Research On The Reform And Practice Of Classroom Teaching Mode Of Quantum Mechanics

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Abstract: This paper introduces the course characteristics of quantum mechanics and the requirements for the quantum mechanics course in the new era of professional personnel training. Combined with the teaching of quantum mechanics course in our school, this paper introduces the teaching reform of this course. This paper analyses the current situation and learning needs of science and engineering students in learning quantum mechanics. This paper puts forward the mixed teaching mode which should be combined with the traditional teaching mode in the new era, especially the three-dimensional teaching on and off line; the visualization of computing platform and the bilingual class-based teaching are deeply discussed and studied. Our teaching research is mainly to find out the main problems and shortcomings, and put forward corresponding countermeasures and Suggestions to solve the problems. We hope that our teaching research and reform research can provide meaningful inspiration and reference for improving the teaching effect of quantum mechanics.

1. Introduction

Quantum mechanics is a compulsory basic course for undergraduates and some graduate students majoring in science and engineering, such as physics, photoelectric science, communication engineering, and computer science [1-4].From the point of view of the content and function of the course, this course is a characteristic subject, which is a basic professional course of physics and its science and engineering. This course not only provides the necessary theoretical basis and tools for the study of subsequent professional courses, deepens and expands the knowledge of theoretical physics, but also perfectly cultivates students' physical thinking ability and comprehensive ability, and enhances the comprehensive application of analysis and application tools in practical problems. Quantum mechanics course is a basic theoretical course developed on the basis of mechanics, electromagnetism, optics, atomic physics, electrodynamics and thermodynamic statistical mechanics, etc., in order to solve the problems of science and engineering in the micro field.

At present, quantum mechanics has established a relatively complete teaching content, frame structure, as well as teaching materials courseware. With the development of science and technology, the construction of teaching materials has been intensified to constantly bring forth the new, so as to meet the needs of scientific application and personnel training. The teaching mode of quantum mechanics is also updating, both traditional and modern; There are three-dimensional teaching, there are visual teaching, and to today's online and offline mixed teaching model. This course combines quantum physics and physical Mathematics; so to speak, it is both a physics major course and a theoretical foundation course for many science and engineering courses. In particular, it is most obvious in the application of quantum mechanics. The starting point is often not physical problems, such as communication engineering and materials science, etc., which ultimately boil down to several typical theoretical modeling and equation establishment, or physical problems related to quantum mechanics. Quantum mechanics and theoretical mechanics, thermodynamics and statistical physics, electrodynamics constitute the four major mechanics. Quantum mechanics is an

important part of the four major mechanics, which expands the scope of mechanics and enhances the ability to solve problems.

However, the contents of this course is more, the coverage is very wide [5-6], involved in mathematics and physics, from a relativistic quantum mechanics to the theory of relativity, quantum mechanics has a very wide range of background knowledge, such as from physics to biology, medicine learn astronomy, etc., and difficulty is big, the problem solving skill is also very strong, is an acknowledged difficult to teach, one of the difficult subject. At the same time, the course contains a lot of logical reasoning, very rigorous mathematical proofs. Often the derivation is not simple and not easy, and the results are complex, difficult to understand, difficult to remember, and have high requirements for both teachers and students. Many students, even if they do listen carefully, find it very difficult to review the exercises after class. Meanwhile, the coherence of quantum mechanics course is very strong, and the previous knowledge directly affects the subsequent learning, which is also the reason why it is difficult for students to stick to the course well.

On the other hand, textbooks do not match well with students' major, which makes students confused. In this way, it is also very difficult and a very big challenge for students to master the quantum mechanics course content in a short semester. Therefore, according to the needs of discipline construction and talent cultivation, combined with the actual characteristics of students, we must make appropriate adjustments and reforms in the teaching process from learning content to teaching method, from the selection of examples to exercises, as well as each chapter testing and final examination.

"Practical Research on English-Chinese Bilingual Teaching of Courses" has become an important subject in the curriculum reform of Chinese colleges and universities. It is an important aspect to promote the reform of education and teaching by exploring and exploring a new way to reform the curriculum system, teaching content and methods of quantum mechanics and other majors. It has become an urgent task for physics teachers and students to carry out bilingual teaching of quantum mechanics in order to make it play its due role in the optimization of students' knowledge structure and the cultivation of their abilities and qualities.

Through English-Chinese bilingual teaching, students can learn professional knowledge with the help of English, cultivate both professional knowledge and English ability, arouse students' enthusiasm and initiative in learning, and strengthen the training of English-Chinese bilingual talents in physics courses. The teaching objective of bilingual teaching is, first of all, to enable students to master the basic concepts, basic theories, basic methods and basic skills. The second is to let students further understand foreign advanced ideas, ways of thinking and research results. The third is to enable students to master the English expressions of professional knowledge and cultivate their ability of international academic exchanges in this field.

This paper analyzes the shortcomings in the current teaching of quantum mechanics, puts forward some solutions and countermeasures, and applies them in the teaching practice of quantum mechanics, and obtains good results, and can be extended experience. The results show that the teaching quality and teaching level of teachers have been improved effectively, which has been recognized and welcomed by students and achieved good teaching effect.

2. Current situation and problems of quantum mechanics teaching

At present, according to the needs of social progress and industry development, the new requirements and new goals of cultivating professional talents are put forward for higher education, and the teaching system is also reformed urgently. How to adapt quantum mechanics to the new needs is also the direction that teachers are trying to explore, and how to promote the university teachers to continuously carry out teaching research and reform, and improve the teaching effect, these are all problems that need to be solved. At the same time, the expansion of university enrolment, the change of student source structure (for example, the increasing number of ethnic minorities and foreign students), the popularization of university education and other problems also test the improvement of curriculum construction and teaching.

According to our teaching experience and combined with the talent demand of the new era, some problems have been found in the current quantum mechanics course teaching, which are mainly shown as follows:

First of all, the content of the textbook is relatively old and has not been updated in time. In recent years, although the curriculum materials and auxiliary materials have been improved and improved in the construction, they still cannot meet the needs of students' learning. The pertinence of the curriculum content is not strong, and the need of discipline construction is diluted. Most of the commonly used authoritative textbooks in China are aimed at physics majors, and those with professional characteristics are relatively rare. For science and engineering students, there are few contents directly related to their major. Students tend to get lost in learning and lack interest in learning, so they cannot pay enough attention to course learning.

Secondly, teachers have insufficient understanding of the importance of curriculum reform. In the new information era of science and technology changing with each passing day, in order to conform to the development speed of the new era, the corresponding teaching reform is particularly important and urgent. Now is not a textbook, a teaching plan can use the podium, can be used to the age of retirement. Teachers must keep learning, constantly adjust the teaching content, timely update the teaching plan, in order to better adapt to the new requirements of teaching.

Then there are two extremes in teaching methods: one is the traditional teaching mode of "blackboard and chalk", which is dominated by middle and old teachers. The other is the modern teaching style of "multimedia plus PPT" represented by young teachers. The former lays emphasis on logical reasoning and puts a lot of effort into theoretical derivation, systematic and precise. This teaching method has a high requirement for students and is popular among key universities, with good foundation of students, practical application and good teaching effect. But for other ordinary colleges and universities, the latter teaching mode is used more, the teaching effect is not ideal; the examination pass rate is relatively low. And the latter may bring more problems, there is no step by step strict mathematical, logical derivation, students are easy to take the wrong road of passive acceptance. Due to the lack of clear derivation of many formulas, their own calculation to the foundation and more limited, more students have no choice but to take rote methods to cope with the usual practice and examination, leading to students learning effect is very bad.

The fourth is students are not highly motivated to learn and have no interest in attending classes, not to mention taking the initiative to preview and review. When finishing homework after class, most of them also copy the answers. Once they hand in their homework, they do not fully realize the importance of studying the course seriously.

3. Contents and methods of quantum mechanics teaching reform

Over the years, we have done a lot of work on the teaching reform, trying to solve some of the main problems in this course, making quantum mechanics one of the demonstration courses of the discipline reform. Our teaching reform is mainly carried out in the following aspects:

3.1. Reform of quantum mechanics textbooks and course

At present, there are a number of domestic quantum mechanics textbooks well written, very comprehensive. For example, the textbooks compiled by Professor Zhou and Professor Zeng [1 - 4] can be described as thoroughly honed and refined. After a number of revisions, it has been quite perfect, from the content and knowledge from the point of view of impeccable. Of course, it is necessary for the textbook to be rewritten properly, such as new scientific research content, new examples and so on, which can be added to the textbook. In particular, in the course of using the textbook, the pertinence is slightly insufficient, there is no strong pertinence. For this problem, we adopted a more flexible approach, given as follows: First, we use authoritative, classical textbooks on the one hand. The second is to supplement the characteristic teaching materials according to the professional needs to solve this problem. In this way, the integrity of classic textbooks is not affected, which facilitates the learning of all kinds of students. Meanwhile, the teaching content can be supplemented and refined according to the practical needs of the major, so as to meet the needs

of discipline construction.

For example, at present, students of Science and Engineering have a high requirement for learning quantum mechanics. However, the general textbook does not provide sufficient explanation depth, few sample questions and few basic questions, which cannot meet the learning needs. Therefore, we collected a large number of relevant materials, combined with the content of students' subsequent courses, focused and detailed preparation of the content of these two parts. Combined with the study guide reference books in the textbook, we compiled some typical exercises and their answers, bound them into books and distributed them to students. After the implementation of this program, students have responded well, from the point of view of learning interest and test scores, have improved, improve the teaching effect. It is not only used in the learning process of this course, but also can be used as a reference in the following courses of quantum mechanics, such as quantum electrodynamics, quantum optics, quantum computing and quantum signal processing.

3.2. Three-dimensional teaching of quantum mechanics

In the process of teaching, we have strengthened five links and solved many related problems in teaching fundamentally. The five steps are as follows:

The first is to strengthen the supervision and management of the teaching links before, during and after class. It is especially important for learning quantum mechanics to preview quantum mechanics textbooks and ask questions before class. Preview in advance can help you understand the knowledge framework, understand the key points and difficulties of the course have an overall grasp of the content to be learned, especially have a reflection on the problems, and ask targeted questions in class. In this way in the class to listen to the class can be targeted, there is a clear thinking. At the same time, some problems will be encountered in the preview process, such as the origin of formulas, derivation, physical meaning of solutions, and treatment of boundary conditions and so on. Write down your problems so that they can be solved timely when the teacher explains them. Targeted lectures improve the efficiency of the class and solve the problems in the lectures will increase the sense of achievement in learning. With the combination of pre-class and class, review after class to further understand, digest and consolidate the knowledge learned can achieve good learning results [6-7].

The second is to strengthen the teaching and research to promote each other. Teaching and scientific research are two key tasks of teachers, which promote and influence each other. Teaching can lay a good foundation for scientific research, stimulate the enthusiasm of scientific research, and scientific research can continuously improve teachers' teaching level, and constantly integrate scientific research results into teaching. Teachers' scientific research level is crucial for cultivating students. Teachers have a certain depth of scientific research work and apply curricular related knowledge, which can enrich the teaching content, flexibly apply curriculum knowledge, expand students' vision, and play a good role in cultivating innovative talents. Students also see the application of the knowledge in scientific research activities, cultivate students' scientific research skills, stimulate students' interest in learning, and enhance their sense of achievement.

The third is to strengthen the combination of passive and active links. The innovation of teaching mode and the improvement of teaching methods also have great influence on the teaching effect. The traditional teaching mode is that teachers give lectures and students listen passively. In the early stage of students' study, the foundation of students is not good, and the traditional teaching mode is more important and indispensable. With the deepening of the study, the course content increases, the difficulty increases, the traditional teaching mode appears to be insufficient, exposed many shortcomings. Therefore, a passive to active way is adopted to let students actively participate in, select part of the course content, and let students finish it by them. Strengthen the guidance of students' independent study, independent display of learning results, and independent completion of learning tasks. Group discussion, students will discuss results show in class, and cooperate with the MATLAB and Mathematic visualization software, images, animation. Students discuss, put forward various questions, teacher comments. The classroom atmosphere will be very good, the whole

learning process is relaxed and happy, teachers and students in the teaching of frequent interaction. Encourage students to make bold innovations and improve their ability to solve problems.

The fourth is the link of timely feedback and review after class. The highlight of this session is to solve the problem that students reported that they could not find a teacher in their spare time. According to the survey, many students reported that the teacher left the classroom immediately after class and rarely met with them, especially when it was difficult to find a teacher to discuss relevant issues. If there is too much backlog of questions and questions, it is easy for students to gradually lose confidence and interest in a subject. In order to solve the learning needs of students after class and help them solve the problems they did not understand and solve in class, we specially set up an after-class question answering time and also arranged a fixed question answering room.

The fifth is to strengthen the combination of online and offline teaching. At present, we use the rain classroom, wisdom tree, QQ, DingDing and other online teaching platform. Can arrange the pre-class task, check the students' pre-class situation, student-oriented, and stimulate students' learning initiative. Encourage teaching reform and require teachers to actively participate in online and offline blended teaching practice. We moved the classroom online, which facilitated communication with students, introduced scientific and practical technology, and made the classroom more interesting, with more knowledge content, richer materials, and more convenient and timely examination and examination. In particular, we designed the teaching activities, learning mode, learning effect evaluation method and so on. Through the network teaching platform, QQ, DingDing, and other tools to carry out online and offline mixed teaching, give full play to the advantages of micro class, flipped classroom, network learning and other modern technological means, research and practice of course teaching. The purpose is to cultivate students' interest in independent learning and their ability to analyse and solve problems independently. The teaching reform not only improves the teaching quality of the course, but also improves teachers' teaching ability.

At the same time, we should improve teaching resources, reasonably plan teaching strategies, timely feedback evaluation results, and pay attention to the guidance and supervision of teachers in the whole process before, during and after class in the implementation of teaching, so as to finally improve the teaching effect and enhance the teaching level. The practice has proved that the reform and practice of curriculum can promote students' knowledge and teachers' teaching level. Make this period student study effect is better, answer question more convenient, result has been improved generally, teaching effect is better.

3.3. Visualization of quantum mechanics teaching

One of the main reasons why fundamental physics courses are difficult to learn is that they are too abstract, especially in quantum mechanics. After complicated and strict mathematical theory derivation, the formulas extracted are often more complicated and not intuitive. It is difficult for many students to understand the physics background and significance of the formula, and they do not know where to start when solving exercises after class, so their application ability is low. In this way, some students can only cope with the usual homework and exams by rote, remembering a set of methods to solve problems and following the pattern. In particular, the solution of the problem and for its physical meaning sometimes understanding is not in place, some understanding is ambiguous, ambiguous. Although the problem sets and answers have clear physical meanings, for students who are new to quantum mechanics, these mathematical formulas are still confusing and difficult to see the physical images and physical meanings expressed in them. Faced with complicated formulas, not only students find it difficult to learn, but also teachers try their best to do everything, but the teaching effect is still not ideal.

And if we can get these formulas to be able to visualize physical formulas on a computer, we can visualize physical formulas. To express these complex formulas with intuitive graphics can not only help students understand and master knowledge, improve students' interest in learning, but also significantly improve the teaching effect, with twice the result with half the effort. In the early stage of exploring visualization teaching, we try to realize the visualization of physical formulas through

the C language students have learned. In particular, the solution of calculation, transformation, numerical solution and other problems involved in the textbook can be solved with the help of software to achieve visualization. In this way, students can self-verify the correctness of the results.

Visualization in the formula, we use the Tsinghua university press is the MATLAB and Mathematical physics equation method and the visualization [7], we use training course held the MATLAB, and mobilize the students are required to take an active part in related training, will be the latest calculation skills, such as advanced mathematics, the application of Mathematic teaching into quantum mechanics, better service to students, improve the students' learning interest, make students hard, improve the students' feeling and a sense of achievement. The promotion of visual teaching has been fully affirmed and strongly supported by the school, and it has also been welcomed by students, which has improved the learning effect. In particular, in recent years, on the basis of this course, some students participated in college challenge cup, Mathematical modelling contest and physics contest and other aspects of competitiveness has been enhanced, and the performance has been significantly improved.

4. Bilingual teaching practice of quantum mechanics

With the continuous development of reform and opening up, bilingual teaching has been playing an increasingly prominent role in China's education system. In particular, bilingual teaching has become an important index of teaching evaluation in colleges and universities, as well as an important task in China's college education reform. In order to implement the instruction of the Ministry of Education on "Creating conditions for the use of English and other foreign languages in the teaching of public and specialized courses in undergraduate education", we have vigorously carried out bilingual teaching of specialized courses.

English-Chinese bilingual teaching is not only an important part of the teaching work, but also an important link in the whole teaching process of combining theory with practice, cultivating students' English level and professional innovation ability. We mainly carried out the following work:

First of all, how to cultivate practical talents with high English level and strong physical ability through bilingual teaching of Quantum Mechanics is studied.

Secondly, through the practice of bilingual teaching of quantum Mechanics course, the theoretical research results of bilingual teaching of quantum mechanics course are obtained, and a bilingual teaching model suitable for the actual situation is explored.

Finally, the classroom teaching design of quantum Mechanics bilingual teaching with small class system and the practice of teaching reform of Quantum Mechanics bilingual teaching are carried out.

In the aspect of English-Chinese bilingual teaching of quantum mechanics, we will carry out the plan and measure of constructing English-Chinese bilingual teaching and professional English. To perfect and revise the English-Chinese bilingual teaching plan suitable for the training of physics professionals; Actively start bilingual teaching and professional English teaching for senior students. To cultivate and establish excellent teachers who are competent in English-Chinese bilingual teaching. The main research contents and programmes are as follows:

The first is to adopt appropriate teaching mode, teach students according to their aptitude and step by step in the process of bilingual teaching. First use Chinese to teach, in the lecture, interspersed with English names and keywords. In summary, write and express in English.

The second is to improve the construction of English-Chinese bilingual network resources platform. At present, the English-Chinese bilingual network resources constructed are limited, far from meeting the needs of cultivating students' innovation ability, students' interdisciplinary knowledge of this course and other majors, and teachers and students' use of Scientific English to communicate and help them answer questions in this course.

The third is to compile the instruction book and problem set for the English-Chinese bilingual course of quantum mechanics in physics major. And to take an examination of the postgraduate students, because the majority of physics master must learn quantum mechanics. Therefore, we strengthen the summary of theoretical knowledge, increase the intensity of exercises to explain, for

students to participate in the postgraduate entrance examination to give help, improve the graduate examination enrolment rate.

The fourth is through the reform of teaching methods, assessment methods and other aspects, bilingual teaching has realized the whole teaching process of "Student-Centered", greatly improving students' interest in learning, improving students' English expression ability, and laying a good foundation for students to dare to speak English and use English.

Conclusion

In general, quantum mechanics, as an important compulsory basic course for undergraduates and some postgraduates of science and engineering majors, plays an important role in the comprehensive expansion of students' knowledge structure system. In the face of the needs of professional personnel training in the new era and the characteristics of contemporary college students, the course of quantum mechanics needs to make corresponding adjustment and reform, improve the teaching mode, use the teaching platform of high and new technology, and strengthen the online and offline mixed teaching mode.

For various education teaching and the cultivation of talents under the new situation, we summarize the teaching experience, the teaching reform in the school related majors, based on the pertinence of teaching counselling information, implemented by combining traditional and modern technology, as well as achieve visualization, three-dimensional, adopting bilingual teaching guide, teaching model and online hybrid. It can carry out personalized classroom design, enhance teaching interaction, improve course evaluation, improve students' subjective initiative, and achieve better teaching effect. It is hoped that our teaching reform practice can provide a good help and inspiration to the relevant teachers and students, and provide a certain reference for the teaching of quantum mechanics and other relevant courses.

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