

Teaching Reform and Practice of the Course “Mechanical Fundamentals” in Military Colleges and Universities

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Abstract

In order to meet the needs of higher education and military education in the new era, and in response to the current situation of the teaching of the course “Mechanical Fundamentals” in our university, based on the requirements of military academy education reform, and drawing on the beneficial practices of blended learning in local universities, combined with the actual situation of military academies, we will carry out teaching reform and practice based on the course “Mechanical Fundamentals”. Through research and specific teaching practices, it has been found that blended learning mode can effectively improve teaching effectiveness compared to traditional teaching mode, strengthen the cultivation of students’ job skills, and enhance the quality of military talent training.

Keywords

Mechanical Foundations, Military Academies, Blended Teaching

1. Introduction

The talent cultivation of military colleges and universities is guided by the demand for job competency, and shoulders the mission and responsibility of cultivating high-quality new military talents for the army. Therefore, unlike local colleges and universities, each discipline and major has a wide foundation and broad training scope. Our school relies on various first level disciplines to establish different majors with distinct seafood characteristics. While implementing the concept of “broad caliber, solid foundation, and comprehensive quality”, we emphasize the requirement for students to have solid professional knowledge and job skills (Huang et al., 2021).

As a professional background course in our school, the course of “Fundamentals of Machinery” is a compulsory course for majors such as Energy and Power Engineering, Marine Engineering, Safety Engineering, Mechanical Engineering, Weapon Systems and Engineering, and belongs to the professional background course module. In the above-mentioned professional talent knowledge system, it is a critical transitional stage between scientific and cultural courses such as engineering drawing, engineering mechanics, fluid mechanics, and metalworking internships, and subsequent professional courses such as internal combustion engine, power control principles and technology, which serve as a link between the past and the future, laying a foundation for students’ subsequent job courses and career development. The course module is shown in **Figure 1**.

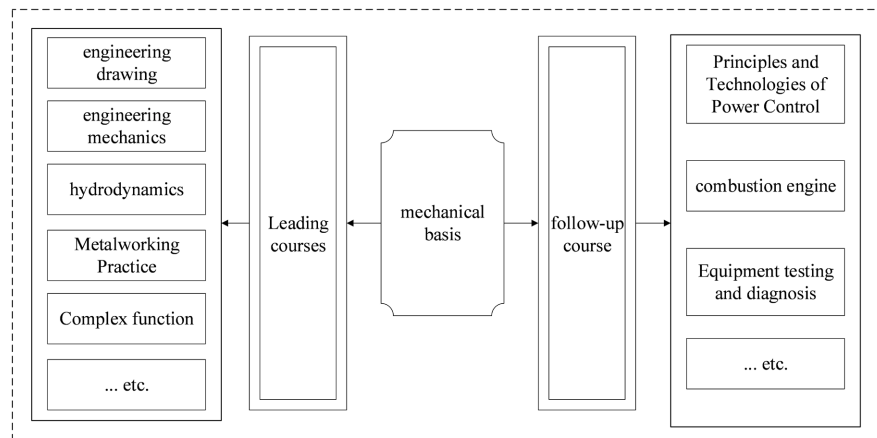


Figure 1. Course module diagram.

2. Analysis of Teaching Status

Currently, the reform of military academies is being fully implemented, and the comprehensive cultivation of students’ comprehensive qualities and abilities has become a clear goal of talent cultivation in military academies. It is imperative to reform the teaching mode focusing on the cultivation of job skills in specific courses. The most important aspect of the course “Fundamentals of Machinery” as a professional background course is to enable students to understand and love equipment, and to lay a solid foundation for students to correctly understand, design, use, manage, maintain, and troubleshoot weapons and equipment. However, in the face of the current situation of the great development of military academy education reform and the new challenges brought by current information-based teaching, the teaching status of the course “Mechanical Fundamentals” is not yet in line with the requirements of cultivating high-quality talents suitable for the military, mainly manifested in the following aspects:

Firstly, the implementation of modern advanced teaching concepts is still insufficient, lacking guidance from advanced educational concepts, and the subject status of students has not been fully reflected; Secondly, the composition of the course content tends to lean towards traditional classic knowledge, with insufficient

attention and integration of emerging materials, technologies, and processes, and insufficient integration with contemporary equipment. At the same time, the teaching philosophy guided by practical needs is not prominent enough, making it difficult to accurately match the comprehensive ability cultivation required for the position; Thirdly, the current utilization of information technology teaching resources is not sufficient, and traditional teaching models still dominate. Teaching design focuses too much on knowledge transmission and neglects the cultivation of students' comprehensive abilities. At the same time, the exploration of ideological and political elements in the curriculum also needs to be deepened; The fourth issue is the lack of diversity in the course evaluation system, which leads to insufficient absorption of theoretical knowledge by students and a widespread phenomenon of concentrated review before exams (Kong, 2024).

3. Building High-Quality Teaching Resources

3.1. Building High-Quality Internet Teaching Resources

The research object of the course “Fundamentals of Machinery” is divided into two parts: commonly used mechanisms and general parts. In fact, it covers the core content of the courses “Mechanical Principles” and “Mechanical Design” in local universities. Although high-quality online courses that fully match the teaching content of this course have not been directly found in current major online resources, several online learning resources related to specific chapters of this course can still be found on the MOOC platform of Chinese universities and the “Military Vocational Education Zone” of the Military Comprehensive Information Network (Liu, 2022).

Therefore, in order to improve the learning efficiency of students in this course and prevent them from feeling helpless in the vast network resources, it is urgent to integrate and screen high-quality online educational resources to efficiently assist students in self-learning. This includes designing micro videos and accompanying tests for pre class preparation, as well as diversified online resources for post class deepening learning, especially focusing on practical application cases of new materials, new processes, and new technologies in mechanical equipment, ensuring that the course content closely follows technological progress and the rapid development of equipment mechanical technology, maintaining the timeliness and foresight of the course (Ding et al., 2022).

3.2. Design of Course Knowledge Structure Diagram

As a professional foundation course in our school, the course of “Fundamentals of Machinery” requires students to review the relevant knowledge in the prerequisite courses such as engineering drawing, engineering mechanics, fluid mechanics, and metalworking internship in a timely manner in order to deeply understand and master the knowledge content contained in this course. Therefore, this course has the characteristics of scattered knowledge points, abundant course content, relatively independent content, and weak coherence. Students generally

feel that the course has too many knowledge points, cannot grasp the key points, has high learning difficulty, lacks a systematic and clear learning approach, and some content is abstract and difficult to understand (Zhang, 2022).

Mind maps, also known as mind maps, are a divergent thinking expression tool proposed by British educator Tony Bazin in the 1960s. They can help learners improve their divergent thinking abilities, clarify their thinking patterns, and review the entire thinking process. As a highly practical visual tool, mind maps are essentially a means of vividly depicting knowledge structures. It cleverly integrates the principle of left and right brain collaboration, using key vocabulary, symbolic symbols, and vivid colors to organize complex thoughts in a clear and organized manner, thereby transforming originally mundane textual information into diverse visual expressions rich in color, graphics, and symbols. This process not only triggers rich associations, but also broadens the boundaries of thinking, making the connections between information intuitive and easy to understand, facilitating deep memory, and achieving effective integration and efficient transmission of information. Research literature and practical experience both domestically and internationally have shown that mind maps have better learning outcomes compared to traditional note taking. The example mind map for this course is shown in **Figure 2**.

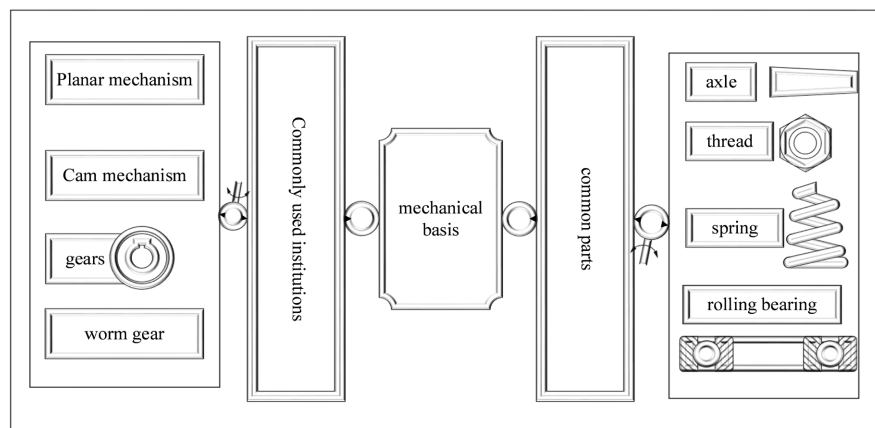


Figure 2. Curriculum content mind map.

4. Specific Teaching Implementation

4.1. Pre Class Stage

The pre class stage mainly involves students self-learning online, while the instructor publishes rich self-learning resources on the platform, including mind maps, short teaching videos, PPT courseware, and test exercises. Based on the mind map, students will organize the knowledge framework of the course content, extract the key and difficult points of the course, and complete the self-examination exercise tasks. During the learning process, if you encounter any questions or generate new ideas, you can submit them immediately through the platform to build an efficient and closed-loop self-learning feedback system, optimize your

self-directed learning experience, and improve learning quality and efficiency. The pre class teaching design process is shown in **Figure 3**.

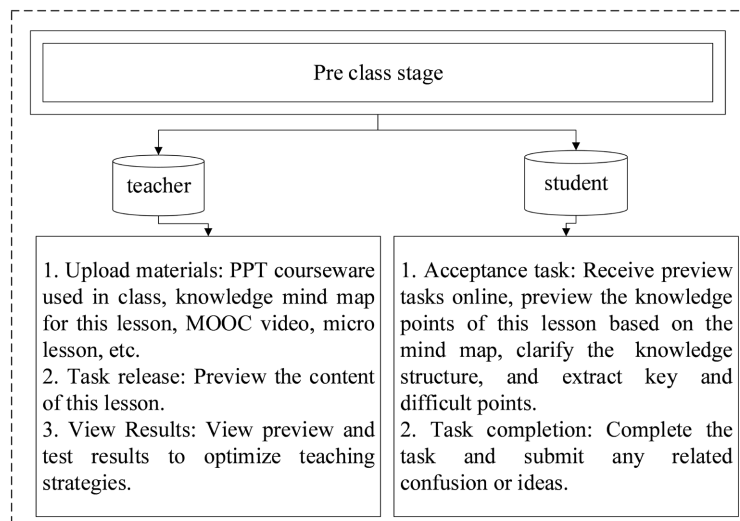


Figure 3. Pre-class teaching design flow chart.

4.2. In Class Stage

The in class stage refers to offline classroom teaching, which mainly consists of five teaching stages. The specific teaching design process of the in class stage is shown in **Figure 4**. Introduction of Equipment Cases: Mainly targeting the actual equipment of the military, starting from equipment usage management, fault maintenance and other issues, establishing the inherent connection between actual equipment cases and knowledge, and cleverly introducing teaching content. Self directed learning review: The instructor reviews the students' self-directed learning situation and points out common problems that exist. Classroom teaching: Based on the common problems that students encounter during self-study before class and the key and difficult points of this teaching, it will be conducted through centralized teaching or organized discussions. Course Ideology and Politics: Deeply explore the hidden elements of course ideology and politics behind course knowledge, and reasonably utilize ideological and political materials to implement the concept of cultivating students for war. Course summary: Building a knowledge system framework, cleverly integrating and linking scattered knowledge fragments by sorting out the internal logical connections between various knowledge points, and achieving refined summary and deepening understanding.

4.3. After Class Stage

The after-school stage mainly focuses on knowledge consolidation and expansion learning, including both after-school and online assignments. The teaching design process for the after-school stage is shown in **Figure 5**. After class, students use selected exercises to reinforce and consolidate the core and difficult knowledge in the course. As for online assignments, they are based on the existing knowledge

framework of students, further expanding their learning horizons and levels, including but not limited to reading and expanding reading materials. These materials focus on cutting-edge fields such as new materials, new processes, and new technology applications, supplemented by comprehensive practical explorations related to weapons and equipment, aiming to promote a deep understanding and wide application of knowledge.

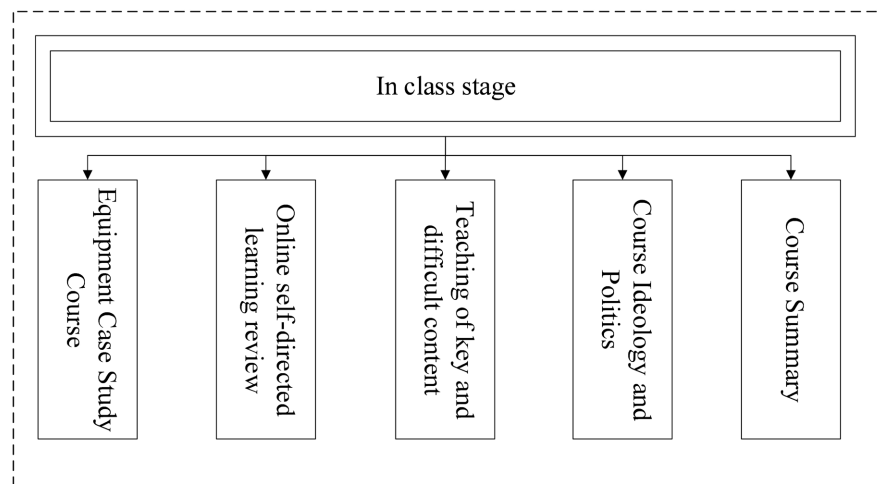


Figure 4. Flow chart of middle stage teaching design.

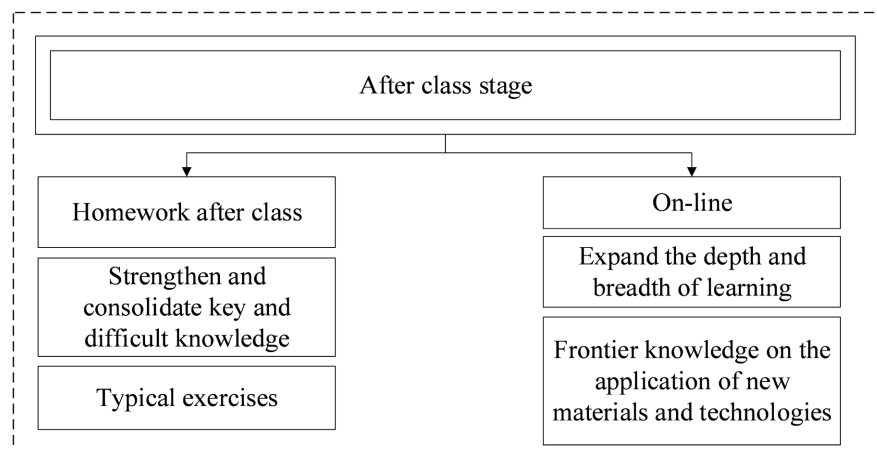


Figure 5. After class stage teaching design flow chart.

5. Teaching Effectiveness Evaluation Mechanism

The comprehensive score of the course consists of two parts: formative assessment and summative assessment. To highlight the importance of formative assessment, the proportion of formative assessment and summative assessment has been adjusted from the original 30% and 70% to 40% and 60%, and the composition of formative assessment has been further refined. The formative assessment module consists of three parts: self-study before class, offline classroom, and online and offline homework after class, accounting for 30%, 40%, and 30% respectively. If

one of the formative or summative assessments fails, the final grade will be considered as failing. In addition, in order to comprehensively evaluate the learning progress of students, a series of qualitative learning status evaluation measures are implemented, focusing on positive changes in learning habits, significant improvement in learning interest, strengthening of learning autonomy, and improvement of learning integrity. These evaluation tasks are mainly carried out effectively through detailed inquiries to student teams and targeted sampling surveys. The composition of the comprehensive course grades is shown in **Figure 6**.

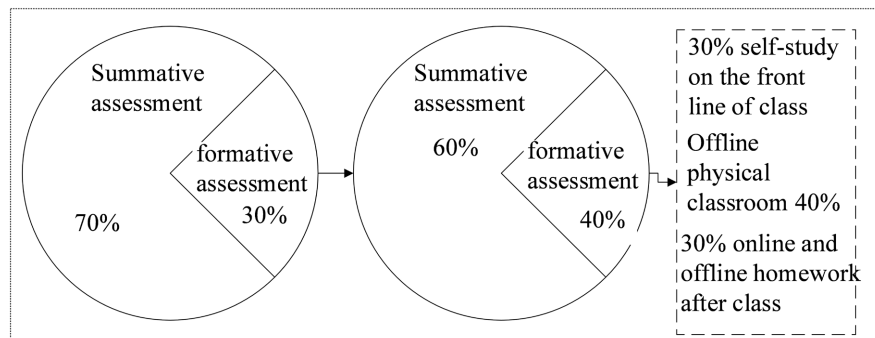


Figure 6. Curriculum comprehensive score composition chart.

6. Conclusion

The reform of teaching mode needs to skillfully integrate the traditional classroom teaching with the rapidly developing Internet teaching, so that the teaching methods and methods not only keep pace with the times, but also skillfully make up for the limitations of traditional classroom teaching. The teaching reform has significantly improved the quality and efficiency of students' learning, while also stimulating their potential for self-directed learning. However, shaping the course of "Mechanical Fundamentals" as a "golden course" in military academy education is still a difficult and long-term task. It requires us to continuously explore, accumulate experience, and optimize it in practice to ensure that it can meet the high standard requirements for military talent cultivation in the information age.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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