

# Exploration and practice of basic mechanics teaching in engineering construction cluster

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**Abstract:** As the core course of engineering construction specialty, basic mechanics plays a very important role in the process of personnel training, and the traditional teaching mode lacks systematic system and practical application. Although many colleges and universities have reformed and attempted the basic mechanics course, there are certain application limitations. On the basis of summarizing the teaching experience of basic mechanics in recent years, this paper explores the teaching of basic mechanics of engineering construction specialty cluster from three dimensions: the construction and realization of the curriculum system, the optimization of the curriculum content, and the reform and application of the new teaching model. With the goal of serving and supporting the specialty construction and the personalized development of students, good results have been achieved through practice.

**Keywords:** basic mechanics; Curriculum system; reform in education

With the transformation and development of colleges and universities, the construction of “new engineering” with the main direction of training application-oriented specialized technical personnel is becoming increasingly perfect. As the concept leader of the construction of “new engineering”, discipline and specialty clusters play an irreplaceable role in many aspects. As the “instrumental” professional basis of engineering, basic mechanics is a key course for professional exploration, learning and research.

The diversity and abstraction of the basic mechanics course content is the main reason why most students lack interest and active learning, and it is also the difficulty of basic mechanics teaching. The traditional teaching method makes the basic mechanics course gradually independent and marginal, lacking systematic system and practical application. Therefore, many teachers have made reforms and attempts in the teaching of basic mechanics, Zhang Juan et al. explored the “four hall integration” hybrid teaching method under the emerging educational technology, reformed and practiced the teaching and assessment of theoretical mechanics, and improved the teaching effect of the course; Yang Xiaofeng et al. conducted the teaching of mechanics of materials in the form of cases guided by engineering problems, enhancing teachers’ sense of participation and students’ sense of achievement in solving practical problems; Song Zheng, guided by the structural design competition, mapped the application of mechanics in the competition to the basic mechanics course through the three-stage teaching design of “guidance teaching reinforcement”, and achieved good results in stimulating students’ interest and learning initiative.

Most teaching reforms are only based on a single aspect of the basic mechanics curriculum, which not only has certain application limitations, but also fails to better solve the problem of systematic and integrated construction of the curriculum. Based on this research, this paper explores from the three dimensions of the construction and realization of the mechanics curriculum system, the optimization of the mechanics curriculum content, and the reform and application of the new teaching model to form a systematic curriculum system of basic mechanics, Through the new teaching mode, we will promote the teaching of basic mechanics of engineering construction specialty clusters.

## 1. Construction and realization of mechanics curriculum system

The basic mechanics course of the engineering construction specialty cluster not only serves as the basic knowledge of the pre guidance courses, but also serves as the inspiration for the practical application methods of the core courses of the follow-up specialty. The importance of its content is self-evident. Looking at the teaching and learning of mechanics courses in colleges and universities in recent years, it is difficult for teachers to promote teaching and students to learn independently. Most students have not formed a clear knowledge system and achieved little in professional application, which has greatly affected the effectiveness of professional learning. The reason is that the basic mechanics teaching has not formed a series and systematic curriculum system, and lacks the connection with core professional courses and practical application, failing to effectively play a connecting role.

As the main course of engineering construction majors, mechanics runs through the whole process of the professional curriculum system from the preliminary understanding of the professional general education course, to the strengthening of the basic professional courses, to the practical application of the core professional courses. In the talent training mode, to some extent, the mechanics course also needs to achieve the effect of “educating people all the time, educating people all the way, educating people all the way”.

### 1.1 Construction ideas of curriculum system

As early as 2015, in accordance with the spirit of the National 13th Five Year Plan and the needs of discipline development and local construction, the college where the author works has set up a professional cluster of engineering construction covering five undergraduate majors, namely, water conservancy and hydropower engineering, civil engineering, road and bridge and river crossing engineering,

engineering management, and engineering cost, and implemented a student-centered “2+1+1” training mode (two years of professional general education courses+one year of professional courses+one year of personalized development), In the process of optimizing the training mode, with the help of the teaching of professional clusters, a “four-dimensional integration” mechanics course platform has been built, which is used to guide the interest of general education courses, teach the knowledge of professional theory courses, consolidate and strengthen professional practice courses, and practice the application of personalized development, as shown in Figure 1.

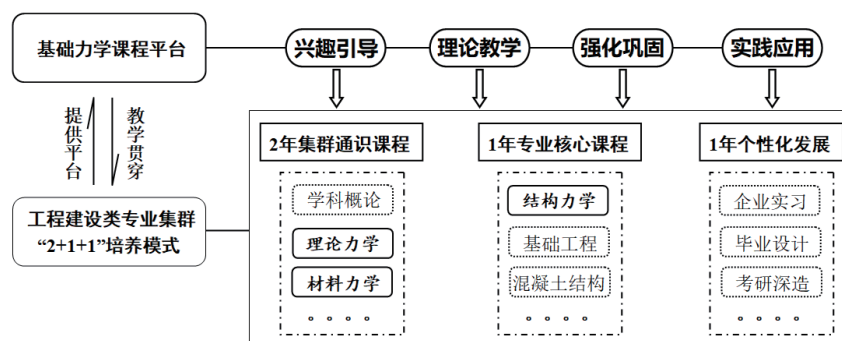


Figure 1 “Four dimensional Integration” Mechanics Course Platform

## 1.2 Implementation path of curriculum system

The traditional teaching is carried out closely around the core issues of the major, lacking professional expansion and cross disciplinary application, and does not meet the needs of the current employers for compound talents. In order to fully reflect the cluster effect and connotative development of the engineering construction specialty cluster, a curriculum system with the general education curriculum, basic curriculum, core curriculum and characteristic curriculum of the cluster specialty as the backbone has been constructed, which has built a good platform for the realization of the “three all-around education” of the basic mechanics curriculum.

(1) Explore the basic mechanics knowledge of various courses to realize “all staff education”

In the project of training engineering construction professionals, we should fully explore the mechanical knowledge of various courses, introduce a large number of practical engineering cases in general education courses, cut from the whole to the part, and stimulate students’ thinking and interest in mechanical knowledge through the guidance of problems. Optimize the relevant mechanical knowledge and connection content in basic courses, core courses and characteristic courses. In the teaching process of basic mechanics, spread the learning of mechanical knowledge to the field of professional courses. In the teaching of professional courses, focus the mastery of professional skills on the content of basic mechanics, pay attention to the cultivation of interest in general courses and the teaching connection and application of professional courses, and achieve “all staff education” in the process of talent training.

(2) Construct interdisciplinary and comprehensive topics to achieve “whole process education”

The knowledge concept and analysis method of basic mechanics are involved in many aspects such as course theory teaching and professional practice application, and their application runs through the whole process of the curriculum system of engineering construction majors. Due to the development of modern science and technology, the application of various professional computing software gradually weakens the students’ understanding and demand for basic mechanics, and the phenomenon that students can complete professional topics but cannot understand the principles emerges in endlessly. This is the main reason why basic mechanics can not really realize the whole process of teaching, and it is also the pain point of engineering construction specialty teaching. In order to solve the above problems, in the teaching process, based on the discipline teaching and research office, integrating the advantages and characteristics of each discipline and combining the needs of students’ learning and professional construction, we have constructed a cross disciplinary comprehensive project of engineering construction. With the goal of completing the overall program of the project, we have conducted hierarchical teaching in the form of sub topics, and solved the “what is” problem of basic mechanics in the cluster general education course, Solve the problem of “what to do” at the stage of professional core courses, and “how to do” at the stage of personality development. Complete the set goal of comprehensive topics with the optimization and combination of phased achievements, and achieve the goal of “educating people in the whole process”.

(3) Strengthen the application and expansion of basic mechanics to achieve “all-round education”

The core of basic mechanics teaching lies in practical application, and abstract concepts and rigorous analysis methods are mastered and expanded through practical application. In the actual teaching, taking the mechanics content involved in professional curriculum calculation, curriculum design, graduation design, practical problems, etc. as the starting point, and based on the basic teaching organization and curriculum team, mechanics teaching modules are added in all aspects of training, and teachers are encouraged to guide students’ personalized, demanding and hierarchical development by teaching scientific research topics, subject competitions, further education, practical projects, etc. Give full play to the supporting and assisting role of mechanics courses in the construction of majors and the

development of students, and realize “all-round education”.

## 2. Course content optimization

### 2.1 Teaching highlights unity and content highlights characteristics

There are many categories of basic mechanics, with different focuses for different majors, and the courses are closely linked with each other. There are many overlapping points in the application of knowledge. Based on the above characteristics, when formulating the teaching syllabus and examination syllabus of basic mechanics, the needs of various disciplines and majors are fully considered, the teaching requirements of the courses are unified, and the contents of the chapters are required to highlight the professional characteristics.

### 2.2 Optimizing the course teaching process

The focus of basic mechanics is the familiarity of basic concepts and the application of analysis methods. The difficulty lies in the understanding of calculation principles and the analysis skills of complex problems. Therefore, in the course teaching, teachers should pay attention to the content review of about 10 minutes at the beginning of the course, the content teaching of about 70 minutes at the middle of the course, and the content summary of about 10 minutes at the end of the course to introduce the learning content of the next course with new questions, Intensity training with after-school thinking and homework.

## 3. Reform and application of online and offline mixed teaching mode

Under the condition that modern teaching means are gradually enriched, the teaching mode of basic mechanics is reformed and innovated: first, the offline teaching mode reform centered on supporting professional construction, closely focusing on the needs of professional construction, strengthening the analysis principle of basic mechanics and the connection with the content of professional courses, targeted hierarchical teaching, serving the needs of students’ curriculum learning and application expansion in professional fields; The second is to build an online course resource platform centered on serving students, make full use of the network platform and resources, unblock the learning and communication channels between teachers and students, and guide students to take the initiative to learn, inquire about knowledge, and improve and expand their professional abilities.

## 4. Teaching practice effect

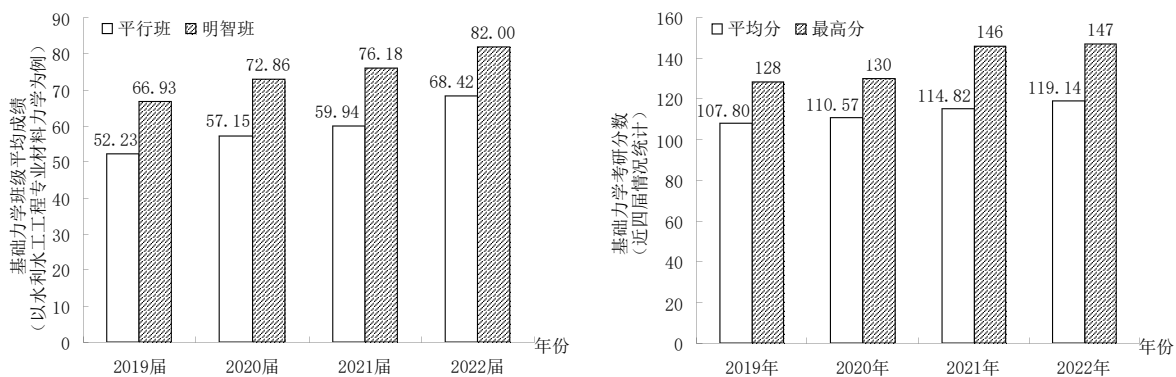


Figure 2 Basic Mechanics Course Score Statistics

After years of improvement and practice, the teaching of basic mechanics for engineering construction majors has achieved certain results. First, in terms of course teaching, an effective online and offline hybrid teaching scheme has been formed, the course hours and content of basic mechanics have been optimized, an online teaching and learning resource platform has been built, and the results of basic mechanics courses have been improved year by year, Its curriculum teaching has achieved good results in guiding students to learn independently and promote development, as shown in Figures 3 and 4; Second, in terms of discipline competitions, the basic mechanics and professional curriculum contents are combined and carried out in the form of competition, guiding students to win nearly 100 awards in a number of national discipline competitions, and its curriculum teaching has made remarkable achievements in serving and supporting discipline competitions; Third, in terms of the teaching team, in the teaching practice process of the “four in one” curriculum platform and the “three in one” curriculum system of basic mechanics, we should innovate and reform the curriculum teaching mode and teaching scheme, focus on the curriculum teaching, gather the teachers’ teaching team, expand the professional construction, spread the cross application of basic mechanics disciplines, and gradually improve the teaching quality.

## 5. Conclusion

The development of industry modernization promotes the construction of “new engineering” in colleges and universities, which is also a new opportunity and challenge for the training of engineering construction professionals. Whether it is the construction of disciplines, or the training of talents and personalized development, the teaching quality of basic mechanics plays an irreplaceable role. As the core course of engineering construction majors, the mastery of mechanics is inexorably linked to the improvement of students’ professional skills. Its teaching should always implement the student-centered teaching philosophy. Serving the needs of student development and professional construction is the core content and ultimate goal of basic mechanics reform and practice. It can not only further improve the teaching quality of basic mechanics, but also provide reference for the construction of other disciplines.

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