Education Theory: Teaching and Learning(ISSN Online: 2771-9030)
June 2022 Vol.1, No.3, pp. 44-49
DOI: https://doi.org/10.55571/ettl.2022.06011

4D Publishing Group

Exploration on the teaching of Experimental Design in Applied Universities

Li-yan Pan*
School of Business and Economics, Shanghai Business School, Shanghai, China

*Corresponding author's e-mail:
liyan_pan@sina.cn

Abstract. Experimental Design is a major compulsory course for Economic Statistics and other majors, and it is an important applied technology subject. This paper explore teaching by analyzing the practical problems existing in the course, emphasizing the teaching content optimization, strengthening real case teaching, paying attention to the cultivation of application ability and establishing diversified assessment system on teaching reform, in order to further elevate the teaching quality, strengthen the consciousness of students experimental design and data analysis, improve students' ability of optimizing research experiment scheme, scientifically analyzing and processing data as well as solving practical problems.

Keywords. Experiment design; Data analysis; Teaching exploration

1. Introduction

Modern society has entered an "informatization" era, and the main carrier of information is data, which plays a very important role in today's information society.There are massive data in every field of any industry, and these disorderly and unsystematic data imply some essential rules, which will provide theoretical basis for decision-makers of all industries to make scientific inference and decision. Data processing is to discuss how to analyze these complicated data [1], reveal the implicit internal rules, discover useful information, and provide theoretical basis for decision-makers to make correct decisions.To achieve efficient and accurate data processing, scientific and reasonable experimental design is a necessary precondition [2].

Experimental design and data processing are the technical principles and methods that engineers and technicians must master. It is a very practical subject. Its biggest characteristic is to arrange the test scheme scientifically and reasonably, so as to achieve more and better production and scientific research results in the shortest time with the least amount of human and financial resources[3].Through the teaching of the course, it can improve the ability of students to independently design research project experiment scheme, promote students' understanding of the

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whole process of scientific research work, guide them to adopt more scientific and effective means to solve various problems in experiment and production practice, and lay a foundation for the subsequent graduation project and related learning. It provides basic training for students engaged in scientific research and practical work in the future, and cultivates students' ability to determine research and experiment scheme correctly, analysis and data processing scientifically.

2. Problems existing in teaching at present

2.1. Theoretical teaching is not coordinated with practical teaching

In the teaching of "integration of theory and practice", some teaching arrangement mainly focus on the teaching and application of data analysis software, and too little on theory; some teaching arrangement also pay too much attention to theoretical teaching, less class time application; some teaching arrangement divide the theoretical and practical into two semesters, which makes students not willing to learn the theory and lack the guidance of the theory in practice.

Theory and practice are not shared, and the content of theoretical teaching and practical training is not determined by training front-line talents' post ability as the center according to the actual needs of the post [4-5].On the one hand, it limits the thinking mode of students , making it difficult for students to think independently and creatively, and their consciousness of putting forward and solving problems is weak; On the other hand, it is difficult to meet the requirements of the society for compound talents and does not conform with the training goal of application-oriented undergraduate talents.

2.2. Learning enthusiasm and participation are not high

Nowadays, many students are utilitarian in their study and are only interested in the courses they think will be useful in their future jobs, while they only pursue passing in other courses. Although Experimental design is a subject with wide application, this course is characterized by many contents, formulas, calculations and charts, etc., which determines that students are not willing to learn theory and lack of guidance in practical application.

Due to the complexity of the course content, the requirements of basic theories are relatively high, which makes the course less attractive to students. Although teachers pay a lot of effort to prepare before class, the content are boring and difficult to understand in the eyes of students, and it is difficult to obtain excellent score. Moreover, some students have not well mastered the prerequisite course "Probability theory and Mathematical Statistics", which makes the learning of this course more difficult. Therefore, many students are not interested in the course.

2.3. The actual needs and the course are not connect

The traditional teaching mode takes the teacher as the main center, the teacher is the speaker, lays emphasis on classroom teaching, and the student is the passive recipient. The teaching effect mainly depends on the teacher's organizational and language expression ability, the interaction between teachers and students is limited, and the overall learning effect is mediocre. Now really accord with the characteristics of students' professional data analysis of teaching materials are less and less, most teaching materials are very informative, so within the prescribed course periods, the teacher can only choose foundation chapters and important chapters to carry on.

So the selected teaching content is randomness and blindness, even exist in phenomenon that the teaching content is selected completely by teaching materials, not well to provide service for the cultivation of professional quality. This makes it difficult for students to feel the practical significance of this course, which directly leads to the lack of enthusiasm and subjective initiative. The ability of

students to independently analyze and solve practical problems can not be improved, and it is difficult to master the essence of experimental design method.

2.4. Teaching method and evaluation mode are not complete

The present teaching method is too single, teaching means are monotonous. Teachers complete the teaching tasks according to the teaching syllabus, and students learn the knowledge taught by teachers in class. The teacher assigns homework according to the content of the textbook, and the students finish the homework in corresponding chapters. Then the teacher checks the homework submitted by the students. Finally, the mid-term and final exams were conducted, and the students were cope with the exams and get credits. As a result, teachers impart knowledge and students passively accept knowledge, it is unknown whether students can apply the theory of experimental design to solve practical problems, which is not conducive to improving students' ability to solve practical problems with the knowledge they have learned.

Nowadays, many courses in colleges and universities still adopt the final written examination achievement assessment mechanism, this kind of assessment system undoubtedly ignore the importance of the inspection in practice operation process at ordinary times, make the students think the daily learning and operating have little effect on performance. Students lack learning enthusiasm in class, it is fail to reach the course teaching goal of cultivating the ability of software practical operation.

3. Teaching reform of Experimental Design course

3.1. Optimize the teaching content, enhance the teaching basic theories and methods

The theory and method of experimental design are rich in content, involving a wide range of applications. One of its main contents is about the design theory, knowledge and skills before the test, including the error of test data, descriptive analysis of data, multiple regression analysis, analysis of variance, principal component analysis, canonical correlation analysis, cluster analysis, discriminant analysis, etc. The second part is about the theory, knowledge, methods and skills of scientific processing of test data after the test, and mainly introduces the method of optimum selection, orthogonal design, uniform design, regression orthogonal design and formula test design.

The optimization of classroom teaching content will have a great impact on teachers' teaching efficiency and students' learning outcome. At the same time, in order to help students to continue learning and apply effective methods in the future, we should pay attention to the teaching and training of basic theories, methods and processes, so that they can master the basic theories and methods of data analysis, as well as the models, concepts, theories and applications of the main contents.

For example, when explaining cluster analysis and discriminant analysis, let students know that they have their own applications. Cluster analysis method is according to the data characteristics of samples (or variables), the similar samples (or variables) tend to be divided into the same category, the dissimilar samples (or variables) tend to be divided into different classes; the discriminant analysis method assumes that groups (or classes) have been sorted in advance to determine which group new samples should belong to [6]. In practical application, cluster analysis and discriminant analysis are often combined, that is, the cluster analysis method is first used to classify the samples properly, and then discriminant analysis method is used to divide the new samples into existing categories.

Due to the large amount of theoretical content and the shortage of class hours, we can appropriately simplify the complicated basic theory proof process in teaching, strengthen the optimization organization of teaching content and the application teaching on the basis of theoretical teaching.

3.2. Strengthen real case teaching, improve students' interest and participation in learning

Interest is the best teacher for students. Only when students have the interest and motivation to learn the course, can they learn the course well and apply theoretical knowledge and methods into practice. Case teaching is a student-centered, interactive exploration process of realistic problems and a specific fact, which can effectively raise students' interest in learning [7].Therefore, we should set out from the practical problem in classroom teaching, carefully choose cases which are sufficient representative, derive from actual problems, enlighten the students to think, analyse, research the question in the case, select the appropriate data analysis methods to analyze problems, combined with the mathematical software to calculate, and then discuss the calculation process and result, finally form a summary report.

For example, when explaining cluster analysis and discriminant analysis, students can use family income and expenditure case as an example. First, students are required to investigate their family income and expenditure according to the following contents: areas, food, clothing, fuel, housing, articles of daily use, cultural life, etc. After data aggregation, determine an appropriate clustering method by comparison, then investigate other classes of students' family income and expenditure by using discriminant analysis method for judging, through this process to make the students not only find the differences between a clustering analysis and discriminant analysis, and also understand the application of data analysis method in practice.

Through case teaching, let students experience the role of data analysis method in solving practical problems and see its wide application in practice, so as to stimulate students' interest in learning this course, gradually master the method of using data analysis to solve practical problems, and improve their comprehensive ability. In the practical teaching, the teacher should not only use case teaching in class, but also assign case homework according to the actual situation, so that students can realize the function of data analysis in practice.

3.3. Pay attention to practical teaching, develop computer software application ability

The development and wide application of experimental design method is closely related to the progress of computer. Without the application of computer, there is no possibility of experimental design theory and method to solve practical problems. As the experimental design and data analysis are mainly used to reveal the implicit internal rules and explore useful information from the complex data to provide theoretical support for decision making[8]. There are a lot of data and variables involved in the problem, so there are a lot of experimental design and data analysis methods available, and the amount of calculation is particularly large, so the problem must be solved by computer.

For example, when forecasting the demand of the automobile market, there are many factors affecting the total automobiles sales, including GDP, the proportion of the tertiary industry in GDP, the investment in fixed assets of the whole society, the total retail sales of consumer goods, annual per-capital income, the year-end savings deposits of urban and rural residents, insurance premiums and so on. At this time, it is necessary to use multiple linear regression analysis method for prediction, because there are many variables involved, and each variable needs multiple sets of values, so only use computer can successfully complete this task.

As a major supplement to theoretical teaching, practical teaching focuses on the cultivation of thinking mode and operational ability, which plays an important role in the whole teaching process. Therefore, it is necessary to strengthen the role of practical teaching, as well as integrate classroom teaching and practical teaching together. Classroom teaching emphasizes the foundation of the course, while practical teaching emphasizes the application of the course. Through this combination of theoretical teaching and practical teaching, students can not only better grasp some analysis processes related to the basic methods of data analysis, deepen their understanding of the basic theory, but also enhance their learning interest, confidence and ability to analyze and solve problems.

Of course, the results calculated by computer combined with software are only charts or figures, and the output must be analyzed in combination with reality. Therefore, teachers should organize students to explain the output results in view of practical problems in teaching, so as to cultivate students' ability to make reasonable decisions on the obtained data results.

3.4. Establish a reasonable course diversified assessment system, ensure the teaching effect

Data analysis itself is a typical representative of "from reality to reality", so in the whole teaching process, we should focus on the cultivation of "ability to solve practical problems", the previous final examination mode of "one paper" deviates from the essence of data analysis. Course assessment is an important part of teaching activities and an effective educational means to guide students' development. Therefore, according to the characteristics of Experimental Design courses and the requirements of teaching syllabus, we should set up a scientific and reasonable course assessment system, so that it can effectively feedback teachers' teaching activities and students' learning activities.

Course assessment should be especially emphasizes the cultivation of the students' practical ability, innovation consciousness and appraisal, can use 2:2:6 assessment score method, that is 20% grade at ordinary times, homework can be open work, according to the actual situation by the students from real life cases, applying experimental design method and data analysis to analyze and solve problems. The results of computer experiments account for 20%. Computer experiments focus on the application of software and analysis of results. The final exam score is 60%, in order to cultivate and improve students' comprehensive ability in all respects.

The usual homework and computer experiments can be compiled case library, requests the student to apply the theory of experimental design and data analysis, establish the model of solving practical problem, select the appropriate application software, code the corresponding program, finally analyze the results. As "modeling training" be the main line of teaching idea, its purpose is to cultivate students' "innovation consciousness and practical ability ". In the future, open assessment can be discussed as the main way, diluting or even canceling the examination mode of "one paper" at the end of the term, highlighting the use of knowledge to solve practical problems and gradually cultivate students' innovation consciousness.

4. Conclusion

To sum up, Experimental Design is an interdisciplinary comprehensive subject with deep theory and wide application. In teaching process, teachers should consider much, study hard, keep broadening knowledge, flexible use of modern teaching methods and means, select teaching content reasonable, fully mobilize the students learning enthusiasm. To enable students to learn the theory, meanwhile improve the ability of correctly determine the research experiment scheme and scientific analysis, data processing and solve practical problems. Only in this way can we gradually realize the goal of building a high-level application-oriented university, deepen the teaching reform and innovate the talent training mode, and cultivate qualified application-oriented talents for the society.

Acknowledgements

The research results of this paper is supported by the Key Curriculum Construction Project of Shanghai Business School. The project number is SBS-2020-XJZD-10.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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