Fuzzy Systems and Data Mining VI
A.J. Tallón-Ballesteros (Ed.)

doi:10.3233/FAIA200753

Monitoring the Development Quality of College Students Based on Knowledge Graph

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Abstract. With the rapid development of higher education, how to innovate management means and ensure the quality of education is an urgent problem faced by higher education management. The paper focuses on a large number of data that include students' enrollment performance, family status, lessons performance, volunteer service, competition, rewards and punishments, social practice, etc. And it puts forward an education quality monitoring means that uses knowledge graph to reveal students' development and can guide the development of students according to the needs of local talents. The means includes three parts: the current situation of students' development, the early warning of development and the guidance of development. Finally, taking the postgraduate education in School of Information Science and Technology, North China University of Technology as an example, it demonstrates the feasibility and effectiveness of the means.

Keywords. Knowledge graph, higher education, quality monitoring

1. Introduction

With the development of China's higher education, the focus of its development has shifted from expanding its scale to improving its quality. Therefore, the management of education in universities is facing an urgent problem that is how to steadily improve the quality of education with the current large scale of undergraduate enrollment. And higher education informatization is an important means to solve this dilemma.[1-2] “Ten year development plan of education informatization (2011-2020)” issued by the Ministry of education of China clearly points out that[3] "education informatization is an effective way to promote education reform and improve quality of education."

In the process of education informatization in China, the education informatization platform has been mature and widely used in universities, which greatly facilitates the education management and has accumulated a lot of data information. However, how to transform all kinds of scattered and large-scale management data (in trillions of bytes) into information that can be understood by educational administrators and guide their work (in thousands of bytes), is a hot issue in the development of higher education informatization, and also the key to the innovative development and quality improvement of higher education[4]. At present, there are relatively excellent research results [5-7], such as practice monitoring, curriculum monitoring, and employment monitoring, etc. However, all aspects of students’ development should interact and

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promote each other. So, we can better improve the quality of education with the overall research. This is also the new task of education informatization.

The research of knowledge graph can provide a feasible research method for the new task of higher education informatization under the new stage. It consists of two parts. One is to acquire knowledge with big data technology; the other is to display the knowledge with graphs, which is one of the most advanced information technologies. And it can integrate all kinds of information and discover knowledge from the massive and complicated words, symbols and digital information [8]. Therefore, how to use knowledge graph to mine and show the laws in the process of education, and then guide the daily work of universities? The paper analyzes these problems in monitoring the development quality of college students, and proposes a means on monitoring the development quality of college students based on knowledge graph that includes knowledge graph of student development, big data monitoring and early warning of student development, and analysis of student development oriented by talent demand. It has realized the integration, analysis and display of scattered students' information with knowledge graph.

2. Problems in monitoring the development quality of college students

2.1. Dispersion and fragmentation of students' development information

Whether monitoring a professional development quality or a individual，it is to monitor the overall indicators, because the result will be one-sided by monitoring part indicators. However, in the process of training students from enrollment to graduation, the indexes information is complex and scattered, and even stored in different management departments. They include students' enrollment performance, family status, lessons performance, volunteer service, competition, rewards and punishments, social practice, etc. [9-10]. University administrators in different positions have access to only the part information about own work, so it is difficult to know the dynamic development of students and the gap between their current situation and training objectives. Access to comprehensive information requires the collaborative operation of multi-post staff, which can not be achieved under normal working conditions [11]. However, in order to achieve accurate monitoring of students' development quality, it is necessary to monitor the overall information of individuals. Therefore, how to systematically understand the overall information in the cultivation process is the primary problem in the monitoring process.

2.2. Lack of early warning mechanism

The management standards of colleges and universities are different. Each counselor is basically responsible for 200 students, and each educational administration personnel is responsible for a major specialty [12]. In fact, with the popularization of higher education, a counselor must manage far more than 200 students, and a management staff has to face the academic management of nearly a thousand students, or even more. This is all the more so for those universities located in first tier cities such as Beijing, Shanghai and Shenzhen. On the one hand, fine manual management is difficult to achieve, on the other hand, students who fail in many courses are regarded as academic difficulties. It's hard to change the academic dilemma, which is the key problem [13].

Often such students can not graduate smoothly, that is the failure in training. Any result is not achieved overnight. If we can timely find out abnormity in the long process of development, especially in the early stage of emergence, the academic guidance of our university staff can play a better role. So, to reduce the training failure cases, how can we discover the individuals with academic difficulties among thousands of students before the academic difficulties have developed? It is not easy to find abnormal individual performance from all kinds of complex training information, and it is impossible to achieve without advanced information technology.

2.3. The backward tracking technology of college students' employment quality

The quality of students' development is good or not, which depends on their employment evaluation. Therefore, the local talent demand should be the guidance of students' development in order to achieve a better match between students and employment companies. The existing quality tracking of students' employment is mainly based on questionnaire survey or company satisfaction survey [14]. On the one hand, the coverage of the survey is not complete. On the other hand, it is lack of sustainability. There is no dynamic development tracking of a whole major. At present, the tracking technology only can get a research report. Either it does not play a practical role in the development of specialty, or it does. However, due to the limitations of research, it can not play an effective role in guiding specialty construction. In addition, it is difficult to accurately reflect the professional market demand by the results of irregular and limited research [15]. The comprehensive and sustainable research should depend on advanced information technology.

These current sustainable researches of college students' employment quality have lagged behind the needs of education development. So, based on the needs of local talent, how to rely on advanced information technology to achieve the accurate guidance of students' development?

3. Monitoring means of college students' development based on knowledge graph

In view of the above problems, the main idea of this means is as follows. The scattered information is integrated with distributed database technology, and the student development database is constructed based on the campus LAN. On the one hand, the big data association mining technology is used to discover the crisis factors that affect learning, and they are stored in a crisis database. On the other hand, we use big data classification technology to find the correlation between the quality of students' employment and the data of students' development. So, we can classify students' development indicators according to different employment, and build a knowledge base of students' development oriented by employment demand. Finally, the knowledge graph is used for visualization display. One is to display the dynamic development of students during the school period, and the gap between the indicators and the professional training objectives; the other is to show the gap between the development of the students and the target of graduation. Once the crisis event is triggered and then academic warning will appear, we can clearly see the situation of students from individual knowledge graph, including the relationship between students, academic performance, extracurricular development, etc.

3.1. Knowledge graph of college Students' development

The knowledge graph can integrate the distributed information in the process of student development. And it dynamically can not only show the various indicators of students' individual development, but also show the gap between individual students and professional training. A knowledge graph of an individual student makes all individual development information clear and be shared, so that the administration personnel can check the personal development of students at any time and guide them accordingly. At the same time, it can also help students to understand their academic situation as a whole and correct their self-development timely.

Figure1. The graph of a postgraduate in school

Firstly, the concept model of the knowledge graph should be constructed. Taking students as the noumenon, it defines the development indicators of students as attributes, and the relationship between development indicators as the correlation of attributes.

Secondly, its data model should be constructed. Its concept mode will be instantiated with attribute set and relation set.

Thirdly, the database of student development information is integrated. It is a distributed relational database, which integrates the information of various management platforms.

Fourthly, the knowledge graph is realized. Formal language can be used to describe the research information. And the knowledge graph of students' development can be realized with Protege program.

3.2. Early warning mechanism of college students' development crisis

There are some significant associations between the results of students' academic development and the training factors, and they can be discovered with the big data intelligent analysis technology. So, the database of student development rules is constructed. Once the impact event is triggered or the individual student deviates from the normal development path, it will quickly remind the university administrators and the students themselves. Before the emergence of academic difficulties, problem individuals can be found in time, such as failure in several courses. So we can guide the students to solve the difficulties earlier. In the case of more students and less management, reducing failed individuals is of great significance to improve the students' development quality in higher education stage.

Firstly, the information of students' development is discretized. There are many types of students' development information. In order to realize its' comprehensive analysis and operation, we should first discretize the information. The discrete range of the various development information is determined based on the big data intelligent computing model, so as to realize the discretization of all information.

Secondly, the mathematical model of dynamic warning is constructed. The rules are represented by mathematical models to realize the reasoning of early warning. The "and" mode is used to express the relationship among multiple conditions.

Thirdly, the warning of academic is established. The early warning system can automatically warn the students with learning difficulties in advance. According to the warning information, we can make academic supervision more detailed and accurate with the knowledge graph of students' development.

3.3. The optimization of college students' development oriented by talent demand

The big data technology can analyze the local vocational recruitment demand in recent years, and excavate the matching path of personal career goals with local talent demand. So we can get the association between different posts demand and key links of student development, and form association rules to guide students' development. Taking local talent demand as the guidance and individual career demand as the goal, we can guide students to develop with higher target to achieve students' career satisfaction and employers' satisfaction. This can make local universities better train applied talents for the local.

Firstly, we define the range of matching degree between employment target and actual employment.

Secondly, we mine the relationship between students' development links and post demand with the association analysis method based on big data. Because the data of individual students are independent, the parallel operation mechanism is used to extract the conditions of excellent students' development and the relationship between the conditions and the employment.

Thirdly, the association rules database is built. Based on the extracted association, the employment data is taken as the antecedent, and the student development information is taken as the consequent to build the association rule database.

Fourthly, the research results are used to guide the development of students. From students' career goals, including employment quality and employment type, we can know the conditions that students need to meet with intelligent reasoning. Combined with the knowledge graph of students' development, we can make clear the direction

that students need to work hard, and then help students get more targeted guidance.

4. Application cases

Taking the postgraduates in School of Information Science and Technology, North China University of Technology as an example is following. In recent years, the number of students enrolled has tripled. At present, there are more than 600 postgraduates on campus. One educational administration and one counselor are assigned to their daily management. The above-mentioned means is used to build a management platform, which realizes multi-department collaborative office.

Students with academic difficulties are found in time with early warning mechanism, and their problems are comprehensively understood and analyzed from their individual knowledge graph, and the key guidance is given to effectively help them out of their learning difficulties. Since 2014, there are 15 students with academic early warning in the college. Among them, 13 students have improved their academic status after guidance (seeing Table 1 for details over the years), and eight of them have successfully graduated and obtained satisfactory job positions, and five of them have come out of their academic difficulties at school, and one of them needs further guidance, and one of them has dropped out of school. The effect of academic warning function has achieved remarkable results with the knowledge graph of student individual.

Table 1. Academic warning situation

year	2014	2015	2016	2017	2018	2019	2020
number of students warned	3	1	2	4	2	3	0
number of students improved	2	1	2	3	2	3	0

In addition, students' development is guided by employment demand based on the knowledge graph of individual development, which promotes students to know their own learning objectives and development plans. This not only promotes students to graduate smoothly, but also improves their employment satisfaction. Since the student development has been differently guided according to the employment demand, the employment rate of the college has been 100% in the past five years, and the employment satisfaction is higher than local level. (see Figure 2).

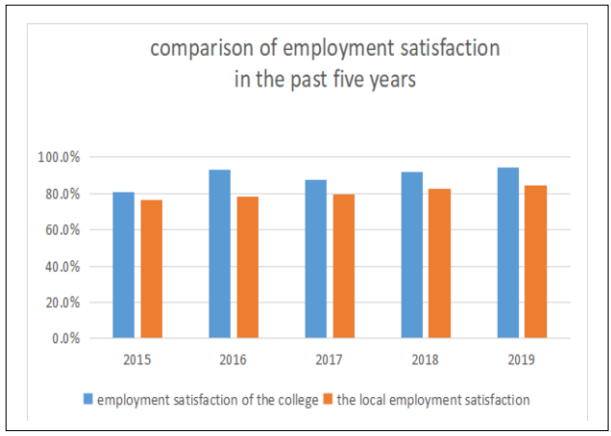

Figure 2. Comparison of employment satisfaction in the past five years

With the help of knowledge graph, satisfactory results have been achieved in improving students' academic performance and employ quality. The platform can display students' personal information comprehensively, which greatly facilitates the coordination of multi-department staffs and promotes the management effect.

5. Conclusion

The informatization process of higher education has achieved the stage of informatization of management platform. It is an important to discover rules and guide practical work. And the relevant research is of great significance to improve the quality of talents in higher education. The development of knowledge graph meets the actual needs of higher education informatization. The monitoring means of college students' development based on knowledge graph is effective and feasible. It can integrate the scattered information of students, display the dynamic development of students, and effectively promote the management of students' training.

References

[1] YING Huiqiong, SU Rong. Promoting practical teaching in applied undergraduate colleges by quality monitoring data. Research and exploration in laboratory. 2020, 39(1):236-240.
[2] WU Jin, ZHANG Yu, HUANG Lifei .Improving the quality of postgraduate training for professional degrees in applied universities. Education and vocation. 2020, (03): 34-41.
[3] FENG Shilan, TAN Ya, JIN Wenwang, JIANG Cheng. The quality of higher education in China and the starting salary of college graduates: a quantitative study based on the survey of employment status of college graduates across the country. World economics collection, 2019, (03): 73-84.
[4] WANG Xingyu. The value turn of the evaluation of the learning achievement of American college students. Development and evaluation of higher education. 2019, 35(05):27-37+114-115.
[5] ZHU Hong. Research on the high-quality development path of international student education. Jiangsu higher education. 2020,(01):64-71.
[6] YANG Dongxiao. Research on the strategies of improving the quality of postgraduate courses from the perspective of course subject incentives. Degree and postgraduate education. 2020, (01):43-47.
[7] PAN Zisong, YAN Cen. A survey of college students' employment situation under the guidance of improving employment quality. Heilongjiang higher education research. 2019, 37(12):139-142.
[8] YING Shuang. Constructing a graduate education quality system with interactive growth between subjects——based on the perspective of psychological contract and service essence. Degrees and graduate education. 2019, (12):7-12.
[9] WANG Jing. Research on the ideological and political work system and team building strategies in colleges and universities. Research in higher engineering education. 2019,(S1):303-304+308.
[10] TAN Chuansheng. Research on the innovation of practice education mechanism in colleges and universities.School party building and ideological education. 2019, (24): 61-63.
[11] CAI Yun, SHI Banghong .Improvement of the model of the measurement factors of higher education quality. China higher education research. 2019, (04):74-79.
[12] PENG Zhengxia, LU Genshu, LI Lijie. Analysis on the influencing factors and paths of university graduates' employment quality. China higher education research. 2020, (01): 57-64.
[13] PENG Zhengxia, LU Genshu. Gender differences in employment quality of university graduates: an analysis based on multi-group structural equation model. Fudan education forum. 2020, 18(01):59-67.
[14] XIE Weiqun, XU Shuo, YU Liying .Evaluation and improvement of the quality of innovative and entrepreneurial talent training. Science and Technology of Chinese Universities. 2019, (11):41-44.
[15] YANG Yi, XIA Huixian. The conception and realization path of the diversified cultivation of doctoral students——based on the reflection of 20 years of research on the quality of doctoral education in my country. Graduate education research. 2020, (01): 15-21.