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Research on Mechanics Course Teaching Reform in Local Universities Centered on Students

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Abstract: Improving the quality of talent cultivation is an important guarantee for achieving high-quality development. The traditional teaching ideas and methods of mechanics courses in local universities cannot meet the needs of high-quality talent cultivation, and new methods for course teaching reform are urgently needed. This paper will explore new concepts and methods of mechanics professional course teaching centered on students in local universities. The main content includes: the application of the new engineering education concept combined with the ideological and political course in the mechanics professional courses; some explorations of student-centered mechanics course teaching ideas, teaching content, teaching methods, and assessment evaluation methods. The research content of this paper can provide ideas for the teaching reform of mechanics courses in local universities and offer beneficial help to improve the quality of talent cultivation in regional universities.

1. Introduction

With the continuous expansion of higher education, China's universities have achieved leapfrog development, with both the number and quality of educational institutions seeing significant improvement. According to statistics, in 2022, the gross enrollment rate of higher education reached 59.6%, with over 46 million students enrolled in universities. At the same time, a group of universities with high academic standards and excellent talent cultivation capabilities have been or are being developed into world-class institutions. According to the requirements for building a modern socialist country, high-quality development has become the nation's top priority. Higher education institutions, bearing the heavy responsibility of talent cultivation, need to cultivate higher-quality talents to meet national demands, presenting a significant challenge for all universities. As an essential part of higher education, local universities have their own advantages and are more likely to form characteristics that align with local development, holding great potential in cultivating high-quality talents. In response to the demands for high-quality talent cultivation, local universities need to take effective measures, including the inevitable reform of teaching concepts and methods. The core of high-quality talent cultivation is to foster students with ideals, responsibilities, knowledge, abilities, creativity, and the willingness to strive, which places higher requirements on student training. Given the differences

in students' foundational knowledge, majors, interests, and employment directions, and facing the diverse demands of students for course learning, establishing student-centered course teaching concepts and methods becomes key to high-quality talent cultivation. As a fundamental course in engineering majors, mechanics plays an irreplaceable role in increasing students' knowledge reserves, fostering innovative abilities, and developing rigorous scientific attitudes. In the minority regions where I work, the teaching of mechanics still largely employs traditional methods, where teachers deliver textbook content and students passively receive it, completing their course learning through memorization and extensive repetitive practice. The design of teaching content centered on exams, the evaluation of academic performance primarily through final exams, and the evaluation of teaching quality mainly through one-time student feedback are increasingly unable to meet the characteristics of contemporary students, let alone the requirements for cultivating high-quality talents in the future. In the teaching of mechanics courses in local universities, how to establish student-centered teaching concepts and methods to meet the requirements for mechanics courses in the process of high-quality talent cultivation is worth in-depth study.

This paper will focus on the teaching reform of mechanics courses in local universities, integrating course ideology and politics into mechanics teaching, and exploring new concepts and methods for student-centered mechanics course teaching reform from aspects such as talent cultivation methods, teaching means improvement, changes in teaching content, application of new teaching tools, methods of academic assessment and evaluation, and evaluation of teaching effectiveness, providing some assistance for local universities in cultivating high-quality talents.

2. Student-Centered Mechanics Course Teaching Reform in Local Universities

2.1. New Teaching Methods for Mechanics Courses Combining New Engineering Education Concepts with Course Ideology and Politics

Faced with a new round of technological revolutions and industrial transformations worldwide, higher education's talent cultivation faces new opportunities and challenges. The Ministry of Education has proposed the construction of new engineering disciplines in higher education institutions to cultivate a group of engineering and technical personnel who will lead future industrial and technological developments. New engineering disciplines emphasize the guidance of concepts and innovation in models, seeking teaching methods directed by students' interests to cultivate talents that meet industrial demands. The mechanics course, a highly rigorous subject, is related to people's life safety, social economic operation costs, resource utilization, and environmental protection, making it significantly meaningful to cultivate students' rigorous scientific attitudes, high sense of responsibility, honesty and trustworthiness, and correct views on life and the world through mechanics education. Integrating the new engineering concept with course ideology and politics into mechanics teaching is one of the important means to address these issues. The main measures adopted include: (1) Establishing ideals and beliefs among students and integrating patriotism education into the course. As an important basic application subject, mechanics plays a significant role in safeguarding national security, improving international status, and building a prosperous country. The history of mechanics development is a textbook for patriotism education. Therefore, introducing relevant content can play an important role in patriotism education, such as introducing the experiences of famous mechanics scholars, especially a group of excellent mechanics workers in the early days of the founding of the People's Republic of China, who devoted themselves to the research and development of atomic bombs, hydrogen bombs, nuclear submarines, artificial satellites, etc., laying a solid foundation for the prosperity and strength of the country. Currently, the country faces a complex international situation, and many bottleneck problems restrict the development of the national high-tech industry, where the application of mechanics-related knowledge can be key to

solving these problems. Therefore, combining the latest scientific and technological developments with mechanics knowledge in the course can more effectively arouse students' learning interest, while cultivating students' patriotism and spirit of dedication. (2) Cultivating students' sense of responsibility and rigorous scientific attitude. In the mechanics course, there are many engineering safety, cost, and environmental protection issues. Minor mistakes in design or construction can lead to the destruction or damage of engineering structures, causing significant losses. Therefore, the application of mechanics knowledge in engineering examples can more effectively cultivate students' sense of responsibility, making students realize the importance of a rigorous scientific attitude to engineering safety. At the same time, teaching students how to ensure safety while reducing engineering costs and improving material utilization is an important means of cultivating students' sense of responsibility. (3) Cultivating students' perseverance and spirit of innovation. Most current students, born after 2000, have grown up in a relatively privileged environment, leading to widespread psychological fragility and an inability to face setbacks among students. Mechanics courses, which combine basic and applied learning, require strong theoretical knowledge and problem-solving abilities. The complex process of deriving mechanics formulas can effectively cultivate a spirit of perseverance, allowing the tedious calculation process and rigorous method to instill a fearless quality in students. At the same time, assigning complex mechanics problems to students to solve is an important means of fostering an innovative spirit, with different solution approaches, methods, and tools all playing a crucial role in nurturing students' creativity. (4) Cultivating students' integrity and correct life views. Due to the relatively lax educational environment and social influences, students' integrity has become an urgent issue. The previous method of strict discipline to educate students has become ineffective, hardly impacting students' mistakes. Additionally, changes in some external environments have greatly influenced students' life views, adversely affecting talent cultivation. Mechanics, a subject with strong logic and rigor, requires a solid foundation for accurate problem-solving. Therefore, a strict problem-solving process in mechanics can effectively improve students' integrity, eliminating lazy and slack thoughts and establishing the value that effort leads to rewards. At the same time, mastering complex mechanics knowledge and improving personal abilities require firm goals and aspirations; otherwise, it is difficult to acquire rich knowledge. (5) Combining current new materials, new equipment, and new energy technologies with mechanics problems, guiding students to use acquired knowledge to solve related problems can effectively improve problem-solving skills, foster innovative thinking, and make interest-driven learning more beneficial for students to achieve success, allowing students to integrate their interests with mechanics knowledge and solve problems of interest using mechanics means, enhancing students' sense of achievement. In summary, combining new engineering education concepts with course ideology and politics in mechanics courses is an important means to enhance students' patriotism, sense of responsibility, scientific attitude, perseverance, spirit of innovation, and correct life views. Integrating ideological and political elements into mechanics courses will further facilitate the cultivation of high-quality talents.[1]

2.2. Student-Centered Mechanics Specialty Course Reform and Practice

Mechanics courses, as applied foundational courses for engineering students in higher education, require both solid theoretical knowledge and strong application abilities. Only by mastering both can the teaching requirements of mechanics courses be met. The traditional mechanics course teaching process mainly follows these methods: (1) Providing an overall introduction to the relevant mechanics courses, understanding the content of the course, assigning learning tasks, and highlighting key points for assessment; (2) Teaching according to course chapters, generally following a process from simple to complex, transmitting knowledge points to students through lectures while emphasizing the

importance of exam points; (3) Assigning homework for each chapter, requiring students to submit on time, with teachers correcting and returning the homework, which mainly includes exercises from the textbook supplemented by related external exercises, and providing targeted explanations for problems encountered in homework; (4) Conducting a course review and the final knowledge examination, emphasizing exam points to prevent students from deviating during the review process. This traditional teaching mode mainly focuses on the process of teachers lecturing and students receiving knowledge, lacking the development of students' thinking and problem-finding abilities, leading to a lack of initiative in student learning and disinterest among some students. Based on the shortcomings of traditional education methods, implementing student-centered mechanics specialty course teaching concept and method reform becomes particularly important.[2]

To address this issue, implementing student-centered mechanics teaching methods reform is an effective solution, with specific methods including: (1) Tailored teaching, implementing personalized teaching and homework assignments. Teaching in groups based on students' knowledge levels, dividing the class into several small groups, ideally with 4-6 students per group, covering students with different foundational levels in each group, and fostering cooperation and competition among groups. The main time of each class is dedicated to introducing basic concepts and theories, then, according to students' mastery of knowledge, classroom exercises are assigned, improving learning efficiency for excellent students and providing opportunities for students with lesser grasp to catch up, with group students forming a mutual learning model to achieve outstanding performance, thus effectively enhancing students' learning efficiency. Additionally, homework can also be personalized according to students' needs, catering to different students' knowledge mastery requirements, with difficulty levels tailored to individual students, leveraging group members' mutual understanding for targeted group assignments, fully utilizing students' learning motivation; (2) Engineering case teaching method. Traditional teaching often simplifies models and considers single mechanics problems, which, while effective in solving specific issues, significantly differ from complex engineering realities. Introducing real engineering cases into teaching allows students to explore based on the actual background of engineering problems, seeking solutions with acquired knowledge, stimulating students' initiative and creativity, and playing a role in solving engineering cases, proposing multiple solutions, and selecting the best outcome for implementation. This teaching approach enhances students' self-learning, problem-solving, collaborative, and self-improvement abilities, becoming a crucial means of fostering innovation; (3) Mechanics-based interdisciplinary course content. Mechanics knowledge is closely linked to many engineering disciplines, and studying mechanics issues cannot be separated from relevant engineering applications. Integrating knowledge from different disciplines into mechanics courses helps students better understand the application prospects of course content, fostering interdisciplinary thinking. For example, mechanics has wide applications in civil engineering, mechanical engineering, aviation, and electronics, where related knowledge can solve some issues, allowing students to apply mechanics knowledge through understanding content from other disciplines, proposing their ideas for existing structure modifications and designs; (4) Combining online teaching with a new question-and-answer teaching method. With the rapid development of internet technology, online education provides students access to high-quality mechanics courses from renowned domestic and foreign universities, significantly compensating for the lack of high-quality mechanics courses in regional universities. Utilizing online high-quality mechanics courses to assist classroom teaching greatly improves teaching efficiency and quality. However, online courses cannot immediately address students' difficulties nor meet differentiated teaching requirements. Therefore, combining online supplementary teaching with a question-and-answer teaching method can compensate for these shortcomings. Using spare time, assigning online teaching content according to students' learning situations meets personalized course teaching content demands, while regularly conducting question-and-answer sessions through teacher-

student and student-teacher interactive methods to examine and accurately evaluate students' mastery of content; [3]

(5) Student-Centered Academic Assessment and Evaluation Methods. Traditional mechanics course assessments have mainly focused on final written exam scores, combined with regular grades, as the standard for academic performance evaluation. This conventional approach has shown significant drawbacks, such as the randomness of final exams, frequent occurrences of homework plagiarism, and inattention after class check-ins. Objectively evaluating students' academic performance in mechanics courses is crucial to ensuring the quality of teaching. Constructing a student-centered mechanics course assessment and evaluation method is key to ensuring fairness and rationality in evaluations. Increasing on-site academic evaluations for each student helps ensure the rationality and fairness of evaluations, such as assigning comprehensive engineering mechanics problems for students to complete in group reports, with evaluation panels grading based on each student's on-site defense; additionally, incorporating students' participation in extracurricular online activities into the overall grade can motivate learning and knowledge mastery; regular online knowledge unit exams using online resources and teaching materials enable teachers to precisely evaluate students' learning situations.

(6) Student-Centered Teacher Assessment and Evaluation Methods. Currently, post-course student evaluations of teaching effectiveness are the main means of testing teachers' teaching effects, but this evaluation method has significant issues. First, teaching evaluations are greatly influenced by human factors; a relaxed teaching environment and courses that are easy to score well in become preferred by students. Second, the one-off nature of course evaluations presents disadvantages. Mechanics courses often span many hours and cover a long period, making it difficult to objectively and effectively evaluate the entire course. The performance in the final period of the course determines over 90% of the results, lacking objectivity. Lastly, students' attitudes towards evaluating teaching affect the objectivity of evaluations, with some students filling in evaluations arbitrarily, leading to random results. Adding periodic teaching evaluations can better reflect the objectivity of students' teaching and evaluation results. Using unit knowledge lectures as milestones for regular teaching evaluations can timely reflect students' attitudes towards the course, providing immediate information for teachers to adjust teaching methods. This approach results in more accurate outcomes and timely feedback on teaching effectiveness, helping to improve teaching quality and truly implement student-centered teaching methods.

In summary, with the demand for high-quality talent cultivation, traditional mechanics teaching methods can no longer meet the requirements for talent cultivation in mechanics courses, making it inevitable to undertake teaching reforms. Through personalized teaching and homework, engineering case teaching methods, providing mechanics-based interdisciplinary content, combining online teaching with question-and-answer methods, student-centered academic assessments and evaluations, and periodic teaching effectiveness evaluations, the reform towards student-centered teaching methods can offer beneficial exploration for talent cultivation.

3. Conclusion

In response to the issues faced in the teaching of mechanics courses in local universities, this paper proposes a student-centered approach to mechanics course teaching reform. By integrating the new engineering education teaching philosophy with ideological and political education in courses and combining it with general education courses, the reform aims to cultivate students' rigorous scientific attitudes, high sense of responsibility, honesty and trustworthiness, and correct views on life and the world. Establishing student-centered teaching concepts, content, methods, assessment methods, and methods for evaluating teaching effectiveness is aimed at improving the quality of talent cultivation.

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