



A new team teaching mode in university physics teaching

Un nuevo modo de enseñanza en equipo en la física universitaria

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Abstract

This article, in terms of the characteristics of higher education popularized at present in China, puts forward a new team teaching mode in university physics teaching, in which two 'teachers' one of whom is a well prepared student teach together. Now some experimental results during the first stage in adopting the teaching mode in university physics teaching indicate that innovations in teaching mode are important in current university physics teaching reforms.

Key words: teaching mode; university physics; innovations; higher education.

Resumen

Este artículo, hace referencia a las características de la educación superior de la actualidad en China y muestra un nuevo modo de instrucción de la física universitaria en equipo con dos profesores de los cuales, uno es un estudiante bien preparado. Los resultados experimentales durante la primera fase de estos cambios en el modo aplicado de instrucción indican qué innovaciones presentadas son importantes para promover las reformas actuales en la enseñanza de la física universitaria.

Palabras clave: física universitaria, innovaciones, educación superior, enseñanza en equipo.

INTRODUCTION

As it was pointed out at the 23th Representative Assembly of the Association of the International Pure Physics and Applied Physics, "Physics, which studies substances, energy and their interactions, is an international business and is crucial to the human progress in future. It is important and necessary for all the nations in the world to support the study of physics education". Among all the courses of science and engineering, university physics, which is a basic course, can enrich the students' scientific knowledge and cultivate their scientific thinking, hence provides a foundation for their future studies in their specialties. In the history of science, numerous notable physicists have greatly contributed to human civilization. Their spirit of striving for science perseveringly and their ingenious ideas of designing experiments are the precious wealth of human beings to the future scientists and a great help to produce creative talents. But in the past few decades we have always been adopting the traditional teaching mode, one-teacher teaching mode in our teaching (LAFACI and RICHTER, 1970; SACCOMAN, 1996), and have got accustomed to arranging the book knowledge in good order, with the teacher dominating the whole class, explaining the contents of the course in great detail and the students sitting there listening attentively and taking notes all the time. The teachers tell the students in advance the difficulties in the textbook, which would cause any misunderstandings among the students. They often avoid mentioning the new things in modern physics, which they are afraid they cannot explain clearly and the students cannot understand well. Even when a discussion was occasionally carried out in class, only the teacher puts forward questions while the students just answer them passively. It is very difficult to produce a creative atmosphere in the one-teacher teaching mode, for in this teaching mode the students just develop a habit of reading their textbooks without much independent and creative thinking. Physics has become a course that drowns students in large amounts of formula. As a result, we have educated more students with relatively a lot of systemic textbook knowledge but without enough all-round quality, especially the scientific quality (WU, 2001). In research and exploitation, they are usually contented with copy or imitation only. Lacking in creative consciousness, they can hardly make any original and creative inventions. In the 1990's, Anderson (ANDERSON, 1989) emphasized the importance of team teaching mode again but at the same time he pointed out that the problem was that the authorities worried about cost while adopting this teaching mode. (BUCKLEY, 1999). This article, in terms of the characteristics of the popular higher education at present in China, analyzes the characteristics of the university physics education and points out that if the team teaching mode is applied

in an improved way, that is, if one teacher and one student teach together in a class, university physics will be taught and studied more efficiently and the education of university physics will certainly play a greater role in cultivating the students' scientific research ability and their creative ability and hence provide a greater motive force for the rapid development of the national economy.

A NEW TEAM TEACHING MODE AND ITS SUPPORTING THEORIES

In the last few years, the Department of University Physics of Nantong University has, according to the basic pedagogy theories and popular characteristics of higher education, reformed the traditional one-teacher teaching mode and has first tried applying a new team teaching mode. The theory supporting team teaching mode with two 'teachers' relates to 'Discovery Learning'. Generally speaking, 'Discovery Learning' requires that the teaching process should be divided into 4 steps (XU, 2001): (1) design a proper situation according to the content of the course and then explain the problem to be solved in the situation; (2) the students provide possible solutions or hypotheses through various activities (3) the possible solutions are tested through theories and practice (4) discover new theories (or new knowledge). The main advantage of the 'Discovery Learning' is the transfer of emotional factors well enough to uncover the students' intelligence potential and develop their independent study ability. Its main disadvantage is that it costs so much time that teaching doesn't seem to be so efficient. How to overcome its disadvantage? The reason for consuming much more time in this teaching mode is the obvious difference in knowledge and experimental ability that exists between the teacher and students in this teaching mode. The teacher has to spend much more time designing a situation of a problem before class and also extra time establishing such a situation in class. Therefore, we have been trying adopting a two-teacher teaching mode, in which a teacher and a well-prepared student teach together in class. Acting just as two TV hosts do in a TV talk-show program, they try to create a proper situation where the student-teacher or teacher assistant, asks the teacher questions. This encourages other students to ask questions one after another. In this way, the questions, which have been put forward, are exposed and answered with the over all knowledge of university physics. What's more, an inventive atmosphere is created and the students' thinking range is broadened. The teacher, the students-teacher, students or students' groups discuss the answers to the problems together in an active and creative atmosphere. In the process of trying to work out the problems together, different opinions between the teacher and the students will inevitably appear and even conflict with one another, which will improve the students' thinking quality, especially their innovative thinking quality. In the new team teaching mode, since the two 'teachers' are comparatively close on the level of knowledge and ability, it will be easier to develop a situation for the problem and the teaching efficiency may be increased. Here, the student-teacher also serves as a bridge between the teacher and the other students. The teacher, the student-teacher and all the students are equal in class. A student or a student group can go to the front of the classroom at any time to give his or their opinions and all the students are actively taking part in the heated discussion. As a result, the atmosphere in class is more light-hearted and the students are thinking more actively. In addition, the teacher and the student-teacher may design the teaching process beforehand and explore the problem. For this reason, the discussion is more fluent, and it will be easier to achieve the teaching aim. Moreover, because there are two 'teachers' in class, they can control the pace of the discussion and analyze the process more easily so that they attain liveliness rather than disorder. Because the problems put forward by the students are sometimes unexpected, it is a more demanding task for a teacher. Therefore teachers should keep on learning all the time to enrich their knowledge and adapt themselves to the new situations. A teacher is

still required to have enough courage to face the students who may ask any questions that the teacher himself can't answer. The key to innovation education is to train teachers' innovation spirit. We can cultivate a lot of young teachers with innovation spirit in the new team teaching mode quickly. In 2001, one of the young teachers who participated in this teaching reform won the second place prize in the second teaching contest on university physics of Jiangsu Province of China. In order to provide the teaching opportunity to more students and not to make it a burden to one student we arrange for a few students to be the student-teacher one by one. By preparing the lessons together with the teacher, the students get to know how much work a teacher has to do before class and how much knowledge a teacher should have in order to perform a good class. Thus they will work much harder to study physics well. The students have increased their interest in studying physics by participating in teaching.

THE APPLICATION OF THE NEW TEAM TEACHING MODE

Adopt the encouraging mechanism in the teaching mode

In order to develop students' innovative personality and their creative thinking, we needed to apply an encouraging mechanism in addition to a light-hearted and democratic atmosphere in class. In the new team teaching mode, we once tried to establish the prizes for amending mistakes, asking questions, competing and cooperating with others in order to arouse the students' creative desire. The prize for amending mistakes was to praise those students who pointed out the errors made by the teacher, in the reference books or in the text books so as to train the students' courage to challenge authority. The prize for asking questions was to praise those who ask more in class or ask better questions, especially to encourage the students to diverge their thought, to make the class teaching full of the color of scientific research. The prize for competition and cooperation is to praise those who positively participate in the competition and the cooperation with a group or a small class (30 students). Our practice in teaching indicates that the two-person teaching mode is more suitable to arouse the students' competitive and cooperative desire in a large-sized class (around 120 students) and to promote the exchange of different ideas among the students and activate the students' courage to challenge the authority (the teacher is the authority in class). Now our students have got rewarded with good scores. We think it may be better to set up a scholarship for each course in college. Under the great pressure of the exam oriented education, many teachers think that students are discouraged to speak out their different opinions from their teachers' in class, therefore they dare not practice any reform in teaching. Our experimental teaching proves that by introducing the two-teacher teaching mode and the encouraging mechanism in teaching, the teacher can arouse the students' creative enthusiasm which has almost vanished and can convert the disadvantages of the large-sized class teaching into the advantages for cooperation and competition which are the main source of different ideas. In applying this teaching mode, we got a great deal of useful and exciting first-hand data and examples. We were deeply touched by the students' great enthusiasm and strong curiosity. Our experiment showed, by adopting this teaching mode, not only can we improve the teaching efficiency and strengthen the students' self-educating migration ability. Also the students read more extensively and discover the problems from similar phenomenon.

Establish various research groups among students outside class to make their studies in and outside class facilitate mutually

Mr. YANG ZHENLIN, a Nobel prize winner, emphasized, when talking to the students on several occasions, that a person should not confine himself to a narrow domain, s/he should instead develop extensive interests and think independently. Extensive interests can make the students more sensitive to the new things in their studies and hence have new ideas instead of always following other people's examples. Scientific research is the most effective way to train students' creative consciousness and ability; therefore we organized such groups as an experiment fabrication group, as a creative forum group and as an academic article group in addition to class teaching. By establishing these groups, we can arouse students' interests in scientific study and research. In their group activities the students have to discover problems by themselves and solve the problems they have found with cooperation and independent thinking so that their studies both in and outside class can be promoted. Our practice indicates that the fresh-

man and sophomore can also do some scientific research. In the last few years, we cultivated students' interests in science consciously with the actual teaching condition of the university physics by using the two-person teaching mode. We tended to guide the students to do scientific research and have obtained satisfactory results. By adopting such teaching mode, our students have been able to do research on the problems appearing in the reference book, phenomenon in daily life, write the research papers and have applied for some patents, especially in 'Creative Contest in Jiangsu Province on University Physics in 2001', all our the students participating in this teaching reform got the prize, one of whom got the first prize.

REFORM THE MEASURE METHOD OF THE STUDYING EFFECT AND ADAPT TO THE REQUEST OF THE CREATIVE EDUCATION

While applying the new team teaching mode, it is particularly important for the teachers to establish a proper system to evaluate the students' studies, which is helpful to encourage students' innovation. The traditional assessment system which was static and the answer was unique for many years, can't meet the demand of quality education for it has no concrete way to encourage students' innovative ability. In evaluating the students' studies, we have done some reform mainly in two aspects: first, the traditional pure result evaluation is converted into a result evaluation *combined with* the process evaluation. Here the creative contributions and ability in the two-person teaching is an important part of a student's total score of university physics; Secondly, the 'spur' of the final examination is fully utilized. In order to enhance the test of the students' creative ability in final exam, we set out 20% additional subject, which had open answer, encouraging and acknowledging those excellent students in creative ability and innovative labor. In doing this, we probably can't cover all the book knowledge in the exam, give students all-round physics knowledge, but we can enable the students to obtain the knowledge by themselves. As the saying goes "To teach now aims at not teaching in the future".

Through the practice of the reformation on university physics teaching in last few years, we believe that it is essential to reform on the traditional university physics teaching content and particularly the teaching mode. The teacher's mission should not primarily be to help the students recite the large quantity of formula and axioms, but rather to help them discover problems and encourage them to look for the answers to the problems using their own initiative. Only in this way, will they have courage to break through the decided frame and to perform creatively in their future work!

CONCLUSIONS

1. If one teacher and one student teach together in a class, university physics will be taught and studied more efficiently and not increase any cost.
2. If the new "team teaching" mode is adopted, large class teaching (120 students) will be better for cultivating the creativity of students in competition and cooperation, the intercourse of kinds of ideas, and increasing their courage in challenging authority.
3. By preparing the lessons together with the teacher, the student-teacher get to know how much work a teacher has to do before class and how much knowledge a teacher should have in order to perform a good class. Thus they can comprehend better teachers' hardship and work much harder to study physics well.

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