Evaluation of Intelligent Student (Work) Management and Evaluation Information System Based on K-means Algorithm

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Abstract. Student guidance is an important part of school leadership. Currently, only the computerization of student data has been widely practiced. However, due to the diversity of data sources, the lack of structured data on student guidance, and the use of subjective evaluations and single indicators as evaluation criteria, the technical computerization of the student guidance evaluation process is still in its infancy, and the maturity of the technology is not yet sufficient. The evaluation of the effectiveness of student guidance has always been based on subjective judgment, and the experience of expert groups is not always inherited and retained. Therefore, it is necessary to introduce mechanisms in the management system to optimize evaluation effectiveness, such as eliminating errors and utilizing past data. The article focuses on the intelligent information system for management and assessment of college graduates (work) based on K-means algorithm. Firstly, the K-means algorithm and the intelligent student management and assessment system are briefly introduced; secondly, the theoretical basis of the K-means algorithm is elaborated; finally, the paper conducts an empirical study on student management and assessment based on this method. The results of the study show that the intelligent information system (questionnaire) for student management and assessment based on the K-means algorithm is more comprehensive than the traditional assessment method. According to the K-means algorithm, the media class of 2015 is the most suitable, and there is a great improvement in all aspects.

Keywords: Student Information Management, Intelligent Evaluation, K-means Algorithm, System Analysis

1 Introduction

In colleges and universities, it is not only necessary to spread basic knowledge to students, but also to manage students. The introduction of innovative student affairs management mode in the school information management system can fully reflect the benefits of the management system and promote the physical and mental health of college students. The new model of student affairs management in the student

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information management system is of great significance to the development of college teachers and students.

Scholars have long conducted specialized research on student (work) management and evaluation information systems. At Madura University, there are still many issues that hinder students from giving practical work speeches. One reason is that many students often change their temporary accommodation, resulting in a long time for course selection. Due to the fact that people who register for work courses are usually arranged closer to their residence (reception home/residence), various issues arise. This program is often subjectively evaluated by students who teach for practical work. Therefore, in order to facilitate Madura University students in finding their internship classroom location, it is necessary to have a computerized information system to assist them in finding the internship classroom location. On this basis, Putra F P E proposed an algorithm applied to Distance matrix to build the information evaluation system, and its effectiveness was verified through experiments [1]. Sudana I M collected practical data on automated skill testing during the COVID-19 pandemic through survey questionnaires distributed to participants, examiners, and administrators. The focus of the measurement tool was the role and influence of information system management in the pre evaluation of professional certification examination, as well as the interaction among participants, examiners and PCI managers. The results showed that using information systems to manage professional evaluations was effective in notifying examiners and students of evaluation schedules, linking them to evaluation reports, and reminding administrators of license expiration. Therefore, administrators had effective methods to automate these information management systems [2]. A widely used indicator for evaluating investments is the expected value of information. However, traditional expected value methods have limitations in reflecting risks and uncertainties. Bjornsen K proposed an extended semi quantitative method that incorporates elements related to knowledge intensity into the decision-making foundation, making decisions more comprehensive. The experiment demonstrated through an example how this extended method could improve EVOI evaluation in security management. That is to say, it was possible to learn more about human reliability before selecting different security training programs [3]. Although the above studies have evaluated information management systems, the technology is relatively complex and the practical significance is not high.

With the development of information technology, the application of intelligent information systems in student or work management would continue to expand. In order to fully play the necessary role and effectiveness, it is also necessary to start with the design, development, and implementation of information assessment work to improve the effectiveness of intelligent information systems. The intelligent information system for student performance (work) evaluation based on K-means algorithm considered in this article was more comprehensive and of research significance compared to traditional knowledge evaluation techniques.

2 Intelligent Student (Work) Management and Evaluation Information System and K-means Algorithm

2.1 K-means Algorithm

1) Principle of K-means Clustering Algorithm
For distance based model measurement, European distance, Taxicab geometry, Markov distance, Minkov distance, and all other distances that meet the distance axiom can be selected. Norm Minkov distance, that is, European distance [4], is used in KNN (K-Nearest Neighbor) algorithm.

$$\mathrm{Dis}_2(m,n)=\|m-n\|_2=\sqrt{\sum_{j=i}^{d}(m_j-n_j)^2}=\sqrt{(m-n)^T(m-n)} \quad (1)$$

Assuming (m,n) is a set of points in Euclidean space, its arithmetic mean μ is the unique point with the smallest sum of squares of Euclidean distances D among all data points.

$$aru\min_n \sum_{m\in D}\|m-n\|^2=\mu \quad (2)$$

By taking the gradient and making it 0, the formulas are as follows:

$$\nabla_n \sum_{m\in D}\|m-n\|^2=-2\sum_{m\in D}(m-n)=-2\sum_{m\in D}m+2|D|n=0 \quad (3)$$

$$n=\frac{1}{|D|}\sum_{m\in D}m=\mu \quad (4)$$

2) Basic Idea of the Algorithm
From a dataset of N points, K (K=3) points are randomly selected as the initial cluster center, and then the distance from each point to the cluster center K is calculated using Euclidean formula, and these points are grouped to the closest cluster center in the class [5-6]. After all points are grouped, the average value of the points in each class is calculated, and the average value of the class is used as the new clustering center [7]. The class average is used as the new class center, and the clustering is repeated until both centers are equal to complete the clustering. The algorithm steps are shown in Fig.ure 1 [8-9].

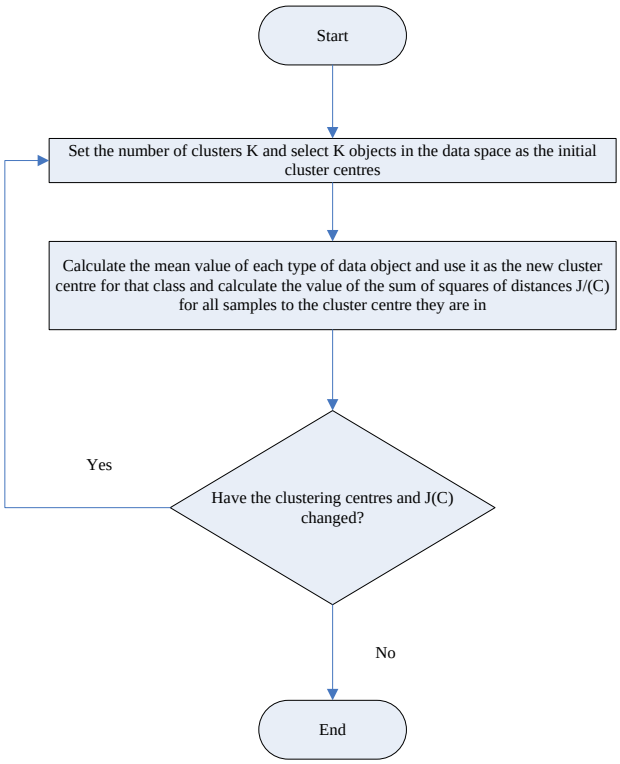

Fig. 1. Steps of K-means algorithm

2.2 Intelligent Student (Work) Management and Evaluation Information System

The work of university students (work) is an important link in the organizational management of universities, and its implementation would directly affect the management level of university organizations and the quality of student (work) work [10-11]. The informationization construction of student (work) work in universities is one of the important contents of informationization construction in universities. The work of college students (work) is a complex task, and its information construction is also a difficult problem [12].

Student management work involves all aspects of school work, and there are many sources of data, so there is no unified standard for evaluating student management work [13]. On this basis, student management evaluates students through feedback, emotions, teaching styles, extracurricular skills, and objective evaluations (including academic performance, attendance, competition awards, etc.). There is no unified format and field description for these data [14]. Due to its textual and detailed nature, it is difficult to directly process with traditional information management systems, which means comprehensive evaluation cannot be conducted. However, empirical evaluation mainly relies on human subjective judgment and there is noise. Teachers' perception of learning outcomes is often distorted, which affects the accuracy of evaluation results [15].

1) Significance of the New Model of Student Work Management in Universities under the Student Information Management System

The new model of student work management with innovation and vitality not only conforms to the trend of new curriculum reform, but also adapts to the growth stage of students [16-17]. On the one hand, it strengthens students' theoretical knowledge, develops their creativity, and enhances their service spirit. While respecting the uniqueness of students' development, it can introduce specific teaching methods to fully unleash students' learning autonomy. On the other hand, the new model can play an important role in guiding students' development, thus helping them form a correct understanding of learning and development, and promoting self-reflection and self-development. Excellent student development means improving the quality of teaching in universities [18-19].

Considering the role of the system in the management of student activities in colleges and universities, this paper combs the existing systems in some colleges and universities. The results show that some colleges and universities have established their own systems, such as the Academic Affairs Office, the Student Affairs Office, the Admission and Accommodation Office, the Student affairs Office, the Library and the Public Relations Office. These units have their own portals and independent systems, and some units have less workload. At the same time, there are still some problems in filling out and submitting the registration form on paper [20].

Firstly, both efficiency and accuracy are not high. In practical work, the method of manually filling in and copying is not only a complex task, but also a heavy workload. When comparing and matching, manually filled content would inevitably have duplicates, as well as certain omissions, errors, and non-standard writing, resulting in statistical errors and serious results. At the same time, data extraction becomes difficult due to data maintenance and reprocessing.

Secondly, data updates are slow. In the manual provision of statistical data, students usually fill out certain forms and submit them by class or department, which cannot guarantee certain accuracy. The data submitted by different individuals, classes, or departments is also uneven.

Thirdly, the information is not standardized. Due to the lack of corresponding support systems, traditional information collection and storage methods cannot comprehensively preserve all aspects of student information, such as inconsistent storage locations, inconsistent formats, unclear information when facing dynamic changes, and lack portability. If the questionnaire survey is not done and links are not made, manual modifications would be required, which would cause inconvenience to the staff.

Fourthly, the development of university information is usually the responsibility of the school's information department, and many software for managing the system is outsourced to software companies or research departments. This often involves development or direct purchase.Due to their different functions, they should be different from each other. However, due to various factors, the implementation of the system may not necessarily be products of the same organization or software development company, which brings many problems to the mutual use of the system, such as standardization of design, compatibility and exchange of data, and ease of use of functions. However, many information work and data exchange still require manual calculation and communication, leading to a regression of traditional work

methods, which in turn reduces efficiency.

Fifthly, in terms of student affairs, there is almost no prior involvement in implementing the software. There was no effective research, organization, and integration of actual workload and requirements, and no detailed communication with software suppliers. As a result, the software system did not match the actual needs of the school and did not play its due role. If the school department needs to support, update or improve the system based on actual usage, it must first communicate with the information technology department to explain the situation, and then the information technology department would contact the software supplier. In an environment where control is still in the hands of parents and teachers, students' thirst for knowledge is relatively low, which is related to the management of student work information in higher education institutions.

2) Requirements Evaluation and System Design of an Intelligent Student (Work) Management and Evaluation Information System

(1) Requirement analysis

The purpose of the intelligent student (work) management and evaluation information system is to support and intelligently evaluate the performance of students in a higher education institution in X city. The system sets different permissions and tasks for each department. Each department should fill in the corresponding information according to their respective permissions and tasks, and complete the corresponding assessment work according to their respective permissions; Managers are fully responsible for the operation of this system. The evaluation management information system is divided into three levels to manage evaluation indicators. The evaluation system consists of a table that records evaluation data, ratings, and content. The results of each evaluation can be queried and obtained in the future.

Considering the subjectivity of the existing data structure and evaluation system, the reference values are obtained through intelligent evaluation of various data using experimental algorithms, and the intelligent evaluation interface is not integrated into the main module.

(2) System design

The student management evaluation information system is designed in two parts according to system requirements: ① external functions, which mainly include user information management, project information retrieval and organization; ② Internal functions mainly include core components such as analysis of evaluation results, system and project management, and each core component is further subdivided into functional sub modules. In order to make the system more scalable, a flexible architecture was chosen in system development, so that the content of the indicator system is not constrained by the database structure.

3 Experiment on an Intelligent Student (Work) Management and Evaluation Information System Based on K-means Algorithm

This experiment takes the index system for student work evaluation in a certain higher education institution as the system framework, mainly designed for the interaction between student management personnel and the school, with a large number of

complex application data sources. A complete evaluation system for student work involves organizing, categorizing, constructing data structures for various complex materials in student work, and utilizing information management systems for unified management. When evaluating students, they are divided into two parts: subjectivity and objectivity, and various factors related to student management are fully considered. This has no impact on establishing a comprehensive evaluation system.

The main criteria for the selection of the outstanding class group of the College of Mathematics and Computer Science are: the number of group members, the passing rate of College English CET-4 and CET-6, the passing rate of the computer professional exam, the score of the College of Civilization, the award of scientific research projects, and the award of various cultural and sports activities. Details of some of the classes and grades assessed are shown in Table 1. The numbers 2015jil, 2015tx, 2015tj, and 2015sx refer to the accounting class 1, communications class, statistics class, and math class of 2015 respectively.

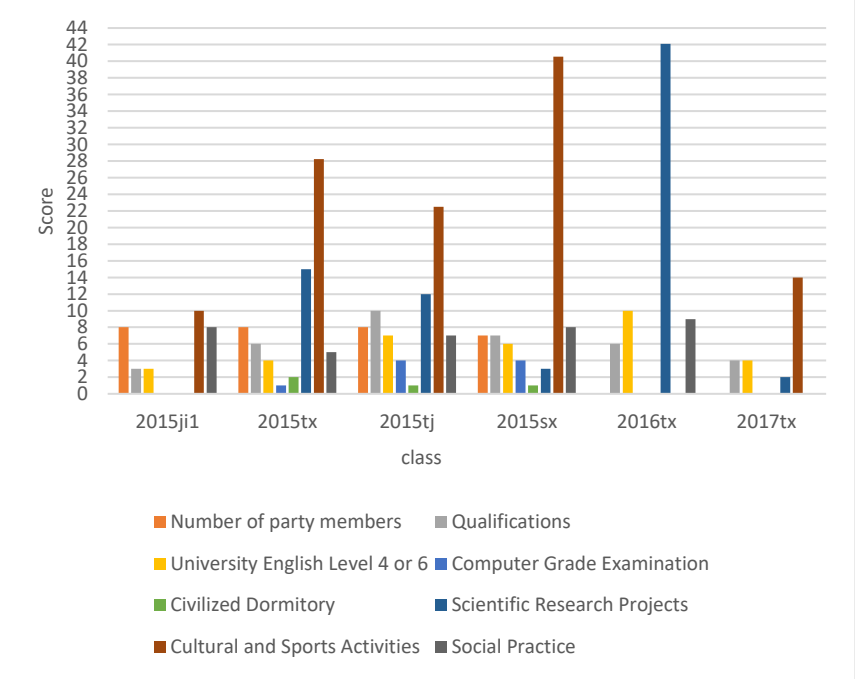

Fig. 2. Class collective evaluation data

From Fig.ure 2, it could be seen that the evaluation methods used during 2015, 2016, and 2017 were basically the same. However, between 2016 and 2017, due to class size limitations, some communication classes had lower or blank attribute values, which had a significant impact on class performance. This method selected a group with balanced development as the initial value, starting from this initial value and continuing until the center of the group changes.

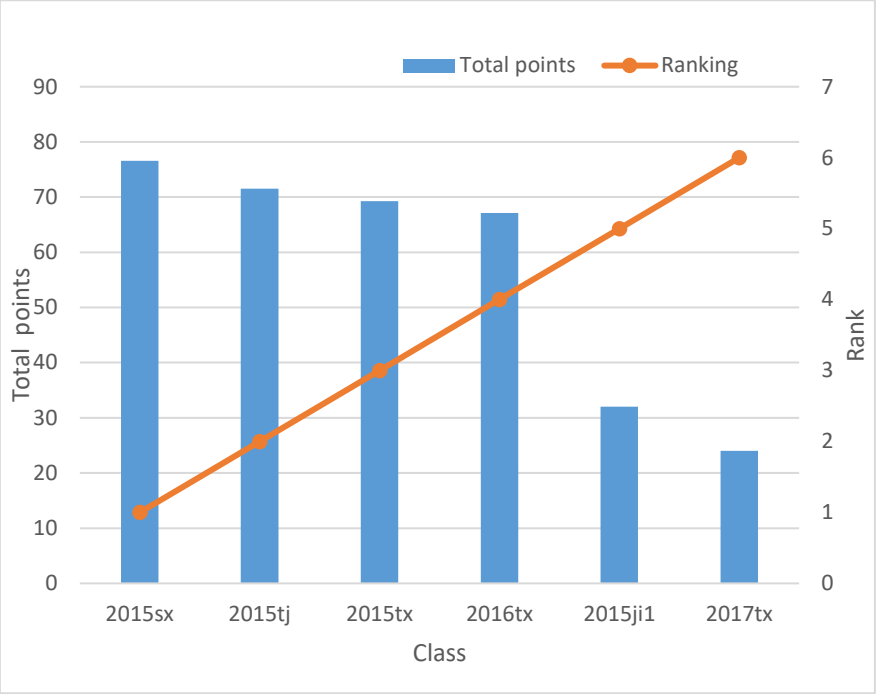

Fig. 3. Total score and ranking of the class group

As shown in Fig.ure 3, the ranking and total score were only obtained by adding up the total scores of various indicators, which meant that the best class selected by traditional methods must be the 2015 math class ranked first with a total score of 76.55. On the contrary, the clustering analysis results are vastly different from traditional methods, as shown in Table 1.

Table 1. Cluster results

Balanced Development Classes	Off Development Classes	Worst Development Classes
2015tx	2015sx	2015ji1
2015tj	2015ji2	2015xx

Table 1 shows the student data for each grade group in 2015. Among them, 2015x represented the 2015 grade group in computer science. Based on the characteristics corresponding to the 2015 cluster, 2015 tx, 2015 sx, and 2015 ji1 were selected as the first clustering centers for the imbalanced and worst-case classes. K-means algorithm was used for experiments, and the optimal clustering results were obtained as shown in Table 2. The results of clustering and conventional methods are compared in Table 2.

Table 2. Comparison of Excellent Class Collections

K-mean clustering	Traditional methods
2015tx	2015tx
2015tj	2015sx

4 Conclusions

As the number of students continues to increase, the difficulty of recording student information increases, and the redundancy of student information increases. If administrators continue to use the traditional method of recording people for management, it is a difficult problem to complete in a short time. This not only improves work efficiency, but also reduces the complexity of workflow, reduces human and financial costs, and greatly improves teaching quality. This article introduced an intelligent information system for student (work) management and evaluation based on the K-means algorithm. This system utilized the advantages of high processing speed and large memory capacity of computers to efficiently and accurately process various types of student information. Due to the high accuracy and speed of information storage management, the labor and time costs of administrative personnel were significantly reduced, and university resources were significantly reduced. The ability to process and manage university data was enhanced, and data confidentiality was improved. Establishing a student information management system became an integral part of modern universities.

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