|----------------|--------------------------|-----------------------------|
|     |                  |                | Static View of UML       | Software Engineering        |
| 19  | Class Diagram    | ①             |                          |                             |
| 22  | Object Diagram   | ②             |                          |                             |
|     |                  |                |                          |                             |
| 287 | Integration      | ③             | Integration Testing Process | Software Testing           |
| 288 | Stub Module      | ①             |                          |                             |
| 280 | Driven Module    | ②             |                          |                             |
|     |                  |                |                          |                             |
| 75  | Inheritance      | ③             |                          |                             |
| 76  | Polymorphism     | ④             |                          |                             |
| 77  | Encapsulation    | ⑤             | Design of a Class         | Object Oriented Programming |
| 19  | Class Diagram    | ①             |                          |                             |
| 22  | Object Diagram   | ②             |                          |                             |
|     |                  |                |                          |                             |

5. Conclusions and Further Work

In this paper, MOOC elements are based on integrable ware which are designed and constructed for some courses of software engineering major, and they could be freely combined to form all sorts of MOOC learning knowledge points to the MOOC resources database as a subsystem of E-MOOC platform.

Furthermore, in big data era, the construction of teaching resource database is also the basis on the integration of teaching resources in universities in the future [1]. Further work will be done is the following.

Firstly, all sorts of MOOC resources based on big data are needed to be developed and applied continuously to expand and extend the depth and scope of teaching resources using on local universities. Compatible supported conditions on software and hardware should be created to promote the integration of teaching resources based on big data and maximize the utilization of MOOC resources in universities [1].

Secondly, teachers' comprehensive application capabilities based on big data need to be improved. Integration and reusing of various types of MOOC resources based on integrable ware by teachers in big data environment is essential, teachers should optimize the teaching idea and integrate the big data teaching theory with information technology in the MOOC teaching practice.

Thirdly, more and more reusable MOOC elements based on integrable ware for the courses of other majors should be designed and constructed for personalized learning on local campus, to improve the level of teaching information.
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