Analyzing the effective application of inquiry-based teaching in biology teaching in universities

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Abstract. Inquiry-based teaching is an interactive teaching mode that is highly respected in the international community, which integrates teachers' teaching and students' research learning, and is characterized by research and innovation. In this paper, the connotation of inquiry teaching mode and the necessity of teaching are elaborated, and how to use inquiry teaching mode in biology teaching in universities is discussed in depth, which is of great significance to improve the level of teaching in colleges and universities and to cultivate high-level innovative and applied talents.

Keywords: inquiry-based teaching, biology, universities.

1. Introduction

On May 29, 2023, General Secretary Xi Jinping, while presiding over the fifth collective study of the Political Bureau of the 20th Central Committee on the construction of a strong educational country, emphasized that the construction of a strong educational country is a strategic precursor to the comprehensive completion of a strong socialist modernization, and that the leading role in the construction of a strong educational country is higher education. Under the background of "double first-class" construction, in order to cultivate innovative biological talents and meet the needs of social development, universities continue to improve their scientific research capacity, pay attention to the level of teaching management, and constantly explore the reform of teaching mode. Inquiry teaching is a kind of teacher-student interactive teaching mode, which takes the problem as the starting point, takes the students as the center, and stimulates the students' subjective consciousness and cooperative consciousness under the guidance of the teachers [1,2], and ultimately achieves the cultivation of the students' ability to think about the problem, analyze the problem, and solve the problem, and then cultivates the students' biological thinking mode.

2. The connotation of inquiry-based teaching mode

The idea of inquiry-based teaching method originated from Socrates more than 400 years B.C. Until 1962, it was formally established as a scientific teaching method by Schwab [3,4], which laid a solid foundation for the application of inquiry-based teaching method, and since then many countries have experimented with and applied the inquiry-based teaching method to organize teaching.

Inquiry-based teaching method is through the creation of problem situations, put forward hypotheses, analysis and discussion, stimulate the students' sense of subjectivity and sense of cooperation, so that students solve problems through their own efforts. In this process, students can experience their own sense of accomplishment in solving problems and cooperative learning to bring a good classroom atmosphere, which invariably increases students' interest in learning and motivation, and then to achieve the purpose of promoting the mastery of skills. Inquiry-based teaching reflects the principle of human-centered subjectivity, further interpreting the students are the main body of teaching, and teachers are the guides of student learning.
3. biology teaching in colleges and universities

Traditional teaching is teacher-centered, the transmission of teaching content is one-way, students lack of practical experience in the learning process, memory-based understanding, lack of innovation [5]. This leads teachers to deviate from the requirements of the core literacy of biology teaching in the whole teaching process, that is, they can not achieve the purpose of cultivating students with biological learning ability, scientific inquiry thinking and experimental manipulation ability, and it is difficult to adapt to the needs of the new era of teaching with the goal of cultivating innovative and applied talents.

According to the source of the inquiry question and the characteristics of the inquiry process, inquiry learning can be divided into four types: information-based inquiry, history of science inquiry, experimental inquiry and investigative inquiry. Data-based inquiry and history of science inquiry do not require students to operate, focusing on the cultivation and training of students' scientific literacy and scientific thinking; while experimental inquiry and investigative inquiry require students to operate, focusing on the promotion and enhancement of the spirit of cooperation and the ability of students to conduct independent investigations[6]. Inquiry-based teaching emphasizes students' independent learning and cooperative inquiry under the guidance of teachers, which fully embodies the student as the main body[2]. This model helps students to improve their inquiry skills and innovation ability while solving problems and acquiring knowledge, making learning more efficient. Therefore, university teachers should not only think deeply about teaching phenomena and problems in teaching, but also transform the reticent practical knowledge into teaching theory to serve teaching[7]. Diversified inquiry activities can comprehensively and effectively promote the achievement of students' core literacy.

4. The application of inquiry-based teaching mode

4.1 Transform the mode of instruction, guide students to independent inquiry

From the teachers' point of view, teachers should change their thinking and reform the mode of teaching. Teaching activities should be "student-centered" scientific design, closely around the teaching objectives and carry out, so that the center of education from the object to the subject of the transfer of education from the "selection of students suitable for education" to "make education suitable for students" on[8]. Make education suitable for students" up[8]. The role of the teacher should be changed, no longer nanny-style teaching, but mentor-style teaching. In the classroom, teachers should give students more opportunities to think, stimulate students' desire to explore, and master more knowledge in a limited time.

From the students' point of view, the development of human beings should not only be comprehensive development but also common development, "so that every student has progress" is the core value orientation of inquiry-based teaching, and the participation of all is a characteristic of inquiry-based teaching. The process of inquiry teaching is carried out in the form of cooperative groups, in accordance with the principle of "group homogeneity, group heterogeneity" for grouping, but also the proportion of male and female students should be coordinated, on the one hand, to eliminate the impact of gender differences on the process of inquiry, to avoid disparities between boys and girls, on the other hand, to prevent the "Matthew effect", to eliminate the "Matthew effect", to eliminate the "Matthew effect". Matthew effect, eliminating polarization[9]. Only when the individual differences of all students are recognized and respected will there be full participation in the true sense of the word, and all students will have the opportunity to improve their bioscience literacy.

Teaching modes can be diversified, such as case teaching, classroom questioning, literature review, survey visits, special lectures, and subject research. Teaching can be done in class or after class. Different strategies should be adopted for different levels of inquiry. Inquiry teaching with a
topic or project as a task should be carried out in the form of a project, scientific research methods and requirements; other forms of inquiry such as case studies, etc., are created by the teacher to solve the problem with classroom inquiry-based teaching[2]. Inquiry teaching motivates teachers to change their teaching ideas, guides students to discover and study problems, effectively improves the quality of biology classroom teaching in colleges and universities, and then promotes the teaching reform of biology in schools.

In the teaching of Mendel's Laws of Heredity in Genetics, teachers can teach by asking questions and creating situations to stimulate students' interest in learning and introduce new lessons[10]. For example, teachers can introduce students to the situation: both parents have double eyelids, why is the child single eyelid? Lead students to observe, speculate, and generalize to activate students' thinking. The process guides students to think independently, which not only guarantees the main position of students' learning, achieves the understanding of knowledge, but also helps students to apply knowledge to practice and improve their problem-solving ability.

4.2 Emphasize on experimental teaching and promote students' cooperative inquiry

Biology experiment is a powerful supplement to theoretical knowledge, not only emphasizes the necessity of experimental investigation, but also teaches students to scientifically investigate biological knowledge and develop good habits of inquiry from the perspective of living, visualization and concretization[11]. Today's era requires us to cultivate students who not only have solid basic theories, but also have strong experimental skills and innovative spirit.

Students explore the topic, design and simulate the scientist's experiments, think and solve the problems in the experiments, and effectively cultivate students' scientific inquiry thinking. Designing experiments to prove that phosphorus is an essential element for plants. This kind of experiment not only requires students to use a variety of knowledge and experimental principles to design experimental programs, but also requires students to use their existing knowledge to find problems, analyze problems and solve problems. For example, the induction and identification of plant polyploidy, students can be guided to consult the information to design experimental methods, designed by the teacher to determine whether to implement the experimental methods. Let students take the initiative to participate in the whole process of experiments, that is, from the configuration of reagents, materials, equipment, preparation and debugging work, and then guide the analysis of the experimental results, summarize the completion of the experimental report, in order to stimulate the students' interest in experiments, and to cultivate a good scientific research thinking and methodology.

4.3 Scientific research feeds teaching and cultivates students' innovative thinking

Teaching and scientific research have always been interdependent and mutually reinforcing, and are the two pillars of talent cultivation in colleges and universities[12]. Scientific frontier problems and scientific research results in this field are introduced into the classroom in the form of case teaching, special lectures or subject research, which are shared with students and discussed in the classroom to cultivate students' scientific research consciousness and innovation ability.

Famous experts and academic leaders are invited to go to the podium and communicate and interact with students in classrooms, scientific research bases and other venues where classes are held through group discussions, cognitive experiences and other ways to stimulate students' thirst for knowledge and interest, and to guide them to discernment, discovery, evidence-seeking and innovation[13].

4.4 "Internet +" inquiry-based teaching mode

The application of "Internet +" technology in modern education reform is becoming more and more mature, which requires teachers to improve the traditional teaching methods and create a space for students to learn independently and cooperate and explore. As an extension of classroom
teaching, Internet teaching expands students' knowledge, increases the capacity of teaching, and improves students' interest in learning[2,5].

The use of information technology teaching means to enrich the teaching classroom, teachers in the teaching design and teaching preparation stage, through the network platform to expand the teaching content, respect the student's subjective position, and take the initiative to absorb the opinions and ideas of students. In the choice of teaching content, the combination of sound, image and network materials can be used to create an interactive multimedia teaching scene, making biology teaching more vivid, interesting and effective. In the preparation stage, modern information technology is used to make PPT, and real and effective data materials are used to improve the biology classroom and experimental training program, to stimulate students' interest in learning, to cultivate students' good learning habits, and to make students experience the fun of knowledge transformation in the learning process. Through the application of modern information technology, students are able to ask teachers for advice anytime and anywhere, guiding students to turn passive learning into active learning; through the introduction of microclasses, catechism and other pedagogical methods, students are able to realize independent extracurricular learning. Teachers use cell phone software and network classroom APP to establish learning exchange groups, set up inquiry topics around the teaching theme, divide students into multiple learning groups to discuss the topics together, so that students can participate in the practical exploration to create a good learning environment.

Many colleges and universities are equipped with virtual simulation laboratories, which effectively solve the problems of colleges and universities in terms of experimental equipment, space, time, etc., make up for the shortcomings in the teaching of production practice, and greatly promote the improvement of the level of production practice teaching[14]. Virtual simulation experiments can realize inquiry-based experimental teaching, students can not only carry out independent material selection for the upcoming experiments, and in the process of operation, they are also able to carry out multiple experiments through their own understanding, but also be able to explore and understand the knowledge in multiple experiments, which enriches the breadth and depth of the content of practical teaching, stimulates students' interest in learning, and enhances their hands-on ability and thinking ability[15,16].

5. Conclusion

Inquiry-based teaching mode is a teaching mode in which teaching activities are problem-centered and students learn through discovering problems, analyzing problems, proposing solutions and solving problems under the guidance of teachers. It pays more attention to the students' personal experience in the learning process, and can transfer the knowledge, emotions and methods obtained in the inquiry process to the real life to solve real problems. The application of inquiry-based teaching method fully mobilizes students' enthusiasm and initiative in learning, enhances students' knowledge application ability, cultivates students' biological literacy, and lays a solid foundation for their subsequent development. At the same time, inquiry-based teaching promotes teacher-student interaction and communication, which greatly enhances the effect of biology teaching.

References


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