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Research on Intelligent Organization and Management Method of Civic and Political Education Content Based on Knowledge Map

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ABSTRACT

This paper proposes knowledge representation based on knowledge graph embedding (TransE model) and based on deep wandering (DeepWalk model) to enhance the level of intelligent recommendation of knowledge points. Synthesize and construct a knowledge graph-based Civic Education model. Analyze the node centrality specifics of the model. Carry out a controlled experiment of model application and investigate student satisfaction on this basis. The three nodes with the highest node centrality are "life view and values", "morality and law" and "patriotism and nationalism". The average score of the test questions in the experimental class is 71.25, and the correct rate of the six types of test questions is higher than that of the control class. Most of the students' satisfaction level with the intelligent teaching mode combined with the model was between 65 and 100 points. 92% of the students found the teaching mode interesting at a level between (75,100]. 90% of the students' content mastery satisfaction level was between 85 and 100 points. Intelligent teaching using the knowledge graph-based Civics education model can help students improve their interest in learning Civics knowledge and construct Civics knowledge system.

Keywords: knowledge graph, TransE model, DeepWalk model, Civics education model, node centrality

1. Introduction

Ideological and political education is a more complex value of parenting activities, but also the implementation of the fundamental task of moral education of the people of the key courses, in this trend of its old teaching methods are in urgent need of reform and innovation [1]. In the era of digital intelligence, the application of artificial intelligence technology in the whole process of education, teaching and management of civic and political education is an inevitable move to promote the scientific and intelligent education and teaching of civic and political education [2-3].

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The traditional teaching mode of Civics and Political Science is “case + conclusion + meaning”, and the advantage of this kind of knowledge indoctrination is that it is systematic, logical, and intellectual, which makes it easy for students to grasp the conceptual and memorized knowledge points [4-6]. However, due to its typical indoctrination characteristics, students' learning initiative and motivation have not been fully mobilized, and the effect of nurturing is not very satisfactory [7-8]. In the context of today's ever-changing information age, knowledge mapping technology, as a powerful and efficient knowledge integration and intelligent application technology, is gradually becoming an important tool in the academic and practical fields [9]. It can effectively integrate huge and scattered data resources, build a knowledge network rich in semantic associations, and provide functions such as intelligent retrieval, intelligent response and personalized recommendation through advanced reasoning and analysis mechanisms, bringing profound changes to the field of education [10-12]. In the era of digital intelligence, “knowledge map” empowers the teaching of ideological and political theory courses in colleges and universities, promotes the construction of online and offline hybrid courses and virtual simulation teaching centers, and makes the intelligent and digital teaching reform of ideological and political courses develop from “formal” digitalization to “connotative” digitalization. The intelligent and digital teaching reform of Civic and Political Education has developed from “formal” digitalization to “connotative” digitalization [13-16]. In short, to promote the innovation of teaching resources for ideological and political education in colleges and universities, we should take the adaptive learning knowledge map as a bridge, interact with each other, give full play to the guiding function of ideological and political education, and ensure that the ideological and political education resources keep abreast of the times, so that they can be internalized in the heart and externalized in the behavior, and improve the level of ideological and political character.

The new form of teaching and learning based on knowledge graph is a new way of teaching and learning, which carries out teaching and learning activities by constructing a new type of teaching and learning architecture, and for this reason, a large number of scholars have explored how to use the knowledge graph, a new tool for organizing and representing information, to help learning and teaching. Literature [17] shows that knowledge graphs are mostly used as a peripheral source of educational materials rather than an instructional design tool, which leads to difficulties in achieving consistency of educational content in instructional practice, and thus proposes a mutual inverse instructional design framework based on knowledge graphs, which not only manages the instructional data in the knowledge graph format efficiently, but also provides interactive and consistent editing of the lesson plan to achieve a more rational instructional design. Literature [18] studied the construction method of hierarchical knowledge mapping for courses based on ternary knowledge extraction, which helps students realize personalized independent learning mode by optimizing the organization and management form of teaching resources in order to quickly meet their learning needs. Literature [19] proposed the use of knowledge mapping to improve the information classification algorithm and management process in educational resource management to realize the effective management of multimedia educational resources in view of the widely developed forms of distance multimedia education. Literature [20] used knowledge graph to construct an e-learning content recommendation framework that contains contextual signals related to student characteristics and relationships among educational entities, which can recommend appropriate educational content for learners to enhance personalized learning experience. Literature [21] establishes GSA, a progressive learning suggestion system based on curriculum knowledge mapping, in which teachers and students can interact with each other to generate personalized curriculum learning paths that meet students' development from the complete curriculum knowledge system. Literature [22] proposes an innovative teaching model based on a personalized learning recommendation system, which uses a fusion algorithm of knowledge graph and collaborative filtering to calculate the contribution of different learning resources to students' learning needs, and recommends learning resources with personalization and high quality for students in course learning.

Literature [23] designed SoLeMiO, an instructor's instructional material preparation tool for recommendation and integration, by identifying relevant concepts and constructing semantic representations using open knowledge graphs in order to automate the preparation of high-quality learning materials. It can be found that knowledge graph technology can be applied not only to educational resources development and new teaching materials design, but also to teaching management and optimization of students' personalized learning paths. Applying knowledge graph to the teaching of Civics and Political Science courses can better construct knowledge and its logical system, and form a well-organized, closely related and complete knowledge system, which is worthy of in-depth research.

This study digs deep into the knowledge of the Civics and Political Science courses in colleges and universities, breaks through the disciplinary knowledge barriers, and constructs the Civics and Political Science education model based on knowledge mapping. The knowledge graph and intelligent knowledge expression are used to realize the combing of the Civics and Political Science curriculum and its related basic knowledge points as well as the relationship between the knowledge points, and to improve the ability of associated knowledge recommendation. The centrality characteristics of nodes in the knowledge graph are analyzed to help Civics teachers grasp the core and basic knowledge points. Through controlled experiments, the effectiveness of applying the knowledge graph-based Civics education model to actual Civics teaching is studied. Use questionnaires to collect students' satisfaction with this intelligent teaching model.

2. Construction of Civic Education Model Based on Knowledge Map

This chapter constructs a knowledge graph-based model for Civics education. The curriculum ontology of Civics and Political Science discipline is selected as the model layer to standardize the data. The Civics and Political Science exercises are selected and the quality of the exercises is measured for the knowledge concept identification related to the knowledge graph and the study of the hierarchical relationship between the knowledge concepts. Introduce the knowledge graph embedding (TransE) based method and the knowledge representation method based on DeepWalk to vector learn and represent learners and resource items, learning paths, etc. in the knowledge graph, and improve the level of knowledge recommendation related to the knowledge graph.

2.1. Knowledge mapping design

2.1.1. Ontology. Ontology is the use of computer language to constrain the knowledge in the domain, the ontology expresses the commonly recognized knowledge concepts and the relationship between knowledge concepts in the domain, it reflects the common knowledge or relatively constant knowledge. However, the information about knowledge points, relationships between knowledge points and the importance of knowledge points involved in knowledge mapping is not relatively constant knowledge, but very specific and fluid. Knowledge mapping uses ontology as a schema layer to standardize the data. This study constructs ontologies for courses in the discipline of Civics and Politics, such as ideology, morality and the rule of law, basic principles of Marxism, outline of modern Chinese history, introduction to Mao Zedong's Thought and the theoretical system of socialism with Chinese characteristics, and situation and policy, in order to lay the foundation for the subsequent establishment of a knowledge graph.

2.1.2. Entity Identification and Relationship Extraction. In this study, the open-source Protégé tool is used to complete the construction of an ontology for the Ethics and Rule of Law and Civics-related courses from the top down, with reference to the “seven-step approach”, in order to define the knowledge hierarchy of chapters, sections and subsections of the courses. The specific steps include: defining the domain and application scope of the curriculum ontology; examining the possibility of

reusing the existing ontology; summarizing the important knowledge concepts of the curriculum, defining the hierarchical structure of the knowledge concepts, defining the object attributes of the knowledge concepts, defining the data attributes of the knowledge concepts and defining the facets of the attributes. Among them, the core steps are how to summarize the knowledge concepts in the curriculum and the hierarchical structure of knowledge concepts, i.e., entity identification and relationship extraction.

2.2. Exercise Quality Measurement

In this study, the exercise question resources for constructing the model of Civic and Political Education domain come from the question bank system of a university, and they are all objective questions. In order to initially check the quality of the exercises, we randomly selected the examination scripts of the Civics and Political Science related courses of the university (the scripts were taken from the question bank of the university), scored the scores of all the questions in the scripts one by one, and calculated the actual difficulty and differentiation of the questions; based on the difficulty and differentiation in the scripts, we made a judgment on the quality of exercises by combining with the pedagogical measurements. Exercises of acceptable quality were selected for the conceptual analysis of knowledge.

2.2.1. Practical difficulties. Difficulty is divided into target difficulty and actual difficulty. The target difficulty is the difficulty expected by the question writer and is usually set by experts; the actual difficulty is obtained by calculating the actual difficulty based on the students' answers in an exam. In this paper, the actual difficulty of the exercises is first calculated to illustrate the quality of the domain model construction in this study. In the domain model, the target difficulty of each exercise is determined by experts as the basis for exercise recommendation.

Actual difficulty is one of the most important indicators of the quality of a topic, and for objective questions, it is generally the ratio of the number of people who can answer the question correctly to the total number of people who answered the question. It can be obtained by dividing the number of correct answers to that test question by the number of draws. The formula for calculating the actual difficulty of the exercises in this study is:

$$P = \frac{R}{N} \tag{1}$$

where P is the actual difficulty, R is the number of people who answered the question correctly, and N is the total number of people who participated in answering the question. The P-value classification: $P < 0.45$ is hard, $0.45 \le P < 0.85$ is medium, and $P \ge 0.85$ is easy.

2.2.2. Distinctiveness. Distinctiveness is the degree to which a question distinguishes or identifies the actual level of the test taker. Usually, the degree of correlation between a student's score on a question and his or her total score on the examination is taken as the degree of differentiation for that question. For objective questions, the point-two column correlation coefficient method can be used to calculate the degree of differentiation with the formula:

$$\gamma_{pd} = \frac{\overline{x}_p - \overline{X}_q}{S_t}\sqrt{pq} \tag{2}$$

where γ_{pd} is the degree of differentiation; p is the actual difficulty of the question; q is the proportion of the number of people who did not pass the question, i.e., $1 - p$; $\overline{X}_p$ is the mean of the total scores of those who passed the question, $\overline{X}_q$ is the mean of the total scores of those who did not pass the question; and S_t is the standard deviation of the total scores.

When there are too many candidates, in order to calculate conveniently, this study uses the discriminating index method for calculation, arranges the total scores of all candidates from high to low, designates the 30% of candidates with the highest total scores as the high group, and the 30% of candidates with the lowest total scores as the low group, and calculates the passing rate of the two groups of candidates on a certain question respectively, and the difference between the two passing rates is the differentiation of this question.

2.2.3. Reliability and validity. Errors can occur in any measurement, and pedagogical measurements are no exception. Reliability is a statistical measure of how trustworthy an examination result is. Studies generally use the split-half method to measure its estimated reliability coefficient (r_{xx}). The questions in a paper are divided into two papers according to the odd and even number of questions, and the correlation coefficient (r_{hh}) is calculated using the scores (x_1, x_2) obtained by each candidate in the odd and even papers.

$$r_{hh} = \frac{\frac{\sum x_1 x_2}{N} - \overline{x}_1 \overline{x}_2}{s_1 s_2} \tag{3}$$

Then corrected with the Spearman-Brown formula:

$$r_{xx} = \frac{2r_{hh}}{1 + r_{hh}} \tag{4}$$

The reliability coefficient is only ≥ 0.65 and the reliability is only acceptable. In this study, mean discrimination was used as an indicator of validity.

2.3. Knowledge representation module

2.3.1. Knowledge representation based on knowledge graph embedding. The structure of Civic Education Knowledge Graph belongs to heterogeneous knowledge graph, in order to meet the input requirements of the recommendation task on learners, resource items and interaction relations, this paper chooses the method based on knowledge graph embedding (i.e., TransE model) to represent the head and tail entities and relations for learning.

For ternary (h, r, t), the TransE model projects the head vector and the relation vector into the same vector space through mapping operation, and regards the relation vector as a translation between the head and tail entities. The core idea is as follows:

$$V_h + V_r \approx V_t \tag{5}$$

where V_h denotes the head entity vector, V_t denotes the tail entity vector, and V_r denotes the relationship entity vector. And set the score function of TransE learning model as:

$$f_r(h,t) = \left| V_h + V_r - V_r \right|_{L1/L2} \tag{6}$$

The model models the loss function through the negative sampling method, and the specific formula is shown in equation (7). Where $[\cdot]$ indicates the calculation result of taking the value of $\cdot$ when the value of $\cdot$ is greater than 0, otherwise the equation takes the value of 0; margin is a boundary parameter, usually taking a positive value; the set of positive samples is S, and the set of negative samples is S'.

$$Loss = \sum_{s} \sum_{s'} \left[m \arg in + f_r(h,t) - f_{r'}\left(h', t'\right) \right] \tag{7}$$

There are many kinds of knowledge graph embedding learning methods, and we choose the TransE

model which has the best knowledge representation effect.TransE involves fewer parameters and can be effectively used in the scenarios with larger data sparsity, which helps to solve the knowledge sparsity problem in the later recommendation process, and the vector representations of the entities and relationships can be obtained after the learning of the TransE model.

2.3.2. Knowledge representation based on deep wandering. TransE model can realize the vectorized representation of learners and resource items in the knowledge graph of Civic Education. It also needs to mine the learners' learning paths, so this paper introduces the DeepWalk model on the basis of TransE to learn the path information of resource items.DeepWalk is a knowledge representation learning algorithm based on randomized walk, which aims to represent the nodes in the knowledge graph as low-dimensional vectors, and these vectors can be used for the subsequent recommendation tasks. DeepWalk consists of two main components: stochastic wandering and Skip-Gram modeling.

Random wandering is a method of randomly selecting paths in a graph with the purpose of generating local neighborhood information of nodes in the graph. For the set of educational resources I and the set of learners U in the Civic Education Knowledge Graph, random wandering starts at node i_0, randomly selects neighboring nodes along the edges of the graph, and transfers to the next node with a certain probability. This process is repeated for a number of steps until a predetermined wandering length is reached T. The model uses the resource i_0 node where the learner first starts learning as the initial node, and repeats the randomization process to generate a large number of node sequences that are used to capture local structural information in the knowledge graph.

The Skip-Gram model is responsible for learning a vector representation of nodes that maximizes the conditional probability of predicting the arrival of a given node at a neighboring node, calculated as:

$$L = \sum \left(\log \Pr \left(N(i) \mid V_i \right) \right) \tag{8}$$

where i is a node in the resource sequence, $N(i)$ denotes the set of neighboring nodes of node i, and V_i denotes the vector representation of node i. The conditional probability $P_r\left(N(i) \mid V_i\right)$ can be calculated by softmax function:

$$P_r\left(N(i) \mid V_i\right) = \exp\left(V_i * V_m\right) \Big/ \sum \left(\exp\left(V_i * V_n\right) \right) \tag{9}$$

where m is a neighbor node of node i, n is any node in the knowledge graph, and V_m and V_n denote the vector representations of node m and node n, respectively. The vector representation of each node is learned by maximizing the objective function L.

3. Application of knowledge map-based model for civic education

Research on the teaching practice path of Civics and Political Science course with the assistance of the model. Analyze the centrality of nodes in the knowledge graph, grasp the core concepts and basic concepts of the Civics course, and sort out the teaching arrangement of Civics knowledge points. Design model application control experiments, analyze the experimental results, count the experimental teaching satisfaction, and study the specific application value of the Civics education model based on the Civics mapping.

3.1. Teaching Practice Path of Civics Classes

By applying the Civic Education Model based on Knowledge Mapping to the teaching of Civic Education, teachers can guide students to actively explore the intrinsic connection between Civic Education knowledge, deeply understand the knowledge and construct the system, and improve the level of Civic Education in an all-round way.

1) Reconstructing Teaching Content. Traditional Civics teaching often revolves around textbooks and recounts theoretical knowledge in a linear way, which is difficult to stimulate students' desire for knowledge and cannot adapt to students' comprehensive and personalized learning needs. Teachers use the Civics education model based on knowledge mapping to visualize the abstract concepts and theories of the Civics course, and relate the multiple dimensions of the knowledge points to each other in the form of nodes and links, helping students gain an intuitive insight into the deep logical structure and understanding of the comprehensive nature of the Civics course. The personalized learning path is customized according to students' learning interests and cognitive abilities. The dynamic updating characteristics and integrated application function of the knowledge map give the teaching content the ability to reflect social progress and policy changes in a timely manner, ensure the timeliness of the teaching content, enhance the flexibility of teaching and the depth of the content, and strongly promote the cultivation of students' critical thinking and innovation ability.

2) Adopt diversified teaching methods. Traditional teaching of Civics and Political Science tends to be in the form of a single lecture, with limited interaction and low student participation. With the visual expressiveness of knowledge mapping, the complex theories of Civics and Politics are transformed into graphical knowledge structures, which are closely connected with the actual situation and help students memorize the knowledge points in depth. By utilizing the dynamic updating and sharing characteristics of the knowledge map, teachers and students can participate in the construction and expansion process of the map together, forming a teaching atmosphere in which teachers and students can co-create and grow together. Through the knowledge map, students' academic activities and progress are systematically recorded, so that teachers can grasp the students' learning status in real time, adjust teaching strategies and implement personalized guidance and assistance.

3) Utilize multi-dimensional teaching evaluation methods. Traditional evaluation methods often focus on summative assessment results and ignore the process and comprehensive consideration. By utilizing knowledge mapping technology, dynamic learning process evaluation is introduced. With the help of knowledge mapping, teachers can continuously track students' mastery of knowledge points and provide real-time feedback on their learning progress, and then evaluate students according to their exploration paths and depth of understanding in the mapping. Introducing the evaluation dimension of cooperation and communication. The social nature of knowledge mapping provides a platform for students to share insights and discuss issues, and integrates the effectiveness of critical thinking training into the assessment system as a reference for evaluation. Implementation of contextualized evaluation. Knowledge mapping has the function of simulating real-life situations, and teachers conduct comprehensive evaluation based on the effectiveness and innovativeness of students in solving contextualized problems.

3.2. Node Centrality Analysis

Civic and political education knowledge graph constructs a complex network structure of knowledge points through nodes representing knowledge concept entities and edges representing the hierarchical structural relationship between knowledge concept entities. When applying the Civic and Political Education model based on knowledge graph to assist teaching, it is necessary to first analyze the node centrality of the model in a certain way, to clarify the core concepts and basic concepts and other specific contents in the knowledge graph, so as to facilitate the design of teaching experimental programs for teachers.

After running the three centrality algorithms on courseKG tool, the three centrality results of each node in the knowledge subgraph are calculated. Table 1 shows the centrality of nodes in the knowledge point subgraph (TOP10). The centrality is output in descending order of degree centrality, proximity centrality, and meso centrality, and only the top 10 knowledge points are listed here. They are: outlook

on life and values, ideals and beliefs, morality and law, ideological and moral literacy, patriotism and national spirit, reform and innovation, spirit of the times, characteristics of the new era, Marxism, and service to the people.

Figure 1 shows the three knowledge point nodes with the highest node centrality ranking. Where 1-16 are the knowledge point node name codes. "Outlook on life and values" is the result of degree centrality algorithm, 'morality and law' is the result of median centrality algorithm, and 'patriotism and national spirit' is the result of proximity centrality algorithm. The results of "Patriotism and National Spirit" are close to the centrality algorithm. It can be intuitively seen that "outlook on life and values" has the largest number of relationships, "morality and law" is an important bridge connecting the two knowledge points, and "patriotism and nationalism" is easier to reach the other nodes in the subgraph. The "Patriotism and Nationalism" is easier to reach other nodes in the subgraph.

Using the degree centrality algorithm, we can find out the knowledge points with frequent transactions, and analyze the scale and association status of the knowledge points, we can find that the maximum value of the degree centrality of the subgraph of this knowledge point is 0.053, and the minimum value is 0.004. According to the index value, we can clearly point out the core knowledge points in the curriculum such as outlook on life and values, ideals, and beliefs.

The centrality algorithm can indicate the connectivity of each knowledge node, and the "pivotal knowledge points" of two knowledge points, which cannot be ignored in the actual teaching process. The maximum value of the meso-centrality of the knowledge subgraph is 1, and the minimum value is 0.01, and the key knowledge nodes such as morality and law, ideological and ethical literacy, etc. are the "bridges" and "links" connecting the courses.

The proximity centrality algorithm is used to find the distance and correlation between knowledge points, which plays a key role in the shortest path for subsequent knowledge point interventions. The maximum value of proximity centrality of this knowledge point subgraph is 0.98 and the minimum value is 0.193, which can be expressed as. The knowledge points of patriotism and national spirit, reform and innovation, and the spirit of the times are closely related to other knowledge points and are not difficult to learn.

Therefore, when teachers formally carry out teaching experiments, they must give priority to grasping the basic and core concepts, emphasizing the interrelationships between knowledge points, and analyzing the role and articulation of individual knowledge points in the teaching content, so as to better utilize the knowledge map-based Civic and Political Education Model to design teaching resources that can reflect the teaching objectives and improve the quality of teaching. Considering the relationship between knowledge points through courseKG, it can be found that when the higher the ranking of knowledge points, the greater their importance, the closer the connection, and the less difficult it is to learn. Based on this characteristic, the teaching arrangement and expansion of knowledge points can be more reasonable, helping students to integrate into the learning of Civics courses more quickly and improving their ability to adapt to learning.

Table 1. Node centrality of knowledge dot graph (TOP10)

Number	Knowledge point name	In-degree	Out-degree	DC_i	BC_i	CC_i
1	Outlook on life and values	6	12	0.053	0.525	0.313
2	Ideals and beliefs	5	11	0.046	0.289	0.329
3	Morality and law	13	3	0.046	0.229	1
4	Ideological and moral accomplishment	12	3	0.043	0.104	1
5	Patriotism and national spirit	7	7	0.040	1	0.474
6	Reform and innovation	9	5	0.040	0.415	1
7	Zeitgeist	10	3	0.037	0.162	1
8	New era characteristics	4	9	0.037	0.139	0.318

9	Marxism	3	9	0.033	0.310	0.394
10	Serve the people	3	2	0.033	0.142	0.401

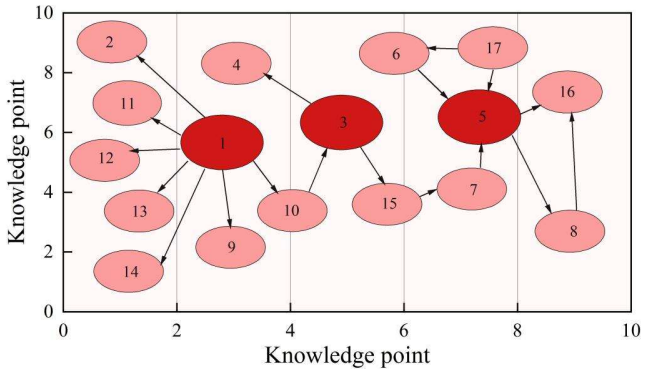

Fig. 1. Three knowledge points with the highest ranking of node centrality

3.3. Experimental design for model application

After analyzing the node centrality and grasping the node association of knowledge points, a controlled experiment of applying the model to classroom practice was designed. Two hundred freshmen from a university were chosen as the experimental subjects, and they were evenly divided into 2 classes of 100 students each for a semester-long experiment. For the study of the Civics course of Ideology, Ethics and the Rule of Law, the case of Basic Issues of Economic Development and Social Progress and the case of Complex Issues of Culture and Education were selected for the practical application of Knowledge Graph-based Civics Education Model. The experimental class was taught with the knowledge mapping-based Civic and Political Education Model as a teaching aid, and the control class was taught routinely. The teaching implementation process was carried out with the help of the practical teaching instructor and two IT teachers from the university. The procedure of this teaching experiment contains three steps: pre-test, post-test and data analysis.

3.3.1. Experimental variables. Independent variable: control class for teachers to conduct regular teaching, experimental class for teachers and students to conduct teaching using the knowledge graph-based model of Civic and Political Education as a teaching aid.

Dependent variable: changes in students' knowledge structure and cognitive structure.

Interfering variables: teachers' teaching styles, attitudes and emotions; initial levels of students in both classes.

3.3.2. Experimental subjects. Based on the results of the university's freshman college entrance examination, 200 students were divided into control and experimental classes. The control class was class A (100 students) and the experimental class was class B (100 students). The students in the two classes had essentially the same performance in the subject of politics in the college entrance examination. Before the knowledge graph-based Civic and Political Education model was integrated into the teaching practice, the students' scores in the college entrance examination political science subject were used as the pre-test data. In order to make the score analysis and comparison more accurate and intuitive, SPSS-26 software was used to compare and analyze the scores of the experimental class and the control class. Figure 2 shows the pre-test scores of the experimental and control classes. From the box plot of the pre-test scores, the mean value of the experimental class scores is 62.53, and the difference between it and the 62.07 of the control class is small. After the independent samples t-test, the significance is greater than 0.05 (t=0.184, Sig=0.808), indicating that there is no significant difference in the achievement of students in the two classes before the teaching experiment using the knowledge mapping-based model of Civic Education. Through the above analysis,

the cognitive starting point and academic level of the two classes are basically the same can be selected as the experimental class and control class of the Civics and Politics teaching experiment. In addition, both classes were taught by the same Civics teacher, with the same teaching progress and teaching style.

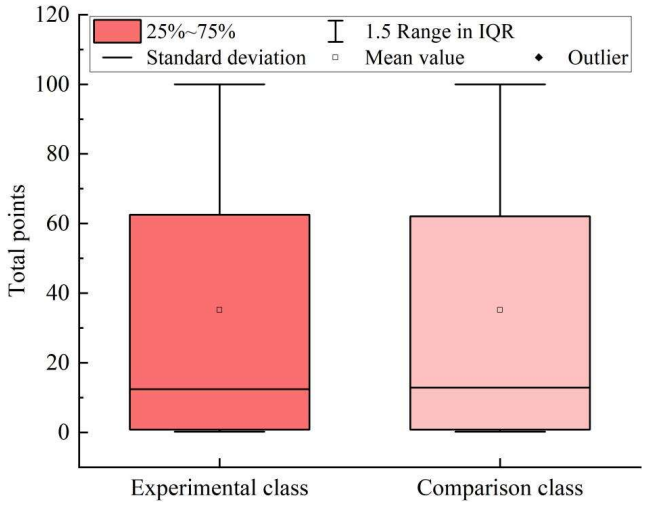

Fig. 2. Pre-test results of experimental class and control class

3.3.3. Analysis of experimental results. As a visualization tool, one of the beneficial effects of the knowledge mapping-based Civics education model on education and teaching is to help students establish the connection between basic knowledge, new knowledge, and expanded knowledge, which in turn promotes the cultivation of students' Civics competence, realizes learning by example, and improves the efficiency and effectiveness of Civics learning. The study analyzes the performance of the test questions of Ideological Ethics and the Rule of Law in the experimental class and the control class through the application of Civics Knowledge Mapping for Complex Issues, and explores the effectiveness of the Civics education model based on Knowledge Mapping in the practice of Civics teaching for Complex Issues.

The subject knowledge involved in the test questions of Ideology, Ethics and the Rule of Law can be roughly divided into three categories: basic knowledge, new knowledge and expanded knowledge, all of which are single-choice questions with a duration of 30 minutes and a total score of 100 points. Using SPSS-26 software to carry out independent sample t-test on the test scores of the experimental class and the control class after the experiment, the results show that the significance is 0.001, which is less than 0.05, indicating that there is a significant difference in the learning achievement of applying the knowledge map-based model of Civic Education in Civic Education. Looking at the overall situation, on the one hand, the average score of the test questions in the experimental class was 71.25, and the average score of the control class was 62.4; on the other hand, the average submission time of the test questions in the experimental class was about 17 minutes and 56 seconds, and the average submission time of the test questions in the control class was about 28 minutes and 03 seconds. The experimental class scored higher on the test questions and answered them faster. Figure 3 shows the results of the comparison of the correctness of the whole set of test questions between the experimental and control classes. The correct rates for questions 1-6 in the control class were 86.26%, 52.93%, 72.54%, 50.97%, 52.93%, and 74.5%, respectively; and the correct rates for questions 1-6 in the experimental class were 88.01%, 58.01%, 80.01%, 68.01%, 60.01%, and 82.01%, respectively. The correct rate of the experimental class is higher than that of the control class in the specific topics of the whole set of test questions, which indicates that the application of the Civic and Political Education Model based on Knowledge Graph has a positive effect on improving students' learning level.

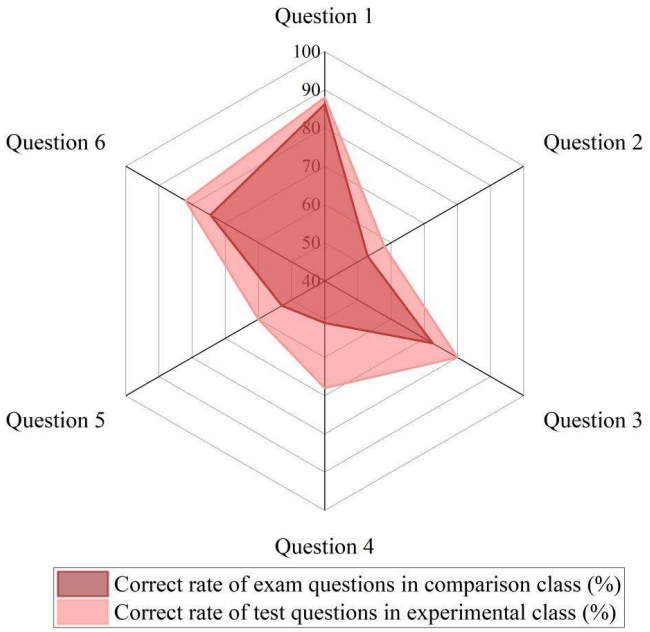

Fig. 3. Comparison of the correct rate of the two classes

3.3.4. Statistics on Teaching Satisfaction. Analyzing the results of the control experiment, the level of the experimental class using the knowledge mapping-based Civic and Political Education Model as an auxiliary teaching tool is significantly higher than that of the control class, which verifies the practicality of the model. The students in the experimental class were given questionnaires to carry out teaching satisfaction statistics, to understand the students' evaluation of the use of the model to assist teaching, so as to facilitate the teachers to improve the knowledge map-based Civic and Political Education Model, and to intelligently organize and manage the relevant knowledge resources in the Civic and Political Education content system.

Data collection and statistics on the questionnaire. Figure 4 shows the distribution of students' actual satisfaction with the use of knowledge mapping-based Civic and Political Education Model for assisted teaching. From the overall distribution characteristics, it can be seen that most of the students' satisfaction is above 65 points, and the satisfaction of some students even reaches 100 points. It shows that this intelligent teaching method of using knowledge mapping-based Civics education model for Civics teaching can be accepted and recognized by most students.

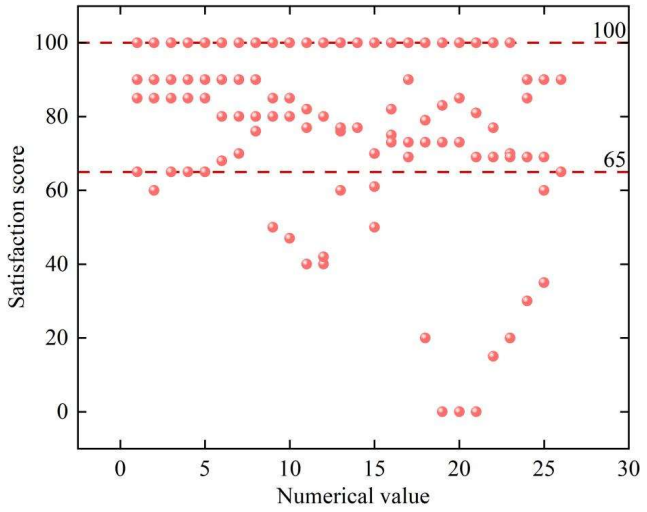

Fig. 4. Distribution of student satisfaction

Classroom interestingness is of great pedagogical significance to enhance the level of students' motivation to learn Civics and cultivate their enthusiasm for learning Civics knowledge. Data statistics on students' classroom satisfaction, Figure 5 shows the results of classroom interestingness statistics. In the intelligent context classroom using the knowledge mapping-based Civics education model for teaching, about 92% of the students gave an interestingness satisfaction between the interval (75,100], that is, they thought that the classroom teaching under the model had a high interestingness. The introduction of Civics education model based on knowledge graph helps to enhance the fun of Civics classroom and attract students to actively participate in classroom learning.

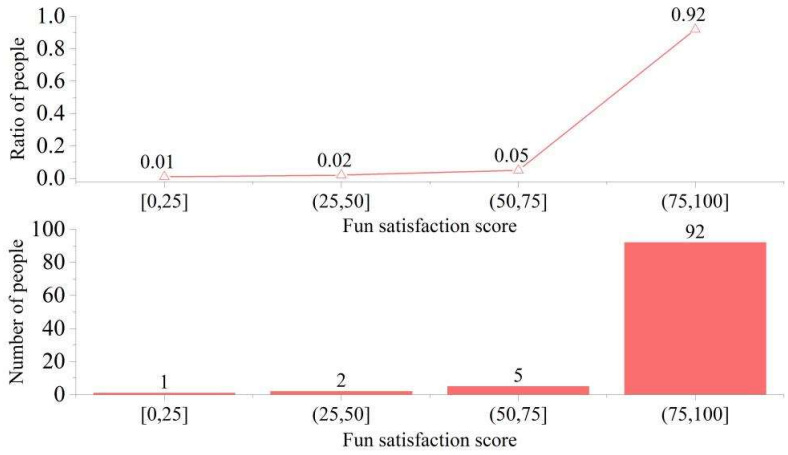

Fig. 5. Classroom fun statistics

Whether the teaching content is mastered or not is of great indicative significance for evaluating the effectiveness of a teaching model, so this study investigates and counts for the students' satisfaction level in content mastery when analyzing the data statistics. Figure 6 shows the content mastery satisfaction statistics. 90% of the students have a satisfaction level of 85 points and above, indicating that the introduction of the knowledge graph-based Civics education model for assisted teaching can help students fully understand the Civics knowledge points and construct the Civics curriculum system.

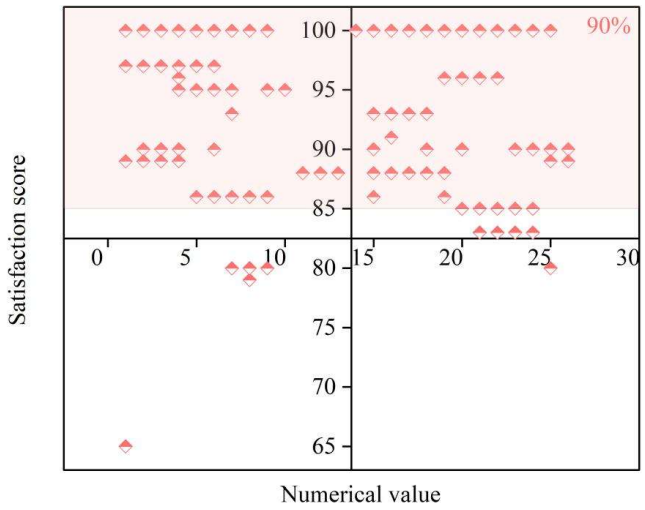

Fig. 6. Content mastery satisfaction

4. Conclusion

This paper constructs a knowledge graph-based Civics education model and applies it as an auxiliary teaching resource in actual Civics teaching to help students construct a perfect Civics knowledge

system and enhance their interest in Civics learning. Three centrality algorithms are used to calculate the center nodes of the Civics knowledge graph, and the top three center nodes are “outlook on life and values”, “morality and law”, “patriotism and nationalism”. Combined with the bridging role of these three central nodes and other characteristics, when Civic Teachers use the knowledge graph-based Civic Education Model to carry out actual teaching, they can appropriately connect relevant Civic knowledge points to help students deeply understand the connotation of Civic knowledge of a certain chapter and build their own personalized Civic system.

Setting up a controlled experiment on the knowledge graph-based model of civic education. Analyzing the average test scores of the experimental and control classes after the experiment, the average score of the test questions of the experimental class was 71.25, which was nearly 10 points higher than the average score of the control class. Also, the experimental class answered the test questions faster than the control class. Statistical data on the evaluation of this intelligent teaching model by the students in the experimental class. The majority of students had overall satisfaction levels in the [65,100] range. Around 92% of students believe that using knowledge graph-based Civic Education model for intelligent teaching. It can enhance the interest of the classroom. around 90% of the students are on the [85,100] range for content mastery satisfaction.

Introducing the knowledge graph-based Civics education model as an auxiliary teaching tool in actual Civics teaching can improve students' satisfaction with the classroom and better help them master Civics knowledge points. Comprehensive analysis of the reasons for this is mainly based on the knowledge map of the civic education model introduced intelligent knowledge representation, so that the knowledge map of the various types of civic knowledge is more closely linked, and can be targeted according to the student's learning path, such as the intelligent recommendation of relevant knowledge, thus helping students gradually build their own civic system, clarify the learning ideas, and form a virtuous cycle of the learned knowledge points - related knowledge points - knowledge system. At the same time, combined with the students' exercises, etc., the knowledge map can be further updated, so that the organization of the content in the knowledge map-based Civic and Political Education Model can be more in line with the changing learning needs of the students, and ultimately help the students to improve the level of Civic and Political Education. Overall, the knowledge map-based Civic and Political Education Model has high application value.

References

[1] Zhang, D., Chen, J., & Zhang, M. (2022). Practical Exploration on the Deep Integration of Ideological and Political Education and Curriculum Teaching—Taking Modern Educational Technology as an example. Open Journal of Social Sciences, 10(13), 44-54.

[2] Yang, D., Liu, S., Fu, H., & Shen, J. (2024, September). Research and Practice on the Construction of Course Ideological and Political Education Based on Knowledge Graphs and Large Language Models. In Proceedings of the 2024 International Symposium on Artificial Intelligence for Education (pp. 193-198).

[3] He, T., & Wei, S. (2024). Hybrid Teaching Platform Design for Ideological and Political Courses Based on K-Means Clustering. In Intelligent Computing Technology and Automation (pp. 660-668). IOS Press.

[4] Zhang, T., Huang, G., & Liao, H. (2023). Research on a New Teaching Model Combining" Project Oriented" with Curriculum Ideological and Political Education. Curriculum and Teaching Methodology (12). doi: 10.23977/CURTM.

[5] Ouyang, S., Zhang, W., Xu, J., Rashid, A. M., How, S. P., & Hassan, A. B. (2024). Unmasking the challenges in ideological and political education in China: A thematic review. Heliyon.

[6] Huang, C. (2023). Research on the Design and Implementation of Ideological and Political Curriculum in Normal University. The Educational Review, USA, 7(4), 416-420.

[7] Tian, F. (2023). Case Study and Practice of Ideological and Political Education in the Course. Advances in Educational Technology and Psychology, 7(13), 64-71.

[8] Yongliang, Z., Qian, L., & Han, W. (2024). Integration of Ideological Education and Curriculum Teaching on. Advances in Educational Technology and Psychology, 8(3), 153-158.

[9] Wang, H., Zhao, X., & Shen, Z. (2021). Curriculum Design Based on Knowledge Graph. International Journal of Information Technology, 27(1).

[10] Ramazanova, V., Sambetbayeva, M., Serikbayeva, S., Sadirmekova, Z., & Yerimbetova, A. (2024). Development of a knowledge graph-based model for recommending MOOCs to supplement university educational programs in line with employer requirements. IEEE Access.

[11] Cao, Z. Y., Lin, F., & Feng, C. (2024). Interpretation of course conceptual structure and student self-efficacy: an integrated strategy of knowledge graphs with item response modeling. BMC Medical Education, 24(1), 563.

[12] Meng, B., & Yang, F. (2025). Design of Computer-Aided Instruction Model Based on Knowledge Graph Construction and Learning Path Recommendation. International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 20(1), 1-16.

[13] Huang, Z., Tian, R., & Fu, G. (2024). Mining and Teaching Practice of Ideological and Political Course Elements Based on Text Extraction and Knowledge Graph. Journal of Combinatorial Mathematics and Combinatorial Computing, 119, 95-104.

[14] Feng, T. (2023). Research on the development path of internet ideological and political education based on deep learning. Soft Computing, 1-10.

[15] Yao, Y. (2023). Research on the Utilization Path of Ideological and Political Education Data based on the DIKW Model. Academic Journal of Management and Social Sciences, 5(1), 92-98.

[16] Wang, R. (2022). Research on the Application of Mobile Devices and Mind Map in Curriculum Ideological and Political Education. Curriculum and Teaching Methodology, 5(11), 37-43.

[17] Chan, J. C., Wang, Y., Li, Q., Baciu, G., Cao, J., Huang, X., ... & Ng, P. H. (2022, November). Intelligent instructional design via interactive knowledge graph editing. In International Conference on Web-Based Learning (pp. 41-52). Cham: Springer International Publishing.

[18] Yang, Y., Chen, S., Zhu, Y., Zhu, H., & Chen, Z. (2023). Knowledge graph empowerment from knowledge learning to graduation requirements achievement. Plos one, 18(10), e0292903.

[19] Gao, J., & Wu, L. (2023, August). Research on Multimedia Distance Education Resource Management System Based on Knowledge Graph. In International Conference on E-Learning, E-Education, and Online Training (pp. 111-125). Cham: Springer Nature Switzerland.

[20] Troussas, C., Krouska, A., Tselenti, P., Kardaras, D. K., & Barbounaki, S. (2023). Enhancing Personalized Educational Content Recommendation through Cosine Similarity-Based Knowledge Graphs and Contextual Signals. Information, 14(9), 505.

[21] Dong, J., Li, W., Wang, Y., Li, Q., Baciu, G., Cao, J., ... & Ng, P. H. (2023, November). Gradual Study Advising with Course Knowledge Graphs. In International Conference on Web-Based Learning (pp. 125-138). Singapore: Springer Nature Singapore.

[22] Niu, Y., Lin, R., & Xue, H. (2023). Research on Learning Resource Recommendation Based on Knowledge Graph and Collaborative Filtering. Applied Sciences, 13(19), 10933.

[23] Grévisse, C., Manrique, R., Mariño, O., & Rothkugel, S. (2018). Knowledge graph-based teacher support for learning material authoring. In Advances in Computing: 13th Colombian Conference, CCC 2018, Cartagena, Colombia, September 26–28, 2018, Proceedings 13 (pp. 177-191). Springer International Publishing.