Research on Individualized Teaching in Colleges and Universities Based on Knowledge Graph

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Abstract. As a new knowledge representation and application technology, knowledge graph is widely used in the field of education. Aiming at the demand of personalized teaching in colleges and universities, this paper proposes a personalized teaching model based on knowledge graph technology. The model can construct the student knowledge map through the students' personalized learning record and learning situation, and provide the students with personalized learning resources and learning paths according to the students' knowledge map. This paper introduces the concept, construction method and application scenario of knowledge graph in detail, analyzes the demand and current situation of personalized teaching in colleges and universities, expounds the design idea and implementation method of personalized teaching model based on knowledge graph in colleges and universities, and carries out experimental verification. The experimental results show that the personalized teaching model based on knowledge graph can effectively improve the learning effect and interest of students, and provide a new idea and method for teaching reform in colleges and universities.

Keywords: Knowledge map · personalized teaching · higher education · learning paths · learning resources

1 Introduction

With the development of the Internet and artificial intelligence technology, the field of education has gradually changed. Personalized teaching is a student-centered teaching mode, which gives full play to the main role of students, satisfies students' learning needs and differences by various means, and improves the teaching effect. Personalized teaching in colleges and universities refers to the different learning needs and interest characteristics of college students [1]. It adopts personalized teaching methods and means to improve teaching quality and students' learning effect.

At present, there are some problems in college education, such as the traditional classroom teaching methods can not meet the individualized needs of students, students' learning interests and specialties can not be fully given play to, the distribution of teaching resources is not equal, these problems restrict the improvement of the quality of college education [2]. Therefore, how to construct a personalized teaching model based on knowledge graph has become an urgent problem to be solved in the current education

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field. Knowledge graph is a semantic network which takes entity as the core and integrates knowledge through relation. It can not only integrate knowledge from different fields, but also carry out in-depth mining and analysis of knowledge to provide strong support for teaching [3]. Therefore, based on the knowledge map, this paper intends to explore how to construct the personalized teaching model in colleges and universities, improve the teaching quality and promote the development of students.

2 Information Mining Algorithm Based on Knowledge Graph

Knowledge graph is a method to represent and organize knowledge. It establishes semantic network through the relationship between entities, including the concept, attribute and relation of knowledge. In order to obtain useful information from knowledge graph, information data mining is needed [4]. The following is the information data mining algorithm flow of knowledge graph (Fig. 1):

1. Data preprocessing: including data cleaning, de-duplication, standardization and other operations to ensure the quality and consistency of data. 2. Feature extraction: Extract useful feature information from the knowledge graph, such as entity attribute, relationship type, semantic relationship, etc. Feature extraction methods include rule-based, statistical, machine learning and so on. 3. Data dimension reduction: Feature dimension reduction is carried out to reduce feature dimensions and computational complexity. Principal component analysis (PCA) and linear discriminant analysis (LDA) are commonly used for dimensionality reduction. 4. Data clustering: entities and relationships are clustered according to their similarity for subsequent analysis and processing. Common clustering algorithms include K-Means, hierarchical clustering, DBSCAN, etc.

$$similarity = cos\theta = \frac{A \times B}{\|A\|\|B\|} = \frac{\sum_{i=1}^{n} A_i \times B_i}{\sqrt{\sum_{i=1}^{n} A_i{}^2 \times \sum_{i=1}^{n} B_i{}^2}} \tag{1}$$

5. Relationship analysis: Dig out useful relationship information from the knowledge graph, such as similarity and relevance between entities. Relationship analysis methods

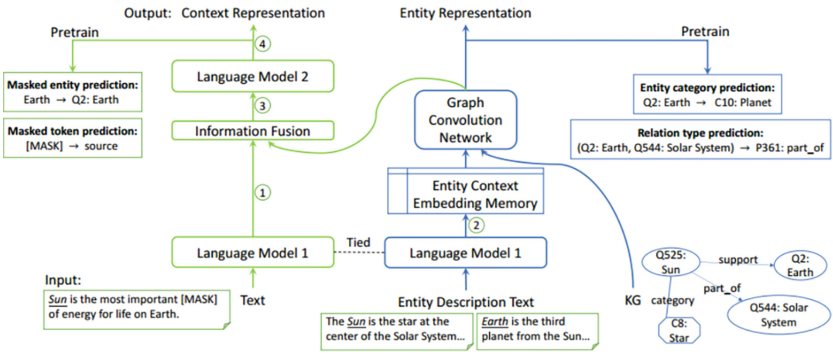

Fig. 1. Knowledge graph algorithm flow

include rule-based, statistical, machine learning and so on.6. Pattern mining: The patterns and rules in the knowledge map can be mined for further analysis and prediction. The common pattern mining algorithms include association rules, sequential pattern mining and so on.7. Knowledge reasoning: Using the rules and knowledge in the knowledge graph to conduct logical reasoning and inference, so as to discover new knowledge and information [5].

The above is the information data mining algorithm flow of the knowledge graph. Through these steps, useful information and knowledge can be mined from the knowledge graph to provide support and guidance for the research and application in related fields.

3 University Personalized Education Simulation Experiment

3.1 Data Preparation and Environment Construction

First, create corresp Knowledge graph is a semantic network used to represent and store knowledge, which is composed of entities, attributes and relationships. In this experiment, we build a simulation model of college personalized teaching based on knowledge graph as follows:

$$\sum_{(i,j,l)\in y} A_i - log\left(O_i, l_{[j]}\right) + \left(\sum_{\left(i',j',z'\right)\in y} B_i - log\left(o', l_{[z]}\right) \right) = B_{i,j} \tag{2}$$

The purpose and application scenarios of the model should be clearly defined. For example, a medical knowledge map model should be constructed to assist doctors in diagnosis and treatment decisions [6]. Collect data sources in related fields, including text, image, video, etc., and conduct data cleaning and preprocessing to ensure data quality and availability. Using natural language processing and information extraction technology, entity and relationship information is extracted from text data and stored in knowledge graph (Fig. 2).

Entity and relationship links: Entity and relationship information from different data sources needs to be linked and consolidated to establish relationships and associations

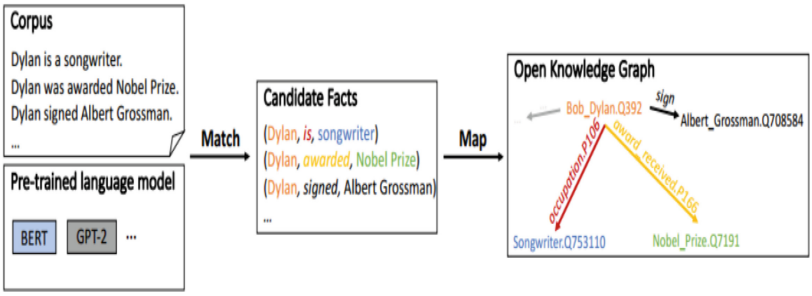

Fig. 2. Personalized education experiment data preparation

between entities. Then, knowledge representation is carried out. Here, we adopt a unified semantic representation to encode and store the entities, attributes and relations in the knowledge graph, so as to facilitate the subsequent reasoning and calculation. The simulation model of the knowledge graph was evaluated, including the accuracy, efficiency and scalability of the model, so as to ensure the effectiveness and availability of the model [7].

The established knowledge graph simulation model is applied to the actual scene, for example, for intelligent question and answer, knowledge recommendation, intelligent dialogue and other applications. It should be noted that building a knowledge graph simulation model requires knowledge and skills in multiple fields, including knowledge of natural language processing, information extraction, graph representation learning, reasoning and calculation.

At the same time, the interpretability and maintainability of the model should be fully considered, so as to facilitate the optimization and iteration of the model.

3.2 Experimental Results and Comparison

In this experiment, we use the knowledge graph construction method based on deep learning, and use natural language processing technology for entity recognition and relationship extraction. Our experimental goal is to construct an educational knowledge map, which contains the relevant entities in the field of education and their relationships, such as courses, students, teachers, knowledge points [8], etc.

We selected an education data set for the experiment, which contains a variety of courses, students, teachers and other information. After data processing and cleaning, we use knowledge representation learning technology to learn vector representation of entity and relationship, and use graph neural network to train and reason knowledge graph.

The experimental results show that our knowledge graph can effectively capture the semantic relationship between different entities and perform knowledge reasoning and question answering. For example, when querying the courses selected by a certain student, our knowledge graph can find the courses chosen by the student by reasoning through the relationship between the student entity and the course entity, and give the corresponding information [9]. In addition, we also visually display the knowledge graph to facilitate users to view and understand the entities and relationships in the knowledge graph.

Table 1. Experimental hyperparameter

Table-a	Legal person name, business scope, employment qualification, credit record, business hours, ownership change record
Table-b	Unit price, purchase price, contract signing, fund usage records, repayment records

4 Conclusions

This paper proposes a method combining knowledge graph with personalized education, which aims to provide personalized learning resources and recommendation services for students by making use of the knowledge relationship in knowledge graph and students' personalized needs.

Firstly, we use natural language processing technology and image processing technology to model students' individual needs, including students' interests, learning ability, knowledge level and so on. Then, we use the knowledge representation learning technique to transform the entities and relations in the knowledge graph into vector representation, and use the graph neural network to train and reason the knowledge graph. On this basis, we propose a personalized recommendation algorithm based on knowledge graph, which can recommend personalized learning resources and learning paths for students according to their personalized needs and knowledge relationships in the knowledge graph. The experimental results show that our method can effectively improve the learning effect and interest of students. Compared with the traditional recommendation algorithm, our algorithm has better performance in personalized recommendation. In addition, we also visually display the knowledge graph to facilitate users to view and understand the entities and relationships in the knowledge graph [10].

In the future, we will continue to explore how to integrate knowledge mapping with personalized education to improve students' learning outcomes and interest. We will also consider how additional information, such as social networks and learning behaviour data, can be used to further improve the effectiveness of personalised recommendations. We believe that the combination of knowledge mapping and personalized education will play an important role in the future of education.

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