

# Study on Teaching Reform of Biomechanics in Biomedical Engineering

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## Abstract

Biomechanics is one of the important professional basic courses of Xinxiang Medical University of biomedical engineering. It has a wide range of content, lots of cross-cutting knowledge and large subject spans, but few teaching hours. So it is difficult to learn for students because of miscellaneous teaching methods. In view of the content of engineering courses and the characteristics of medical application of the college of biomedical engineering, this article starts from the teaching methods, teaching materials, assessment methods and other aspects, and studies and discusses the current teaching of biomechanics. The use of modern network technology will improve the student ability. Besides it can improve the teaching and learning efficiency as well as activating the classroom atmosphere and increasing teaching achievements.

**Keywords:** *Biomechanics; Teaching Reform; Innovation; Biomedical Engineering*

## 1. Introduction

Biomechanics is a sub-discipline of the mechanics in the biology research, and it is also a new discipline that intersects and penetrates many disciplines [1]. People combine basic mechanics principles such as continuum mechanics, multiple media mechanics and physiology, medicine, and biology to research organism, eventually serving clinical, biomedical engineering and biotechnology.

At present, the biomechanics course in school is mainly for sophomore students majoring in

biomedical engineering and biomedical engineering medical equipment. As the only engineering department of Xinxiang Medical College, in order to provide students with a deeper understanding of the development direction of the major, this course is designed to enable students to learn how to use mechanical principles to analyze the phenomenon of biomechanics and cultivate their ability to use knowledge. However, the biomechanics course has a wide range of content and many cross-cutting knowledge. The traditional classroom teaching methods cannot meet the needs of students at the current stage. This paper proposes the study of biomechanics teaching reform.

## 2. The reform of teaching methods

The class of biomechanics courses consists of 3 classes for biomedical engineering and medical equipment engineering. It has reached 78 students and has more teaching content. In order to complete the content of the syllabus, the knowledge points have to be simplified. As a result, the teacher has little interaction with the students in the classroom teaching, and the students are not in a good grasp of the knowledge. In addition, the assessment method of the biomechanics course is a closed-book exam with a perfect score of 100 points. 40% of the usual performances scores, 60% of the final exam scores, and the usual results are determined by homework and attendance. However, plagiarism among students is very common, and it is impossible for teachers to judge whether each student is plagiarised. The

student's performance is basically determined by a final exam paper, which does not reflect the student's usual learning attitude. As a result, students' ability and confidence in solving practical problems are reduced, and it is difficult to meet the requirements of the school for student ability development.

### 2.1 Expand multimedia teaching methods

Biomechanics is based on the viewpoints, methods, and theories of mechanics to research the mechanical properties and movement laws of organism[1]. Its content involves the human body system, organs, tissues and cells and other levels of sports phenomenon. Using multi-form multimedia teaching, the intuitive and visual presentation of teaching content can stimulate students' interest in learning, expand their horizons, and inspire students to learn in depth. With the popularization of the PPT teaching model today, multimedia technology should be integrated with text, pictures, video and other elements to carry out teaching reforms, improve the monotony of traditional teaching, carry out multiple stimulations from the visual and auditory aspects, and revitalize student thinking.

When making courseware for "Biomechanics", we must pay attention to overall design and overall arrangements. Due to the relatively large number of expressions used, images, texts, tables, and other elements must be linked and complemented with each other, and the overall order of the elements must be considered. In the courseware, the use of a network grading system (for example, a blackboard) uses different colors to express knowledge points of different degrees of importance, and develops students' self-orientation and understanding of concepts [2]. In the concept of visual teaching[3], the selected video, animation, etc. should be closely linked to the theme of the subject. What's more, stricting the control of time is serious, and time

controlled in less than half a minute can get the best effect. At last, there should be a timely summary after reading.

### 2.2 Group discussion

Inquiring and cooperative learning strategies can improve students' academic performance and problem solving ability more than classroom teaching[4]. Before class, students can read and organize multiple documents, obtain as much knowledge as possible within a limited time, preview the contents of the next class, and mark the problems they have encountered. During the class, the teacher will leave students with a portion of their knowledge. During the class, the teacher will leave some practice and encourage students to express their own views and questions. In this way, it not only helps the student himself to grasp the key to the problem more accurately, but also enhances the student's learning motivation and improves classroom efficiency[5]. For example, with the simple analysis of the shear force of the beam, the students discuss each other in groups, and then send individual representatives to explain the topic. The results of the class are shown in Figure 1.

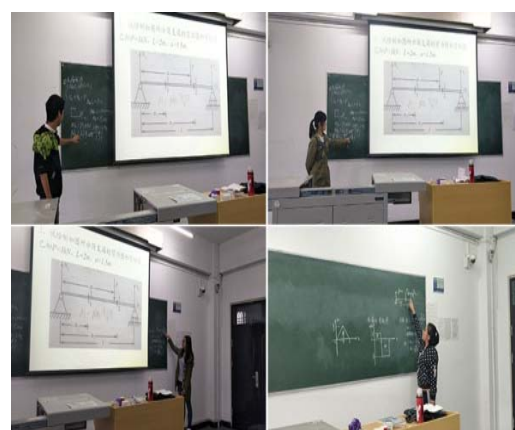


Figure 1. Students are divided into several groups and presentation

### 2.3 The combination of theory and the actual case

Biomechanics mainly studies the mechanics and movement characteristics of the living human body and the human body's overall motility system. Case analysis can bring knowledge closer to life and fully stimulate students' active motivation. And clinical case studies contribute to the development of clinical reasoning strategies, basic scientific knowledge and integration. Combining theoretical and practical cases will help improve students' learning experience in biomechanics and clinical case studies[6]. The implementation teacher can pre-arrange a case to the student before the lecture, allowing the student to collect information through a variety of channels, in-depth understanding of the key points, problems and solutions of the case; in the teaching, mutual exchanges, discussions, and can also be combined with the board, Images, videos, animations and other materials to analyze from different perspectives using a variety of teaching methods. With vivid teaching scenarios and rich teaching content, the theoretical basis and applied fields of the cases are concisely analyzed to improve students' learning ability.

#### 2.4 Virtual Simulation Experiment Teaching

Biomechanics is a practical course. However, there is no uniform rigid test for the contents of the experiment. In schools where the equipment and hardware facilities are relatively completed, some experiments with a certain degree of difficulty or higher levels may be conducted. While in the areas where conditions and equipment are relatively backward, only simple and feasible experimental teaching can be done. Due to the current conditions of the Institute, there are certain difficulties in the practical operation of some experiments. Therefore, it is necessary to give full play to the experimental

teaching methods of virtual simulation and use the conditions of the Henan Medical Engineering Virtual Simulation Experimental Teaching Center, where irtual simulation can be performed for a large number of experiments and a long experimental period. For example, vascular dynamic stent surgery simulation experiments can clearly see the changes in blood vessel stress through finite element software, but the actual operation is not easy to obtain.

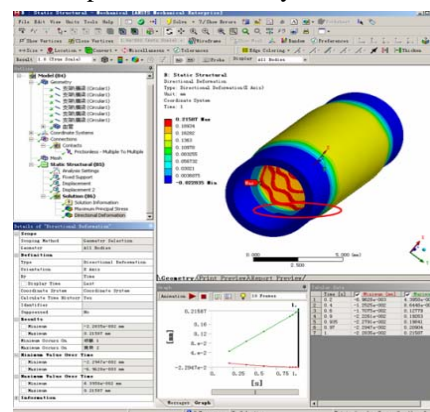


Figure 2. Experimental teaching of virtual simulation

In addition to conducting simulation experiments, it is also possible to conduct simple quizzes in theoretical teaching to make boring knowledge vivid. Students are no longer passively accepted, but actively explore, generate interest in learning, and better apply theory to practice. For example, use the functional model of the two hair band representative components to analyze the spatial relationship of joints and explain the role of muscles around joints [7]. In the end, students will expand their thinking space and enhance their ability to think and practice independently, thereby improving the quality of teaching.

#### 2.5 Enhance "Internet+" technology applications

In the current era, "Internet +" technology has developed rapidly, and QQ, WeChat and other software have been widely used. In the classroom, teachers use the scan of the QR code to enable students to enter the classroom,

achieve student sign-in, arrange assignments, and randomly select students to answer questions. In addition, teachers can use the WeChat platform to set up answering and rewarding mechanisms, such as WeChat answering, etc.. The top few students can get some red envelope bonuses randomly. If they answer correctly, they can also get 3 to 5 points in normal time. It can achieve a friendly interaction between teachers and students in classroom teaching, mobilize the students' enthusiasm for learning. At present, the WeChat sign-in has been put into use in the biomechanics classroom, and the student's class rate has been significantly improved with significant results.

At the same time, third-party software can be used to establish a biometrics information resource platform. On this platform, students can learn about biomechanics courses at major universities and enjoy the sharing of biomechanical resources across the country. In addition, the video of the excellent biomechanics teacher can be upload, students can leave messages under the video, the author answer questions to achieve all-day learning. The response of students to different teaching modes is shown in figure 3:

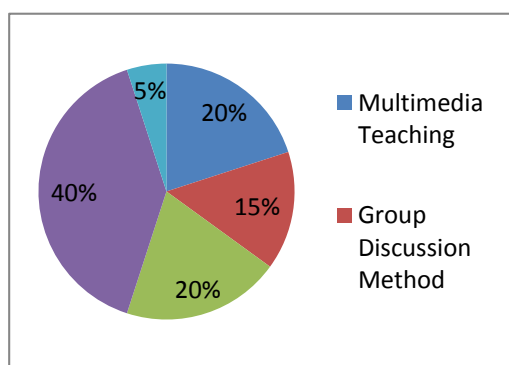


Figure 3. Students' choice of lecture modes

## 2.6 Teaching and research combined with interest groups

Biomechanics has a wide range of teaching, where theories are combined with practice

closely[8]. The discipline involves in sports physiology, anatomy and mechanics. The teaching direction of the instructor is also biomechanics and rehabilitation mechanics, which can give students an overview of the latest research results in the field, allowing students to have a general understanding of the future of the field; at the same time, establish a biomechanical research interest research group to cultivate more students. Encourage students to participate actively in research projects such as university-level innovation projects for university students, scientific research projects at provincial level, national challenge cups, and innovation and entrepreneurship reporting for college students. Besides, it organizes cooperative journal club activities. In this collaborative learning activity, students regularly select and discuss a biomechanical journal and conduct personal assessments based on their own experiences[9]. Let students participate in the literary creation process of scientific research so that they can have a deep understanding of technical knowledge and develop lifelong learning skills.

## 3. The Reform of the examination mode of the course

As a limited course, the school generally takes the final exam score as the final grade of the course. However, this type of examination can easily result in students skipping classes, not attending lectures carefully, not completing assignments carefully under the class, temporarily clinging to their feet before exams, rote memorization, and even pinning all hopes on the cheating in examinations. Therefore, they are trapped in the vicious cycle of not paying attention to the exam and not listening to the lecture. This leads students to fail to learn the knowledge and improve their ability. This course exam breaks the traditional examination method and uses a combination of a closed book

examination and a written review to make up for the disadvantages of a single assessment method. However, although the assessment method is a combination of written examination and review, the emphasis is still on the final written examination, accounting for 60% of the total score. Therefore, the effect of improving the learning atmosphere is not significant, and more in-depth explorations of assessment methods are needed, such as the use of attendance, classroom questions, assignments, literature review, and writing reviews to combine assessment methods to strengthen students' daily learning. The supervision promotes the quality of teaching and enables students to master knowledge and their ability to use [10]. The popularity of different assessment modes in students is shown in figure 4:

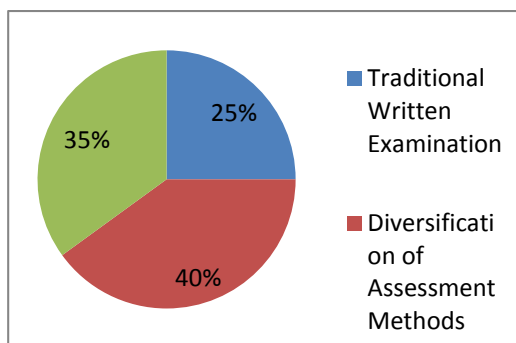


Fig.4 The students' choices of assessment modes

#### 4. Research on teaching effect

After the course was over, 78 students in the college were made a survey on whether they liked the classroom after the reform. The survey results are shown in Table 1 below:

Table 1 evaluation of teaching methods after

Content	Students' choices	The number of students	The percentage
Dou you like the reformed teaching mode?	Yes	69	80.23%
The impact of the new teaching model.	Listen carefully and learn more.	67	77.90%
The combination of theory and practice.	Often	77	89.53%
What kind of teaching models do you prefer?	The teaching mode after teaching reform.	79	91.63%

teaching reform (N=78)

From Table 1, it can be seen that after the curriculum reform, students respond better and their enthusiasm improves. 80.23% of the students preferred the classroom after the reform. Among them, 77.90% of the students were reflected in the course of lectures. The vivid atmosphere of the classroom enabled them to follow the teacher's ideas, think hard, and improve the effectiveness of the lectures. 89.53% of students believed that the teacher's simulated simulation experiment inspired thinking and enabled them to combine knowledge with reality, not only mastering knowledge, but also developing biomechanical thinking. To sum up, 91.63% of the students preferred the teaching mode after teaching reform, which shows that the teaching reform is really successful. That stimulated students' initiative in learning and enhanced the students' interest in learning greatly.

## 5. Conclusion

Through the study of teaching methods, a method of teaching reform of the "biomechanics" course that is more suitable for the current situation is found. It makes the abstract content more intuitive, the concept expressed more clearly, mobilizes the enthusiasm of students' learning, and improves the efficiency of teaching. Besides, the teacher supplements the virtual simulation experiment to better show the students how to use what they have learned; the added essay experiment exercises students' hands-on ability and sense of innovation, and improve the quality of teaching.

The study of this course aims to lay a good foundation for cultivating the talents required for the new era. The new teaching mode not only uses the combination of theory and practice, but also broadens the field of vision. Most importantly, it provides students with new ideas, enhances students' practical ability, and facilitates students to apply theoretical knowledge into practice. At the same time, it provides a reference for similar professional teaching experiment reform in biomedical engineering college.

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## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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