ISSN:2790-167X Volume-5-(2023)

Research on the application of data mining in the quality monitoring of talent training in private universities

Yu Sun [1, a], Liwei Tian [2, b]

[1]School of Management, Guangdong University of Science and Technology, Dongguan City, Guangdong Province, China;

[2]School of Computing, Guangdong University of Science and Technology, Dongguan City, Guangdong Province, China;

[a] 57694230@qq.com, [b] 656453927@ qq.com.

Abstract. How to achieve the coordinated development of education scale and talent training quality is closely related to the revitalization of the nation and the future of the country, and is also the only way for private universities to survive and seek development. According to the survey and statistics, the students of private universities have relatively weak independent learning ability and lack of self-supervision. Therefore, in addition to the reform of talent training mode, private undergraduate universities also urgently need to improve the corresponding talent training quality monitoring system. This paper uses data mining technology and statistical analysis methods to carry out relevant research on the quality monitoring of talent cultivation in private universities at this stage. The research results can provide reference for improving the monitoring and evaluation management of talent cultivation quality in private universities.

Keywords: private university; Quality monitoring; data mining.

1. Introduction

The quality of talent training is the most important standard to measure the level of running a university. The UK uses the coordination and cooperation of the Higher Education Quality Committee and the Quality Evaluation Committee to review the quality of education through social supervision, supervision of the education department, parallel supervision, and supervision of teachers to students [1]; Japan mainly supervises and manages the evaluation of university education quality through the implementation of the "University Setting Benchmark" and other regulations. In general, the quality of education in foreign colleges and universities is mainly controlled by the way of off-campus monitoring by governments and research institutions.

China's higher education quality monitoring usually includes three levels of monitoring: national macro monitoring, provincial mesoscopic monitoring, and university self-monitoring [2]. From the perspective of internal talent training quality monitoring in colleges and universities, Chinese scholars have built an internal teaching quality monitoring system that conforms to the characteristics of colleges and universities. From the relevant literature, Wang Xiaowu took Anhui Xinhua University as an example to explore the practice of constructing the internal teaching quality monitoring system of "three levels, four supervisors and five systems" in private undergraduate universities [3]; Li Xianfeng put forward the principles and content system for the construction of practical teaching quality monitoring system in private universities [4]. With the development of information technology, the data of teaching management and monitoring system has been increasingly improved, and various monitoring systems using data mining and machine learning have emerged as the times require. For example, Liang Qiang [5] proposed the evaluation and optimization research of university talent training mode based on data mining technology; Wang Chuyue [6] and others proposed to use the random forest algorithm in ma-chine learning to build a talent demand model. Based on above, this paper explores and analyzes the monitoring of talent cultivation quality in universities using data mining technology.

2. Related work

2.1 Data mining technology

Data mining is a data analysis technology that can process a large amount of data. Common analysis technologies include: cluster detection, decision tree, neural network, regression analysis, etc. [7]. Data mining technology can find out the homogeneity, commonness and relevance of things, classify and cluster them, and predict the future development trend of things by mining the hidden meaning of historical data. At present, data mining technology has been widely used in various fields such as government management decision-making, business operation, scientific research and industrial enterprise decision support. Therefore, introducing data mining technology into the field of higher education, mining out the key information hidden in talent training, and applying it to the talent training quality monitoring system can not only provide the most direct basis for talent training mode innovation, but also further improve the quality of talent training in universities.

2.2 Learning state analysis and curriculum warning.

The students' learning status is the core content of quality monitoring, and the students' course performance is the direct basis to reflect the course learning effect. Through monitoring and analyzing the relationship between the students' subject performance, clarify the complex relationship between the professional course systems, and combine the students' course learning status, provide early warning suggestions and assistance measures for follow-up courses for vulnerable students, so as to improve the students' course learning effect, and standardize and guide the students' development process, improve the quality of talent training, meet the graduation requirements, and successfully graduate, then effective quality control can be achieved.

Course early warning is to predict the course results in advance through data mining technology, and implement the course early warning mechanism to ensure that students can successfully complete the target requirements of subject knowledge, ability and literacy, and graduate successfully [8]. Realize early prompt for students who may have poor or even failed in learning, significantly eliminate the negative impact on follow-up courses, and improve learning quality [9].

3. Model building

After the above relevant research, the author concludes that the quality monitoring of talent cultivation in universities can be implemented around the level of teachers, the effectiveness of curriculum learning, the ability and quality of students, and the employment status of students. We need to use data mining technology to effectively use the above-mentioned monitoring factors of talent training quality to help universities make more scientific and rational management decisions. Combined with relevant research, the technical route of talent training quality monitoring based on data mining is designed, as shown in Figure 1.

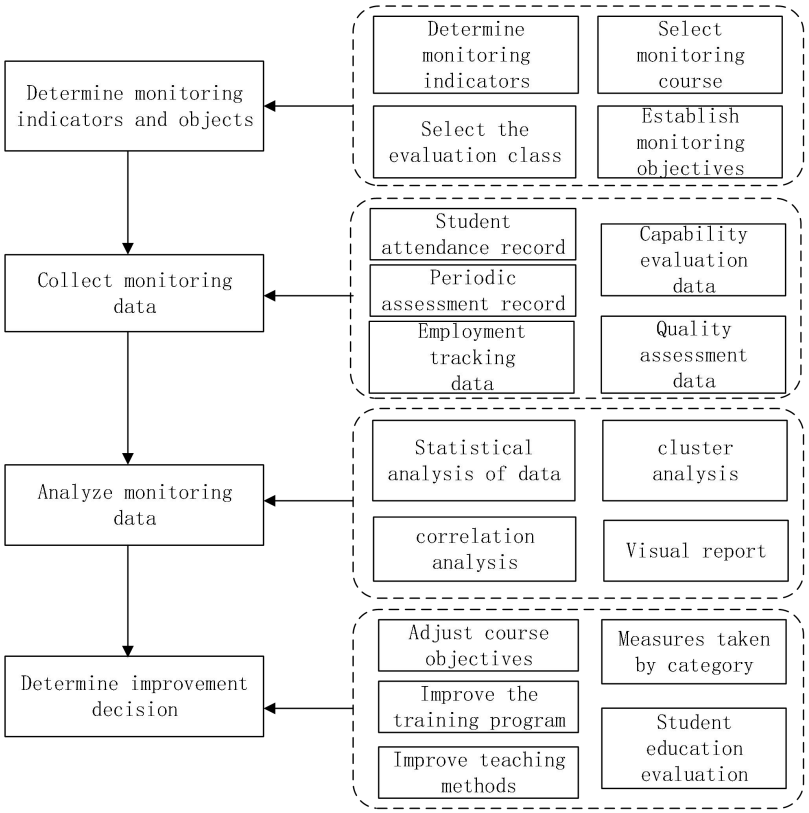

Fig. 1 Technology roadmap

4. Implementation process

4.1 Data collection and preprocessing

The data source of this paper is collected from the first semester of the 2022-2023 academic year of the 2021 major of big data management and application in a private university. The students of this major are the first batch of students of big data management and application in the university, with a total of 160 students. The teaching goal of the professional teachers is to cultivate students' project practice ability in stages, and the teaching reform is carried out by means of stage assessment. The collected data sources include student number, name, course name, phased course examination results, literacy evaluation data and other data. In the data preprocessing phase, it is necessary to count the results of the five phased examinations of the core professional courses "Data Structure", "Operations Research" and "Statistics" in this semester. The collected results need to be classified and statistics and data cleaning to eliminate the incomplete data caused by special reasons.

4.2 Data analysis and results

4.2.1 Judge the basic ability of students through stage test analysis, and analyze the learning situation.

Due to the relatively low entrance examination scores of students in private universities, their autonomous learning ability is weak and their quality is uneven [9]. Therefore, it is a very important link in the quality monitoring of talent cultivation to find students with outstanding ability and weak foundation from the first stage of assessment. This paper analyzes the results of the first phase of the three core professional courses "Data Structure", "Statistics" and "Operations Research" that were offered in the semester. As can be seen from Figure 2, due to the strong logic of Data Structure, the students' understanding ability of Data Structure is not enough. The average score of the first stage is low, but we also find students with excellent ability. They can be trained as reserve players in relevant competitions and continue to improve their professional skills. From the box

chart of Operation Research, we can see that the average score of the students is the highest, but there are also some students whose scores are not ideal, which indicates that the foundation of these students is weak, and we should also focus on these students in the subsequent course study.

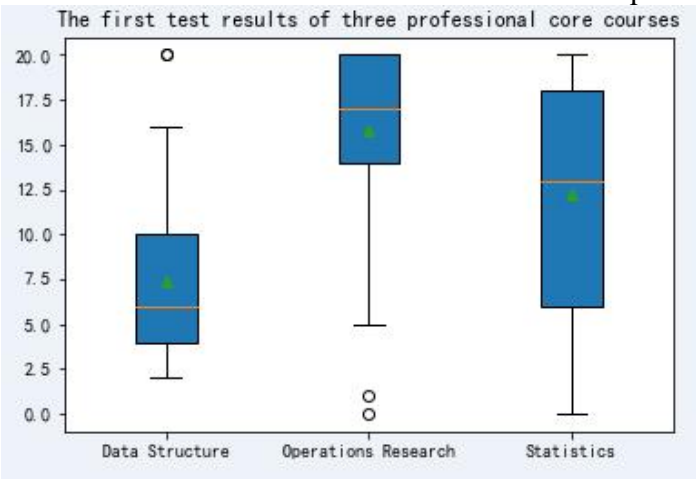

Fig. 2 Technology roadmap

4.2.2 Carry out correlation mining on the collected data.

In the supervision and control of talent training quality, it is not only necessary to judge the training quality based on the test results, but also need to add data such as ability assessment, literacy assessment, employment assessment, attendance, and periodic assessment. Since this major is only open until the second academic year, the statistics are not perfect. This paper analyzes the data of Statistics this semester. From Figure 3, we can see that the attendance scores, classroom performance scores and final examination scores are analyzed by Pearson correlation coefficient, Kendall correlation coefficient and Spearman correlation coefficient, and the corresponding results are all positive correlation. This means that students' learning attitude has a positive correlation with the final exam results, so teachers need to monitor the teaching effect of students in an all-round way.

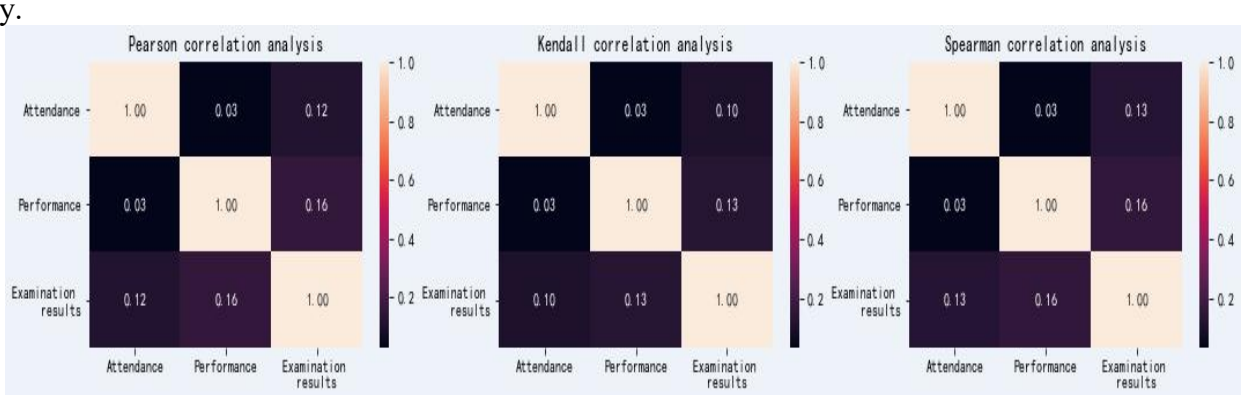

Fig. 3. Thermal diagram of correlation analysis

4.2.3 Realize learning early warning.

Since the major of big data management and application of the university has just come into contact with the professional core courses this semester, the course difficulty is increased and the students are not adaptable, so the overall performance in the first stage of the professional courses is not ideal, and the failure rate is high. In order to better understand the learning situation of students and help students with learning difficulties shorten the transition period, it is necessary to establish a learning early warning system. First of all, according to the results of the assessment data in the second and third stages, the K-means method in data mining is used to classify the learning status of students. Considering that the grades of students are divided into four grades: excellent, good, medium and poor, the number of categories in the K-means algorithm is selected as 4. See Table 1-2 for specific classification data.

Table 1. Cluster results.

Student number	Stage 2 assessment results	Stage 3 assessment results	K-means classification category
2021117101	50	100	3
2021117102	100	100	1
2021117103	50	75	4
2021117104	100	100	1
2021117105	70	75	3
…	…	…	…

Table 2. Average score of each category.

Cluster / Average score	Category 1	Category 2	Category 3	Category 4
	98.5	80	72.5	58.2

It can be seen from the clustering results in Table 1-2 that the first group of students performs best in this subject, with their average scores far higher than those of the other three groups of students. We should encourage this group of students to expand their professional knowledge, tap more potential, and help other students make progress together; The overall performance of the students in category 4 is poor, and their average stage test results are all unqualified, which leads to the risk of failing the course. This group of students should pay attention to the study of this course. It is suggested that the teachers and teaching managers should organize ideological education meetings for the students in this category, conduct interviews, timely grasp the students' ideological trends, provide help and other measures to improve the learning effect. For students in categories 2 and 3, continue to maintain a good learning state in professional knowledge and improve professional skills. Teaching managers can encourage students to consolidate basic knowledge and strive to enter higher level group. Therefore, it is helpful to take different monitoring measures to find different student groups in different learning states by data mining: education warning and assistance measures for students with weak foundation and learning difficulties; Help students from the middle group to encourage and consolidate the foundation for further improvement; Encourage students from excellent groups to expand their thinking, improve their innovation awareness and create great results.

4.3 Monitoring effect.

The previous article uses a variety of data mining methods to analyze the learning situation analysis, correlation analysis, curriculum early warning and classification measures, and find out the existing problems in time, so as to put forward suggestions and strategies for teaching quality monitoring, help students and teaching managers improve teaching and learning, and realize the dynamic tracking and implementation feedback of internal talent training quality monitoring. After this round of teaching reform and the implementation of talent training quality monitoring, the monitoring of teaching quality has achieved certain results. Taking Data Mining, which is offered this semester, as an example, the average scores of the five periodic examinations of this course have been improved step by step. See Table 3 for the specific data.

Table 3. Comparison table of assessment results in talent training quality monitoring stage.

Indicators / Stage	Periodic assessment				
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Average score (points)	35.93	61.65	82.34	85.25	92.88
Pass rate (%)	12.50%	38.13%	86.25%	91.88%	98.75%

Number of pass (person)	20	61	138	147	158
Excellent rate (%)	1.88%	23.75%	58.75%	38.75%	69.38%
Number of outstanding people (person)	3	38	94	62	111

It can be clearly seen from Table 3 that under the dual effects of the reform of talent cultivation mode and the monitoring of talent cultivation quality, the students' assessment results have been significantly improved. Among them, the average score of the assessment in the fifth learning stage has increased by 159% compared with the assessment in the first stage. At the same time, the students' learning enthusiasm has also been constantly improved. See Figure 4 for the distribution of test scores at different stages.

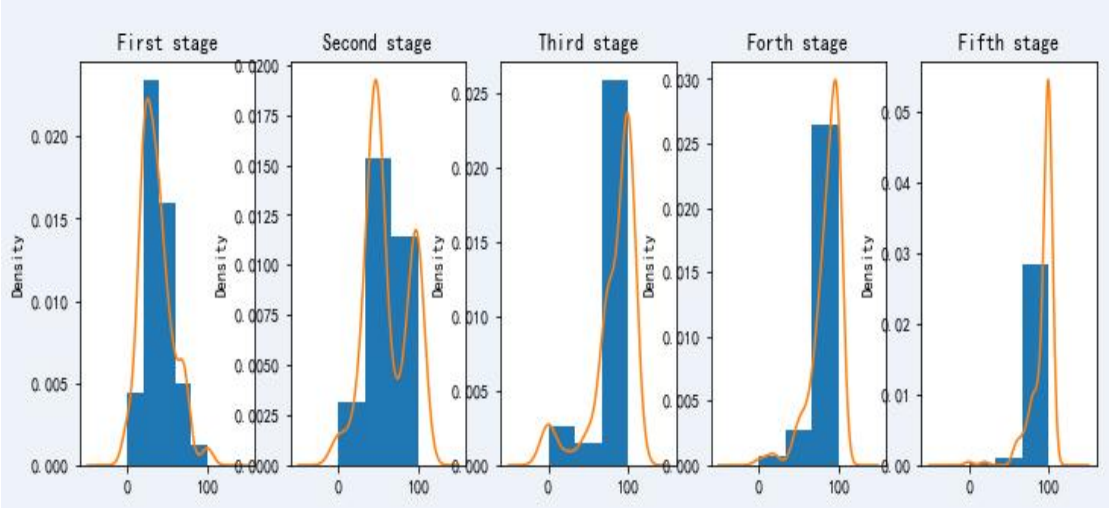

Fig. 4. Distribution of assessment in five stages

5. Conclution

For private universities, grasping the task of talent training center is the key to win the competitive advantage. In addition to innovating teaching methods, optimizing teaching process and reforming curriculum assessment and other traditional education methods, teachers of private universities need to use information technology to monitor the quality of talent training. Based on data mining technology, this paper actively explores the monitoring methods of talent cultivation quality. Through data mining technology, students can have a clear understanding of their learning status by analyzing the learning situation, analyzing the correlation of evaluation indicators, and setting up learning warning. At the same time, teaching assistants can also use different monitoring methods according to the classification results. After a semester of monitoring measures, the key abilities and post abilities of students majoring in big data management and application in this private university have been improved to a certain extent, which has improved the degree of achievement of course objectives, as well as the satisfaction of students' learning results, and ensured the quality of training of talents in this specialty. Since this major has only been open for more than one year, data collection is still not comprehensive. In the follow-up research, we will continue to collect data on knowledge, ability, literacy assessment and employment for further mining and analysis, and continue to improve the research work on talent training quality monitoring.

Acknowledgment

The paper is funded by the 2022 research project of the Professional Committee of Private Higher Education of Guangdong Provincial Education Association: Research on the quality monitoring of talent cultivation in private undergraduate colleges under the digital background

(2022MBGJ025) and Higher education teaching reform project of Guangdong University of Science and Technology: Research on interdisciplinary integration mechanism based on big data management and application specialty (GKZLGC2022134).

References

[1] He Lilai, Xu Xiaofei. Comparative study on the survey of undergraduate teaching quality monitoring [J]. China Electric Power Education, 2008 (07): 19-21.

[2] Zuo Qing. Strengthening provincial monitoring of teaching quality in higher education [J]. China Higher Education, 2004 (07): 23-25.

[3] Wang Xiaowu Practical exploration on the construction of the internal teaching quality monitoring system of "three levels, four supervisors, and five systems" in private undergraduate colleges and universities -- taking Anhui Xinhua University as an example [J] Journal of West Anhui University, 2016, 32 (003): 45-49.

[4] Li Xianfeng The construction of practice teaching quality monitoring system in private colleges and universities [J] Journal of Beijing City University, 2011 (3): 6.

[5] Liang Qiang. Evaluation and optimization of university talent training mode based on data mining technology [J]. Journal of Dalian University for Nationalities, 2020,22 (01): 92-96.

[6] Hu Bo, Zhang Qiao Innovation and practice of vehicle engineering talent training mode for machine learning application [J] Automobile knowledge, 2022, 22 (3): 3.

[7] Brito C R , Ciampi M M , Vasconcelos R M , et al. Rethinking engineering education[C]// IEEE Frontiers in Education Conference. IEEE, 2017.

[8] Guo Yanmei. On the establishment of the early warning mechanism of college students' repetition and strengthening the management and transformation of students who have failed to pass grades [J]. Southern Review, 2012 (04): 102-105.

[9] Zhang Guohua. Application and practice of data mining in curriculum early warning of independent colleges [J]. Modern Electronic Technology, 2016,39 (17): 136-139.

[10] Li Fang Research on the current situation and improvement of classroom teaching quality in private colleges and universities [J] Industry and Technology Forum, 2022, 21 (14): 259-260.