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Research on the Management Model of University Teaching Materials based on Knowledge Graph

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Abstract: Colleges and universities will produce a large number of teaching materials in their teaching work. It is of great significance to collect and manage teaching materials. In this study, knowledge graph technology is applied to the management of teaching materials in colleges and universities, and an ontology model of teaching materials in colleges and universities based on knowledge graph is proposed. Based on the relevant norms of teaching resources ontology in China, the ontology model of teaching materials in colleges and universities is constructed by seven-step method, and it is transformed into the attribute graph model of teaching materials in colleges and universities, which is stored in the Neo4 j graph database. The model can define the entity type and the relationship between entities, and construct the subject knowledge framework.

Keywords: Teaching Material Management; Knowledge Graph.

1. Introduction

With the continuous development of the times and the continuous progress of science and technology, schools must fully understand the increasingly complex needs of the society and give full play to the important role of information data management system in teaching, so as to ensure the quality of education services.

In the teaching work, a large number of teaching materials will be produced, that is, text, pictures or videos and management materials that are of auxiliary value to teaching. These are precious wisdom for the school, so it is of great significance to collect and manage the teaching materials. In recent years, many excellent teaching-related information systems have emerged in China, but most of them focus on academic processes such as course scheduling and course selection. The research on teaching material management system is still in the development stage.

After the research is completed, it is expected to improve the efficiency of staff, liberate academic staff and teachers from the pressure of teaching materials management, reduce the waste of human and material resources, reduce costs, play an important role in teaching materials sharing, realize the effective use of teaching materials, and improve the quality of teaching activities.

2. Related Theories and Technologies

(1) Relevant norms of teaching resource ontology

The construction of educational resources is an important part of educational informationization. Whether the educational resources can be effectively constructed and managed will affect the quality of educational informationization. With the rapid development of the network, the number of educational resources has soared. At the same time, there are many forms of text, images, audio and video, which lead to the difficulty of managing, querying and sharing educational resources. In order to solve this problem, the concept of metadata was introduced into the field of educational resources construction, and the concept of learning object metadata was born. Metadata is the data that describes other data. Learning Object Metadata (LOM) is the data that describes educational resources. It defines the attributes, structures and other characteristics of educational resources data in order to efficiently manage, effectively query and evaluate educational resources.

(2) graph databases

Database can be divided into relational database and non-relational database. The relational database organizes data with relational models, and has become the mainstream database in the decades after its birth with the advantages of easy understanding and simple use. Non-relational database is also known as NoSQL database. The meaning of NoSQL is 'Not Only SQL (not just SQL)', which is a supplement to relational database. By sacrificing the ACID feature, NoSQL databases can achieve high read and write efficiency, easy expansion, and storage of data in multiple formats.

(3) Jieba Tool

Jieba word segmentation is developed by Python and is considered to be the best Chinese word segmentation component in Python. Jieba word segmentation supports four-word segmentation modes: precise mode, full mode, paddle mode and retrieval engine mode. The precise mode is mainly used for text analysis, which can separate sentences with high accuracy. The full pattern shows the results of all possible words in the sentence; the paddle mode uses the Paddle deep learning framework to train sequence labeling to achieve word segmentation; the retrieval engine mode is to cut the long sentence again on the basis of the precise mode. Jieba also allows users to build a custom dictionary from a text document (.txt), with each line

3. The Definition of University Teaching Material Management Model

(1) Paper-based management process of teaching materials

In the paper-based borrowing process of teaching materials, teachers need to fill in the application form related to the borrowing of teaching materials, specify the reasons for borrowing, the date of borrowing and returning, submit and obtain the consent of the teaching materials management

personnel before borrowing the teaching materials. During the borrowing period, the borrowed teaching materials should be properly kept, and the damaged teaching materials such as folding and altering should not be made and returned on time. The paper-based management process of teaching materials has the following problems: It is difficult to deal with the increasing number of teaching materials because of the low efficiency of collecting and sorting teaching materials manually. Paper teaching materials are easily damaged by weather, temperature, fire or man-made factors. If the required teaching materials have been lent out, they need to wait for them to be returned before they can be borrowed. Therefore, it is difficult for teachers to screen and obtain teaching materials that meet the needs, and the sharing of teaching materials is inefficient. It is difficult to manage the teaching materials such as presentations commonly used by teachers.

(2) Electronic management process of teaching materials

Compared with the paper-based collection process of teaching materials, in the electronic collection process of teaching materials, teachers upload teaching materials according to the collection needs of teaching materials. The teaching materials administrator only needs to approve, classify and sort out the teaching materials, which saves a certain tedious process, greatly shortens the time required for the collection of teaching materials, and the teaching materials can be put into use faster.

However, there are some problems in the electronic management process of teaching materials in some schools: Only pay attention to the accumulation of teaching materials in quantity, without classifying them or mining the correlation between teaching materials, teaching materials form 'information islands' with each other, and the utilization rate is low. The search algorithm used only mechanically matches the input words with the file name, but the file name can only reflect some of the features in the teaching materials. At the same time, the teacher's search needs have not been fully understood. Therefore, teachers still need to spend a certain amount of time and energy to identify and screen the teaching materials they need. There is no unified electronic management standard of teaching materials, which makes it difficult to share educational information resources between schools and schools, schools and other teaching materials information platforms.

(3) Optimize the management process of university teaching materials management model

In view of the problems existing in the above-mentioned teaching material management process, this study proposes a university teaching material management model that optimizes the management process.

The first step is to use the seven-step method to construct the relevant ontology of teaching materials in colleges and universities according to the theoretical guidance of 'Metadata Specification for Learning Objects' (CELTS-3] and 'Technical Specification for Educational Resources Construction' (CELTS-41) proposed by the Ministry of Education of China. The related ontology of university teaching materials constructed by is a simplified model that abstracts the characteristics of university teaching materials that meet the needs. Its definition and the relationship with other ontologies are accurately defined. Therefore, it can better support logical reasoning and semantic search, and at the same time facilitate resource sharing with the teaching resource database constructed according to the same specifications.

The second step is to transform the ontology of university teaching materials constructed in the first step into the attribute graph model of university teaching materials, import it into the Neo4 j graph database, and construct the preliminary framework of the knowledge graph of university teaching materials. The construction of the knowledge graph of university teaching materials will be completed after the subsequent introduction of teaching materials.

4. The Construction of Knowledge Map of University Teaching Materials

(1) Construction of teaching materials ontology

Determine the professional field and coverage of building ontology: The ontology to be constructed in this study will cover the field of teaching materials in colleges and universities. It is applied to effectively integrate and organize the teaching materials and subject knowledge of colleges and universities, make them structured, and construct a knowledge map of teaching materials in colleges and universities. The knowledge map can find out the framework of teaching materials and subject knowledge and the relationship between them, so that teachers can obtain the required teaching materials more efficiently, so as to improve the utilization rate of teaching materials. Listing the competency problem list will help to determine the type of information that should be included in the constructed ontology.

(2) Examine the possibility of reusing existing ontology

The goal of this step is to check whether there is an existing ontology of the same type, and to learn and improve it on the basis of it, which is conducive to the expansion and sharing of ontology information. After searching, it is found that the " Learning Object Metadata Specification " (CELTS-3) and " Educational Resource Construction Technical Specification " (CELTS-41) proposed by the Ministry of Education of China provide theoretical guidance and a general conceptual model for the construction of teaching resource ontology. Therefore, this study will manually construct an ontology suitable for the research field of this paper based on these two specifications, which is conducive to resource sharing with other teaching resource databases.

(3) List important terms in ontology

The goal of this step is to extract the important terms of the domain covered by the constructed ontology. These important terms can briefly describe and define the concepts in the domain ontology, and prepare for the subsequent steps such as defining classes and class attributes. In order to make a comprehensive list of terms as far as possible, the terms listed should include not only the classes in the field, but also the attributes of the classes. At the same time, the relationship between terms and the possible overlap of concepts are not considered for the time being, and further improvement is needed in the follow-up steps.

(4) Define class and class hierarchy

In the process of defining classes and the hierarchical system of classes, there are three commonly used methods:

Top-down method: first define the most top-level and most general concepts in the determined knowledge field, and use this as a starting point, gradually refine down according to the needs, and define smaller concepts.

Bottom-up method: first define the lowest and most

specific concepts in the identified knowledge field, and take this as a starting point, gradually upward according to the needs, define a higher-level concept that can summarize the underlying concepts.

Comprehensive method: Combining the top-down method and the bottom-up method, the concept of the middle layer in the knowledge field is defined first, and according to the demand, the upper layer concept is defined by upward generalization, and the lower layer concept is defined by downward refinement. Among the three methods, the top-down method is the most intuitive and not easy to miss key classes, and it is more appropriate to organize knowledge points in units of courses. Therefore, in the process of defining classes and class hierarchies, this study mainly adopts the top-down method. First, define the top-level class school in the field, and begin to refine the definition of other classes downward.

(5) Define the attributes of a class

After defining the class and the hierarchy of the class, it is necessary to define the attributes of the class to describe the internal conceptual structure of the class. Class attributes are divided into two types: object attributes and data attributes. Object attributes describe the relationship between classes, and data attributes describe the relationship between classes and their basic data types (such as attributes). In the process of defining object attributes, this study divides the relationship between classes into vertical relationship and horizontal relationship. The former describes the relationship between different classes, and the latter describes the relationship between the same classes.

(6) Define the facets of attributes

The Facets of attributes refer to the value characteristics of the attribute. The concepts of value type, allowable value range and number of values belong to the Facets of attributes. The number of values that can be valued defines how many values the attribute can have. If the minimum number of values is N, the attribute must have at least N values. If there will be at least one metadata contributor to the teaching materials in this study, the minimum value is 1; if the maximum number of values is M, the attribute can have at most M values. If the maximum number of keywords in the teaching material class in this study can only have 10, the maximum number of values is 10. The value type defines the type of the attribute that is allowed to be valued. Commonly, there are Integer, Float, String, Boolean and Date attribute types.

(7) Definition of teaching material attribute graph model

The preliminary framework for constructing the knowledge graph of teaching materials in colleges and universities needs to store the related ontology of teaching materials into the Neo4 j graph database, so it is necessary to define the attribute graph model of teaching materials. The property graph model is an extension of the edge-labelled graph and is currently used by some major graph databases such as Neo4j. The attribute graph model consists of nodes, edges, attributes and labels. The preliminary construction of the knowledge graph of the teaching materials of Guangxi University for Nationalities.39 represents the entity, the edge represents the connection between the entities, and both of them can be labeled. The node label defines the role of the node in the model, and the edge label defines the connection type between the entities. The attribute graph model allows nodes and edges to store one or more attributes in the form of key-value pairs, providing them with richer semantic information.

(8) The preliminary framework of knowledge graph of university teaching materials

After constructing the ontology of university teaching materials, it is finally stored in the Neo4j graph database through py2neo, and the preliminary framework of the knowledge graph of university teaching materials is obtained.

5. Conclusion

In the context of the information age, it is of great significance to use information system to collect and manage a large number of teaching materials produced by colleges and universities, which conforms to the trend of educational informatization and educational modernization. However, there are some problems in the management of teaching materials in colleges and universities, such as the difficulty of relational database to meet the needs of teaching materials management, the failure of effective integration and organization of teaching materials in colleges and universities, and the inconvenience of consulting teaching materials. This study has carried out in-depth analysis and research on the above problems, combined with knowledge graph and graph database technology, and constructed a knowledge graph of university teaching materials.

This paper studies the concept of ontology and the commonly used method of domain ontology construction, and analyzes the teaching materials of colleges and universities. On the basis of a certain understanding of the relevant norms of China's teaching resources ontology, 'Learning Object Metadata Specification' (CELTS-3) and 'Educational Resources Construction Technical Specification' (CELTS-41) with LOM specification as the core, the seven-step method is used to design the teaching materials of colleges and universities. The ontology defines the attributes of the class and the relationship between the classes, and finally defines the attribute graph model of the teaching materials of colleges and universities. The relevant data is stored in the Neo4 j graph database to construct the knowledge map of the teaching materials of colleges and universities.

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