Research on the Design of Network Learning Resources under the Background of Recommendation Technology

Zhenhua Li*

Network and Information Management Center,
China West Normal University,
Sichuan Nanchong, China
*Corresponding author: lzh@cwnu.edu.cn

Abstract—**Recommendation technology provides new ideas and solutions in solving the problem of "information-mazing" and assisting students in individualized learning. E-learning resources are the objects handled by recommendation technology. In the recommender system, multimedia resources, learning path information, learners and teachers can all be recommended as objects. Therefore, people need to have a new understanding of the connotation, internal structure and life cycle of online learning resources. On the construction of web-based learning resources, learning resources themselves should be open, fragmented and aggregatable., and learning resources tracing mechanism and difficulty grading mechanism must be established.**

Keywords—design of network learning resources; recommendation technology; meta-data

I. INTRODUCTION

The network learning resources is the electronic resources that have been digitized under the network environment. They usually refer to the digitized text, audio and video, animation and other digital resources. It is a very important part of online education, and plays an important role in promoting the innovation of teaching concept, teaching method and teaching mode. The Chinese government actively has developed "Internet+education" in the 13th Five-Year plan and promoted the construction and sharing of high-quality resources by promoting the construction of "Three connections and two platform" [1]. After years of development, China's e-learning resources construction hasmade some achievements. Especially since 2012, with the rise of MOOC and flipped classrooms, the construction of MOOC and other excellent curriculum resource platforms has also made rapid development, and the number of MOOC courses stays at the front row in the world. In terms of standard construction, China issued Education Information Technology Standards (CELTS), among which CELTS-3, CELTS-41 and CELTS-42 are metadata standards related to the construction of learning resources [2].

II. CURRENT SITUATION OF LEARNING RESOURCES CONSTRUCTION

Although China has made great achievements in the construction of learning resources, it has encountered many problems such as the single form of resource media, lacking scenario design for resource application, personalization, interaction and related theoretical support. All the deficiencies restrict learners to use learning resources efficiently [3]. Facing the massive learning resources, there is an obvious problem of "information-mazing" in the process of learners' learning. The so-called "information-mazing" refers to the phenomenon: when students jump from one network location to another many time in the task of information collection, they are attracted by irrelevant information and hardly return to the original position or forget the task target. Many factors can cause "information-mazing", such as learners' weak attention maintenance ability, weak self-monitoring ability and lower information literacy. But the main reason is that the capacity of network resources itself is massive, the hypertext network structure, the organization and presentation of network resources are complex, which cause information overload and confuse students [4]. To solve the problem of "information-mazing", many researchers have done a lot of research and put forward many solutions, which are divided into subjective and objective aspects. In the subjective aspect, it can reduce the influence of information navigation by improving learners' information literacy, self-control, meta-cognition and self-monitoring ability. In the objective aspect, it can guide students to learn effectively and improve the presentation of information by designing an effective navigation system. This conforms to learners' cognitive laws and scientifically helps learners to allocate attention and learning time effectively [4-5]. Although these solutions directly point to the key of the problem, the results of these solutions can not have an immediate effect, and the implementation cost is considerable. With the application of computer technology in the field of education, the recommendation system based on collaborative filtering technology and machine learning technology has brought new ideas to solve the problem of the "information-mazing" of learning resources.

The solution based on recommendation technology firstly models the learners and learning resources respectively, and then uses the corresponding recommendation algorithm to recommend suitable learning resources for learners. The recommender system was first used in the field of e-commerce. Merchants recommend products that users might like based on their hobbies and interests. Amazon and eBay, the famous e-commerce companies, have studied and applied the recommendation system for many years. With the development and progress of technology, various websites, such as movie websites and music websites, have successively used recommendation systems to improve the experience of visiting users and use the technology to create economic benefits for themselves [6]. If the process of using learning resources by a learner is analogized to the process of consuming a commodity, then the process of recommending suitable learning resources to learners using a recommendation system becomes very natural. In fact, in the 1990s, many educational platforms and institutions began to use recommendation technology in learning systems to improve the learning efficiency of learners. Domestic researchers also did a lot of research on learning resources. Generally speaking, learning resources recommendation is divided into three parts: user modeling, learning resources modeling and algorithm. User modeling and learning resources modeling are used to accurately describe the user and the model itself so that the algorithm can make more accurate recommendations. The accuracy of model construction has an important impact on the accuracy of the recommendation. The algorithm part is the main part of the recommendation process. The quality of the algorithm is directly related to the effectiveness of the recommendation. It is the key to the recommendation system. Many researchers have also invested a lot of energy into the algorithm. Traditional recommendation algorithms mainly include a content-based recommendation, collaborative filtering-based recommendation, social network data-based recommendation, and hybrid recommendation integrating many algorithms. With the rapid development and popularity of machine learning in recent years, the recommendation of learning resources based on deep learning technology is also gradually becoming the focus of researchers' attention. Deep learning technology has the "end-to-end" feature, that is, users do not need to extract the features of the model themselves and directly hand over the data to the deep learning model. The model automatically learns the data features without human intervention [7]. The deep learning model needs to be trained with a large amount of sample data during its construction process. The quality of the resulting model will affect the effect of the model and the model structure itself as well. The data generated in the learning process can be used as the training data. These data include the log data generated in the learning process, the metadata describing learners, the access data of learning resources, etc. The accuracy of the description of learners and learning resources directly affects the final accuracy of the model trained from these data. If the data does not accurately describe the learners or learning resources, then the trained model may not solve the actual problem well, even if it performs well. All the resource design and construction methods are very basic and important for the recommendation of learning resources. With the continuous development of

technology and learning theory, it is necessary to re-understand the learning resources.

III. RE-UNDERSTANDING OF ONLINE LEARNING RESOURCES UNDER THE BACKGROUND OF RECOMMENDED TECHNOLOGY

In general, online learning resources are an important carrier of knowledge in the online learning process. With the development of media technology and the popularization of Web 2.0 technology, the content and presentation of learning resources have been greatly enriched. Various new technologies emerge in endlessly. Online learning resources based on 3D, VR, AR and information visualization technologies have greatly improved learners' learning effects and experiences. The development of social networks and the diversification of interaction methods enable learners to benefit in learning communities. New learning methods such as MOOC, mashup teaching, panoramic education, integrated teaching, multi-dimensional learning and maker space have begun to emerge and made people's understanding of online learning and new understanding of the meaning of online learning resources constantly evolve [8]. The changing trend of learning resource construction has the following characteristics: from plane to three-dimensional, multi-terminal, from closed to open, from presets to generation, from content to activities, from resources to processes, from results to processes, from general to personalized. [9-10]. In the past, e-learning resources were limitedly understood as e-learning content such as network courseware and e-books. Now, this understanding method is no longer applicable. We should have a new understanding of the content, internal structure and life cycle of online learning resources from a new perspective.

A. Reconsideration of the Connotation of Online Learning Resources

The gradual cross-fusion of social media and the learning community, the application of emerging technologies such as virtual reality and somatosensory interaction in education, the application of intelligent tutoring assistants, robot tutors in teaching, and gamification teaching have greatly enriched the content of online learning resources. Yang Xianmin and Zhao Xinshuo believed that "e-learning resources are centered on the learner, and the ultimate goal is to promote meaningful learning, which organically integrates content resources, activities, tools, and interpersonal wisdom" [12]. From the perspective of recommendation technology, not only resources such as multimedia courseware, e-books and online courses can be recommended to learners, but also learning peers, study groups, and network tutors can be recommended, and even suitable learning paths can be recommended for learners. The individualized learning path, learning system and so on, the emergence of new technology has enriched the connotation of learning resources.

B. The internal structure of learning resources

In the early days of the rise of online multimedia, due to technical limitations and cognitive limitations, it was believed that the function of online learning resources was very single, and only played a role in assisting teaching and transferring knowledge. Nowadays, in addition to supporting teaching,

online learning resources also carry the functions of social, connectivity, collaboration and community, realizing the transformation from information chain to intelligent chain [12]. Looking into the future, the development of learning resources must meet the requirements of openness, connectivity and intelligence. The so-called "openness" refers to the open access, application, modification or release of learning resources under the condition of copyright permission. "Connectivity" refers to the combination and connection of learning resources according to different needs or different cognitive styles of users. "Intelligence" refers to the intelligent detection and adaptive presentation of multiple terminals, as well as the collection of user data, feedback and other information. To adapt to the future development trend, learning resources must also be able to adapt to the future development trend. Professor Yu Shengquan proposed a learning resource organization method called "learning element". The learning objectives can exist independently and can be dynamically aggregated in a network way. It is easy to access, reusable, intelligent and self-evolving. This model expands and reconstructs the traditional content-based resource structure, and is a very representative learning technology resource model.

C. The life cycle of learning resources

At present, with the rapid development of software technology, a variety of simple and easy-to-use multimedia software emerged one after another. Coupled with the decline in the price of multimedia equipment, it used to require professionals to complete the production of learning resources, and now a regular teacher can complete it. The current software technology is developing rapidly, and a variety of simple and easy-to-use multimedia software is emerging. The decline in the cost of multimedia equipment has made it popular gradually. The production of learning resources that used to be done by professionals can be completed by general educators themselves. And, the role of learners is not only users of learning resources, but also producers and disseminators of resources. The participation of a large number of learners has led to a rapid increase in the number of learning resources. The increase in the number of resources will bring about the problem of reduced resource utilization efficiency. The future construction of learning resources should try to avoid this phenomenon. The life cycle of resources should not only disappear with the end of the learning process and the passage of time, but also develop towards the sustainable and generative direction to maximize the value of learning resources.

IV. DESIGN AND CONSTRUCTION OF NETWORK LEARNING RESOURCES UNDER THE BACKGROUND OF RECOMMENDATION TECHNOLOGY

Metadata is used to describe network learning resources when they are constructed. It is very important to promote the efficient use of network learning resources. The so-called metadata is simply "data describing the data". Metadata itself is a structured encoded data that describes the characteristics of information resources and can be used to find, access, use and manage these information resources [13-14]. The essence of metadata is a coding system whose purpose is especially to

describe, encode, and establish a framework that is easy for machines to understand according to certain standards. Therefore, in the current background of recommendation technology, it is very important to improve the design or selection of metadata standards. At present, there are many popular metadata standards, such as the Dublin Core (DC), LTSC LOM and ADL / SCORM, which are widely used in the field of education. In 2001, the Educational Technology Sub-Committee of the National Information Technology Standardization Technical Committee of China promulgated national standards (GB / T21365-2008) based on the LOM which is based on the IEEE1484 framework. The standard mainly defines a conceptual data model for defining the structure of learning object metadata instances [15-16]. Due to the uncertainty of technological development, metadata standards cannot be used to predict future technology trends very precisely when they are formulated. Therefore, support for future technologies may not be optimal, but they can be adapted to future technologies by modifying and expanding metadata standards Application and development. As far as the recommended technologies are concerned, the author believes that the following aspects should be considered at least:

A. Resource construction needs to meet openness requirements

Under the general trend of openness and sharing, the sharing of openness should be taken as the most basic requirement in the construction of learning resources. Only the openness and sharing of resources can bring continuous development and progress. The so-called "openness" includes 1) Under the premise of ensuring copyright, the authority is moderately open. For example, on the basis that the core modules of the learning resources cannot be modified, other users are allowed to reprocess and reassemble learning resources according to their own needs; 2) Open access to resources. Visitors from different regions and different groups can easily access resources; 3) The internal interface of learning resources is open to the outside world. The development interface enables learning resources to be accessed, tracked and integrated by other learning systems. Learning resources should also meet two characteristics: self-contained and addressable. "self-contained" means that learning resources are independent of each other and can exist independently; "addressable" means that each learning resource can be uniquely identified by network address [17]. The construction of the current national education resource public service platform is an excellent example of the Internet open sharing concept.

B. Fragmentation and reorganization of learning resources

In the context of big data, the emergence of huge resources, the diversification of information dissemination, and the fragmentation of information text have formed a fragmented external environment for learning resources. On the one hand, the fragmentation of learning resources meets the current requirements of ubiquitous learning, mobile learning, and micro-courses. On the other hand, it is an inevitable result of improving resource utilization and reuse rates. With the help of mobile phones and tablets, learners take advantage of the fragmented time to study, which inevitably requires the

learning resources themselves to be "thinned" to adapt to the new learning methods. The emergence of recommendation technology can dynamically adjust and arrange the learning content according to the learners' learning situation, so it also requires that learning resources have the characteristics of fragmentation, can be split and reorganized, to easily build a combination of resources to meet the learners' individualized learning.

C. Aggregation of learning resources

In the process of learning resource recommendation, another problem to be considered is the granularity of recommendation. The granularity problem is to recommend a single related knowledge point, multiple knowledge points that have a successful relationship with each other, or a related domain knowledge when recommending to learners. The essence of the granularity problem is that there should be a certain aggregation relationship between learning resources. The aggregation granularity needs to be determined by the recommendation algorithm and system according to the specific learning situation and user situation. For example, the IEEE LOM standard divides the granularity of resources into four "aggregation levels": Atomic, collection, networked, hierarchical and linear [18]. SCORM 2004's content aggregation model divides content model into micro-unit, shared content object, learning activity and content organization.

D. Establishing the reference and traceability mechanism of learning resources

The open sharing of network learning resources enables learners themselves to participate in the production and release of resources, greatly enriching the number of learning resources. However, the reprocessing of learners in the process of resource transfer will affect the authority and accuracy of resources. Therefore, it is necessary to establish a resource reference and traceability mechanism. It has the following advantages: 1) it meets the copyright requirements of the publishers of learning resources; 2) it is convenient for learners to understand the development and generation path of learning resources, and it is also helpful for learners to distinguish and evaluate resources; 3) it forms a network to connect all resources with the help of reference traceability mechanism, which further strengthens the connection between resources; 4) it provides a basis for the quality classification of resources. For example, quality can be graded according to the number of times of learning resources that are referenced.

E. The difficulty grading mechanism of learning resources

The recommendation of learning resources should not only meet the individual needs of learners but also meet their learning level and learning ability. Therefore, it is necessary to grade the difficulty of learning resources. The requirement of difficulty grading is just a reflection of "Scaffolding Teaching". Based on the recent development zone theory of wigowski, scaffolding teaching gradually leads the students' understanding to the depth by consciously creating problem scenarios, providing a conceptual framework, learning methods, learning tools, resources, etc., and helps them to get the ability

improvement step by step through the recent development zone [19]. After difficulty classification, learning resources are essentially equivalent to resource-based learning scaffolds. It can arouse learners' interest in learning, improve the guidance of learning objectives, and give learners suggestions and help on learning paths, to ensure that learners gradually complete their learning objectives.

V. SUMMARY

The progress and development of network technology not only brings great convenience to our work and life, but also slowly changes our living habits, thinking mode and cognitive mode. The application of recommendation technology in education is only one side of the development of individualized education in the future. Although the technology is still in the development stage, with the continuous development of knowledge map technology, intelligent tutor system and intelligent robot technology in the future, the functional demand for network learning resources will increase day by day, and the research on the design and construction of learning resources will also get a lot of response. It has been improved and perfected in use and experiment.

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