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Exploration and Practice of OBE+BOPPPS Teaching Mode in the Teaching of Environmental Hygiene

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Abstract: *This study mainly explored the practical value and application value of the "OBE+BOPPPS" teaching model in the teaching of the Environmental Hygiene course. Students from the 2020 Preventive Medicine Class (108 students) and the 2021 Preventive Medicine Class (109 students) of the School of Public Health of our university were selected as research subjects. The former received traditional lecture-based teaching, while the latter received the "OBE+BOPPPS" teaching model combined with Rain Classroom. The results showed that, compared with the traditional teaching model, the "OBE+BOPPPS" teaching model achieved higher average scores and a higher rate of good or excellent grades (P<0.05), improved student satisfaction and participation, and was recognized by most students as a new teaching model. The findings indicate that the "OBE+BOPPPS" teaching model can enhance students' learning enthusiasm, comprehensively reflect students' performance, and improve their self-directed learning ability. In the future, the improvement and promotion of this model can be further strengthened.*

Keywords: *Environmental Hygiene, OBE concept, BOPPPS teaching model, Teaching reform*

1. Introduction

A sound ecological environment is the most equitable public good and the most inclusive benefit to well-being [1]. Environmental Hygiene, which studies the relationship between the environment and health, influences the development of public health professionals through its teaching quality and is crucial to implementing policies such as "Healthy China" [2]. Against the background of "Big Health and Big Hygiene", how to reform Environmental Hygiene teaching, improve students' professional competence, and promote their all-round development is an urgent problem.

Under traditional teaching, Environmental Hygiene faces several pain points. First, students' summarization and synthesis abilities are weak. One reason is that multiple core courses are offered simultaneously, dispersing students' energy; those preparing for postgraduate entrance examinations often choose epidemiology and health statistics, and some institutions do not list Environmental Hygiene as a key examination subject, limiting student investment [3-4]. Another reason is inefficient learning methods, low goals, and weak achievement. Before class, clear knowledge objectives and guidance on key and difficult points are lacking. During class, students are asked to draw mind maps, but most do so perfunctorily, copying the textbook contents without marking key points or logical organization; this does not help review and becomes a burden.

Second, teaching methods and means are monotonous. Classroom teaching remains teacher-dominated, with students as supplements. Although platforms such as Rain Classroom and Xuexitong are used, their functions are underused, student participation is low, and interest is difficult to stimulate. In laboratory classes, students perform poorly in case analysis, are inactive in discussion, and rely on the Internet or AI for answers. Scores on case analysis questions in final examinations are generally low, with inaccurate and incomplete answers. The root cause is that environmental problems in cases require comprehensive application of knowledge from multiple chapters, information condensation, flexible integration, and knowledge expansion. In addition, case- or problem-based teaching places higher demands on teachers' preparation and professional level.

Finally, the course evaluation system is imperfect. Traditional evaluation systems generally have three problems: over-reliance on quantitative data and neglect of qualitative evaluation; single methods

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and limited objective evaluation; and predominantly one-way evaluation lacking interactivity [5]. This makes it difficult for teachers to grasp the achievement of course objectives and continuously improve teaching, and for students to gain a sense of achievement. The Public Health Licensed Physician Examination includes skill and written assessments; the skill assessment covers clinical, disease prevention and control, and public health skills. Environmental Hygiene knowledge accounts for a large proportion of public health skills, mainly assessing students' ability to investigate and analyze environmental pollution incidents and to collect and determine environmental samples. However, final-examination-dominated evaluation emphasizes memorization over application and poorly reflects problem-solving, practical operation, and teamwork abilities.

This study combines the OBE concept with the BOPPPS model, emphasizing student-centeredness, learning outcomes, professional ability development, and two-way teacher-student evaluation, thereby shifting evaluation from the teaching process to learning outcomes and practical abilities [6]. Its teaching process includes six links: bridge-in, objective, pre-assessment, participatory learning, post-assessment, and summary [7], forming a continuous closed loop of "design-guidance-learning-evaluation-summary." This provides logical and internalization support for integrating ideological and political education into the curriculum. Therefore, this paper uses the Rain Classroom platform and the "OBE+BOPPPS" model to explore and practice Environmental Hygiene teaching and to achieve continuous improvement in teaching effectiveness.

2. Course Teaching Design and Implementation

2.1 Teaching Design

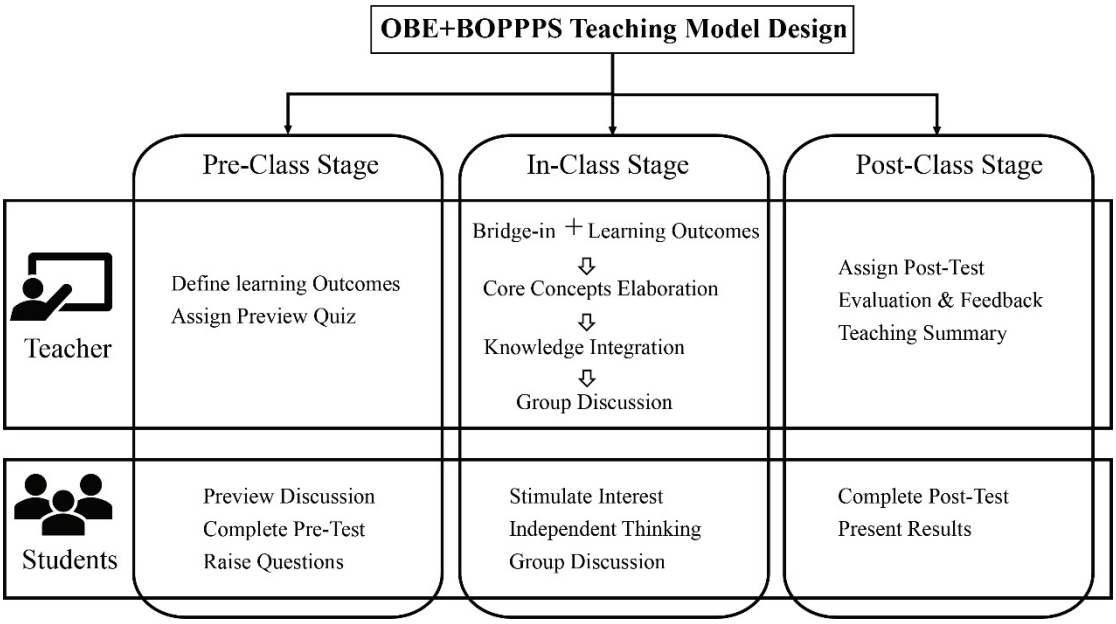

Figure 1. The "Three-Stage, Six-Step" Instructional Design Based on OBE+BOPPPS.

According to student characteristics, OBE teaching objectives were designed for each chapter. Relying on resources such as the Yangtze Rain Classroom, MOOC videos, and a virtual simulation experiment platform, various teaching methods such as case-based teaching, problem-based learning, and flipped classroom were adopted according to the characteristics of different chapters in the BOPPPS teaching model based on the OBE concept. Teaching activities were designed according to the "three stages and six links" [8]. The "three stages" divide the entire learning process into pre-class, in-class, and after-class stages, and the "six links" correspond to the six links of the BOPPPS teaching model. Specifically, in the pre-class stage, pre-class tasks, teaching objectives (Objectives), and pre-assessment were pushed through Rain Classroom. Students clarified their learning tasks and gained a certain understanding of the course content, and teachers could also adjust the emphasis on key and difficult teaching points according to students' learning situations. In the in-class stage, pictures or videos of real cases were used to stimulate students' interest in learning the content of the lesson (Bridge-in). Then, through raising questions, group discussions, teacher explanations and theoretical instruction, example exercises, and flipped classroom, students were engaged in the teaching process (Participatory learning),

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reflecting the "student-centered" teaching philosophy. The summary was conducted both in class and after class. The teacher summarized and sorted out knowledge points during class and assigned a case analysis question as an after-class task (post-assessment). After class, students sorted out the classroom knowledge again according to the case analysis question. Teachers evaluated the teaching effectiveness of the lesson by combining the results of the pre-assessment, in-class performance, and post-assessment. The specific teaching design diagram is shown in Figure 1.

2.2 Teaching Implementation Process

This study selected a total of 217 undergraduate students from the 2020 and 2021 preventive medicine majors of the School of Public Health of this university as research subjects. The 108 undergraduates from the 2020 cohort were used as the control group, and the 109 students from the same major in the 2021 cohort were used as the experimental group. The control group was taught mainly by the traditional classroom lecture-based teaching method, assisted by multimedia. The teacher mainly gave classroom explanations during class and published an appropriate number of Rain Classroom in-class quiz questions. In the later part of the classroom explanation, case analysis was used to sort out and summarize the classroom content, and students were assigned to draw mind maps after class. The experimental group adopted the OBE+BOPPPS teaching model, as detailed in the teaching implementation process section.

The main indicator for effectiveness evaluation was the final course score of the two groups of students. Course score=35% usual performance+65% final examination score. The usual performance of the traditional teaching group included attendance (5%), classroom performance (5%), and mind maps (25%); the usual performance of the "OBE+BOPPPS" teaching model group included attendance (5%), classroom participation (5%), platform test scores (15%), and presentation performance (10%). The final examination part of both groups was a closed-book examination, and the test questions were determined after repeated testing and verification by the teaching team according to the principle of parallel equivalence. Course scores were divided into bands (full score of 100 points): ≥90 as excellent, 80-90 as good, 70-80 as medium, 60-70 as pass, and <60 as fail. The number and proportion of people in each score band were counted and compared and analyzed.

Based on the teaching design idea of "three stages and six links," the following takes Chapter 6, Soil Hygiene, as an example to specifically explain the teaching implementation process.

Pre-class stage: The teacher published learning tasks through Rain Classroom, asking students to watch the Environmental Hygiene MOOC course taught by Professor Yuan Bifeng of Wuhan University on the China University MOOC platform. The main contents were "Soil Pollution, Self-purification, and the Fate of Pollutants" and "Impacts of Soil Pollution on Health." Students independently consulted materials for preview, completed the pre-class test (mainly multiple-choice questions), and listed the problems existing in the preview. The teacher adjusted the in-class teaching content and arrangements according to the pre-class learning situation.

In-class stage: The teacher introduced the teaching objectives to the students, as shown in Table 1. The course introduction was conducted by watching the video "Hunan: Soil Pollution Status Is Worrying, How to Remediate?" and raising three questions for students to think about and discuss: First, what are the main types of soil pollution faced by Hunan Province and their key causes? Second, which natural and human factors jointly led to the aggravation and spread of soil pollution in Hunan Province? Third, through what pathways does soil pollution in Hunan Province pose threats to ecosystem health, agricultural product safety, and human health? After the students' discussion was basically over, several students were randomly selected to answer separately. The teacher evaluated and summarized the students' discussion results and introduced the key and difficult points of the course: the characteristics and harms of soil pollution. In the second round of participatory learning, the key and difficult knowledge points and the investigation of soil pollution incidents were sorted out. A case video was watched: the "Ghost Shaved Head" incident in Huilong Village, Xingren City, Guizhou. Students thought about the question: How should the expert investigation team respond to this incident? What inspiration does it give us? Students discussed and answered, and the teacher summarized the working approach of the investigation team in discovering, analyzing, and solving problems. At the same time, ideological and political education was integrated into the course: solving problems with a dialectical materialist and pragmatic attitude, abandoning feudal superstition, eliminating residents' fear of the incident, and at the same time establishing correct values and enhancing the sense of responsibility and mission for environmental protection. At this stage, research on an emerging pollutant-microplastics-could be integrated to cultivate students' scientific research awareness and innovative spirit. Finally, the teacher summarized the content of this lesson closely according to the 2025 Public Health Licensed Physician

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Examination syllabus and once again emphasized the key and difficult points of the learning content.

After-class stage: The teacher published an after-class assignment through the Rain Classroom platform-a case analysis about a soil pollution incident-to strengthen the consolidation of knowledge content and achieve internalization and absorption of knowledge. The teacher commented on the students' after-class assignments and provided answers to questions. The courseware for this lesson was published, with MOOC videos inserted into the courseware. The main contents were "Sources of Soil Pollution" and "Harms of Persistent Organic Pollutants" taught by Professor Zhang Zhihong of Shanxi Medical University, and "Investigation and Detection of Health Impacts of Soil Pollution" taught by Professor Li Wanwei of Shandong Second Medical University. Students could conduct follow-up review through Rain Classroom.

Table 1: OBE Teaching Objectives for Chapter 6: Soil Hygiene.

Training Objectives	Specific Content
Knowledge objectives	Systematically explain soil composition and functions; distinguish and analyze the core concepts of soil pollution and analyze its sources and self-purification mechanisms; assess the hazards of typical pollutants (thallium, chromium, pesticides, etc.); understand the formulation and application of soil environmental standards and describe the fate and transformation patterns of pollutants; evaluate waste treatment technologies and preliminarily select soil remediation methods; grasp the role of the soil hygiene supervision and monitoring system.
Ability objectives	Cultivate students' ability to analyze soil pollution cases and identify the main risk factors of soil pollution; learn basic methods for soil sample collection and preliminary analysis; enhance students' environmental protection awareness and ability to solve soil hygiene problems.
Quality objectives	Stimulate students' interest in and sense of responsibility for environmental protection, cultivate a rigorous and scientific research attitude, and promote the concept of harmonious coexistence between humans and nature.

3. Reform Outcomes

3.1 Comparative Analysis of Scores

The scores of both groups showed a skewed distribution. The maximum and minimum values were 83.3 and 38 in the control group, and 88.23 and 57.75 in the experimental group. The course scores of the experimental group were better than those of the control group (P<0.05), as shown in Table 2.

Table 2. Comparison of Student Course Scores Before and After Teaching Reform

Group	n	Course Score	Z	*P*
Control group	108	69.84 (65.43, 74.77)	-6.119	<0.05
Experimental group	109	75.78 (72.33, 79.51)		

Table 3 shows that, by comparing the constituent ratios of the two groups in each score band, the rate of good or excellent grades in the experimental group was higher than that in the control group (χ^2=13.096, P<0.05). The difference in the distribution of course score grades between the two groups was statistically significant (χ^2=33.901, P<0.05). The scores of the control group were mainly concentrated in the pass and medium bands, while those of the experimental group were mainly concentrated in the medium and good bands. Therefore, after adopting the "OBE+BOPPPS" teaching model, students' scores improved significantly, indicating that this model has achieved certain results in improving students' learning effectiveness.

Table 3. Comparison of the Constituent Ratios of Students' Course Scores in Each Score Band Before and After Teaching Reform [n (%)]

Group	n	Fail	Pass	Medium	Good	Excellent	Rate of Good and Excellent (%)	χ^2	*P*
Control group	108	7 (6.5)	48 (44.4)	48 (44.4)	5 (4.6)	0 (0)	4.6	33.901	<0.05
Experimental group	109	3 (2.8)	15 (13.8)	68 (62.4)	23 (21.1)	0 (0)	21.1		

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3.2 Student Feedback

According to students' homework completion and presentation sessions, students' homework completion was relatively high, and their self-directed learning ability improved. Classroom questioning was active, students' classroom enthusiasm increased, and they no longer resisted teacher questions. They also actively communicated with teachers after class, bringing students and teachers closer. From the student teaching evaluations, students relatively recognized the teacher' teaching, and the average teaching satisfaction score reached 93. Some students commented that this teaching method was novel and classroom efficiency was high, while others believed that this teaching method integrated multiple teaching means and that they actively participated in classroom learning.

4. Conclusions

This study carried out teaching reform and practice in the Environmental Hygiene course based on the "OBE+BOPPPS" teaching model. The results showed that the adoption of the new model effectively improved students' course scores. Combined with student feedback, this model achieved positive results in enhancing students' learning effectiveness, classroom participation, self-directed learning ability, and teacher-student interaction.

The three major problems existing in the traditional teaching model-weak student summarization ability, monotonous teaching methods, and an imperfect evaluation system-were effectively improved in the design of this teaching reform. The OBE concept is outcome-oriented and clarifies the three-dimensional objectives of knowledge, ability, and quality. Combined with the closed-loop design of the BOPPPS teaching model, which includes bridge-in, objectives, pre-assessment, participatory learning, post-assessment, and summary, it helps students shift from passive listening to active construction [9], effectively improving students' academic performance and enhancing their classroom satisfaction and participation. For example, in the "Soil Hygiene" chapter, through real case introduction, step-by-step question discussion, integration of ideological and political elements, and after-class case analysis, it not only stimulated students' learning interest and improved classroom participation, but also systematically trained students' ability to integrate and apply knowledge and solve complex problems. This effectively addressed the shortcomings of "inaccurate and incomplete answers" in students' case analysis and simultaneously improved their ability in the Public Health Licensed Physician skill examination. Relying on Rain Classroom's pre-class tasks and tests, teachers could accurately grasp the learning situation, adjust teaching priorities, and solve the problem of unclear learning objectives, while diversified process-based evaluation overcame the limitations of traditional evaluation.

The State Council issuing the New Generation Artificial Intelligence Development Plan, which proposed the requirement to "accelerate the cultivation of artificial intelligence talents and promote the deep integration of AI with various industries" [10], AI-empowered teaching has become a trend. The three-stage and six-link teaching design of "OBE+BOPPPS" combined with AI tools provides a clear and stable structural framework for teaching implementation [11]. In the pre-class stage, teachers can use tools such as DeepSeek and Doubao for lesson preparation, improve teaching design, and enrich teaching methods. They can also use Rain Classroom to push MOOC resources and pre-class tests to achieve initial knowledge transfer and learning situation diagnosis, while students can use AI tools for knowledge organization and expansion. In the in-class stage, cases and problems drive deep participation, emphasizing knowledge internalization and ability cultivation. At the same time, teachers can guide students to correctly use AI tools for problem inquiry. In the after-class stage, targeted assignments and expanded resources promote knowledge consolidation and transfer, and exercises on the virtual simulation experiment platform can compensate for experimental operations that are difficult to carry out in traditional laboratory classes. This structure ensures the coherence and logic of the teaching links. Rain Classroom runs through the entire teaching process, improving the efficiency and precision of teaching management and truly realizing a "student-centered, teacher-assisted" approach.

The successful implementation of the "OBE+BOPPPS" teaching model depends on teachers' course design and classroom management abilities [9]. Teachers need to carefully design cases and questions that meet OBE objectives, organize classroom discussions, and provide timely and effective feedback. This requires teachers to possess depth of professional knowledge, awareness of teaching innovation, and information technology literacy. In addition, as the State Council issuing the Measures for the Setting and Management of Interdisciplinary Disciplines (Trial) and the deepening advancement of the construction of "New Medical Sciences" and "New Engineering" [12-13], the interdisciplinary integration of medicine with engineering and information technologies has become an important direction for talent

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cultivation. As a natural intersection connecting environment, health, and technology, Environmental Hygiene is an ideal carrier for promoting teaching reform in medicine-engineering interdisciplinary education. This means that teachers need to further expand their interdisciplinary horizons and actively learn and integrate frontier knowledge and technologies such as environmental engineering, intelligent monitoring, and big data analysis, so as to better reflect interdisciplinary characteristics in teaching and cultivate composite public health talents that meet the requirements of the new era.

5. Conclusions

In summary, the "OBE+BOPPPS" teaching model combined with Rain Classroom constructs a deeply participatory learning environment, addresses the pain points of traditional teaching, and improves teaching effectiveness and students' comprehensive abilities. In future teaching practice, this teaching model should be continuously explored and improved, with efforts focused on building "smart golden courses", so as to cultivate public health talents with a composite knowledge structure and innovative ability.

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