Exploration of Modern Educational Technology Application Experiment Class Based on Ability Cultivation —— Taking "Plant Physiology and Biochemical Experiment" as a Teaching Case

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Abstract: The aim of this study is to investigate the integration of contemporary educational technology into the "Plant Physiology and Biochemical Experiment" course and its subsequent impact on student skill development. Through the introduction of advanced educational tools, we seek to overcome the constraints inherent in traditional experimental teaching methods, thereby enhancing students' practical, innovative, and critical thinking skills. To this end, we have incorporated various modern technologies such as multimedia presentations, online learning platforms, and virtual reality into the course curriculum. By devising and executing a teaching plan centered around these technologies, we conducted a comparative analysis of student performance between an experimental group and a control group. Our findings reveal notable improvements in the experimental group's laboratory skills, data interpretation, problem-solving abilities, and teamwork. This not only underscores the benefits of modern educational technology in practical teaching but also offers valuable insights for reforming the "Plant Physiology and Biochemical Experiment" course.

1. Introduction

With the steady advancement of science and technology, modern educational tools are evolving rapidly, presenting fresh opportunities in the realm of education [1]. These educational technologies are trending towards diversity, interaction, and smart capabilities [2]. Elements like multimedia resources, online learning platforms, and immersive technologies such as virtual reality (VR) and augmented reality (AR) are seamlessly integrating into education, enhancing the learning experience for students with richer and more intuitive content [3]. This technological evolution has revolutionized conventional teaching methods, boosting students' engagement and learning efficiency [4].

"Plant Physiology and Biochemical Experiment" stands as a complex, hands-on course, demanding that students grasp not just theoretical concepts but also experimental techniques and data interpretation skills [5]. Traditional lab teaching, however, is often constrained by experimental conditions and time limits, impeding students' autonomy and creativity [6]. Additionally, integrating theory with practical application to enhance students' overall proficiency remains a significant challenge.

In the context of the "Plant Physiology and Biochemical Experiment" course, several obstacles hinder skill development: firstly, experimental conditions are limited, preventing adequate practical experience for students; secondly, the rigid traditional teaching approach restricts the cultivation of students' innovation and critical thinking; thirdly, an imperfect curriculum evaluation system fails to accurately assess students' comprehensive abilities. This study aims to investigate the utilization of modern educational technology in practical classrooms, specifically focusing on the "Plant Physiology and Biochemical Experiment" as a case study, to analyze its potential in fostering students' skill development.

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2. The theoretical basis of modern educational technology and ability training

2.1. The theoretical basis of modern educational technology

Modern educational technology is based on the theories of many disciplines, including but not limited to pedagogy, psychology, computer science and communication [7]. Its core theory lies in using advanced technical tools and teaching methods to optimize the teaching process and improve students' learning effect. Constructivism learning theory, multiple intelligences theory and human-computer interaction theory are all important supports of modern educational technology [8]. These theories emphasize student-centered, stimulate students' interest in learning through technical means, and promote their active exploration and learning.

2.2. Educational concept of ability training

The educational philosophy of ability training underscores the comprehensive growth of learners, extending beyond mere knowledge impartation to enhancing multiple skillsets [9]. This approach asserts that education must strive to foster learners' self-directed learning, analytical thinking, collaborative skills, and innovative capabilities, aligning with future societal demands. Guided by this framework, teaching evolves from being a unilateral transfer of knowledge to a dynamic, interactive process involving teachers and learners, encouraging collective exploration and problem-solving.

2.3. "Plant Physiological and Biochemical Experiments" and the combination of capacity-building

The course "Plant Physiology and Biochemical Experiment" itself has the characteristics of strong practicality and rich knowledge points, which is very suitable as a carrier for ability training. Through experimental operation, students can exercise their hands-on ability, observation ability and data analysis ability. Simultaneously, resolving problems and collaborating during the experimental process can significantly enhance students' innovative thinking and cooperative skills. Incorporating contemporary educational technology into this course offers students a more intuitive and interactive educational setting, thereby more efficiently attaining the objective of skills training.

3. Teaching case analysis of "Plant Physiological and Biochemical Experiment"

3.1. Teaching case selection and experimental design

When choosing teaching cases, this article mainly considers the representativeness, practicability and operability of the cases. Several key experiments in the course of "Plant Physiology and Biochemical Experiment" are selected as the research objects. These experiments not only contain basic theoretical knowledge, but also have certain challenges, which can fully test students' ability. The subjects are students majoring in life sciences, who have a certain biological foundation and are suitable for this study.

In this article, a control experiment was designed, and the students who participated in the experiment were randomly divided into two groups. One group adopts traditional teaching methods for experimental teaching, while the other group introduces modern educational technology for auxiliary teaching. During the implementation of the experiment, we recorded the learning process, experimental operation and experimental results of the two groups of students in detail, so as to make a comparative analysis of the teaching effect in the future.

3.2. The application of modern educational technology in this case

In this instance, we employ a diverse range of modern educational technology tools and platforms, such as multimedia teaching software, online education platforms, and VR technology, among others. These resources offer students an interactive learning environment with abundant learning materials, thereby boosting their learning interest and enhancing their learning outcomes.

During the teaching process, we utilize multimedia teaching software to illustrate experimental principles and procedural steps, enabling students to grasp the experimental content more intuitively.

Simultaneously, we encourage students to engage in autonomous learning and discussions via the online education platform, fostering their self-directed learning capabilities. In addition, we also try to use virtual reality technology to simulate the experimental operation, so that students can practice the experimental operation in the virtual environment and improve their experimental operation ability.

3.3. Teaching effect evaluation and student feedback

To assess the teaching effectiveness holistically, this study employs a mixed-method approach combining quantitative and qualitative evaluations. For the quantitative aspect, a comparison was made between the experimental outcomes and practical skills of two student groups. For the qualitative assessment, we observed students' learning progress and analyzed their experimental reports to discern improvements in their abilities. Detailed findings are presented in Tables 1 and 2.

Table 1 Comparison of quantitative evaluation results

Evaluation index	Experimental group	Control group	Promotion percentage
Average experimental results	85.3	76.8	+11.1%
Operational ability test score	90.2	81.5	+10.7%
Data analysis ability test score	87.6	79.3	+10.5%
Experimental report quality score	8.5/10	7.2/10	+18.1%
Time required to complete the experiment	120 minutes	150 minutes	-20%

Table 2 Qualitative evaluation of capacity improvement

Promotion	Evaluation description	Assessment result
Mastery of experimental skills	Improvement of proficiency and accuracy	Remarkable improvement
Problem analysis and solution	Analyze the depth of the problem and the ability to solve it.	Significantly improve
Team cooperation ability	Improvement of teamwork and communication skills	Significantly enhanced
Creative thinking	Proposition and application of new ideas and methods	Get obvious excitation
Learning interest and motivation	Interest and learning motivation in experimental courses	Greatly improve

After the experiment, this article collected students' feedback on the teaching process. Through questionnaires and interviews, we learned students' views and suggestions on the application of modern educational technology in the course of "Plant Physiology and Biochemical Experiment", as shown in Table 3.

Table 3 Students' feedback on the teaching process

Feedback content	Very satisfied (%)	Satisfied (%)	General (%)	Not satisfied (%)
Application effect of modern educational technology	45	35	15	5
Interaction in the process of experimental teaching	40	38	17	5
The help of modern educational technology to understand the experimental content	50	37	10	3
Auxiliary effect on experimental operation	42	38	16	4
I hope to increase the use of modern educational technology.	35	45	15	5
Overall satisfaction with teaching methods	48	40	10	2

These feedbacks provide a useful reference for us to further optimize the teaching plan.

4. Analysis and discussion on the effect of the application of modern educational technology

4.1. Analysis of ability improvement

Upon comparing the performance of students in the experimental and control groups, it becomes evident that the experimental group demonstrates superior skills in numerous areas. Primarily, with regards to experimental proficiency, students in the experimental group, aided by modern educational technology, grasp experimental procedures and techniques with greater precision, exhibiting more adept and exact manipulations during the experiment. Furthermore, these students also display an elevated proficiency in data analysis and problem-solving. They can process the experimental data more quickly, find out the problem accurately and propose effective solutions. In addition, in terms of teamwork and communication skills, the students in the experimental group also showed a stronger spirit of cooperation and were able to cooperate with team members more effectively and accomplish tasks together.

4.2. Challenges and opportunities in the application of modern educational technology

Although modern educational technology has shown remarkable effects in experimental teaching, it also faces some challenges in its application. For example, with the rapid updating of technology, teachers need to constantly learn and master new technologies, which brings them some pressure. At the same time, some students have different acceptance of new technology, which may also lead to different teaching effects.

However, modern educational technology has presented unprecedented opportunities as well. It offers students an abundance of intuitive learning resources, thereby piquing their interest in learning. Simultaneously, teachers can leverage technology to streamline teaching activities and enhance teaching efficiency. Furthermore, modern educational technology aids in fostering students' self-directed learning skills, paving a strong foundation for their future progress.

4.3. Enlightenment and suggestions for future teaching

Based on the results of this study, this article puts forward the following suggestions for future teaching: ① Teachers should actively embrace modern educational technology and constantly improve their technical literacy in order to make better use of technology-assisted teaching. ② Schools should increase investment in modern educational technology, provide necessary technical support and training, and create a good teaching environment for teachers. ③ To maximize teaching effectiveness, teachers ought to utilize modern educational technology in a flexible manner, tailored to students' specific situations and curriculum requirements.

5. Ideas on the improvement of the course "Plant Physiology and Biochemical Experiment"

Based on the results of this study, this article puts forward the following ideas for the improvement of the course of "Plant Physiology and Biochemical Experiment": ① The application scope and depth of modern educational technology can be further increased, such as introducing more advanced virtual reality and simulation experiment technology to provide richer and more real experimental experience. ② We can strengthen the connection between curriculum and practical application, and provide more practical opportunities and career development guidance for students through cooperation with enterprises or research institutions. ③ We should continue to pay attention to students' learning needs and feedback, and adjust teaching strategies and contents in time to ensure that the course always keeps pace with students' learning needs.

6. Conclusions

Through empirical analysis, this study discovered that the integration of modern educational technology into the "Plant Physiology and Biochemical Experiment" course notably enhanced students' skills in experimental operations, data analysis, problem-solving, and team collaboration. This improvement is evident not just in the higher scores achieved by the experimental group, but

also in their more engaged learning attitude and stronger motivation to practice. The findings support the hypothesis that modern educational technology can considerably boost students' capabilities in experimental learning environments. By contrasting the performance of the experimental and control groups, this article reveals that students in the experimental group exhibited superior abilities in multiple areas, thereby affirming the validity of the research hypothesis.

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