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The Application and Practice of Bloom's Questioning Method in Deep Learning of College Biology Education

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Abstract: This paper aims to explore the application of Bloom's questioning method in college biology education. The Bloom teaching method has a wide range of applications in education. Bloom's questioning method is a teaching method based on cognitive goals, aimed at promoting students' deep learning and thinking development. In biology education, this method can be exercised and applied through continuous practice. The Bloom teaching method emphasizes the organic combination of cognitive goals, learning stages, and evaluation methods, aiming to promote students' deep learning and critical thinking. Through a case study of using Bloom's questioning method on soil phosphatase teaching, we can know how to practice students to question and learn actively. Thus, students can use this method to learn other contents. Thus, inspire the inner identification of students and reach a satisfactory teaching effects.

Keywords: Bloom's questioning method; Biology education; Deep learning

1. Introduction

As an important component of the higher education process, biology education and teaching in universities play an indispensable part in talent education. With the continuous development of biology education and teaching in universities, more and more people choose to study biology as their major. Therefore, the requirements for biology education and teaching in universities are gradually increasing. Although the forms of biology education and teaching in universities are gradually diversified, problems hinder the development and deepening of biology education and teaching activities in universities still exist.

The Bloom questioning method provides an innovative approach to education that emphasizes students' active participation, thinking, and creativity, thereby achieving more effective learning. The core principles of Bloom's teaching method include setting cognitive goals, designing learning stages, and applying multi-level assessments.

2. Problems in the deep learning of biology education in modern universities

2.1 Deep learning has not yet formed a system

With the higher demands placed on educational activities and students' learning outcomes in modern society, how to cultivate students' abilities of self-directed learning, deep understanding, dialectical thinking, reverse thinking, transfer, application, evaluation, and creation in learning is attracting people's attention. Thus, college biology education should change teaching ideas.

2.2 The reform of teaching methods is too fast

Asking questions is a good way to stimulate students' thinking, in order to avoid cramming education. Some people simply understand and reflect the reform of deep teaching concepts as a change in teaching methods thus some classrooms have changed the cramming education to full classroom questioning. Such a series of problems result in insufficient time and space for students to think independently, making it difficult to achieve deep digestion of knowledge, and improving their thinking ability to become true learners.

2.3 The combination of teaching methods and courses is too rigid

At present, some universities' teaching reforms are aimed at reform, without a deep integration of course content and teaching methods. In the process of talent cultivation, teachers are still the main focus, failing to reflect the cultivation of students' independent learning and innovation awareness. As a result, students only study to complete course exams, and pay too much attention to grades, relatively neglecting students' hands-on, practical abilities, and knowledge transfer and application abilities.

3. The application of Bloom's questioning method on college biology education

3.1 Cognition and grading of Bloom's teaching method

Benjamin Bloom, an educational psychologist in the United States, believes that if teachers can ask more critical questions, it will help improve students' knowledge and skills. The Bloom teaching method divides the learning process into different cognitive levels, including six levels: knowledge, comprehension, application, analysis, evaluation and creation (Table 1) [1]. Teachers design teaching activities and evaluation methods through clear learning objectives, guiding students to engage in deep learning at each level, in order to encourage students to engage in deep thinking and learning at different levels [2]. Through this approach, students are not only passively receiving information, but also encouraged to actively ask, discuss, and solve problems in the classroom.

Table 1. Dimensional indicators and specific description of Bloom's taxonomy

Cognitive Objectives	Primary Dimension	Secondary Dimension	Specific Description
Low-Level Cognitive Levels	1 Knowledge	1.1 Recognition	Being able to evoke experiences and memories when encountering learned content
		1.2 Recall	Accurately recalling relevant knowledge when encountering learned content
	2 Comprehension	2.1 Explain	Transforming from one representation to another
		2.2 Illustrate	Finding specific examples to illustrate concepts or principles
		2.3 Classify	Determining that something belongs to a specific category
		2.4 Summarize	Generalizing the main themes and key points
		2.5 Infer	Making predictions or judgments based on patterns or logical reasoning in existing content
		2.6 Compare	Identifying similarities and differences between two perspectives, objects, or similar entities
		2.7 Elaborate	Constructing a causal model diagram
	3 Application	3.1 Execute	Proficiently applying a method or procedure to complete similar tasks
		3.2 Implement	Choosing and applying a procedure to complete an unfamiliar task
High-Level Cognitive Levels	4 Analysis	4.1 Differentiate	Distinguishing between irrelevant or unimportant and relevant or important parts within existing material
		4.2 Organize	Clarifying how various parts within a system or framework operate and interact
		4.3 Attribute	Identifying implied meanings or elements
	5 Evaluation	5.1 Verify	Assessing the rationality and scientific validity of a process operation
		5.2 Judge	Evaluating the accuracy of results and identifying errors or contradictions in the process, and providing appropriate new processes
	6 Creation	6.1 Creation	Generating multiple hypotheses that can be chosen based on criteria
		6.2 Plan	Designing a program or scheme for an unfinished task
		6.3 Produce	Inventing a product

3.2 Application cases of Bloom's questioning method in biology education curriculum

Soil enzymes are major proteins produced by microorganisms, plants, and animals that play a key role in numerous important soil processes. They catalyze biochemical reactions that are essential for nutrient cycling, organic matter decomposition, and overall soil health. Take soil phosphatase as an example to demonstrate the use of Bloom's questioning method.

3.2.1 Knowledge Level

At this level, questions can focus on understanding the basic concepts related to soil phosphatase, such as what it is, the importance of phosphatase in nutrient cycling, and its role in plant nutrition.

Example questions:

What is soil phosphatase?

Why is phosphatase important in nutrient cycling?

How does phosphatase contribute to plant nutrition?

3.2.2 Comprehension Level

This level involves questions that assess the ability to interpret and explain the functions and mechanisms of soil phosphatase.

Example questions:

How does soil phosphatase break down organic phosphate compounds?

Explain the relationship between phosphatase activity and phosphorus availability in soils.

3.2.3 Application Level

Application Level: Questions can be designed to apply knowledge of soil phosphatase to solve practical problems or analyze real-world scenarios.

Example questions:

How can soil phosphatase activity be an indicator of soil fertility?

How can farmers manipulate soil phosphatase activity to improve phosphorus availability in their soil?

How can we estimate phosphatase activity to be highest or lowest?

3.2.4 Analysis Level

Analysis Level: Questions at this level prompt students to analyze data or information related to soil phosphatase activity and draw conclusions.

Example questions:

Given a dataset of soil phosphatase activity from different soil samples and analyze the potential influencing factors.

Compare and contrast the effects of different environmental factors (e.g., temperature, moisture, substrate availability) on soil phosphatase activity.

Evaluate the potential impact agricultural management or pollution on soil phosphatase activity.

3.2.5 Evaluation Level

Evaluation Level: Questions can assess the ability to critically evaluate research findings or propose improvements to existing studies on soil phosphatase.

Example questions:

Critically analyze the limitations of using phosphatase activity as a sole indicator of soil health.

Evaluate the strengths and weaknesses of different methods for measuring soil phosphatase activity.

3.2.6 Creation Level

The creation level of Bloom's taxonomy involves the ability to generate new ideas, produce original work, or design innovative solutions.

Example questions:

Design a novel experiment to investigate the effect of different organic amendments on soil phosphatase activity.

Create a new technique or tool to measure soil phosphatase activity more accurately and efficiently.

Devise a comprehensive management strategy for optimizing phosphatase activity in agricultural soils while minimizing environmental impacts.

4. Conclusion

By applying Bloom's questioning method to the study of soil phosphatase, educators can encourage students to not just memorize facts, but also actively engage with the material, develop higher-order thinking skills, and gain a deeper understanding of this important soil enzyme. By engaging students in activities that require them to create or generate new ideas related to soil phosphatase, educators can foster their creativity, critical thinking, and problem-solving skills. This level challenges students to go beyond the existing knowledge and contribute to the field of soil science. Bloom's questioning method can be used for deep learning of biology education in universities.

References:

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