

Exploration and practical research on the high-level construction of theoretical mechanics teaching

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Abstract: The theoretical mechanics course is an important professional course, and it is also a course with strong theory, strong practicability and strong comprehensiveness. The reason why theoretical mechanics is difficult to learn is that the exercises are difficult to do. The main reason is that the thinking mode required to solve the theoretical mechanical problems is different from the thinking mode established by students in the past. Based on the teaching reform and practice of theoretical mechanics course as the research platform, combined with the cultivation of students' higher-order thinking ability and the higher-order design ideas of curriculum objectives, this paper discusses the ideas and practice of higher-order construction of theoretical mechanics course. Through the further reform of the teaching system, we should strengthen students' understanding of basic knowledge and cultivate their comprehensive abilities in order to achieve better teaching results. How to cultivate students' innovative thinking in the actual teaching process of "theoretical mechanics" is the responsibility and mission of colleges and universities. So as to provide some ideas and reference for the curriculum education and teaching reform to improve the quality of talent training.

1. Introduction

With the continuous progress and innovation of science and technology, the standards for measuring talents in the machinery manufacturing industry are more stringent, and colleges and universities are also seeking to change the training methods of talents [1]. Theoretical mechanics is a basic technical course for engineering undergraduates, and it is a specialized subject for students to contact practical engineering problems for the first time and study the motion analysis of mechanical mechanisms. Theoretical easy-to-understand and difficult-to-solve problems are a common reflection of previous students on theoretical mechanics, and this problem has not been solved for a long time, which has greatly hindered the improvement of the teaching effect of theoretical mechanics, so this problem should be paid attention to [2]. Theoretical strength study questions require thinking with higher flexibility, rigor, breadth and unique "vector" thinking. It is necessary to analyze and study the thinking mode of theoretical mechanics. In order to better complete the teaching task of theoretical mechanics, we should also consider that the teaching contents are interconnected but different from physics. The arrangement and deletion of the teaching contents need to be seriously considered [3]. Therefore, it is necessary to optimize and improve the teaching content, teaching methods and assessment links, so as to cultivate the ability to solve practical projects with mechanical knowledge, creative problem solving ability, logical thinking ability and master the ideas and methods of scientific research [4].

2. Teaching status of theoretical mechanics

Theoretical mechanics course is a technical basic course for engineering students in colleges and universities such as machinery, civil engineering, water conservancy and other majors, and it is also the basis for subsequent mechanics courses and related professional courses [5]. As a systematic and highly theoretical course, the teaching process of theoretical mechanics introduces a procedural way of thinking. As a systematic and theoretical course, the teaching process of theoretical mechanics introduces a programmed way of thinking. Its analysis and research methods are typical

in scientific research, which enables students to gradually form correct logical thinking in the whole learning process. Theoretical mechanics is a teaching course of thinking. It takes time and space as the framework, axioms as the basis, maintains the most basic and simple mechanical movement and its laws in nature into a scientific and unified whole through the form logic of thinking, abstracts and summarizes the mechanical phenomena in practice, establishes concepts, axioms or laws, and then deduces and infers from mathematics, Derive theorems and conclusions to guide further practice]6]. There are theoretical derivation of some theorems in mechanics, and some derivation processes are difficult. Every time it comes to theoretical derivation, many students will lose patience. In addition, when it comes to the analysis of comprehensive problems, we can't comprehensively apply the theoretical knowledge we have learned to solve problems, and we don't have the confidence and patience to solve complex problems.

3. Discussion on Teaching Reform of Theoretical Mechanics Course

3.1. Reform of Theoretical Mechanics Course Content

Courses constitute the basic unit of undergraduate talent training, and countless basic units are combined to form the whole undergraduate talent training system [7]. The content system of China's traditional basic mechanics courses basically follows the model of the former Soviet Union, and each course is relatively independent and has its own system; The common theory is deduced repeatedly and the same content overlaps, which not only accounts for more class hours, but also the knowledge system is scattered and lacks coherence and integrity. Students lack the overall understanding and mastery of the necessary basic mechanics knowledge.

There are several steps for the establishment and implementation of the module. The first step, under the current curriculum system, according to the needs of different majors, the main mechanics curriculum contents should be deleted and combined as necessary. The new theoretical mechanics course should be modular, and the modules should avoid duplication, but they should be closely connected to form a relatively complete knowledge system. The modules should be basic, extended and innovative, so as to meet the requirements of course selection in different directions and different levels of students [8]. It is the mechanical basis of engineering calculation, and students must master stress diagram, force system simplification and balance calculation, etc. The focus of kinematics teaching content is the composite motion of points and the plane motion of rigid bodies. The content of dynamics teaching focuses on the parts that are not covered by physics. That is, the application of differential equations of rigid plane motion, D'Alembert's principle (dynamic and static method) and virtual displacement principle and other problems of analysis and problem-solving ability training and training. The basic equations of particle dynamics, the theorem of momentum, the theorem of moment of momentum and the theorem of kinetic energy have many repetitions with the content of college physics courses, but the concept expressions are slightly different [9]. Theoretical mechanics is the basis of the core courses of subsequent majors, which is particularly important for mechanical students. It is closely combined with practical engineering problems and needs to be explained with emphasis.

3.2. Reform of classroom teaching methods and methods

According to the previous teaching experience, traditional teaching methods are easy to make students tired and inert, and the learning efficiency is not high. Therefore, setting a teaching thinking mode in line with students can not only enable students to learn professional knowledge in the learning process, but also improve students' interest in learning, so that students can well understand the theoretical knowledge of theoretical mechanics, Improve the ability to solve practical problems. . The objective of the course is to adhere to the organic integration of knowledge, ability and quality, and to cultivate students' comprehensive ability and advanced thinking in solving complex problems. The course content emphasizes breadth and depth, breaks through the habitual cognitive mode, and cultivates students' spirit and ability of in-depth analysis, bold questioning and innovation. From the perspective of curriculum objectives, the high-level

construction of courses should not only teach students knowledge, but also focus on the integration of knowledge, ability, and quality to cultivate students' higher-order thinking ability [10]. Students' higher-order thinking is not innate, but requires teachers to carry out scientific and systematic teaching design and train students in technical methods through specific teaching processes. Figure 1 shows the relationship between the cultivation of students' ability and the design of curriculum teaching objectives.

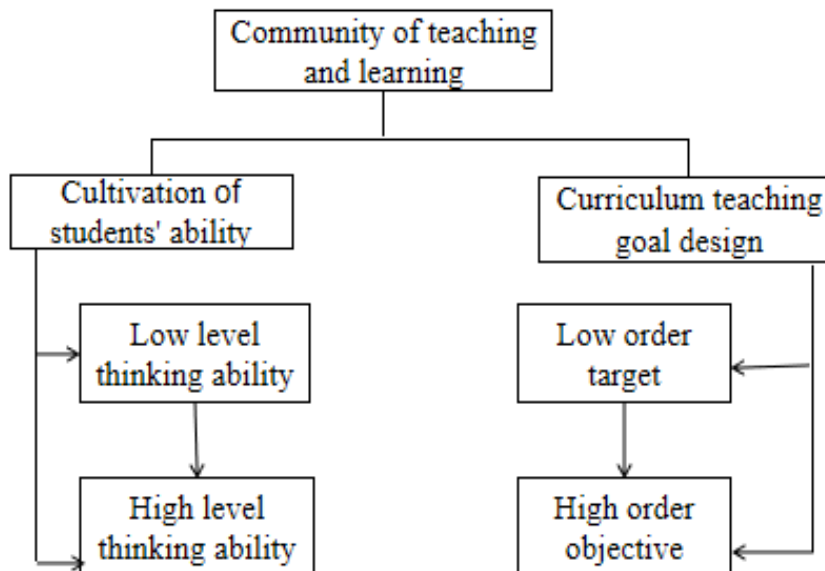


Fig. 1 The relationship between students' ability training and curriculum teaching goal design

Therefore, the high-order course should be built around "result-oriented, student-centered, process evaluation and continuous improvement".

4. Construction practice of advanced theoretical mechanics courses

4.1. Find breakthroughs in problem solving and cultivate flexibility of thinking

The general thinking mode of solving physical problems is to analyze the characteristics of the research object and the physical process involved, clarify the physical laws followed by the physical process, formulate equations and solve them according to the problem setting conditions, problems and laws in the physical process, and discuss them when necessary. Solid models (teaching aids) are added to the classroom and combined with engineering practice. Taking scientific research projects as the carrier, the classroom teaching of theoretical mechanics is mainly to cultivate students' practical and innovative ability. Logic reasoning is a kind of method used in theoretical mechanics course, which takes a problem as the core or starting point, and deduces the knowledge layer by layer to solve the problem, so that the association of one knowledge point can be extended to multiple knowledge points, and knowledge area and knowledge system can be formed. For example, when explaining the chapter on the theorem of the moment of momentum of the particle system relative to the center of mass, the method of deductive reasoning is used, starting from the concept of moment of momentum, and deriving the momentum of the particle system relative to the center of mass from the moment of momentum of the particle system to a fixed point and the moment of momentum theorem Moment and Momentum Moment Theorem, and then introduce basic theories and applications such as differential equations of plane motion of rigid bodies. When solving mechanical problems, dig hidden conditions and express them with suitable mathematical expressions.

4.2. Pay attention to students' participation and guide students to carry out research-based learning

The high-level construction of theoretical mechanics courses should be carried out around the

high-level objectives of the course, in which the cultivation of students' analytical ability is the foundation, the comprehensive ability is the core, and the evaluation ability is the test. In the classroom, while imparting knowledge to students and carrying out logical and concentrated thinking training, they also pay more attention to creative thinking training for students, and consciously guide students to carry out exploratory, intuitive, divergent and imaginative thinking activities to stimulate innovative awareness and cultivation of innovative ability. After teaching some chapters, class discussions are arranged in class hours, and teachers or students put forward relevant difficult questions about the contents of the learned chapters, which are sent to students in advance. Students randomly choose topics, discuss collectively, report in class, ask questions on the spot and answer questions in time, and students' representatives form judges to score, and the scores are included in the course scores [11]. The cultivation of innovation ability is an issue of great concern in the whole process of education. As a course with high requirements for programmed logical thinking mode, theoretical mechanics does not exclude the application of innovative thinking ability. On the contrary, innovative thinking ability should be vigorously advocated in the teaching process of theoretical mechanics. It not only strengthens the purpose of learning, but also improves students' interest in learning, and at the same time increases innovation ability, which better solves the key and difficult problems in the course.

5. Conclusions

On the one hand, the teaching goal of theoretical mechanics is to cultivate students' ability to analyze and solve problems, on the other hand, it is to lay a good mechanical foundation for subsequent courses. In the teaching of theoretical mechanics, we should further optimize the curriculum reform from the aspects of specific teaching contents, teaching methods and methods. By means of heuristic teaching, research-based teaching mode or project-based tasks, we can lead students to open their minds, reveal the richness and complexity of knowledge connotation, and cultivate students' high-order thinking. According to the teaching hours, we should add appropriate content to the course practice, and strive to make students better grasp the course content and improve their ability to analyze and solve problems. Optimize the teaching process, apply teaching strategies, innovate teaching modes and build effective classrooms, so as to activate students' interest in learning and inspire students' innovative thinking [12]. The high-level construction of the curriculum is not achieved overnight, but it is gradually formed by teachers who need to work hard every day, continuously combine teaching, learning and research, and conduct in-depth thinking and classroom practice on teaching content and teaching methods. The high-level construction of theoretical mechanics courses is guided by continuous improvement and quality improvement, and is constantly improved and promoted, which promotes the common growth and development of teachers and students.

References

- [1] Yu genghua Exploration on the teaching strategy of high school physics experiment aiming at high-order thinking -- Taking the compulsory course "force decomposition" as an example [J] Physics teacher, 2020, 41 (7): 4.
- [2] Follow the spring Looking for new thinking in theoretical mechanics [J] Science and technology wind, 2019 (27): 1.
- [3] Liu Youwen, long Yuejun Research course teaching: Exploration and practice of the construction of excellent courses in theoretical mechanics [J] China University teaching, 2008 (11): 3.
- [4] Yang Weiming, Zhao Huiming, Zhao Yucheng Exploration and practice of project-based teaching reform of "theoretical mechanics" course under the background of "double first-class" construction [J] New curriculum research (mid day - Single), 2017, 000 (006): 76-77.

- [5] Liu Huihui, Li Tongwei, Wang Hui, et al. Some thoughts on improving the teaching of theoretical mechanics courses under the new situation [J]. Science Education Journal: Electronic Edition, 2021(9):2.
- [6] Xia Qiaoli. Exploration and Practice of Teaching Reform of Theoretical Mechanics Course [J]. Global Market, 2017(26):1.
- [7] Shang Yumei, He Dongqing, Ma Li'an. Teaching Reform and Practice of Theoretical Mechanics Course for Applied Talents [J]. Science Education Journal, 2017(2):2.
- [8] Wang Fei, Liu Xiaoying, Liu Bin. Teaching reform and practice of theoretical mechanics courses in colleges and universities based on flipped classroom [J]. Education and Teaching Forum, 2017(26):2.
- [9] Zhang Yanli, Meng Yu. Exploration and practice of classroom teaching reform of theoretical mechanics course [J]. Science and technology horizon, 2020(7):2.
- [10] Yang Cuili, Zhang Chaoqun. Teaching methods of theoretical mechanics course [J]. Hubei Agricultural Mechanization, 2020(22):2.
- [11] Yuan Lili, Wang Jianmin. Discussion on the teaching of "Theoretical Mechanics" under the double first-class background [J]. Curriculum education research: research on learning methods and teaching methods, 2019(7):2.
- [12] Deng Shuyan. Exploration on the teaching reform of theoretical mechanics course in colleges and universities [J]. People of the times, 2019(14):2.