Exploration on Teaching Reform of SPSS Data Analysis and Application Course Using Project-based Learning

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Abstract: Currently, the teaching process of the "SPSS Data Analysis and Application" course has some problems, such as a disconnect between theory and practice, insufficient teaching content that meets practical research needs, and a lack of effective learning incentive mechanisms. This article aims to explore a set of course reform plans that combine project-based learning to promote the comprehensive improvement of students' abilities. In the study, the innovation and optimization of course content, the introduction of project-based learning, and the reform of teaching methods and evaluation systems have been provided. By doing this, we can enhance data analysis and practical operation skills of students, and improve their ability to solve practical research problems in agricultural machinery and equipment. The preliminary exploration and practice of this educational reform plan will provide valuable experience and reference for the teaching reform of related majors at home and abroad.

Keywords: SPSS Data Analysis and Application; Project-based Learning; Diversified Evaluation System; Teaching Reform Plan

1. Introduction

In the information age of the 21st century, data analysis skills have become an indispensable core competency in various fields. Particularly in agricultural engineering, the rapid development of precision agriculture and intelligent agricultural machinery has made the collection, processing, and analysis of large amounts of data crucial for enhancing agricultural productivity and optimizing resource allocation. SPSS, a powerful statistical analysis tool, is increasingly being applied in agricultural machinery research. However, there are issues with the current teaching situation for agricultural machinery postgraduate students at university, including a disconnect between theory and practice, and a lack of practical operational skills among students. This paper aims to address these issues by exploring a teaching reform plan that integrates project-based learning with SPSS data analysis to comprehensively improve students' abilities.

2. Overview of the SPSS Data Analysis and Application Course

With the rapid development of computer technology and the explosive growth of data, people are increasingly faced with the need to handle large-scale complex data[1]. Also, data analysis has become an indispensable part of agricultural machinery research[2]. In order to cultivate high-level agricultural talent, the data processing and analysis skills of agricultural machinery postgraduates places higher demands. SPSS data analysis and application is a fundamental degree course for the Master's program in "Agricultural Machinery Equipment Engineering" at the university. This aims to cultivate students' thinking in multivariate statistical analysis, the ability to use multivariate statistical analysis methods, and solve practical problems through software operations. Statistical analysis plays a crucial role in natural science research, helping students extract meaningful information from large datasets, reveal patterns and trends behind the data, and provide strong support for research[3]. However, for non-statistics majors, statistical analysis can be complex and challenging. During research experiments, students often need to clean and organize raw data for subsequent analysis. Nowadys, SPSS is widely used in social sciences, medicine, engineering, and other fields. It is particularly important in agricultural machinery data analysis, whether in the experimental design stage or the data collection and analysis process. Nonetheless, effective use of SPSS remains a challenge for students, even

those who have systematically studied statistical theory in their undergraduate or postgraduate studies. When it comes to applying theory to practice.

Currently, teaching of this course generally suffers from a disconnect between theory and practice, teaching content not being closely aligned with actual research needs, and a lack of effective learning incentives. These making it difficult for students to deeply understand the practical application value and operational skills of SPSS. Project-based learning, as an effective teaching method, emphasizes comprehensive use of knowledge and practical application of skills through real projects. Research on project-based learning at home and abroad shows that this teaching mode can significantly enhance students' active learning awareness, teamwork ability, and problem-solving skills[4]. It is particularly in the teaching of applied statistics and software operation skills, project-based learning has been proven to enhance students' learning motivation and effectiveness. Additionally, studies on SPSS teaching indicate that teaching methods combining specific cases and data analysis projects can effectively improve students' understanding and application of statistical knowledge. Accordingly, this paper aims to explore a teaching reform plan for the SPSS Data Analysis and Application course that combines with project-based learning. Through practical operations and project-driven, data analysis skills of students and their ability to solve practical problems can be improved[5].

3. Reform Measures for SPSS Data Analysis and Application Course

3.1 Design of the Project-based Learning Teaching Reform Plan

Traditional teaching involves blackboard, explanations and exercises, which lack innovation. It makes classes dull and causes students to feel bored, uninterested, and unable to concentrate. This reform plan based on project teaching combined SPSS data analysis, aiming to improve the practical operational skills and problem-solving abilities of agricultural machinery postgraduates. The reform content mainly includes three aspects. Firstly, by introducing the latest industry cases and datasets to improve innovation and optimization of the course content, which can increase the practicality and foresight of the course. Meanwhile, teaching cases with regional characteristics based on the characteristics of agriculture in region are developed. Then, we will introduce project-based learning by designing practical projects closely related to agricultural machinery research, which can encourage students to complete project tasks through group cooperation. By doing this, their practical operational skills and teamwork abilities would be enhanced. Finally, teaching methods and evaluation systems will be reformed by adopting flexible and diverse teaching methods. This process concludes flipped classroom and group discussion that to improve students' active learning abilities. Besides, a diversified evaluation system including self-evaluation, peer evaluation, and teacher evaluation is established to comprehensively assess students' learning outcomes[6].

3.2 Adjustment of Teaching Objectives

Based on the data analysis project process, the teaching content is designed with "case-led, task-driven" as the core. Through the analysis of numerous cases closely related to agricultural production, students can be guided to use SPSS software to solve scientific problems. Throughout the process, teachers provide guidance and support, including choosing data analysis methods and explaining SPSS operation skills. This enables students not only to master the use of SPSS software and improve their data analysis and processing skills, but also to enhance their understanding and analysis skills of practical problems in the field of agricultural machinery. Moreover, their interest in learning would be stimulated, and their learning autonomy also be improved. Significantly, group collaboration in the form of workshops and project-based learning can strengthen students' teamwork and communication skills. Also, their practical skills are improved, including data collection, analysis, and report writing[7].

3.3 Updating Teaching Concepts and Models

To achieve the teaching goal of SPSS data analysis and software application through project-based learning, it is necessary to update the traditional one-way knowledge by transferring model to an interactive and student-centered teaching model. Unlike the teacher-centered model, this new model emphasizes a dual approach with students as the

main body and teachers as the guide, promoting the formation of students' innovation and comprehensive abilities[8]. By adopting various teaching methods such as heuristic, inquiry-based, case analysis, group discussions, and on-site demonstrations, students are guided to actively participate in the learning process, stimulating their interest and enthusiasm for learning. For example, when explaining statistical theory, a research-oriented teaching method is used. It regularly conducts inquiry-based group discussions, with a randomly selected student to summarize the previous lesson's content and its application in their field. While other students identify and discuss errors or shortcomings, and teacher leads to targeted discussions and hints and solutions timely. During project-based learning and discussions, students are divided into different groups. Each group autonomously selects a research project related to agricultural machinery. The course provides project guidance, including data collection, selection of analysis method, and SPSS operation skills. During project progress, teachers conduct regular checks and guidance to ensure each group advances according to the plan. At the end of the course, each group submits a detailed project report and presents their research results by analyzing process to the entire class.

3.4 Optimization of Teaching Resources and Content

To increase practical exercises on SPSS software operation and enhance the pertinence and practicality of learning, course content is need to be updated based on the latest industry trends and technological developments. This includes, but is not limited to, basic operations and advanced functional applications of SPSS software, data collection and processing in agricultural machinery research, commonly used statistical analysis methods, and their application in agricultural machinery research.

During the practice activities of teaching reform, project topics should closely revolve around the characteristics and needs of agriculture and agricultural machinery applications in China. For example, a project topic could be analyzing data on the mechanized harvesting of cotton or studying the application effects of intelligent irrigation systems in agriculture. Through such practical projects, students can learn SPSS operation skills and gain a deeper understanding of practical problems and challenges in the field of agricultural machinery. Taken the "Effect Analysis of Intelligent Irrigation Systems" project as example, student groups need to collect farmland data from different regions, including water usage and crop yields. Using SPSS for data analysis, students learn from how to apply descriptive statistics, regression analysis, and other methods. These can evaluate the effectiveness of intelligent irrigation systems and explore their potential value in the sustainable development of agriculture.

Potential problems during the practice process include difficulties in data collection and varying levels of student operational skills. Therefore, teachers need to prepare alternative datasets in advance to ensure all students can participate in practical activities. Additionally, extra SPSS operation training and answering should be organized to help students with weaker skills improve their abilities.

3.5 Establishing a Diversified Evaluation System

The assessment model adopted in the SPSS Data Analysis and Application course is an innovative attempt, differing from the traditional method focus on regular performance and final exam scores. It uses a diversified evaluation system of process evaluation, peer evaluation, and teacher evaluation. It not only focusing on students' final outcomes but also emphasizing participation and teamwork during the learning process, reflecting modern education's emphasis on ability cultivation. This diversified evaluation method allows students to receive feedback from both teachers and peers, learning from different perspectives and methods, which helps cultivate their critical thinking and self-reflection skills[9].

Process evaluation emphasizes the importance of the learning process, accounting for 40% of the total score. It encouraging students to actively participate from the beginning of the course, rather than only preparing at the end. Through the report of project progress, teachers can understand students' learning progress in time. In this process, teacher provides necessary guidance that help to improve learning efficiency[10]. Finally, the student's project report, participation in group discussions and classroom activities are used as the evaluation indicators. It encourages students to actively express their opinions and shares their viewpoint.

In this way, not only does it help to absorb knowledge, but it also strengthens students' awareness of process management and teamwork spirit.

Peer evaluation accounts for 20% of the total score, determined by students' evaluations of their group members. This manner, a valuable supplement to the learning process, will promote interaction and feedback among students. Additionally, it will encourage open and honest communication among students, enhancing their sense of responsibility and fair competition awareness. By doing this, can reflect on their work from a peer perspective, fostering personal and team growth.

Teacher evaluation accounts for 40% of the total score, mainly based on students' final project reports and presentations to comprehensively consider students' data analysis abilities, problem-solving skills, and teamwork. This part of the evaluation criterion includes the accuracy of data analysis, the innovativeness of problem-solving solutions, and the performance of teamwork. The teacher's evaluation not only recognizes students' learning outcomes but also summarizes and provides feedback on the entire learning process, which is beneficial for students' long-term development.

Although this assessment model is relatively comprehensive and innovative, there is still room for improvement. For example, introducing industry experts as guest reviewers to participate in the project evaluation. It could enhance the objectivity and authority of the assessment, and provide students with more practical industry knowledge and experience. Additionally, considering individual differences, teachers can give more consideration to students' personal progress and effort in the final evaluation to encourage all students to actively participate and achieve personalized development. Finally, these improvements can make the assessment model more complete and better promote the comprehensive development of students.

4. Conclusion

This teaching reform plan closely integrates project-based learning with SPSS data analysis teaching. Firstly, it uses real industry cases as learning carriers to strengthen students' practical operational skills and teamwork abilities. Then, by continuously updating and optimizing course content, the plan ensures that the learning content stays in sync with the latest industry developments. Finally, the establishment of a diversified evaluation system, combining process evaluation, peer evaluation, and result evaluation, comprehensively assesses students' learning outcomes. With the teaching reform plan that integrates project-based learning with SPSS data analysis adopted, it will be more effectively enhance the practical operational skills and innovative thinking of agricultural machinery postgraduates. It also cultivate more high-quality talents to meet the development needs of future agricultural technology. Besides, the successful implementation of this reform plan will promote innovation in course teaching methods and the improvement in the teaching evaluation system. Also, this can provide valuable experience and references for other disciplines and other universities. However, there is still room for improvement, such as optimizing the relevance and practicality of project topics and strengthening individual guidance to ensure that every student benefits from the process.

5. Prospect

In the future, the postgraduate courses of agricultural machinery will continue to explore and refine the teaching reform plan, mainly focusing on the following aspects. Firstly, taking the special needs and characteristics of Chinese agriculture into account, it need to further develop and deepen project-based learning content closely integrated with regional characteristics. For example, we can select the water resource management and efficient planting techniques in arid areas as cases, to enhance the practicality and regional relevance of the courses. Then, introducing more real data and research cases to strengthen cooperation with external institutions. Meanwhile, we should improve technical support for SPSS and related data analysis software, including software licenses, online resources, and workshops, to enrich learning resources and practical opportunities of students. What's more, considering the diversity of students' abilities, more flexible and personalized learning paths and tutoring programs should be designed[11]. Based on initial ability assessments, we can provide some project topics that align with students' interests and levels and offer personalized tutoring and support according to students' learning progress. And then,

cooperation between agricultural machinery majors and related disciplines such as statistics and computer science must be encouraged and promoted, offering interdisciplinary project-based learning courses. This not only improves data analysis skills of students but also broadens their horizons and enhances their ability to solve complex interdisciplinary problems. Last but not least, a continuous course evaluation and feedback mechanism can be established. This not only collects feedback through evaluations at the end of the course but also makes real-time adjustments to teaching methods and content during the course. With the online platforms to gather student feedback and regularly organize communication sessions between teachers and students adopted, we can understand learning status and needs of students timely and thereby continuously adjusting and optimizing the teaching plan.

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