

Research on Curriculum Construction in the Background of New Engineering Disciplines—Exploring Interdisciplinary Training through the Foundation Course of Data Analysis Technology

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Keywords: Data analysis technology; New engineering disciplines; Interdisciplinary abilities; Course design

Abstract: This paper delves into the importance of establishing a foundation course in data analysis technology within the context of new engineering disciplines, emphasizing the urgency of cultivating students' interdisciplinary abilities. The core principles of course design are detailed, including clarifying course objectives, integrating interdisciplinary content, employing project-driven teaching methods, addressing data ethics and social responsibility, promoting interdisciplinary collaboration, and continuously updating course content. By adhering to these principles, the paper aims to provide methodologies for assessing the importance of cultivating a foundation in data analysis technology in undergraduate education.

1. Introduction

In the digital era, computer technology is flourishing, and the concept of new engineering disciplines injects new impetus into education. However, the evaluation direction may deviate, with software applications emphasizing operability while overlooking in-depth data analysis. In the context of new engineering disciplines, computer fundamental education requires a more comprehensive understanding of data analysis. For instance, financial software like Kingdee Financial Software has embedded functionality for analyzing datasets using code, highlighting the importance of data analysis technology. To meet the demands of the new engineering disciplines, curriculum design needs to be more practical, cultivating students' interdisciplinary thinking. Data analysis technology will become a key component of computer fundamental courses, helping students stand out in future career competition. Therefore, this paper will explore how to integrate data analysis technology, cultivate students' practical application abilities through real-life cases and projects, and meet the challenges of the new engineering disciplines era.

Many universities have begun curriculum development in the context of new engineering disciplines, including training in data analysis technology. Paul Gardiner calls for further research on the benefits of interdisciplinary metacognition in a range of learning environments, considering the need to move beyond the typically fixed adversarial critical thinking approach and establish

epistemological positions based on inclusive cooperation and emerging creativity^[1]. The data science course developed by Kross S and others introduces collaboration with industry^[2]. Broo D G and others propose four strategies, including lifelong and interdisciplinary education, sustainability, resilience and human-centered design modules, data fluency and management course practices, and human/machine/robot/computer interaction experiences^[3]. Li Jinhuan suggests valuable experiences focusing on the precision of target cultivation, emphasizing student subjectivity, flexibility of course methods, multidimensional faculty teams, diverse course evaluations, and shared course resources^[4]. Wang Qing and Guan Lili propose that by adopting a flipped classroom teaching format, students' autonomy can be fully utilized, achieving true internalization of computational thinking; and through cumulative and progressive knowledge point tasks, comprehensive coverage of teaching content can be achieved. Stanford University and the Massachusetts Institute of Technology in the United States offer interdisciplinary data science courses aimed at cultivating students' computational thinking and data processing abilities. In China, Tsinghua University and Fudan University have also begun introducing data science-related courses in computer science and other fields^[5].

Interdisciplinary collaboration is being increasingly promoted both domestically and internationally. Institutions and enterprises collaborate across boundaries to jointly research the application of data analysis in different fields. This collaboration helps to extend the reach of data analysis technology to a wider range of fields, facilitating more innovation.

With the continuous development of artificial intelligence and big data technology, data analysis technology will become more powerful and ubiquitous. This will further drive the application and education of data analysis in various fields.

2. Data Analysis Foundation Course

2.1 Clarifying Course Objectives

In the context of new engineering disciplines, we aim to clarify the core objectives of the computer foundation course to comprehensively cultivate students' core abilities in the field of data. Firstly, the course aims to stimulate and develop students' data thinking, enabling them to apply data analysis methods to solve real-world problems by fostering sensitivity to and understanding of data. Secondly, we seek to enhance students' data processing capabilities, including comprehensive mastery of data collection, cleaning, analysis, and visualization. Through systematic learning of data processing tools and techniques, students will be able to handle various types of data efficiently and accurately, extracting more valuable information from them. Most importantly, the course will focus on cultivating students' interdisciplinary collaboration awareness and problem-solving abilities. By introducing real-life cases and team projects, students will learn how to apply their learned data analysis skills in real-world scenarios, collaborate with peers from other professional fields, and jointly address complex practical issues.

Through these three clear objectives, we aim to cultivate a new generation of computer professionals with profound data thinking, superb data processing skills, and the ability to collaborate across disciplines to solve practical problems. These core competencies will make students more competitive, enabling them to stand out in an increasingly complex and diverse professional environment.

2.2 Integration of Interdisciplinary Content

To achieve the clear course objectives, we will deeply integrate interdisciplinary content to enhance students' comprehensive literacy. Firstly, as data analysis technology serves as an interdisciplinary tool widely applied in fields such as finance, healthcare, and social sciences, it

provides students with opportunities for interdisciplinary practice. By delving into case studies of data analysis applications across various disciplines, students will gain a better understanding of the crucial role of data in solving problems in different fields, fostering interdisciplinary thinking. Secondly, the course will emphasize the integration of interdisciplinary knowledge, enabling students to blend computer science, statistics, business management, and other disciplines in the process of data analysis. This helps break down disciplinary barriers and cultivates students' comprehensive abilities in problem-solving. For example, through project collaboration, students combine computer technology and statistical methods to analyze business data, achieving comprehensive problem-solving.

By integrating interdisciplinary content into the course, we expect students to have a more comprehensive understanding and application of data analysis technology, not only achieving outstanding achievements in the field of computer science but also finding broader applications in other disciplinary fields. Students developed in this way will be more competitive, able to demonstrate excellent comprehensive abilities in various industries.

2.3 Project-Driven Teaching Method

The project-driven teaching method is a pedagogical approach centered around projects, aiming to promote students' learning and development through their participation in real projects. In this teaching method, the selection and design of projects are crucial as they directly impact students' direct engagement with and resolution of real-world issues. Projects should be chosen based on practical application scenarios to ensure that students can directly apply their knowledge and skills to solve real problems. Additionally, project design should highlight the application of data analysis techniques in different fields to stimulate students' interest in interdisciplinary practice and promote integration and communication across disciplines.

During the data collection and cleaning stage of the project, students will face the challenge of handling complex data from multiple sources, gaining early exposure to real-world scenarios. They need to collect data from different sources and perform cleaning and preprocessing to ensure data accuracy and usability. This process will cultivate students' ability to handle real-world data and enhance the practicality of their data processing skills, as well as deepen their understanding of the characteristics and challenges of data.

In the data analysis and visualization stage, students will use more data analysis models for in-depth analysis to enhance their depth of data analysis skills and professional proficiency. At the same time, they also need to focus on the design of visualizations to vividly and clearly present analysis results. This not only enhances students' communication and expression abilities but also improves their understanding and application of data analysis results.

After completing the project, students need to write a professional report detailing the problem background, data analysis process, and conclusions. Through reports and presentations, students will cultivate systematic thinking and expression abilities, while demonstrating their abilities in teamwork and disciplinary integration. This not only enhances students' competitiveness but also better prepares them to face future career challenges.

In summary, the project-driven teaching method, through project selection and design, data collection and cleaning, data analysis and visualization, and reporting and presentation, comprehensively promotes students' overall quality improvement and professional skill development (Figure 1). The teaching method discussed in this paper not only enables students to better apply their knowledge to solve real problems but also cultivates their teamwork, communication, and systematic thinking abilities, laying a solid foundation for their future learning and career development.

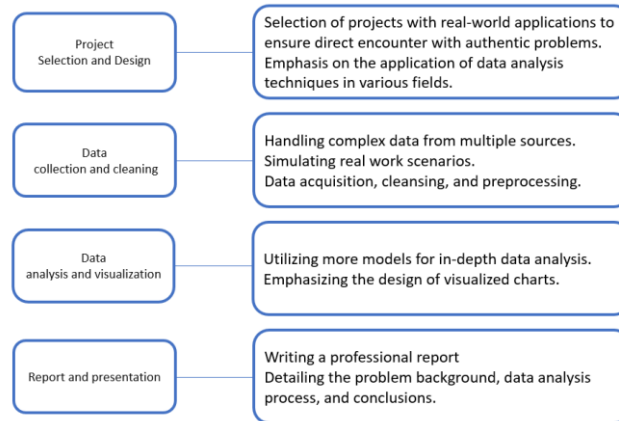


Figure 1: Project-Driven Teaching Method Flowchart

2.4 Improving Assessment Methods

The assessment method for the course aims to explore a project-based assessment approach in data technology education, aiming to enhance students' overall qualities and cultivate their abilities in applying data technology. Firstly, determining the project theme serves as the starting point of this approach. Students or teacher teams propose a challenging and practical data technology project based on real-world needs. Subsequently, student teams develop detailed project plans covering task allocation, scheduling, and resource requirements to ensure effective and efficient project implementation. During the data collection and cleaning phase, students enhance their abilities in data acquisition and processing by collecting relevant data and performing data cleaning and preprocessing, while deepening their understanding of data quality. In the data analysis and modeling phase, students apply the data analysis tools and techniques they have learned to conduct in-depth analysis and establish corresponding models to discover patterns and trends in the data and propose solutions. Following this, student teams evaluate and optimize the models to ensure their accuracy and stability. Finally, students write project reports detailing the background, methods, results, and conclusions of the project, and present their findings within the class or school to share their learning experiences with classmates and teachers. Through this project-based assessment approach, students not only gain early practical experience in data technology but also cultivate teamwork, problem-solving skills, and innovation awareness, laying a solid foundation for their future career development. Moreover, this teaching approach provides teachers with a more comprehensive understanding of students' learning situations, thereby promoting the improvement of teaching quality.

2.5 Cultivating Data Ethics and Social Responsibility

In the curriculum, there is a strong emphasis on cultivating students' awareness of data ethics and social responsibility. Firstly, attention is given to data privacy and security. Through case analyses, students learn how to ensure user privacy and prevent security risks such as data breaches during data processing. Secondly, ethical principles of data usage are emphasized, including fairness, transparency, and traceability, to ensure the legal and ethical use of data and to highlight the importance of adhering to ethical standards when analyzing and interpreting data. Lastly, through case studies, students are guided to reflect on the impact of data analysis on society and develop an understanding of social responsibility. Emphasis is placed on data professionals' responsibility to society, ensuring the fair and just use of data in practice. Through comprehensive training like this, students will develop a strong sense of social responsibility in their practical applications.

3. Course Features

3.1 Importance of Interdisciplinary Collaboration

In the context of new engineering disciplines, interdisciplinary collaboration becomes a crucial strategy for student development. This is not only because interdisciplinary collaboration provides students with a broader perspective but also because it effectively bridges the gaps between disciplines and integrates knowledge from multiple fields. Through interdisciplinary collaboration, students will better understand professional terminology and ways of thinking in different fields, cultivating their ability to solve real-world problems. This multidisciplinary competence is precisely what modern society urgently needs in talent, enabling students to be more collaborative and innovative in teams. To promote interdisciplinary collaboration, we adopt a project-driven teaching method, guiding students to collaborate with professionals from other fields through practical projects and cultivating their ability to integrate disciplines. Through this comprehensive teaching strategy, we aim to cultivate a more comprehensive and creative new generation of computer professionals who can achieve greater success in interdisciplinary collaboration.

3.2 Curriculum Innovation and Development

Curriculum innovation aims to integrate Excel operations and Python programming to promote students' visualization skills in data analysis and cultivate their programming thinking. By introducing Python programming, students will gain a deeper understanding and application of the logic and algorithms of computer science, thereby enhancing their logical thinking in programming. Meanwhile, by combining intuitive operations in Excel with code reproduction, students will more easily understand the role of code and deepen their understanding of programming techniques. This integrated approach helps cultivate students' programming skills and logical thinking in programming, enabling them to analyze data more effectively and present analysis results.

3.3 Interdisciplinary Team Projects

To promote interdisciplinary collaboration, we construct team projects with diverse disciplinary backgrounds. Firstly, through careful selection and allocation of team members, we ensure that each team covers expertise from different fields such as computer science, statistics, and business management, creating interdisciplinary teams with rich diversity.

In case studies, a series of successful examples of interdisciplinary collaboration are explored in depth. These cases involve multiple fields such as finance, healthcare, and social sciences, demonstrating the outstanding achievements of interdisciplinary teams in solving real-world problems. By analyzing successful cases, effective methods to promote team collaboration are summarized, providing valuable experience for future interdisciplinary projects.

By constructing interdisciplinary team projects, students are provided with richer team collaboration experiences, enabling them to better understand and apply knowledge from various disciplines, cultivate their ability to solve real-world problems, and meet the challenges of a diverse workplace.

4. Development and Challenges

4.1 Rapid Technological Advancements

Given the rapid development in the technological landscape, we particularly focus on the

continuous evolution of data analysis technology. By maintaining close connections with various industries, we can promptly grasp the latest technological trends and industry demands, integrating this information into curriculum updates and development. This ensures that our teaching content stays abreast of industry trends and enables students to acquire the latest and most practical data analysis techniques during their learning process, providing them with a competitive advantage for their future career development.

4.2 Challenges and Strategies for Updating Course Content

Updating course content presents challenges in keeping up with rapid technological advancements. To address this challenge, we employ flexible strategies, regularly reviewing and updating course outlines, and introducing emerging technologies and practical case studies. Simultaneously, we establish close connections with industry professionals, engaging in industry research to ensure that our course content reflects the latest technological trends and application scenarios. Such strategies not only help us tackle technological challenges but also ensure that students consistently learn the most forward-thinking and practical knowledge, providing them with a solid foundation to thrive in the workplace.

5. Conclusion

In the context of the new engineering disciplines, interdisciplinary training in the fundamentals of data analysis technology is particularly crucial. Whether it's to meet the demands for data analysis across various fields or to cultivate students' computational thinking and data processing skills, data analysis will play a vital role in education and interdisciplinary collaboration. This trend not only facilitates the integration of knowledge from different fields but also promotes innovation and drives future development. Therefore, providing students with solid training in the fundamentals of data analysis will lay a strong foundation for their future careers, enabling them to better tackle various interdisciplinary challenges and opportunities.

Acknowledgement

This work was supported by the second batch of pilot projects for curriculum assessment reform at Sanya University (SYJGKH2023139)

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