

## *Original Paper*

# Status and Development of Teaching Reform in Management Operations Research: A Case Study of Engineering Management

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### **Abstracts**

*Management Operations Research is a professional core course integrating professionalism, practicability and comprehensiveness for engineering management majors, and it is also an important professional course for students of applied majors to acquire professional core competence. Taking the engineering management major as an example, this paper describes the current status of teaching reform construction, which is carried out from the aspects of teaching orientation and objectives, characteristics of teaching methods and teaching design, integration of course Civics and assessment mechanism. Finally, by comparing the final grades of the two classes of students before and after the reform, we analyze the effect of the reform, and analyze the current problems, and look forward to the continuous teaching reform of the course.*

### **Keywords**

*operations research for management, reform of the teaching profession*

## **1. Introduction**

The National Vocational Education Reform Implementation Program, issued by China's State Council in 2019, proposes to promote the transformation of general undergraduate colleges and universities into application-oriented institutions. It also encourages colleges and universities with the necessary resources to develop majors or courses in applied technology. The implementation of the program provides an effective guarantee for cultivating craftsmanship with "persistent concentration, excellence, meticulousness, and the pursuit of perfection". Numerous colleges and universities have collaborated in conducting research related to the development of applied undergraduate education.

Managerial operations research is a basic discipline for management majors and is one of the core specialized courses in engineering management. Management operations research is mainly a discipline that uses scientific optimization technology to decide how to best operate and systematically analyze the operation process (Wang & Li, 2019). In this paper, taking engineering management as an example, we start from professional orientation and course objectives, organize course resources, construct course system and content, analyze the learning situation, carry out scientific and reasonable teaching design, formulate assessment mechanism, and finally compare before and after the teaching reform, analyze the effect of the reform and carry out teaching reflection and outlook.

## The Current State of Teaching Reform in Management Operations Research

### *1.1 Course Orientation and Objectives*

As the core professional foundation course of engineering management, management operations research course is a widely applied professional foundation course, which provides a quantitative decision-making basis for management. Meanwhile, Management Operations Research is a comprehensive theoretical-practical integration course that focuses on quantitative analysis, combines engineering ideas with management ideas by means of system thinking, and obtains optimal decision-making by means of modeling.

In order to fully realize the requirements for the construction of the gold course, the course system with breadth, depth and gradient is casted from all aspects of content, methods and results. The first of the objectives is to master the basic knowledge of the discipline, to form a complete knowledge framework and system, and to master the exclusive knowledge and skills of the discipline. Second, to be able to think systematically about problems, propose solutions to problems, and generate innovative approaches. To form a systematic, practical and innovative high-level way of thinking. Finally, at the level of value shaping, to stimulate students' aspirations and potentials, to develop optimized and innovative thinking, to focus on the efficiency of resource use, and to enhance the sense of social responsibility. It is summarized as: firm foundation, strong ability, and enhancement of literacy.

### *1.2 Teaching and Learning Resources*

In order to achieve the above teaching objectives, teaching resources and contents need to be carefully organized.

#### (1) Learning Resources

First of all, the choice of textbook is "Fundamentals and Applications of Operations Research", and the practical content mainly uses matlab software as a computing platform. The teaching content includes several modules, such as linear programming models, the simplex method, sensitivity analysis, the duality theory of linear programming, transportation modeling, project planning, goal setting, graph and network analysis, plan evaluation techniques, critical path method, dynamic planning, and decision analysis. Course design is assigned at midterm and at the end of the semester. In the course hours arrangement, 30 hours of classroom teaching to build the basic ability to analyze problems and establish models, 18 hours of practical teaching to enhance the operation of software and the ability to

solve practical problems, and two course design to enhance the comprehensive ability.

At the same time, this course provides a comprehensive set of online resources at different levels to complement the offline resources (Liu & Feng, 2022). Online resources include courseware, question banks, chapter videos, tests, etc. constructed on the Learning Access platform, while introducing students to public numbers that are adapted to students' learning abilities, e.g., Operations Research Speak. From surface to point, the level by level refinement, to meet the needs of students with different learning abilities, not only reflects the "high level" requirements of the construction of the Golden Course, but also realizes the requirements of the "degree of challenge".

## (2) Teaching Team

Teaching team is the constructor and utilizer of teaching resources, as well as the reformer and pioneer of teaching methods and design. In the faculty team of Management Operations Research, there are both seniors who are rigorous in teaching and elaborate in educating people, and juniors who are pragmatic and hardworking. The teaching team consists of two levels: professors and lecturers. Since the establishment of this course, the course team has published several key journals and successfully applied for the university-level first-class undergraduate courses, while all the members have presided over or participated in the university-level projects. Young and middle-aged faculty members work together to create and polish a truly golden course quality.

### 1.3 Situational Analysis

As the saying goes, "If you know yourself and know your enemy, you will not be in danger." Before entering the teaching process, we must familiarize ourselves with the teaching object, that is, to do the analysis of the learning situation. In the past, teaching did not pay attention to analyze the characteristics of the teaching object, there is no target, can not make the best use of their strengths and weaknesses, according to the local conditions. Therefore, conducting an in-depth analysis of the learning situation is one of the key aspects of teaching reform.

The course of management operations research is offered in the third semester of engineering management majors. Its predecessor courses include fundamental mathematical disciplines such as probability theory, advanced mathematics, linear algebra, and more. After completing a year of foundational courses, students are filled with anticipation for the specialized courses. Their interest and enthusiasm for learning have reached their peak at the university, driven by strong motivation and a positive attitude. However, they have great emotional fluctuations, and they are easy to avoid and suffer blows when they encounter difficulties. In this period, the differences of individual students are gradually obvious. Analytical ability, modeling ability and software application ability appear as strong points in different individuals. According to this characteristic, the course design is primarily focused on group tasks, where the group leverages its strengths and collaborates to achieve success. In addition, there is a feature of the academic situation that has to be emphasized, which is subject bias. According to a survey conducted by a researcher, 71.07% of the students believe that the management operations research course is "difficult". However, 87% of the graduates consider this course to be beneficial for

their careers. In response to this bias, we have focused our course design on transforming “difficult” into “interesting”. We achieve this by creating a conducive classroom atmosphere, incorporating engaging course content, and providing immersive experiences. These strategies aim to help students overcome their biases and embrace challenges.

#### *1.4 Teaching Methodology and Instructional Design*

In response to the results of the learning situation analysis, the course team has made more efforts on the teaching methods and instructional design of the course, presenting a series of results that are more distinctive and have better learning effects.

One of the features of teaching methods and instructional design is placed in the offline classroom, adopting the immersive case teaching method. Through real-life cases, virtual scenario construction, and role-playing, students are guided to immerse themselves in the scenarios and take initiative in finding solutions to problems. Within the classroom, optimization paths and methods are studied based on self-selected roles. Once the final goal is achieved, students will then think differently, switch roles, and continue to explore. For example, in the chapter on dyadic theory, assuming that the known conditions include: a factory uses four types of equipment to process in the order of ABCD to produce two products, A and B. Knowing the number of machine hours required to process each product, the value of the profit of each product, and the number of machine hours available for each type of equipment, the students can be divided into two groups, one of which will arrive at the production plan for the product according to the conventional principle of profit maximization. The other group, considering the current resources, is discussing the possibility of generating additional profit by renting out the equipment, pricing the machine hours, and collecting processing fees. The two strategies create a competitive situation, and both parties will focus on whether the new plan can be more profitable. This will lead to a deeper appreciation and understanding of the dyadic model. The same problem, different positions, different optimal decisions, while cutting into the elements of Civics, to learn to consider the problem from the other side’s point of view, with a dialectical point of view of the problem. Another example is the introduction of hierarchical analysis, citing that students are very familiar with the case of “optimal foundation program processing”. Students choose different departments according to their personal preferences (establishing the criterion layer), such as the environmental protection department, construction department, technical department, financial department, and analyze the influencing factors (establishing the indicator layer).

The second feature of the teaching methodology is the blended approach. It is reflected in the following three aspects. The first is the hybridization of resources. Online and offline resources are organically integrated, multi-level, multi-dimensional racking course resources (Li, 2022). Students with good acceptance in the classroom are assigned extra practice problems in the learning pass as a boost. Students with average acceptance can watch the basic teaching video of any chapter in the learning pass platform. At the same time, in the after-class tutoring, the top students can be a reserve for statistical modeling contests and other subject competitions, and multi-person review and discussion

meetings can be carried out for general problems. Both grasp the foundation, but also take into account personalization. Secondly, the combination of real cases and virtual situations, in the case guide, choose and students are more familiar with the professional scene, learning scene, life scene, the combination of virtual and real, to enhance the ability to solve practical problems. Thirdly, the mixture of modernized courseware and traditional board books. For example, in the process of simplex calculation, the calculation of optimality test number and feasibility test number is extremely important and cumbersome, adding the board calculation, the students' feedback will be more clear and concise.

The teaching process is designed in such a way that the case is introduced before the lesson, the pre-study scene is set up and the background of the case is understood, so that students can open the work related to role selection and data collection, which confers a sense of significance to the problem solving. During the lesson, explain the key points and difficulties, share the excellent results, summarize and summarize, do the enhancement, and give a sense of efficacy in problem solving. After the lesson, online reviews and offline Q&A sessions are combined to complete the group task, providing a sense of accomplishment in problem-solving. Finally, actively expand beyond the classroom, pay attention to practical application, participate in hands-on activities, and gain an understanding of the underlying principles and internal logic of real-world problems. This, combined with modeling theory, will enhance overall proficiency (SHANG, ZHANG, & QIU, 2022).

Teaching practices are designed. First of all, quality cases should be selected. Based on the principle of staying updated with the current trends in society and taking into account the unique characteristics of each specialty, relevant cases are carefully chosen to closely align with real-life learning experiences. Secondly, two comprehensive course practice task books are issued every semester. These books cover all knowledge modules and include self-selected topics that are open-ended, allowing for further exploration (WANG & JIANG, 2020). Thirdly, the software operation practice encompasses the entire tracking process, emphasizing regular accumulation and end-of-semester summary submission. It places importance on the overall accumulation process and enhances the sense of achievement.

### *1.5 Integration of Civics and Politics in the Curriculum*

In May 2020, the Ministry of Education issued the Guideline for the Construction of Civic and Political Education in Higher Education Courses, pointing out that it is necessary to carry ideological and political education through the talent cultivation system, comprehensively push forward the construction of the cultivation of higher education courses, give full play to the nurturing role of each course, and improve the quality of talent cultivation in colleges and universities (Zhou & Wang, 2017).

In view of the characteristics of operations research teaching, excavate and refine the elements of ideology and politics contained in the teaching process, through the operations research course of ideology and politics case lectures, the value shaping, ability cultivation and knowledge impartation are organically integrated through all aspects of teaching, cultivate the patriotism spirit of students and the sense of mission to undertake the great rejuvenation of the nation, and guide the students to establish a correct outlook on the world, life and values (SONG, WU, XIA, et al., 2018). The specific combination

is shown in Table 1.

**Table 1. Civic Integration Table**

Knowledge Sections	Civic Mapping and Integration Points	Expected effectiveness
Applications of Operations Research in Ancient China	Tian Ji horse racing and Dujiangyan water conservancy project reflect the excellent traditional culture of the Chinese nation	Sense the profoundness of Chinese culture and enhance the sense of national pride.
Operations Research into Modern China	Patriotism-centered scientific spirit of scientists such as Qian Xuesen and Hua Luogeng	Exploring the values behind disciplinary development to enhance the sense of national mission
Mathematical modeling of linear programming problems	Improve the production efficiency of enterprises through the construction of models and problem analysis, and cultivate students' awareness of science and education.	Reinforcing the national strategic thought that "if science and technology prosper, the nation will prosper; if science and technology are strong, the country will be strong".
Presentation of Pairwise Theory	By solving the dyadic problem, the original problem and the dyadic problem are viewed as relative from their respective starting points.	Applying a dialectical perspective
target programming	Satisfactory solutions are obtained by analyzing the planning solution for each conflicting objective in real production.	Cultivate students' ability to identify and comprehend the main conflicts
续表 1		
game theory	Nash's Continuous Improvement of Game Theory in the Face of Frustration	Lead students to think about attitudes and responses to setbacks and suffering
Decision analytics	When teaching	Scientific understanding of the

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decision-making strategies, world to embrace its diversity  
 students are guided to  
 understand the subjective  
 nature of the different styles of  
 decision-makers and that there  
 is no right or wrong  
 decision-making

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“To lead a man to the great way, to enlighten a man with great wisdom” is a well-known saying. The “salt” of Civics and Politics is sprinkled into the “soup” of education to cultivate students’ national sentiment and social responsibility.

### *1.6 Assessment Mechanism*

The assessment mechanism is divided into two parts: process evaluation and level evaluation. Process evaluation focuses on students’ ability to identify, analyze, and solve complex engineering management problems (Qin, 2017). The process evaluation results are composed through information acquisition, knowledge cognition, chapter task quizzes and course mission statement and daily attendance. And the horizontal evaluation, while examining the personal qualities of students’ courage to explore, challenge themselves, and have the ideal, ability and responsibility, mainly through the final open-book comprehensive examination results and extracurricular extension results composed. At the same time, based on the students’ growth feedback in graduation design and employment units, it guides the adjustment and optimization of course design.

## **2. Analysis of the Effect of Teaching Reform**

The above teaching reform measures were applied to the teaching of management operations research course for the engineering management students of the class of 2020, which lasted for one semester of teaching practice and was compared and analyzed with the traditional teaching practice for the engineering management students of the class of 2019. The number of students in the two terms is similar, the overall quality of students and the learning atmosphere are basically similar, the course materials, syllabus, lecturers and the amount of class hours are the same, the final examination is conducted in the form of open-book written examination, and the final composite final grades are shown in Table 2.

**Table 2. Comparison of Engineering Management Scores for Classes 2019 and 2020**

Engineering Management, Class of 2020 highest: 95 minimum: 46 average: 73					
score band	100-90	89-80	79-70	69-60	60 以下
quorum	4	8	20	22	8

percentage	6.45%	12.9%	32.26%	35.48%	12.9%
Engineering Management, Class of 2019 highest : 89 minimum : 33 average : 64					
score band	100-90	89-80	79-70	69-60	60 以下
quorum	0	2	15	45	12
percentage	0%	4%	20%	60%	16%

As shown in Table 2, the Class of 2020 achieved an impressive pass rate of 6.45% in Engineering Management, whereas the Class of 2019 had no students in the 90-100 grade range. The average GPA of the Class of 2020 was 73, which was 9 points higher than the average GPA of the Class of 2019. Furthermore, the Class of 2020 saw a decrease in the failure rate from 16% in the Class of 2019 to 12.9%. The distribution of grades was more evenly spread across the passing 60-79 score band for the Class of 2020, while 60% of the Class of 2019 class was close to the passing line. These reflect the effectiveness of the instructional reforms.

Meanwhile, in the extension of the course, the Value Operations Research Studio established on the basis of Management Operations Research, students actively participate in extracurricular practices and competitions, successfully applying for a number of innovative and entrepreneurial projects, applying for a number of majors, as well as winning prizes in modeling competitions.

### 3. Reflection

Stimulated by the demand for applied talents in social and economic development, a large number of general undergraduate colleges and universities have been transformed into applied, and if we want to truly cultivate applied talents, we must carry out curriculum reform. In this context, we have to systematize the teaching content of management operations research, jump out of the original framework and main line, refine the processing of each module, find the nodes of intersection with other disciplines, layout the ultimate goal of the talent cultivation program and constantly adjust and optimize it, so that the students have a higher vision, and enhance the applicativeness and practicability of the management operations research course. In the subsequent process of professional practice, it is also necessary to draw on the principles of management and operations research courses to enhance overall ability and commitment.

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## References

- Li, S. F. (2017). The practice of engineering thinking in the course of “Management Operations Research”. *Journal of Jiangsu Ocean University: Humanities and Social Sciences Edition*, 15(10), 134-137.
- Li, X. F. (2021). The Application of Online and Offline Hybrid Teaching Mode in the Teaching of Management Operations Research Course. *Academy: The spiritual home of scholars*, 14(27), 10-12.
- Liu, J. Q., & Feng, S. (2022). Innovative research on multidimensional three-dimensional online and offline hybrid teaching—Exploration and practice based on operations research course in Fuyang Normal University. *Journal of Inner Mongolia Agricultural University: Social Science Edition*, 24(1), 27-32.
- Liu, W., Wang, G. F., & Wang, L. (2021). Teaching Reform of Management Operations Research Course for Logistics Management Majors Based on OBE Concept. *Logistics Science and Technology*, 44(1), 170-172.
- SHANG, L. J., ZHANG, X. F., & QIU, Q. G. (2022). Practical teaching design of applied undergraduate “operations research” course—Taking industrial engineering as an example. *Science and Technology Perspectives*, 2022(26), 101-103.
- Song, J. K., & Fu, F. (2019). Research on the Teaching Reform of the Operations Research Course. *Mathematics Learning and Research*, 0(23), 9-10+12.
- SONG, X. D., WU, G. H., XIA, W. H. et al. (2021). A case study on political education in the course of “operations research”. *Journal of Higher Education Research*, 44(3), 91-95+103.
- Wang, F., Han, X., & Zhou, H. P. (2021). An analysis of the reform of the Management Operations Research course for business administration majors based on students’ feedback. *Innovation and Entrepreneurship Theory Research and Practice*, 4(11), 45-46+49.
- Wang, J. N., & Li, L. H. (2021). Research on the Reform of Teaching Content in Applied Undergraduate Management Operations Research. *Education Informatization Forum*, 5(11), 82-83.
- WANG, L., & JIANG, L. (2020). The Application of MOOC+SPOC-Based Blended Teaching Mode in the Teaching of Operations Research Course. *Experimental Technology and Management*, 37(8), 211-215.
- Wang, L., & Li, F. T. (2019). Research on curriculum teaching reform based on the discipline’s connotation: A case study of the management operations research course. *Journal of Henan University of Technology: Social Science Edition*, 15(3), 121-126.
- Xiang, Q. (2017). Construction of vibrant classroom of operations research in applied undergraduate “task-driven” mode[J]. *China Management Informatization: Comprehensive Edition*, 20(1), 256-257.
- Xu, J. W., & Zhu, Y. L. (2011). *Design of an experimental teaching system for the course of*

*Management Operations Research*, 2011.

Zhou, X. J., & Wang, Y. L. (2022). Discussion on the Reform of Civics Teaching in Operations Research Course. *Inside and Outside the Classroom: High School Edition (A Edition)*, 2022(7), 155-160.