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Teaching Reform and Practice of Statistics Courses in Big Data Management and Applications Major in the Context of New Quality Productivity

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Abstract: In the new era, the impact of emerging productive forces has permeated every sector of industry. As the core production factor of these forces, data plays a pivotal role in industrial transformation and social development. Consequently, many domestic universities have introduced majors or courses related to big data. Among these, the Big Data Management and Applications major stands out for its interdisciplinary approach and emphasis on practical skills. However, as an emerging field, it has not yet accumulated a robust foundation in teaching theory and practice. Current instructional practices face issues such as unclear training objectives, inconsistent teaching methods and course content, insufficient integration of practical components, and a shortage of qualified faculty—factors that hinder both the development of the major and the overall quality of education. Taking the statistics course within the Big Data Management and Applications major as an example, this paper examines the challenges faced by statistics education in the context of emerging productive forces and proposes corresponding improvement measures. By introducing innovative teaching concepts and strategies, the teaching system for professional courses is optimized, and authentic classroom scenarios are recreated through illustrative examples. Questionnaire surveys and statistical analyses of data collected before and after the teaching reforms indicate that the curriculum changes effectively enhance instructional outcomes, promote the development of the major, and improve the quality of talent cultivation.

Keywords: New quality productivity; Big data; Compound talents; Statistics course; Teaching examples

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1. Introduction

In recent years, with the rapid development of technologies such as big data, artificial intelligence, and the Internet of Things, the global industrial and social structure has undergone profound changes. In this industrial upgrade and

transformation, the role of data in productivity has become increasingly prominent and an irreplaceable part of the new quality of productivity [1]. In particular, big data, as a new type of productivity, has become the core driving force for the intelligent transformation and innovative development of all walks of life. The application of big data not only covers the fields of business, finance, and medicine, but also promotes innovation in the field of education [2]. Against this background, the Big Data Management and Applications major came into being, aiming to cultivate compound talents with data analysis and industry application capabilities [3]. Before the establishment of this major, there were already many majors related to big data, among which the most typical representatives were information management and information systems and data science and big data technology. Although the training objectives of these two majors include the analysis, processing, and application of big data, there are significant differences in their focus and training objectives compared with the Big Data Management and Applications major. The biggest difference is that the Big Data Management and Applications major focuses more on the actual needs of production and life, and aims to cultivate students' ability to use big data analysis to deal with practical problems encountered in the production field, so as to support decision-making and resource allocation in production activities [4]. As an emerging discipline, due to the lack of teaching theory and teaching practice, it faces a series of challenges in the actual teaching process, such as vague training objectives, a mismatch between teaching content and methods, and insufficient practical links. These challenges not only affect the quality of talent training, but also hinder the development of the major. Statistics is one of the core courses in the Big Data Management and Applications major. Its teaching quality directly affects students' understanding and application ability of big data analysis methods [5]. Carrying out effective teaching reform for this course is not only related to students' professional skills, but also directly affects their future competitiveness in big data-related industries, thereby indirectly changing the role of new quality productive forces in social change. To this end, optimizing the teaching methods of statistics courses and exploring new teaching models in the era of big data are important ways to promote professional development.

2. The necessity of teaching reform

2.1. Requirements of new quality productive forces for statistics courses

The data-centric production model is a typical representative of new quality productivity. With the widespread application of technologies such as big data, artificial intelligence, and the Internet of Things, data has become the core driving force for the transformation and upgrading of all walks of life. In this context, statistics, as a powerful tool for data processing, has been set as a professional basic course in many emerging majors. Especially for the Big Data Management and Applications major, the success or failure of statistics course teaching directly affects students' competitiveness in future employment. Therefore, in this new context, statistics courses need to focus on the combination of courses and actual production while focusing on cultivating students' interdisciplinary comprehensive analysis capabilities.

2.1.1. Focusing on the combination of courses and actual production

In real life, the sources of data are complex and diverse, covering various fields such as education, business, finance, medical care, and social media. These data are not only huge in quantity, but also diverse in types and complex in structure. Therefore, statistics courses must be closely integrated with actual production and industry needs to help students understand and respond to the actual challenges of data processing. In the era of big data, pure theoretical knowledge can no longer meet the industry's demand for talent. Students need to master the real application scenarios and analysis skills of data through course learning. Specifically, in terms of courses, specific production environments and business scenarios need to be integrated. For example, in the e-commerce industry, user behavior

data can be analyzed to predict user purchasing tendencies; in the medical industry, patient data can be analyzed to improve the accuracy of disease prediction; in the financial industry, statistical methods can be applied to risk assessment and market trend prediction. In terms of practice, the course should strengthen the full-process practice of data analysis, especially in the acquisition, cleaning, processing, and analysis of data. Through repeated training and key explanations of the above four links, students can master the various skills of data processing. For example, in the data cleaning link, the course should focus on how to identify and process missing values, duplicate values, outliers, and inconsistent data formats in the data. In addition, the use of different programming languages and big data processing tools is also an important part of course practice.

2.1.2. Cultivating interdisciplinary comprehensive analysis capabilities

In the era of big data, the application scope of statistics has surpassed the traditional theoretical framework and has gradually been deeply integrated with disciplines such as computer science, artificial intelligence, economics, and management [6]. By integrating this interdisciplinary knowledge, statistics can not only analyze and process massive data more efficiently, but also propose more innovative solutions to complex problems to adapt to the rapid development of productivity changes. Therefore, statistics courses should focus on strengthening the integration of interdisciplinary knowledge and especially emphasize the cultivation of students' comprehensive analytical ability. In addition, attention should be paid to the cultivation of students' interdisciplinary thinking, so that they can flexibly use computer programming, artificial intelligence algorithms, and management methods to deeply analyze problems from multiple dimensions and angles and design optimization solutions. Such a course design will help students adapt to the ever-changing social needs, improve their competitiveness in the big data era, and further enhance their innovation ability and cross-domain collaboration ability.

2.2. Problem analysis of traditional statistics teaching methods

Statistics, as the basic theory of multiple disciplines, has broad application prospects. In recent years, with the advent of the big data era, statistics is no longer just a branch of mathematics, but has become an important bridge connecting data and decision-making. However, despite the increasingly important status of statistics, the traditional teaching model still faces many problems such as outdated course content, single practical methods, and insufficient practical links. These problems have limited the teaching effect and the comprehensive development of students to a certain extent.

2.2.1. Outdated course content

As a branch of mathematics, statistics includes a large number of laws, inferences, and theories in its course content. Although these contents play a critical role in basic teaching, in practical application-oriented majors, the overly boring theorems and derivation processes are difficult to arouse students' interest and have limited improvement on teaching effectiveness. At present, most statistics courses still focus on classical statistical theories, such as probability theory, hypothesis testing, parameter estimation, and linear regression, while ignoring the introduction of modern statistical methods. With the rapid development of artificial intelligence and big data technology, emerging statistical methods such as reinforcement learning, knowledge distillation, and model quantitative pruning are becoming increasingly popular in practical applications, but many statistics courses have not yet covered these cutting-edge technologies, resulting in the course content not being able to truly keep pace with the times.

2.2.2. Single practical method

The traditional statistical teaching model usually relies too much on lecture-based teaching, where teachers lead the knowledge transfer and students passively accept it. Although this method can effectively convey basic knowledge,

it lacks deep interaction and participation, and it is difficult to arouse students' interest and creativity. The course content is often boring and lacks relevance to real-world problems, making it difficult for students to perceive the value of applying what they have learned. In addition, traditional teaching often ignores case-driven and problem-oriented learning methods. In big data analysis, the discussion of specific cases and problems can help students better understand the practical application of statistical methods and exercise their problem-solving skills. Although some schools have introduced these teaching methods in statistics courses, unfortunately, due to the lack of classic teaching templates for this type of teaching method, it is difficult for teachers and students to adapt to this type of teaching method in the actual teaching process, and even results in twice the effort with half the results.

2.2.3. Insufficient practical links

Traditional statistics teaching mostly focuses on theoretical explanations and exercise training. Although some majors have some simple hands-on exercises, they only stay at the superficial imitation level. Although this method is applicable to many disciplines, it is no longer enough for Big Data Management and Application majors. In modern data analysis, students not only need to understand statistical principles, but also master a variety of data analysis tools (such as Python, R, SQL, etc.), and be able to use these tools for data cleaning, modeling, and visualization. Due to the diversity and complexity of big data, pure theoretical learning and simple experiments can hardly help students truly understand and apply statistical methods. Therefore, adding practical cases of real projects in course design is an effective way to break the gap between teaching and production. Reasonable practical training can improve students' competitiveness in the future workplace.

3. Strategies for teaching reform

3.1. Building a curriculum system under the background of new quality productivity

New quality productivity has a different connotation from traditional productivity. It emphasizes the high integration of technological innovation and intelligence under the premise of data-driven. In this context, the original curriculum system can no longer meet the needs of modern society for data analysis, innovative thinking, and technological application. It has become an inevitable requirement to deeply integrate the existing curriculum system with the development trend of productivity. In order to adapt to this change, the curriculum design needs to undergo fundamental changes. It is necessary to not only strengthen the teaching of basic theories, but also improve students' application ability in technical practice, while focusing on the integration of interdisciplinary knowledge and the cultivation of innovative ability. Therefore, building a curriculum system that adapts to the needs of the new quality productive forces era, covering the three modules of "basic theory + technical practice + case studies," has become the key to cultivating high-quality data analysis talents.

3.1.1. Basic theory module

Theory is still the foundation of statistics-related scientific fields. Theory first is the theoretical foundation and is the premise of all subsequent research and practice. In the context of big data, although the learning of technical applications and data processing tools has become increasingly important, the core theory of statistics is still the basis for students to understand and analyze data. Mastering basic theories such as probability theory, statistical inference, hypothesis testing, and regression analysis is not only a prerequisite for students to conduct actual data analysis, but also the basis for deep learning and technological innovation. In the process of teaching basic theories, it is necessary to clarify the primary and secondary relationships of knowledge. First, we should start with the most basic probability theory to help students build the most basic knowledge framework, and then introduce a variety

of statistical processing methods to consolidate and develop students' understanding of statistics. Finally, we will introduce modern statistical methods and techniques, gradually deepen them, and lay a solid foundation for them to solve complex practical problems in the future.

3.1.2. Technical practice module

Programming languages and various big data processing frameworks have become essential tools for processing and analyzing data. Mastering the use of tools can not only easily complete various tasks in this course, but also cope with various complex challenges in all professional courses and even in actual work. Mastering programming languages such as Python, R, and SQL, as well as big data processing frameworks such as Hadoop and Spark, enables students to extract effective information from massive data, thereby achieving accurate analysis and decision support. In the course design, the technical practice module should focus on the practical application of these tools. Through actual combat exercises and project-driven learning, it helps students transform theoretical knowledge into practical ability, so that they can easily grasp the study of professional courses and enhance their interest in learning.

3.1.3. Application case module

Application cases are the sublimation of theory and an important bridge from theory to practice. Its core lies in combining basic theory with technical practice, making complex theoretical knowledge concrete and perceptible, so as to help students better understand and apply statistical knowledge. In the context of big data, theory and practice become closer, and the role of application cases in teaching becomes more important. Flexible analysis and use of various application cases will make the teaching process interesting and easy. In the information age, a large amount of data is generated every day in various fields. Due to the huge amount of data, the way to process them has also become unusual. For example, risk prediction in the financial market, disease diagnosis in medicine, and user portraits in network communication are all based on massive data. When processing data, different fields need to use different models and experiences according to the scenarios in their own fields, thus forming a more complex processing process. Through the visualization of application cases, teachers and students can sort out their thoughts in the complicated teaching process. In addition, encouraging students to complete a project in groups through cooperation can allow students to recognize their own strengths in practice and further study to reach a higher level.

3.2. Reform teaching methods

3.2.1. Case teaching method

The case teaching method is one of the important teaching methods of statistics courses. By introducing specific industry cases or research cases, students can intuitively see the application of statistical methods in practical problems, so as to better understand abstract theoretical knowledge. For example, by analyzing risk assessment cases in financial markets, students can learn how to use statistical methods for risk avoidance and investment decisions; through medical data analysis cases, students can master how to deal with missing values and outliers and perform predictive modeling. The advantage of the case teaching method is not only to deepen students' understanding of statistical knowledge, but also to effectively cultivate students' analytical thinking and problem-solving ability. In the specific implementation of teaching, teachers can guide students to exercise critical thinking and teamwork ability in the process of discussing and analyzing cases through group discussions and role-playing. Cases have become the core content of most course teaching. Excellent cases can not only stimulate students' interest in learning, but also provide classic templates for teaching. Therefore, in order to give full play to the advantages of the case teaching method, teachers should carefully select cases related to the course content and design appropriate problem situations according to the progress and difficulty of the course. At the same time, the case content should be closely integrated

with the industry development trend and updated in a timely manner to ensure that students can master the latest technology applications and industry dynamics.

3.2.2. Flipped classroom teaching method

Flipped classrooms originated from China's MOOC platform. With the rise of online teaching, it has gradually become a popular teaching method. The core concept of flipped classrooms is to transform the traditional teacher-centered teaching model into a student-centered teaching model. By changing the classroom structure and teaching methods, students become active participants in learning, while teachers become guides and assistants. This model is highly suitable for courses with strong practicality. For the statistics course in the Big Data Management and Applications major, the flipped classroom allows students to master relevant theoretical knowledge and basic skills through pre-class self-study videos, online tutorials, and other resources, and prepare for in-depth discussions and practical activities in class. In class, teachers guide students to apply the theoretical knowledge they have learned and help students understand the practical application of statistical methods through case analysis, problem-solving, and teamwork. After class, students can further deepen their understanding and application of the knowledge they have learned by reviewing class content, completing experimental tasks, participating in discussion groups, or communicating with teachers.

3.2.3. Experimental teaching method

Experiments are one of the important ways for humans to understand the world. As a traditional teaching method, experimental teaching methods have a long history in teaching. However, traditional experimental teaching methods have problems such as outdated teaching methods, insufficient student initiative, formalized experimental reports, and imperfect assessment systems [7]. Therefore, it is particularly urgent to reform experimental teaching methods to adapt to new teaching situations and needs. In the era of big data and big models, data science is no longer merely theoretical research and formula derivation, but also a science of finding data laws and extensions based on repeated experiments. Most effective research results come from continuous experimental exploration. The same is true for the study of statistics courses. Experiments occupy an indispensable and important position in statistics teaching. Only through repeated experiments can students truly understand the application of statistical methods, accumulate experience in solving practical problems, master data analysis skills, and cultivate critical thinking and innovative thinking in the process. In order to better cultivate students' practical ability, experimental teaching must be closer to practical applications, especially combining experimental content with practical problems in modern statistics. Finally, through some challenging experimental tasks, students with spare time are encouraged to think independently and explore freely to tap their creativity to the greatest extent possible.

4. Implementation cases and results

4.1. Teaching case design

With the development of society, financial markets have entered the homes of ordinary people. Preventing and resolving financial risks is a topic that individuals, companies, and even countries must pay attention to [8]. This section will take "Financial Market Risk Assessment and Investment Portfolio Optimization" as a case. Through specific course design and combined with actual financial data analysis tasks, students can not only master the basic methods of statistics, data analysis, and machine learning, but also learn how to apply this knowledge to actual financial scenarios, improving their practical ability and innovative thinking.

4.1.1. Course objectives

The main goal of the course is to help students understand the risk assessment methods of the financial market through actual data analysis tasks, and use statistics, big data analysis, and artificial intelligence technology to optimize investment portfolios. The specific objectives are shown in **Figure 1**.

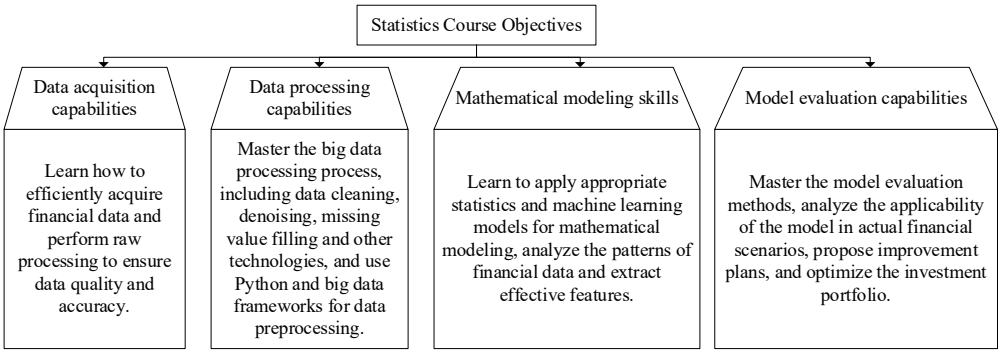

Figure 1. Statistics course objectives

4.1.2. Teaching process

The teaching process covers the entire process of big data management and application, as shown in **Figure 2**.

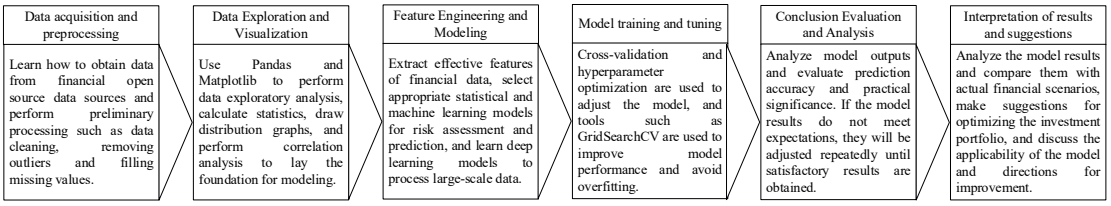

Figure 2. Statistics teaching process

4.2. Analysis of implementation effect

In order to test the effectiveness of the teaching reform of this statistics course, we collected the satisfaction evaluation of the classroom tutorial of this course from students and teachers of the School of Computer Engineering of Guilin University of Electronic Technology in 2022 and 2024, as well as the feedback of students on the relevance of career development. The control group is the data of the two years before the curriculum reform (2022), and the experimental group is the data after the curriculum reform (2024). **Tables 1** and **2** show the results of the teachers' and students' satisfaction evaluation of the classroom teaching situation before and after the curriculum reform, respectively, and **Table 3** presents the feedback results of students on the relevance of career planning before and after the curriculum reform. The results of **Table 1** are selected from 20 statistics teachers of relevant majors in the school as statistical samples, and the results of **Tables 2** and **3** are samples of students of the entire major of Big Data Management and Applications.

Table 1. Distribution of teachers' satisfaction with classroom teaching before and after the curriculum reform

Course satisfaction	2022	2024
Very satisfied	0%	10%
Satisfied	10%	60%
General	60%	20%
Unsatisfied	30%	10%

Table 2. Distribution of students' satisfaction with classroom teaching before and after the curriculum reform

Course satisfaction	2022	2024
Very satisfied	5%	30%
Satisfied	15%	50%
General	65%	10%
Unsatisfied	15%	10%

Table 3. Results of students' feedback on career planning relevance before and after the curriculum reform

Relevance	2022	2024
Jobs related to this major	20%	50%
Uncertain	50%	30%
Jobs not related to this major	30%	20%

Through the data in **Tables 1** and **2**, it is found that after the implementation of the teaching reform, the satisfaction of teachers and students with classroom teaching has been significantly improved. Among them, the number of teachers who are satisfied or above has increased from the original 10% to 70% after the reform, and the number of very satisfied has increased from the original 0% to 10%, indicating that teachers are more motivated to conduct classroom teaching after the curriculum reform. On the other hand, the classroom satisfaction of most students has also changed from general to satisfied, and the number of very satisfied evaluations has also increased to 30%, indicating that students' classroom participation and learning interest have also been greatly improved. Finally, from the results of **Table 3**, it can be concluded that the proportion of students who plan to engage in related occupations after graduation has increased by 2.5 times after the curriculum reform, indicating that students' recognition of the major has become higher and their confidence in learning the major has been greatly improved.

5. Conclusion

This paper takes statistics in Big Data Management and Applications as an example to explore the direction and feasibility of implementing teaching reform under the background of new quality productivity. New productive forces are driven by data and put forward higher requirements for the current data processing discipline. After analyzing several prominent problems in the current statistics course, a teaching reform method with students as the main body and practice as the center is proposed for the statistics course in the Big Data Management and Applications major, which can improve the teaching enthusiasm of teachers and students. Finally, we give an example of teaching demonstration, compare and analyze the ratings of teachers and students on course satisfaction before and after the teaching reform and students' feedback on career relevance, and find that the implementation of teaching reform measures has a positive significance. In addition, the teaching reform results also provide a good reference for the rest of the courses in this major and the statistics courses of emerging majors, with certain guiding significance for many courses.

In future teaching, we will continue to explore and improve the teaching methods of statistics courses in combination with the ever-changing teaching environment and students' learning needs. On this basis, we will optimize teaching design and practice, further improve teachers' teaching ability, create a relaxed and efficient learning atmosphere for students, help them master the course content, and lay a solid foundation for future career

development and scientific research.

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