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Teaching Evaluation of Computer Programming Course in Higher Vocational Colleges Based on Big Data

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Abstract: *The computer programming course has always been considered a difficult course to get started, especially the teaching quality of computer programming courses in higher vocational schools is relatively poor, which has been a problem and challenge for schools and teachers. This paper designs a teaching evaluation method of computer programming course in higher vocational colleges based on big data. Firstly, the paper analyzes the application of big data in the computer programming course of higher vocational college, and confirms the promoting effect of big data on the teaching of computer programming course of higher vocational college. Based on the evaluation results, the author puts forward some strategies to improve the teaching quality. The research results provide valuable reference for the teaching of computer programming courses and the application of big data in higher vocational schools.*

Keywords: *wisdom education; Higher vocational computer programming course; Teaching quality evaluation*

1. Introduction

Education informatization and smart education have become an important direction of education reform and development in today's world. Fortes pointed out that in the context of big data and the Internet, higher vocational colleges are increasingly applying intelligent devices and other related intelligent technologies in teaching and have achieved more significant application results[1]. At the time, many countries have made remarkable achievements in many fields by using big data technology. Teachers are the backbone of implementing teaching reform and promoting educational innovation[2]. The advent of the era of big data has promoted the teaching reform and innovation of computer programming courses in higher vocational colleges, and the teaching mode has become more and appealing. By bringing big data into the classroom, teachers are constantly pushing attractive information and knowledge to students. Open up students' vision and tap students' learning potential.

Nowadays, teachers in the higher vocational colleges in most developing countries are faced with profound teaching challenges. These challenges are largely attributed to factors such as increased diversity, inadequate preparation, language proficiency, teaching methods, etc. Being a good programmer is not only about understanding the syntax of programming, but also about understanding the syntax and flow of computer programming, ultimately to solve complex real-world problems[3]. Many vocational students lack the ability to solve problems[4]. In the context of the Internet and big in order to effectively improve the teaching methods of computer programming, teachers in higher vocational colleges use new technologies and rich teaching methods to cope with the diverse and dynamic needs of students. At present, most universities have established digital data platforms and systems, which can collect and analyze data generated in the teaching process more effectively, greatly facilitating the evaluation and research of teaching effect[5].

The big data online course evaluation early warning analysis system refers to the comprehensive analysis of the information in the teaching process, and the improvement plan is determined according the feedback results[6]. With the deepening of network information in the era of big data, network data analysis has been applied to every field of life and has become an indispensable part of teaching in new fields. Compared with the traditional classroom teaching quality evaluation model, teachers are the main body, students, peers, leaders, supervisors, etc., improve teachers' teaching work, and the use big data analysis of teaching quality can suggest a perfect and reasonable evaluation system, leading to unsatisfactory evaluation results. In the context of big data, how to use big data analysis technology to

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analyze the current situation of teaching evaluation is very important[7]. How to evaluate teachers' teaching ability scientifically and reasonably is of great value to effectively train and comprehensively improve the quality of vocational personnel training. Therefore, it is urgent to use the theory and platform of computer big data to effectively evaluate the teaching ability of college teachers and lay a scientific foundation for the objective and scientific evaluation of teachers' ability.

In order to accurately and effectively understand student classroom behavior, many researchers have investigated online teaching systems to predict academically at-risk students[8], or to develop an early warning system to provide a decision support system for teachers[9]. The researchers found that the online course did not use the learning portfolio dataset to predict student academic performance, and this study incorporated time-related variables and other activities conducted by students during the semester, using big data techniques to predict student performance. This study addresses the following research questions:

How can big data technology mine student learning behavior data in online courses, and what are the warning indicators?

When during the semester does the early warning system predict student performance?

How accurate is it to identify at-risk students in a real educational setting?

2. Related work

This section will introduce the work related to the design of early warning indicators for the teaching of computer courses in higher vocational colleges, form the impact of assessment tasks on learning and student achievement, and the construction of early warning analysis system architecture in the teaching of computer courses.

2.1 Early warning indicators are established to identify students at risk of failure

Identifying at-risk students in the early stages of the curriculum has attracted great interest from educators, and researchers understand the main precursors of dropout through student behavioral data to identify students who are likely to fail, and in turn provide early intervention for at-risk students. Bruce reports that irregular student attendance, poor course grades, and behavioral problems are early warning signs that students are off track[10]. Horton lists a number of key factors, including low self-efficacy, catch-up classes after prolonged absences, prior poor educational experiences, and health and psychological issues, that can affect academic success or are key indicators of at-risk students at the college level[11]. Horten And Veerasamy reported that students' class attendance was negatively correlated with students' performance in formative and summative assessment tasks[12].

2.2 Formative and summative assessment tasks

Formative assessment is a curriculum assessment used to assess and monitor student learning throughout the course. These assessments are primarily used to measure a student's understanding or lack of understanding of concepts to potentially improve student performance and to adjust ongoing teaching and learning strategies, and research has shown that formative assessments improve student performance on final exams[12].

Summative assessment is usually given at the end of the semester and course with one or more grades to assess a student's achievement. Summative assessments are primarily used to determine how much students have learned throughout the course. Summative assessment results are designed to measure students' learning of concepts at a point in time and provide teachers with qualitative insight into student learning to identify students in need of support early and provide timely interventions.

2.3 Build an early-warning analysis system for computer courses based on big data

In view of the shortcomings of current teaching quality evaluation in colleges and universities, all kinds of data related to teaching quality are collected and stored, analyzed and displayed. The use of big data technology can achieve objective evaluation of teaching quality, timely monitoring, early warning and improvement[13], and provide feedback on teaching evaluation through multiple evaluation subjects. In terms of big data analysis methods, Gong used k-means cluster analysis to analyze online teaching quality evaluation, so as to improve the accuracy of college teaching quality evaluation[14].

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This study takes the teaching evaluation of computer programming class as a convenience, verifies and analyzes the representativeness of the original method and the improved method, so as to perfect the feedback system of classroom teaching quality evaluation and improve the quality of college classroom teaching.

2.3.1 Analysis principles and methods

Big data analysis online classroom teaching evaluation is an effective teaching means in the classroom, can effectively improve students' learning enthusiasm and teachers' classroom teaching quality level. The online classroom teaching evaluation early warning analysis system based on big data can conduct in-depth analysis of the evaluation results and find the problems existing in the evaluation results more deeply, providing a good basis for the evaluation of teachers' teaching ability and providing long-term guidance for the self-improvement of teachers' teaching level.

2.3.2 Curriculum assessment early warning analysis system architecture

The system of this study is to monitor and evaluate the quality of classroom teaching, which includes the process of organizing teaching, implement teaching and evaluating teaching. First, teachers and students enter the online education system through the unified identity authentication platform, and teachers can use online exercises, teaching questions and other activities to implement the online teaching process. Then, the teaching monitoring data and classroom test results are analyzed. Finally, the analysis results are sent to students and teachers to improve teaching and improve teaching quality. The early warning analysis system of curriculum evaluation is shown in Figure 1.

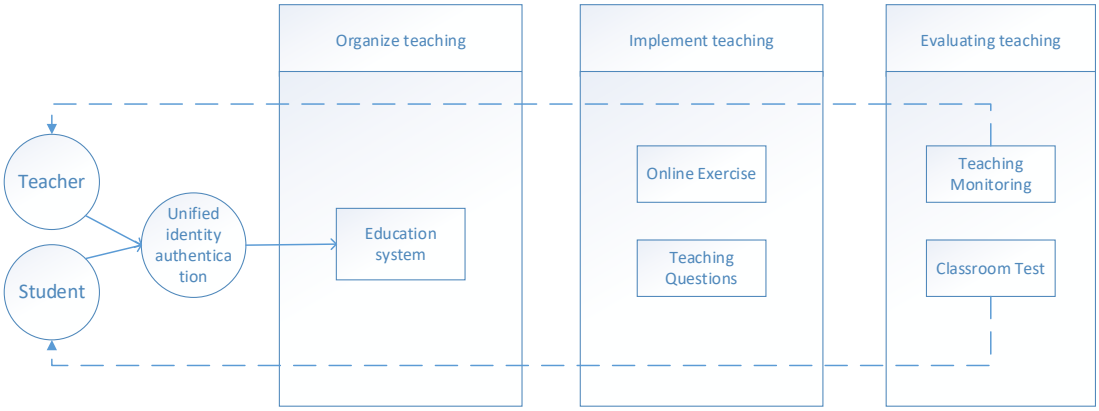

Figure 1 Curriculum assessment early warning analysis system architecture

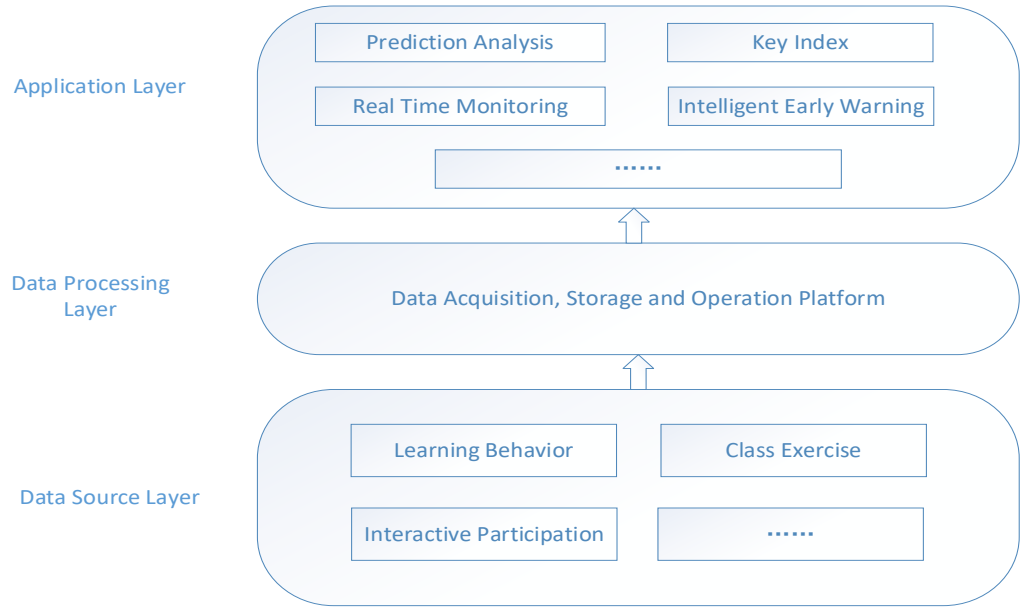

Figure 2 Technical architecture of the platform

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3. Research methods

The approach of this study is to use big data to analyze data on student behavior to predict and identify at-risk students. The curriculum evaluation and early warning analysis system adopts the current mainstream big data framework Hadoop to collect, process and analyze the behavioral data of students' classroom learning behavior, participation and interaction, and classroom practice, forming the overall framework of the data analysis system of students' classroom behavior. Distributed storage and processing of student behavioral data are carried out to realize comprehensive mining and in-depth analysis of student behavioral data, and students' behaviors are predicted according to key indicators. Figure 2 Platform technical architecture.

3.1 Data Sources

The data collected by the online education system includes data about students, teachers and courses. Among them, the specific data of students include: learning behavior data (visit times, online times, visit time), participation interaction (discussion content, in-class exercises, response times), classroom quizzes (grades, rankings), etc.

3.2 Analysis Method

The relevant data of students in the first two weeks of the semester were collected, based on the classification tree analysis method, and students with incomplete or poor scores were identified in the assessment task based on their performance in the formative assessment as the context of student participation. Students who score <=25% on selected assessments are classified as at-risk students and provided with visual guidance for teachers to improve student learning outcomes.

3.3 Curriculum and assessment description

Computer python programming courses cover algorithm design, basic concepts, including variables, values, types, expressions, control structures, data structures, modularity, and classes. The duration of the course is 18 weeks, a total of 72 class hours, each class time is 45 minutes, of which 36 class hours are project exercises. The assessment system in this study can provide immediate feedback based on student behavior data.

3.4 Formative Assessment (FA) : Behavioral data (LB), engagement interaction (IP), classroom exercises (CE)

LB stands for weekly formative assessment tasks, such as how many times and how long students watch courseware and videos using online learning systems. IP represents the number of interactive participation of students in class, such as quick answers and discussion content, per week. CE stands for weekly classroom practice assignments submitted by students, which students can submit multiple times before the deadline, and objective questions can be automatically graded through the online teaching platform.

3.5 Summative Assessment (FEG)

An online summative assessment is conducted at the end of the semester using an online teaching platform, with a maximum score of 100 on the Python programming course exam. The final course grade is calculated based on the final exam score *70%+ (selected formative assessment and class attendance) *30%. The Python programming grade scale is shown in Table 1.

Table 1. Python Programming Entry Level Standard Table

FG	GRADE
0-49	0
50-59	1
60-69	2
70-79	3
80-89	4
90+	5
Actual levels 0 and 1 are considered "risky"; Levels 2 to 5 are considered "no risk"	

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4. Data analysis and results

One research methodology defined in the study assumes that students who perform poorly on formative assessment tasks in the first few weeks of the course will fail the final exam. That is, if a student scores <=25% in LB, IP, and CE in the first two weeks of the semester, then they may fail the final exam and receive a credit score of 0 in the course, and the data of students identified as at risk after two weeks is shown in Table 2.

Table 2 Students identified as at risk after two weeks

Formative assessment <=25%(first 2 weeks)	Did not take the final exam	The final exam score is <60	The final exam score >60	Accuracy rating
38	3	6	29	89.5%

A total of 65 students scored <=25% on the formative assessment during the first two weeks of semester 1 2023, of which 18 students were identified as at-risk and reported back to their course teachers. Of these, three students did not take the final exam and received a failing grade. Of the 15 students who took the final exam, 13 had a final score below 60 and 2 students scored <=25% on the formative assessment during the first two weeks of the semester but still managed to pass the final exam. In the final exam for the first semester of 2023, 20 of the 65 students scored less than 60 points and received a credit of 0. Therefore, the summary prediction accuracy is 90%[(18/20)*100].

Our findings offer some suggestions for students, teachers, and administrators. Performance in formative assessments is closely linked to student performance, which means that the learning process has a substantial impact.

5. Conclusions

The study suggests that early performance in formative assessments can predict final exam outcomes. It found that students scoring s25% in initial formative assessments (learning behavior, interactive participation, classroom exercises) are at high risk of failing the final exam. In the first semester of 2023, 65 students scored s25% early on, with 18 identified as at-risk. Of these, 15 took the final exam, but only 2 passed. The study's predictive accuracy was 90%, highlighting the importance of early intervention and the significant link between formative assessment performance and overall academic success.

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