

Research on the “Trinity” Teaching Mode of Management Operations Research

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Abstract—Operations research has been widely applied in various fields such as production planning, marketing, and engineering technology, provided the scientific basis for management decision-making, and promoted modernization of management. Operations research, as a discipline based on data decision optimization, has made significant development and progress. However, the teaching mode of operations research has not undergone reform and innovation with the arrival of the big data era. In the traditional teaching process of operations research, teachers often overemphasize mathematical theoretical derivation and problem-solving algorithms, while neglecting students' ability to solve practical problems. To further improve the teaching quality of operations research and the training quality of management professionals, this paper analyzes the main problems existing in the teaching of management operations research courses and proposes a ‘Trinity’ teaching mode of management operations research. Based on the above, establish an integrated teaching method that integrates mathematical modeling ideas, computer experiments, and subject competition training. Through the “Trinity” teaching mode, we can deepen the understanding and application of theoretical knowledge, establish students' modeling thinking ability, and cultivate students' ability to use relevant software and solve practical problems. Through the study of operations research, students can use the knowledge and methods of operations research to analyze, model, and solve some typical problems in economics and management with the help of computers.

Keywords—operations research, teaching reform, mathematical modeling, computer experiment, subject competition

I. INTRODUCTION

Operations research has a wide range of applications in production planning, marketing, engineering technology, and other fields. It provides a scientific basis for management decisions and promotes the modernization of management. Operations research is a professional basic course of management. It not only enlightens students' thinking from the idea of scientific management, allows students to think about the entry point and perspective of problems, but also improves students' ability to analyze and solve problems from mathematical methods. It is one of the most widely used disciplines in

the Internet and big data era. Since the 21st century, humans have gradually stepped into the era of big data, and operations research, as a discipline of data-based decision optimization, has made progress considerably. However, the teaching mode of operations research has not been reformed and innovated with the advent of the big data era. In the traditional teaching process of operations research, teachers usually overemphasize mathematical theory derivation and solution algorithms, but ignore students' abilities to solve practical problems. This paper analyzes the main problems existing in the teaching of management operations research courses and proposes a series of teaching improvement measures based on cultivating students' modeling ability, software operation ability, and innovation ability.

II. THE PRESENT PROBLEMS

Combined with the teaching practice and course construction of operations research, this paper summarizes the teaching experience in the teaching process and analyzes the problems existing in the training of management students in the teaching process of operations research courses from three aspects: teaching content, teaching mode, and teaching thinking. The details are as follows:

- (1) Pay more attention to theoretical knowledge rather than practice.

Teachers spend a lot of time on abstract concepts, basic principles, and algorithms in the teaching process of operations research, while they do not pay enough attention to the application cases and software solutions of operations research in production management. Theoretically, this teaching mode ensures the mastery of theoretical knowledge. However, in practice, it is not conducive to the cultivation of students' interests and practical skills. Operations research is very different from other mathematics courses. Some courses like advanced mathematics and linear algebra are abstract so they can't be used in production and life directly. But born in the process of solving practical problems, operations research is closer to production and social practice. In the development of several decades, operations research has formed a set of mature methods and models to solve practical problems, and its theories and methods are applied to solve practical problems [1]. However, teachers mainly focus on teaching materials and after-

class topics, explaining how to build models and how to solve problems, but rarely use software teaching to give solutions for practical problems. It is very difficult to accept many theories and concepts and fail to apply knowledge to practical problems for students with insufficient background knowledge. Meanwhile, students do not improve their practical ability.

(2) The combination of teaching content and major is not enough.

Operations research is a required course in management theory and methods. Operations research courses mainly include linear programming, integer programming, transportation problems, graph theory, network planning, decision theory, and so on. Management majors focus on the combination of theory and practice. Students should continuously exercise and improve their way of thinking through the study of operations research, to realize the clarification and simplification of the quantitative relationship of complex problems [2]. Cultivate the ability of management professionals to solve practical problems through systematic methods of operations research. However, the choice of the content of operations research has not made a reasonable selection according to the nature of the profession. Many students have a weak mathematical foundation, so they will be afraid of difficulties and unwilling to take the initiative to learn in the face of the ability to prove theorems and solve problems, thus affecting the learning effect. In addition, the course content is large, and many management cases such as economic analysis, program decision, and management optimization, which are practical cases of operations research analysis and modeling, do not have enough time to explain or even have not been selected into the textbook. This not only fails to achieve the purpose of strengthening and consolidating the basic knowledge of the major but also makes the operation research courses more boring for students.

(3) The teaching model is too traditional.

In the choice of teaching methods, operations research generally adopts the traditional teaching mode at present so the lecture form is relatively simple. This spoon-feeding teaching way is not good for stimulating students' interest in learning. Because most students learn passively to a great extent, unable to improve learning efficiency, lack of favorable communication and interaction between teachers and students. In this process, the enthusiasm and creativity of students are not mobilized, thus losing their interest in learning operations research. In the process of instruction, teachers mainly teach operational research principles and algorithms not interspersed with historical stories, recent research findings, and applications. This makes students limited to textbook knowledge. Furthermore, students' knowledge structure can't be broadened and it's not enough to stimulate students' interest in learning. Moreover, students often feel bored and find learning difficult because teaching is toward management students, not mathematics.

III. TRAINING OBJECTIVES OF TEACHING REFORM

In the face of the problems of outdated teaching concepts, single teaching methods, boring teaching content, inaccurate teaching focus positioning, and disconnection between theory and practice in the teaching mode of operations research, to improve the quality of teaching and cultivate students' application ability and innovation ability, operations research Teaching reform is imperative [3–7]. The teaching model proposed in this paper focuses on cultivating students' abilities in the following aspects:

(1) Develop students' modeling ability.

Operations research is a highly practical course. In the teaching process of operations research, in addition to teaching the necessary mathematical theoretical knowledge, we should also focus on cultivating students' ability to transform practical problems into mathematical problems and apply the theoretical knowledge they learned to build mathematical models to solve problems. According to professional features of students who are majoring in management, this paper integrates the idea of mathematical modeling into the teaching of management operations research by studying the reform of teachers in the course preparation and teaching methods, so that students can set up an open and innovative way of thinking. It enables students to have stable mathematical modeling ability and lays a solid foundation for further study and development at a higher level.

(2) Cultivate students' ability to operate tools and software.

The existing teaching of operations research focuses on mathematical derivation and relevant algorithm solving but neglects to cultivate students' ability to use computers to solve operations research optimization problems, which cannot keep up with the development of the era of big data. The paper will introduce typical cases based on the characteristics of the major through case methods of teaching combined knowledge and finally guide students to solve practical problems. Based on solving, the students are taught to use Lingo and MATLAB to solve models and clarify the solution report. The paper set up additional cases, requiring students to complete the modeling after class and to solve the model by software in computer class to cultivate students' operational ability to use software for operational research optimization problems.

(3) Cultivate students' creative ability.

Operations research about management is a comprehensive discipline closely combined with practice. Leaders should actively adjust the direction and thinking of teaching to cultivate students' ability to analyze and solve problems creatively. The paper will adopt a heuristic teaching method. By introducing typical cases, students will be gradually guided to complete the process of asking questions, analyzing problems, building models, solving models, testing and finally improving solutions. Based on the content of classroom teaching, the teaching team can launch practical teaching gifted comprehensive, design and innovative operations research and summon students to participate in the "Challenge Cup" National

College Student Curricular Academic Science and Technology Works Competition, China Undergraduate Mathematical Contest in Modeling, etc., to improve students' ability of practice and inspire students' new thought.

Through the above analysis, the purpose of this paper is to deepen students' understanding and application of theoretical knowledge, establish students' modeling thinking ability, and cultivate students' ability to use related software and solve practical problems. As shown in Fig. 1.

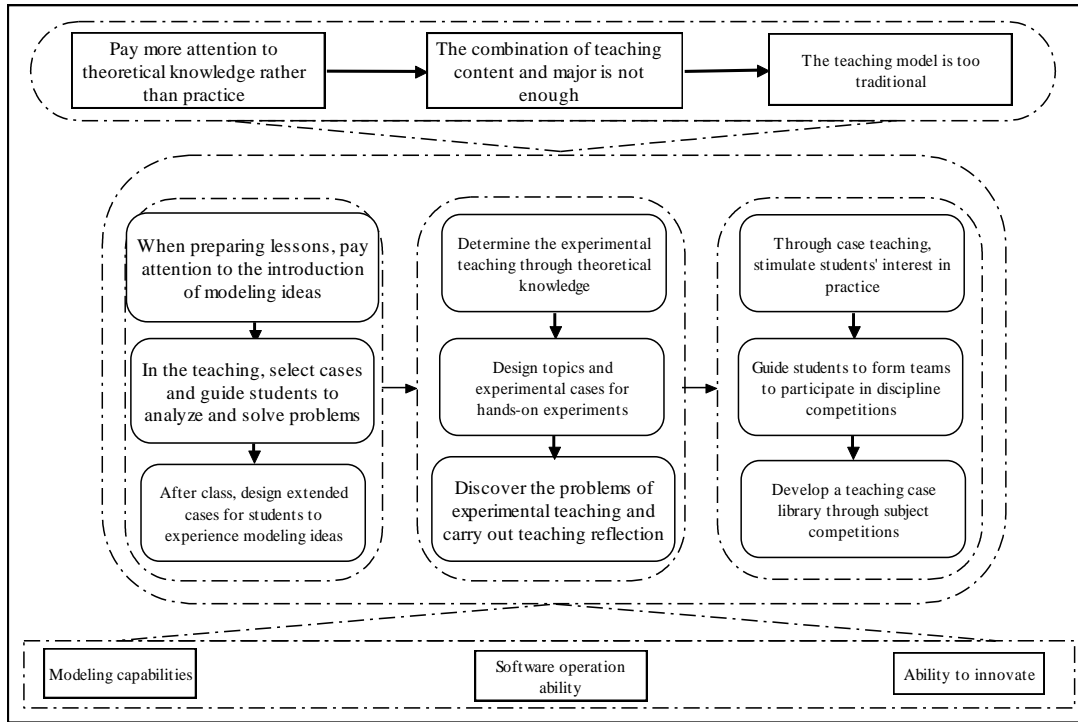


Fig. 1. Pathway to capacity development.

IV. "TRINITY" TEACHING MODEL

After careful analysis of the actual situation of management majors, guided by modeling ability, software operation ability, and innovation ability, the teaching reform of operations research is tried from the following aspects.

- (1) Establish a teaching model of management operations research integrated with mathematical modeling.

In management operations research, various social problems are simulated in the form of modeling, and then the corresponding conclusions are drawn according to the data analysis of the model, to make the most favorable decisions and judgments for managers. Therefore, the thought of mathematical modeling should be integrated into the process of management operations research reform, so that students can establish a sense of innovation in mathematical quantification, and cultivate students' excellent analysis and mathematical judgment ability. The paper will blend mathematical modeling ideas into management operations research from the lesson preparation, teaching, and after-class links. Combine the knowledge points of the course preparation and pay attention to the introduction of modeling ideas in the course preparation. Clarify important explanation objectives. Those chapters with less application or theory can be included as elective content. The mathematical

modeling process in knowledge points should always be regarded as an important teaching objective. In the course of teaching, case teaching and special lectures are adopted in combination with teaching objectives to elicit knowledge and problems related to operations research and gradually guide students to complete the process of asking questions, analyzing problems, building models, solving models, testing and improving solutions [8]. After class, students were given some cases that were further expanded from the classroom cases. Students were asked to complete the whole process of problem modeling and method solving by themselves, to test the learning effect of students and let them deeply understand the modeling idea of solving practical problems with operations research knowledge.

- (2) Design an experimental teaching system of operations research for management.

At present, there is no experimental teaching part in management operations research in our school, and solving operations research optimization problems by software is not included in the teaching content. In the age of big data and informatization, the teaching model and other modern technological means should be fully integrated, actively promoting the reform of operational research teaching content, teaching mode, and methods to improve the student's ability to solve practical problems. This can better reflect the features of the time and meet the new demand for talent in economic and social

development. The experimental teaching of management operations research is mainly to solve the theoretical model. If students are asked to solve practical problems manually, they are likely to make mistakes because of a great deal of steps and the computational burden. The paper will incorporate practical software similar to Lingo, MATLAB, and other solving software for linear and nonlinear optimization problems into the classroom teaching content, separate theoretical teaching and experimental teaching, and set special experimental class hours for operations research. In the computer experiment class, the students' operation is dominant, and tutoring is auxiliary to training students' comprehensive ability in experiment design, data collation and analysis, model building, process solving, and so on.

(3) Classroom teaching and discipline competition are combined to carry out innovative training.

Operations research is a subject of the tool, and it is an effective tool that cannot be fully mastered without the practice of practical problems. The teaching of operations research in domestic colleges and universities mainly adopts classroom teaching. Students have mastered the classroom knowledge, but once they encounter practical problems, they have no way to start. This is mainly because there is no opportunity for students to apply what

they have learned. Therefore, this paper intends to take discipline competition as the entrance to guide students who are learning operations research to form teams to participate in discipline competitions, such as the "Challenge Cup" National College Student Curricular Academic Science and Technology Works Competition, China Undergraduate Mathematical Contest in Modeling, college students business management decision Simulation competition, college students securities investment simulation competition, etc. It can establish the optimization method and the optimization consciousness of operation research, and cultivate the application ability and innovation ability of students [9]. At the same time, exploit the teaching content with the characteristics of management specialty and the teaching case base with the characteristics of the era by closely combining discipline competition and professional quality.

Through the above analysis, students can gradually establish the knowledge system of operations research to solve practical management problems and master the operations research methods to solve practical management problems. The teaching mode of management operations research is designed as shown in Fig. 2.

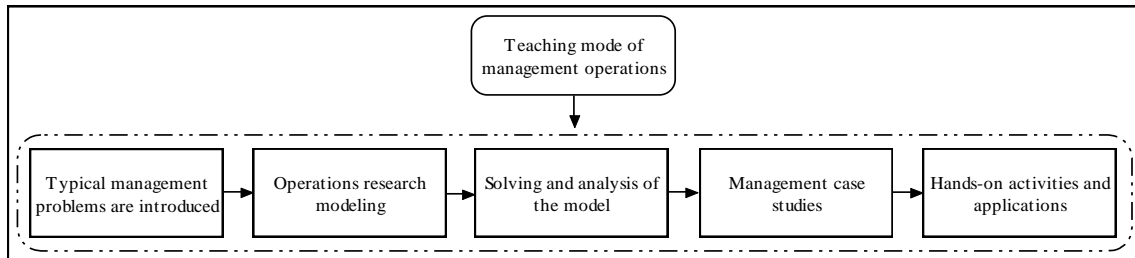


Fig. 2. Teaching mode of management operations.

V. KEY PROBLEMS SOLVED BY TEACHING REFORM

In the teaching reform, given the existing problems, special attention should be paid to the following two key issues.

(1) Optimize the teaching design and strengthen the combination of theory and practice.

Instructional design is a crucial part of teaching and the basis of improving the quality and effect of classroom teaching. The teaching purpose of the management operations research course is that students can use the knowledge and methods of operations research to analyze, model, and solve some typical problems in economy and management with the help of computers through the study of operations research course. Combining the organization of class with the different characteristics and nature of management majors, design and select cases in line with students' realistic level and professional characteristics and establish the case heuristic teaching. That makes students resonate with their professional courses and is conducive to raising [10] students' interest in learning. The selection of cases should be combined with practical scientific research problems and problems faced by enterprises, and it should also be able to guide

students to better understand the theories of each chapter of operations research. The teaching content must be able to solve the practical problems of management research-related knowledge, in line with the training goals of the management major, and students can also innovate to solve similar management-related problems after learning. By revising the syllabus and reconstructing the teaching content, the main knowledge system is established in Table I.

(2) Strengthen the bonds between modeling and experiment to improve students' ability to solve practical problems.

Problems in operations research come from practice, through the analysis of practical problems, and then establish and solve the model and get the corresponding results. Establishing a mathematical model and solving the model correctly is the key step of operations research to solve practical problems. At present, the teaching of management operations research in our school is still based on theoretical explanations instead of experimental courses. However, in the teaching of operations research, we should not only explain the theoretical knowledge but also exercise students' ability to build, analyze, and solve models. It is more important for management students.

For this reason, we should put the idea of mathematical modeling and mathematical experiment methods into the management of operational research in the teaching process, build a teaching environment that integrates mathematical modeling and mathematical experiments, and develop students' abilities in mathematical modeling and programming with known algorithms. In this way, students can improve their ability to solve practical problems from multiple angles and methods.

In the process of teaching, the teaching team found that students' interests and foundation in operations research are also uneven. To effectively cultivate the innovative

thinking of undergraduates and stimulate students' enthusiasm in the operations research experimental course, the teaching team carried out the practical training teaching of operations research and led students to participate in discipline competitions, improve students' practical ability and inspire students' innovative thinking [11]. In the teaching process, operations research teachers combine relevant teaching content and experimental content and organize students to visit enterprises, so that students can personally experience the relevant learning content, and have a deeper understanding of the learning content.

TABLE I. MANAGEMENT OPERATIONS RESEARCH KNOWLEDGE SYSTEM

No.	Course content	1	2	3	4
1	Production planning	Linear programming model	Linear programming Duality problems	Sensitivity analysis	Solved by Lingo
2	Distribution system design	Linear integer Planning Model	Solved by Lingo		
3	Assign issues	Linear 0-1 Planning Model	Solved by Lingo		
4	Production decisions	Multi-objective planning model	Target Programming	Solved by Lingo	
5	Resource allocation	Dynamic programming model	Multi-stage decision -making process	The equation of dynamic programming	Solved by Lingo and Matlab
6	Portfolio optimization	Nonlinear programming models	Genetic algorithm	Particle swarm optimization algorithm	Solved by Matlab
7	Site selection and Postman Problem Shortest path	Network planning	Minimal fees Maximum stream	Solved by Matlab	
8	Enterprise credit classification	BP neural networks	Support vector machines	Solved by Matlab	
9	Demand forecasting	Linear regression prediction	Time series forecasting	Markov prediction	Gray prediction
10	Decision analysis	Analytic hierarchy	Decision tree	Solved by Matlab	
11	Manage system evaluation	Evaluation indicators	Evaluation methodology	Solved by Matlab	

VI. CONCLUSION

This paper puts forward the ideas and measures of the teaching reform of "Operations Research", and proposes the idea of mathematical modeling, computer experiments, and subject competition training as an integrated teaching method, which fully mobilizes the enthusiasm and initiative of students in learning, and has achieved good learning effect. Through classroom teaching, students can master basic subject knowledge and lay a solid foundation for good results in subject competitions. In the teaching process, students are given more opportunities to demonstrate and practice, and students are encouraged to actively participate in activities such as subject competitions. Through the experience of leading students to participate in subject competitions, the theoretical knowledge of operations research is often applied in subject competitions, especially in the "Challenge Cup" college students' extracurricular academic scientific and technological works competition and college students' mathematical

modeling competition. At the same time, discipline competition is also an important method to test the quality of classroom teaching. In the process of participating in discipline competition, it is found that students use curriculum knowledge to solve the problems encountered in the competition, to find and solve some problems existing in curriculum teaching. Therefore, the feature of this paper is to optimize the course content of operations research based on subject competition, promote teaching reform through subject competition, and form a positive interaction between course teaching and subject competition.

CONFLICT OF INTEREST

The author declares no conflict of interest.

FUNDING

This research was funded by Yibin University, grant number JGZ202103.

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