Research on the Application of Data-Driven Approach to Enhance Comprehensive Literacy in Vocational Education

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Abstract. This research aims to explore the application of data-driven decision-making methods in enhancing comprehensive literacy in vocational education. The objective of vocational education is to cultivate students with the ability to possess comprehensive literacy skills, in order to adapt to the demands of societal and career development. Specifically, this study will focus on three aspects: data collection, data analysis, and decision-making, to empirically investigate how data-driven decision-making methods can optimize comprehensive literacy education in vocational colleges. Moreover, the research will emphasize the importance of targeted, effective, and sustainable improvements in comprehensive literacy education, providing scientific and effective decision-making bases and methodological support for curriculum development in higher education institutions.

Keywords: vocational education; comprehensive literacy; data-driven; efficacy enhancement

1.Introduction

With the rapid development of socio-economy and continuous technological advancements, vocational education plays a crucial role in nurturing talents that are adaptable to the modern workplace demands. Traditional vocational education has primarily focused on imparting disciplinary knowledge and professional skills. However, as the workplace environment continues to evolve, students need to possess a broader set of comprehensive literacy, including problem-solving abilities, innovative thinking, and effective communication and collaboration skills[1]. Traditional teaching methods and assessment approaches often struggle to meet these needs.

Data-driven methods have been widely applied in the field of education and have shown promising results. Data analysis and mining techniques can uncover underlying patterns and trends from vast amounts of student data, providing valuable insights and guidance for educators[2]. In vocational education, the introduction of data-driven methods can help education professionals better understand students' learning needs and characteristics, enabling personalized instruction and support to enhance learning outcomes and foster comprehensive literacy development. Comprehensive literacy refers to the holistic development of students in various domains, including knowledge, skills, attitudes, and values, and is one of the key objectives of vocational education[3].

NMDME 2023, October 13-15, Xi'an, People's Republic of China

DOI 10.4108/eai.13-10-2023.2341293

The objective of this study is to explore the application of data-driven methods in enhancing the efficacy of comprehensive literacy in vocational education. By collecting, analyzing, and applying student learning data, we will design and implement personalized learning plans and support strategies to improve students' learning outcomes[4]. Specifically, we aim to achieve the following goals:

Improve student's learning effectiveness:

Data-driven methods can help educators have a more accurate understanding of students' learning status and difficulties, enabling targeted and personalized instruction and support[5]. By optimizing learning paths and resource allocation, we can enhance students' learning effectiveness and academic performance[6].

Cultivate student's comprehensive literacy:

Comprehensive literacy is a crucial factor for success in the modern workplace. Through data-driven personalized teaching and support, we aim to enhance students' problem-solving abilities, innovative thinking, and teamwork skills, thereby improving their competitiveness in their careers[7].

Optimize the allocation of educational resources:

Data-driven methods allow for a more accurate evaluation of the effectiveness of instructional resources, identifying strengths and weaknesses in resource allocation and enabling optimization and adjustments[8]. This enables the rational allocation of educational resources, improving the efficiency and quality of resource utilization.

This study is significant as it provides a research approach to the application of data-driven decision-making in vocational education in higher vocational colleges, offering a viable solution for fostering comprehensive literacy in college students[9]. Furthermore, it contributes to the innovation and improvement of talent cultivation models in higher education institutions, facilitating the establishment of a vocational education system that meets the demands of the current era and lays a solid foundation for nurturing future generations capable of shouldering the responsibility of national rejuvenation.

It is important to note that this paper does not advocate for data-driven decision-making as an independent approach to education decision-making. Rather, it promotes the integration of data-driven methods with traditional educational decision-making processes to optimize and improve decision-making. By utilizing data-driven decision-making methods, the aim is to enhance the accuracy and scientific basis of educational decisions, ensuring they are better aligned with practical needs and exhibit efficiency[10-11].

2.Implementation of a Data-Driven Comprehensive Literacy Enhancement Program in Vocational Education

2.1Data Collection

Student Personal Information:

Collecting students' basic information, including their name, age, gender, hometown, contact

information, etc., is crucial for understanding their individual characteristics and providing targeted student management and support.

Student Performance and Assessment Data:

Recording student's final exam scores, midterm grades, classroom performance, etc., helps evaluate their academic achievements and performance. Additionally, collecting students' learning outcomes data through assignments, tests, papers, etc., can be utilized to assess learning effectiveness and teaching quality.

Student Learning Behavior Data:

Collecting student learning behavior data involves gathering information on learning time allocation, utilization of learning resources, learning progress, etc. This data can be obtained through learning management systems or learning logs, enabling us to understand students' learning habits and patterns of behavior.

Student Feedback and Evaluation:

Collecting feedback and evaluation information from students regarding courses, teaching, and the school is essential. This can be done through methods such as surveys, focus groups, and interviews to gather students' opinions and suggestions. This feedback is valuable for improving teaching methods and providing better learning support.

Employment Market Data:

Collecting and analyzing data on the demand and trends in the job market helps understand the employment situation and career development directions in different industries. This data supports students' career planning and employment guidance, enhancing their employability and competitiveness.

When conducting data collection, it is important to adhere to relevant laws and regulations to ensure the safety and privacy protection of student data. Additionally, it is necessary to follow scientific and fair principles to ensure the accuracy and reliability of the data. Data collection should be transparent, legal, and purposeful, with full consent obtained from students and parents. Clear policies regarding data usage and protection should be provided.

2.2Data Analysis

Detecting abnormal data for students' learning behaviors and performances using the LOF-GMM method[12]. The LOF algorithm identifies outliers based on the density value of the data and is a typical unsupervised detection algorithm. By comparing the calculated local outlier factor (LOF) values of data points within a certain threshold, it determines whether a data point is an outlierr, as shown in Figure 1.

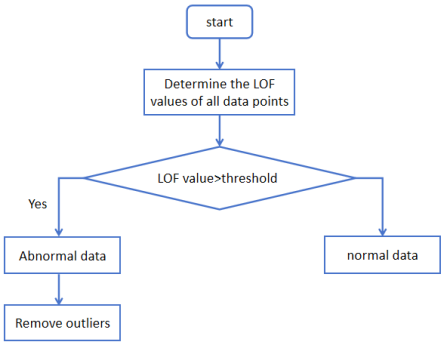

Figure 1 Abnormal judgment flowchart

Step 1: Calculate the m-th distance

$$D_m(x_a, x_b) = \max\{d(x_a, x_b), D_m(x_a)\}$$

Among them, $D_m(x_a, x_b)$ represents the m-th reachable distance from point x_a to point x_b.Both $d(x_a, x_b)$ and $D_m(x_a)$ are the maximum values.

Step 2: Calculate the local reachability density of data points

$$\rho_m(x_a) = \frac{|N_m(x_a)|}{\sum_{x_b \in N_m(x_a)} D_m(x_a, x_b)})$$

Where $\rho_m(x_a)$ represents the density magnitude between the neighboring points and point x_a.$|N_m(x_a)|$ represents the number of points within a distance of m from point x_a.

Step 3: Calculate the Local Outlier Factor (LOF) value for each data point in the collected data.

$$L_{OFm}(x_a) = \frac{\sum_{x_b \in N_m(x_a)} \frac{\rho_m(x_b)}{\rho_m(x_a)}}{|N_m(x_a)|}$$

Where $L_{OFm}(x_a)$ is larger, point x_a is closer to an outlier.$L_{OFm}(x_a)$ represents the average ratio of the local reachability density within a distance of m from point $N_m(x_a)$ to the local reachability density of point x_a.

To apply the LOF-GMM method for dynamic outlier detection in the study behavior and performance of students over a semester, and visualize the results, as shown in Figure 2.

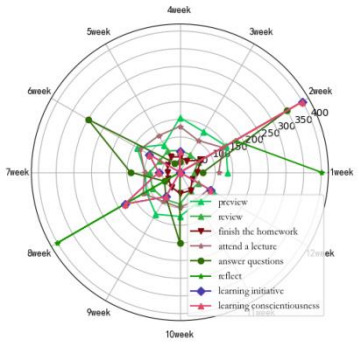

Figure 2 Dynamic screening of learning behavior and performance

2.3 Data-driven decision making

Analysis of learning behavior and personalized education: By analyzing students' learning behavior data, we can gain insights into their study habits, interests, and areas of difficulty. Based on this data, personalized education models can be developed to tailor learning plans, provide appropriate teaching resources and guidance, and enhance students' learning effectiveness and proactiveness.

Optimization and innovation of instructional content: By analyzing students' learning performance, feedback, and evaluations, we can gain insights into their understanding and level of interest in different instructional content. Based on this data, instructional content can be optimized and innovated to better align with students' needs and interests, thus enhancing the attractiveness and quality of teaching.

Establishment of decision support systems: Building a data-driven decision support system can provide scientific decision-making support for managers in higher vocational colleges. By analyzing data related to student enrollment, learning management, and career planning, it can assist universities in devising more rational enrollment plans, optimizing student resource allocation, and providing precise career development guidance.

Analysis of student growth trajectory and intervention strategies: By analyzing multidimensional data related to students' learning, behavior, and social interactions, it is possible to build a student growth trajectory model. This model can predict potential difficulties and risks that students may face and provide corresponding intervention strategies and support measures to help students overcome challenges and successfully complete their studies.

Teacher evaluation and training enhancement: By analyzing student evaluations of teachers, teaching effectiveness assessments, and data related to teaching quality, it is possible to conduct performance evaluations and personal growth analyses for teachers. With the feedback from these data, precise training and professional development programs can be provided to teachers, facilitating the enhancement of their educational and teaching capabilities.

The above applications demonstrate the tremendous potential of data-driven decision-making in vocational colleges' ideological and political career education. Data collection and analysis provide more objective and accurate information, assisting college administrators and teachers in making more scientific and effective decisions, ultimately enhancing the effectiveness of

ideological and political career education and students' comprehensive competence. However, the application of data still faces various challenges, such as privacy protection, data security, and technical capabilities. Therefore, while promoting data-driven decision-making, it is necessary to strengthen the formulation and guidance of relevant laws and regulations and enhance teachers' and administrators' data analysis skills and technical support.

3 Conclusions

Data-driven decision-making has immense potential and value in the comprehensive competence education of vocational colleges. By collecting, analyzing, and applying student and instructional data, it is possible to optimize teaching content, provide personalized learning support, improve teaching quality, promote teacher development, and enhance career development support. Data-driven decision-making can help schools gain a more comprehensive and effective understanding of students' needs, improve teaching effectiveness and quality, and provide better support and guidance for student growth.

Research has shown that the application of data-driven decision-making in vocational education in vocational colleges can bring many important benefits. Through personalized learning support, students can better understand and apply theoretical knowledge, enhance their comprehensive abilities and professional qualities. Teachers and administrators can optimize teaching content and methods based on data analysis results, improve teaching effectiveness and student outcomes. Additionally, data-driven decision-making can also promote teachers' professional development, helping them understand their teaching strengths and areas for improvement, and providing targeted training and support accordingly.

However, there are still some challenges and issues in implementing data-driven decision-making. For example, data privacy protection, data quality, and data credibility. In order to ensure the legal, secure, accurate, and reliable use of data, schools need to establish sound data management and protection mechanisms, and enhance teachers' and administrators' data analysis skills and technical support. Additionally, it is necessary to combine educational ethics and regulations to clarify the scope and purpose of data usage and protect the rights and interests of students and teachers.

In conclusion, data-driven decision-making has significant application prospects in vocational education in vocational colleges. Through proper data collection, analysis, and application, it can promote personalized and differentiated teaching and student development, thereby improving teaching quality and students' comprehensive competence. However, data-driven decision-making needs to address issues such as legality, privacy protection, and data credibility to achieve its maximum benefits and value.

Acknowledgments: Fund project 1: 2023 Jinan Engineering Polytechinc Research Planning Project "Research on Improving the Efficiency of Ideological and Political Vocational Education in Higher Vocational Colleges under the Background of Big Data" (2023KYZC11)

Fund project 2: 2022 Shandong Computer Society Vocational Education Computer related Major Teaching Reform Project "Research on the Establishment of Vocational College Students' Basic Professional Literacy Training System in the Age of Big Data" (2022SDJSJXHZY-24)

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