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Project-based Instructional Design and Reform Based on OBE Concept—A Case Study of Ecology Curriculum

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Abstract: *Based on the exploration and practice of the project teaching reform of ecology under the concept of OBE, this paper discusses the implementation route, implementation process, evaluation and feedback of project teaching by analyzing the current situation of ecology teaching. The results show that the project teaching of ecology course can improve the students' innovative thinking and practical ability.*

Keywords: *OBE, Project-based teaching, Ecology*

1. Introduction

Based on the criticism of traditional education models and rethinking of educational goals, Spady proposed Outcome-Based Education (OBE), which aims to ensure that all students can show certain abilities and achievements after completing education[1]. More and more colleges and universities integrate OBE concept into curriculum construction and teaching reform, teachers turn to student-centered teaching methods, and apply flipped classroom, project-based learning and other means to course design and teaching methods, etc. By identifying students' learning outcomes, reverse curriculum design, continuous evaluation and improvement, etc., emphasis is placed on the improvement of students' practical problem-solving ability and the cultivation of comprehensive quality. A learning outcome-oriented quality assurance system for higher education has been gradually established and improved, and the transparency and credibility of higher education services have been greatly enhanced.

Project-based Learning (PBL for short) is a student-centered and project-centered incentive teaching method, which emphasizes that students solve problems or challenges in real life through practical operation and inquiry, and emphasizes the combination of students' learning and practical application, which is conducive to the cultivation of practical ability and innovative thinking [2]. Students work in teams, learn to collaborate with others, communicate and share with others, and try to apply knowledge and skills from different disciplines to solve complex problems. Both OBE and PBL are important means of curriculum reform, both provide challenging and practical problems, guiding students to achieve predetermined learning outcomes in the process of problem solving. This paper aims to discuss the exploration and practice of the reform of ecology project-based teaching, in order to provide reference for the innovation and development of ecology teaching.

2. Present situation of ecology teaching

2.1 The disconnection between theory and practice

Traditional teaching students lack of practical application of ecological theory and field research opportunities, and field investigation, data analysis, experimental design and other links are few or simple, resulting in their shallow understanding of ecology and boring learning process.

2.2 Difficulty of interdisciplinary integration

The content of ecology is very complicated, involving many subjects such as biology, geography, mathematics, environmental science, etc. The current teaching methods reflect its comprehensiveness and intersections, making it abstract and theoretical.

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2.3 Non-complete course positioning and curriculum system

The curriculum lacks of teaching cases with regional characteristics, and students are exposed to scenes related to ecology at a shallow level and in pieces, which is not conducive to forming systematic thinking.

2.4 Unitary teaching method and unperfected campus ecological environment

Traditional teaching mainly adopts the way of lecturing and listening to lectures, students have little interaction and participation, and their initiative is poor. Many colleges and universities are not rich enough in environmental protection atmosphere, and students' environmental awareness and action are lagging behind.

3. Implementation of project-based teaching based on OBE concept

3.1 The implementation route of project-based teaching based on OBE concept

(1) Demand analysis: analyzing students' learning needs and the teaching status of Ecology course.

(2) Goal setting: Based on the results of needs analysis, setting clear teaching goals.

(3) Project design: Designing challenging and engaging project tasks around teaching objectives.

(4) Teaching implementation: Project teaching method is adopted to carry out teaching implementation, including student grouping, project execution, etc.

(5) Teaching evaluation: evaluating according to specific criteria, including process evaluation and outcome evaluation.

(6) Feedback and improvement: Collecting feedback from students, reflecting on and summarizing teaching reform, and making continuous improvement.

3.2 Matters needing attention in the implementation of project-based teaching

(1) Teachers design challenging and engaging project tasks based on teaching objectives. Project tasks should be closely integrated with practical problems and cases of ecology.

(2) Depending on the size and difficulty of the project task, the students are divided into multiple teams, and each team is assigned a different role, such as project leader, data collector, analyst, etc.

(3) Colleges provide necessary resources such as references inquiry, teaching equipment, experimental sites, online courses and simulation software. Teachers can use group discussion, case analysis and other strategies to make use of good teacher-student interaction to give timely feedback and guidance to students.

(4) Students should actively participate and explore those things, and strive to solve practical problems through field visits, data collection, analysis and discussion.

(5) Project results can be in the form of reports, drawings, videos and other forms. The evaluation system should be perfect, the evaluation content should be transparent, the evaluation object should be fair, the evaluation criteria should be fair, as well as the evaluation method should be flexible, and the evaluation means should be diverse.

(6) It is necessary to summarize the situation of students and their projects, and the teacher should also summarize the project-based teaching, analyze the teaching effect and the need for improvement.

4. Reconstruction of ecology project-based teaching curriculum system based on OBE concept

According to the training program for biological science professionals formulated under the concept of OBE, the following items with strong operability are condensed from the important contents of the ecology course.

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4.1 Ecosystem structure and function issues and projects

(1) Project: Investigation and analysis of campus ecosystem

Question: What types of ecosystems exist on campus? What's the connection between them?

Objective: understanding the composition, structure and interrelationship of different ecosystems on campus through field investigation, and analyzing the causes of their functions and stability.

(2) Project: Urban green space ecological service function assessment

Question: What ecological service functions do urban green Spaces play? How do you evaluate that?

Objective: evaluating the ecological service functions of urban green space in carbon storage, air purification, microclimate regulation and other aspects through investigation, and putting forward optimization suggestions.

Implementation proposal: Students may select a specific urban green space for investigation and research, and analyze the service function of urban green space by investigating air quality, water resource regulation, social and leisure value and other indicators. The purpose of the project is to let students understand the ecological value of urban green space and enhance their sense of responsibility for protecting urban green space.

4.2 Issues and projects for biodiversity conservation and use

(1) Project: Research on conservation strategies of biodiversity hotspots

Question: How can biodiversity hotspots be tracked and protected?

Objective: studying methods for identifying biodiversity hotspots, analyzing threat factors, and developing appropriate conservation measures.

(2) Project: Endangered species conservation and recovery plan design

Question: How do you develop an effective conservation and recovery plan for an endangered species?

Objective: investigating the status quo of endangered species, analyzing the factors that contribute to their endangerment, developing specific conservation and restoration measures, and evaluating their implementation effects.

Implementation proposal: Students choose a threatened species or biodiversity hotspot to study. Through the discussion of its protection status, threat factors and protection strategies. The aim of the program is to make students aware of the impact of human activities on biodiversity and develop their awareness of environmental protection.

4.3 Ecological restoration and governance issues and projects

(1) Project: Design of restoration scheme of degraded ecosystem

Question: Where is ecosystem degradation likely to occur? How to recover it?

Objective: studying the causes and types of degraded ecosystems, designing targeted restoration programs, and assess the feasibility of programs.

(2) Project: Research on ecological control technology of environmental pollution

Question: How to use ecological principles and technology to control environmental pollution? What are the advantages and disadvantages of this technology?

Objective: studying the types and causes of environmental pollution, exploring effective ecological treatment technologies, and analyzing their application prospects and limitations.

Implementation proposal: Students choose a damaged ecosystem to study and propose a restoration plan. Through the analysis of its change, evolution trend, influence, recovery means, students need to design a feasible program. The purpose of the project is to enable students to understand the service value and resilience of ecosystems, and to reinforce their sustainable outlook.

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4.4 Global change and ecosystem response issues and projects

(1) Project: Study on the impact of climate change on ecosystems

Question: What are the impacts of climate change on ecosystems? How to respond dialectically?

Objective: studying the adaptation and adjustment of ecosystems to climate change and to analyze the possibility of their evolution.

(2) Project: Assessment of the impact of land use change on biodiversity

Question: How does land use change affect biodiversity? How to assess its impact?

Objective: analyzing the mechanisms and consequences of land use change on biodiversity, assessing the extent of its impact and making recommendations for the conservation and optimization of land use

Implementation proposal: Students study the impact of climate change on the ecosystem, and find out the control measures of climate change through data comparison. The purpose of the program is to let students understand the threat of climate change to the ecosystem and develop a sense of harmony between man and nature.

5. Project teaching evaluation and feedback based on OBE concept

5.1 Evaluation content and evaluation method

The evaluation content should cover knowledge mastery, skill application, innovative thinking, teamwork and other aspects, including students' interpretation of ecological concepts and principles, ability to solve practical problems with knowledge learned, innovative thinking and creative performance, and ability to cooperate and communicate with team members. The degree of mastery of knowledge and skills is evaluated by means of tests, questions and answers. Students' performance in the project process was paid attention to through observation, recording and group discussion, and indicators such as student participation degree, cooperative spirit, contribution degree and problem-solving ability were set [3]. We need to evaluate the project results completed by students, such as the quality of reports, accuracy and innovation of data analysis, and evaluate the results and performance of students in the project, including project reports, results display, practical operation and data analysis.

The evaluation method can be carried out by the independent evaluation of teachers, classmates and self[4]. Teachers provide specific, constructive feedback based on student performance and outcomes, which can be in the form of comments, oral feedback or written feedback to help students understand their strengths and weaknesses. Members of each group can select representatives to participate in the evaluation, which helps them to communicate and learn. During and after the completion of the project, students will conduct self-reflection and summary for continuous improvement.

5.2 Feedback and guidance

Teachers provide specific feedback and guidance based on student performance and outcomes, help students identify problems and improve them, and encourage students to feedback and learn from each other. In order to ensure the effectiveness and timeliness of feedback, oral feedback, written feedback, electronic feedback and other ways can be flexibly adopted.

6. Problems existing in the implementation of project-based teaching

Project-based teaching has high requirements on the ability and quality of teachers and students, and the resources and conditions required may be complex and diverse. In particular, complicated project design requires a lot of conditions, required cycles and energy consumption, which seriously affects the implementation willingness of both teachers and students, and the feedback evaluation lacks timeliness. The uncertainty and complexity of evaluation indexes in the process of implementation make it difficult to quantify the evaluation criteria accurately, resulting in increased subjectivity of evaluation.

7. The effect of ecology project teaching

Restricted by factors such as course teaching links, implementation methods and actual conditions,

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in the teaching process of ecology of Class 1 of Biological science major in Grade 2020, the content of studying the physiological, ecological and genetic changes of certain plants or animals under environmental stress as well as the protection and restoration measures that can be taken is selected.

7.1 The project teaching implementation plan of this course

(1) Determining the project theme and objective. The teacher guides the students to discuss and determine the project theme and objective as "Study on the adaptation mechanism and protection measures of XX plants or animals under the stress of XX factors".

(2) Grouping and role assignment: The class is divided into two large groups, each group is divided into four groups, and each group includes 6-7 members. Each group selected an animal or plant and an ecological factor to study, and assigned different roles to each group member.

(3) The setting of research content

Each team selects one of the following four aspects to carry out the project research.

① Investigation and observation: It mainly conducts long-term investigation and observation on the individual and population of the studied species, counts their morphology, physiology, population characteristics and other information, determines possible stress factors, and analyzes their future change trend.

② Experiment and simulation: Laboratory simulation or field in-situ experiment is used to simulate the ecological and physiological changes of organisms under environmental stress conditions, such as changing temperature, light and other factors under controlled conditions, to study the physiological response and growth of the organisms. The ecological or genetic model was constructed to simulate the population dynamics under environmental stress, predict the possibility, speed and direction of population recovery, and discuss the impact of environmental stress on population according to the simulation results. Students need to consult the reference, design and carry out the experiment.

③ Genetic analysis: The use of molecular genetics and genomics techniques studies genetic variation and adaptation mechanisms in species under stress. By analyzing changes in gene expression and genetic diversity, the genetic response of species under environmental stress is explored in depth.

④ Restoration or conservation strategies: Students need to explore the possibility of conservation or restoration strategies such as improving environment quality, controlling human activities, establishing protected areas, etc., and develop long-term recovery plans as appropriate.

(4) Experiment or observation

Students conduct experiments or observations according to the designed scheme and record the data. Basic data were collected by means of questionnaire survey, interview and on-site observation.

(5) Data analysis and conclusion

Statistical software excel and SPSS were used to make statistics and analysis of the collected data. Teachers guided students to discuss the conclusions.

(6) Results presentation and evaluation

The team presents the project results in the form of reports, PPT, videos, etc., and the teacher and the evaluation team evaluate and give feedback. Students need to interpret the results of data analysis to determine the impact of environmental stress on plants or animals.

(7) Publicity and policy implementation

Through media, exhibitions, lectures and other means, the research results and protection measures are publicized to the public, so as to improve the public's environmental awareness and ability, thus promoting the development of ecological protection, and providing the basis for the government to formulate relevant regulations and policies in a timely manner.

7.2 The project teaching effect of this course

Through this teaching, students can have an in-depth understanding of the biological adaptation mechanism to the environment, enhance the understanding and application of the basic concepts and principles of ecology by discussing protection measures, and effectively exercise and strengthen their

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practical ability and innovative thinking.

The result shows that the project teaching method is suitable for ecology teaching. By participating in the inquiry and practice of practical projects, students gain a deeper understanding and mastery of the basic concepts and principles of ecology. Students' learning interest and enthusiasm were significantly enhanced. They actively thought and dared to try in the project, put forward many innovative ideas and solutions, and enhanced their practical ability and problem-solving ability. Students' teamwork and problem-solving skills have also been greatly improved. They collaborate and progress together in the project, and successfully solve many practical problems.

8. Conclusion

Through clear teaching objectives, design project tasks, reform teaching methods and perfect evaluation system, the project teaching reform of Ecology under the OBE concept has been successfully promoted. The use of OBE and PBL in higher education curriculum reform has effectively promoted students' active learning and improved the quality of education. In the future, we will continue to pay attention to the development trend and frontier dynamics of ecological education, constantly optimize and deepen teaching reform, and contribute to cultivating more outstanding ecological talents.

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