

Combination of the Research-Based Learning Method with the Modern Physics Experiment Course Teaching

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Abstract

It has been the hotspot to reconstruct the education course based on the research-based learning in the course reform in many countries in recent years. The new course standard of China insists that the teaching is the interactive process that teachers and students communicate and develop together. In the teaching, the relationship between imparting knowledge and cultivating ability, and students' independence and self-determination should be emphasized, and teachers should lead students to doubt, survey, and search, and learn in the practice, and the learning should be the active and individual process under teachers' instruction. The exploring learning is just based on cultivating students' innovational spirit and practice ability. The research-based learning is introduced in the teaching of the modern physics experiment course, and this article mainly explores and attempts the concrete implementation and case design.

Keywords: Research-based learning, Modern physics experiment, Teaching quality

In recent years, to adapt the social development of China and the development of higher education, the expansion of university enrollment has cultivate more excellent talents for the society, which has expanded the scale of higher education, and enhance the overall national quality. But the problems which could not be neglected include that the common decrease of teaching quality, college student quality, basic knowledge, and learning, so it is the key to enhance the teaching quality and develop the teaching reform for the higher education of China and every college teacher, which could cultivate students' world view, strengthen students' ability of analyzing and solving problem, and cultivate students' exploring spirit and innovational consciousness. Combining with the practice of the modern physics experiment teaching, the actuality and problems in the modern physics experiment teaching are analyzed in this article, and many methods such as taking students as the main body, taking teachers as the main principle to enhance the teaching quality of modern physics experiment, and using the exploring learning to reform the modern physics experiment teaching are proposed. The basic concepts of the quality innovation and the research-based leaning are introduced, and the discussion of the research-based learning includes the research-based course theory (teacher teaching mode) and the research-based learning, which mean two directions. From the research-based course theory, the influence of the research-based physics experiment on the cultivation of college students' innovational quality will be discussed in this article. At present, the research-based course theory is widely used, and this article wants to provide a clearer concept and consecution of the quality innovation and the research-based learning to instruct the practice of the teaching of innovational education. At the same time, college students should learn more knowledge about this aspect, and prepare for establishing the innovational consciousness and implementing the innovational practice. In this article, the first chapter introduces some concepts about the innovational talent quality structure, discuss this special factor of the innovational talents' physiological quality, and dissertate that the college stage is the key term to cultivate talents' innovational quality. The second chapter discusses many basic concepts and knowledge such as the essential, the background, the meaning, and theoretical base of the research-based leaning. The third chapter introduces the connotation, the characters, and the subject source, and analyzes and explains the relative content of the college research-based physics experiment in one course survey report. The fourth chapter comprehensively discusses the influence of the college research-based physics experiment on the college students' innovational quality cultivation in detail, including the influence and function of innovational consciousness, innovational psychological quality, innovational ability, and innovational knowledge structure. Combining with the course survey report of the third chapter, this article also proves that the research-based physics experiment is the most effective teaching method and learning method to cultivate students' innovational quality.

1. Content improvement of the modern physics experiment teaching

Through many times teaching reform, though the teaching content of the modern physics experiment has been changed, and new contents occurred in the teaching material, but it still continues to use the old teaching outline, and there are still many disadvantages.

(1) The teaching content of the modern physics experiment contains the link between the college physics course and the high school teaching materials, for example, many contents such as the angle momentum, the rigid body, the narrow relativity, and the quantum mechanics are new contents, but their most contents have been taught in the stage of middle school, so in the teaching, teachers should avoid unnecessary repeat with the teaching range of high school physics.

(2) The teaching content of the modern physics experiment should emphasize particularly on the requirements of the mainstream specialty of the university. Physics is the base of other natural sciences and engineering technologies, and the content of the modern physics experiment course should emphasize particularly on the mainstream specialty of the concrete university, and establish good base for students' further learning.

(3) Because of limited hours, the modern physics in the college physics course should not too occupy the proportion for some half-classic contents. For example, the Bohr atom model is the certain examination content for some university each year, and as the creation and development of the quantum mechanics and the deepening course that people understand the matter structure, this model could enlighten students' innovational thinking and exploring spirit, but this knowledge only needs to be known by students. Furthermore, the classic orbit concept should not be taught profoundly for students, because they will feel very abstract and difficult to understand the description of particle status by the wave function and the Schrodinger equation. The modern physics part including the physical concept and rules in the college physics course is not necessary to be instructed according to the course that people cognize the natural rule.

2. Optimizing the modern physics experiment teaching methods by the exploring learning

To train students' scientific thinking and cultivate students' ability of analyzing and solving problems, teachers should aim at different teaching contents, utilize students' existing knowledge, propose feasible discussion topics, lead students to think independently, and deeply dig the contents in the teaching materials which are fit for elicitation and discussion. First, teachers should lead students to analysis and discuss various physical quantities in various processes. Second, teachers should require students to summarize and induce the differential coefficient forms and the integral forms in various processes. Third, the result of the former two steps is applied to solve responding questions. After above processes end, one student in each group is selected to narrate the solution of the exercise in this group. The homework of this discussion course could be the analysis and induction for students themselves, and in next course, teachers need to emphasize and simply explain the emphases and difficulties about the homework.

Sometimes, teacher should propose a proper topic to lead students to consult materials with questions before the former modern physics experiment ends, and receive students' answers after class, that could not only promote students to listen the course and actively consult materials, cultivate students' abilities such as analysis, summarization, induction, analogy, and association, but also lead students to cognize the balanced and symmetrical aesthetical characters in physics, and teach students to appreciate and dig the interior rules of the science by the aesthetical view, and gradually strengthen their independent ability of grasp the rules of science and nature.

3. Adopting multiple research-based teaching measures to enhance students' enthusiasm of learning the modern physics experiment

(1) Teachers should effectively utilize multiple teaching measures such as multi-media technology to breach bald and single teaching mode. According to relative teaching practice, the visual and simple CAI courseware could stimulate students' sense and feeling for multiple angles such as vision and hearing, and virtually strengthen students' ability to accept information, which could have unmatched advantages comparing with other subjects in the teaching of modern physics experiment, and compensate the disadvantages of the teaching experiment equipments in some occasions, and show some demonstration experiments for students. In the modern physics experiment teaching, the courseware of CAI could effectively visualize abundant and colorful contents of college physics, and more effectively make students to grasp the emphases in the teaching, and understand the knowledge difficulties.

In modern physics experiment, many principles, concepts, processes, and phenomena are abstract, and students are hard to understand, they often feel difficult and bold for physics, and lose interests and confidence, which will largely influence the teaching effect of college physics. The CAI courseware based on the multi-media technology could concretize abstract problems, and randomly prolong or shorten transient process, even randomly fix the process, and gradually decompose the complex process into simple processes, and visually express the content which is difficult to describe by the charts. For example, many concepts such as the wave interference, and the time delay in the narrow relativity were difficulties for students to understand in the past, and the CAI courseware could dynamically display these concepts by the charts for students who could easily understand them, which could

largely enhance students' interests to study physics and receive better effect.

For some key points in modern physics experiment, teachers can propose some questions first and let students to think, discuss, and answer, and then give right answers, so the interaction between teachers and students could form. In thus teaching process, teachers' dominant function could be fully exerted. At the same time, the efficiency will be enhanced because of the application of the research-based learning method, and students' learning enthusiasm could be fully aroused.

(2) In recent years, most colleges increased the investment of the demonstration laboratory, and teachers should fully utilize the demonstration experiment to change the depressive atmosphere of the classroom and students' passive learning state, and lead students to deeply think and analyze problems, and participate in the classroom teaching. According to the teaching content, proper demonstration experiment could be selected for teachers or students, and students could require students to predict the result of the experiment, and ask students to analyze the experiment principle by the experiment result, and further enlighten students' innovational thinking, and encourage them to design the experiment themselves.

4. Influence and function of the research-based learning modern physics experiment on the cultivation of college students' innovational quality

In the background of the international teaching reform, the exploring learning of the modern physics experiment has been the important part of the college physics course. Based on large numerous of relative literatures, the exploring learning research of modern physics is the research combining theory and practice based on the teaching reform practice of China. Based on the survey of teachers and students, the actuality of the exploring learning teaching is studied. On the one hand, based on the research literatures about the teaching exploring learning, the connotation and meaning of the teaching exploring learning are confirmed. On the other hand, combining with the physics, the exploring learning cases of the modern physics are analyzed and discussed, and based on that, the strategies of the teaching exploring learning is further studied. The teaching exploring learning should exert students' learning potential according to students' psychological characters and the rules of the physics research, and embody students' enthusiasm of learning, and by teachers' organization and guidance, based on the situation and approach required to solve the teaching problems, students should fully utilize various physics method to explore the course resources, and collect and research relative information by the practical operation experiment, the physics idea experiment, the data statistics analysis, and the information technology experiment, and students propose research questions and form suspects, and utilize the special case to validate the experiment, experience the process including teaching concept, topic forming and deduction, and experience the generation, solution, and application of physics problems, and further understand the spirit and thinking method of the teaching research, and primarily from the innovational consciousness of teaching, and taste the scientific value, the application value, the human value, and the aesthetic value of the modern physics, and the meaning of teaching exploring learning. The teaching exploring learning is the necessary road to help students obtain concealed knowledge and perfect the personality, and it could establish the platform for students' psychological requirements and fulfill students' interior satisfaction. The teaching exploring learning is also the entrance that the school goes to the opening from the closed state, and it could further cultivate students' innovational consciousness. When implementing the theoretical research of the teaching exploring learning, the analysis and discussion of the teaching exploring learning lesson should be analyzed and discussed. The start of the learning exploring learning is questions. In the exploring learning of the modern physics experiment, the situation of discovering and proposing questions should be established for students, and the situation should help students to propose the exploring questions of modern physics experiment. In the process of solving questions, students' innovational thinking and scientific quality of analyzing and solving problems should be cultivated.

Based on above researches, in various parts including the teaching content, method, and measures, students should be the main body in the teaching of the modern physics experiment, and teachers should exert the dominant function. But how teachers exert the dominant function? In recent years, the college physics teaching is always advocated to avoid the exam-oriented education and emphasize the cultivation of students' knowledge, ability, and quality. But it is hard to achieve, and one cause which should not be neglected is that most teachers were cultivated in the mode of the exam-oriented education, and except for individuals, most teachers are confused for concrete measures of the ability cultivation and quality education. On the one hand, domestic and foreign advanced experiences should be used for references, and teachers should seriously think that how to realize this cultivation target, how to exert their dominant function, how to stimulate students' learning enthusiasm, and how to lead students to study independently. On the other hand, the teaching materials should be studied seriously, and the part about the ability cultivation and the quality cultivation should be fully dug, and teachers should continually improve the teaching method and measures to enhance the teaching quality of the modern physics experiment and further develop the teaching reform.

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