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Innovative Teaching in Environmental Hygiene: Bridging Theory and Practice

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Abstract: *Environmental hygiene is an important core course for undergraduate students majoring in preventive medicine. The teaching mode of integrating theory and practice has a significant impact on teaching effectiveness. This paper based on the nature of the environmental hygiene course, combining with the demand for cultivating practical talents in the context of the new medical science and drawing on the experience of teaching reform at home and abroad, we propose a flexible teaching model and evaluation system in environmental hygiene experimental teaching. This approach aims to boost students' interest in learning, enhance their experimental and problem-solving skills, and cultivate research literacy and professional competence.*

Keywords: *Environmental Hygiene, Preventive Medicine, Teaching Model, Evaluation System*

1. Introduction

Environmental hygiene is a compulsory introductory course for undergraduate students majoring in preventive medicine. It is also an important core course for cultivating students' professional competence in public health and preventive medicine. It has strong applicability and includes theoretical and experimental teaching systems. It strengthens and verifies theoretical knowledge, bridges theory with practice, and fosters students' innovative spirit, innovative consciousness, and practical ability [1-2]. However, the traditional experimental setup in environmental hygiene is primarily centered on validation experiments, diverging from the realities of actual scientific research work. The limited duration of experimental classes, insufficient experimental equipment, and the singular approach to teaching and assessment hinder students' ability to fully grasp and reflect upon the experimental content. These issues have become bottlenecks in comprehensive knowledge transmission, ability cultivation, and quality education for students. Consequently, there is an urgent need to reform the content setting, teaching modes, and evaluation systems of environmental hygiene experimental courses [3].

In the 1950s, Sinai University in the United States first explored and established a new medical education model centered on the organ system. Since the 1980s, Harvard University has carried out three large-scale integrated medical curriculum reforms over 30 years, providing valuable experience for the integrated curriculum reforms of other medical schools [4]. In 1969, McMaster University in Canada first proposed the problem-based learning (PBL) model [5], focusing on cultivating students' self-learning abilities. Since 1990, various medical schools in the UK have also widely implemented PBL teaching [6].In recent years, the teaching reform efforts of various medical colleges in China have been continuously increasing, especially the introduction of intelligent teaching platforms, which have improved the flexibility and effectiveness of teaching and provided basic conditions for cultivating teaching-learning interactions and student self-learning abilities. Based on the demand for cultivating practical talents in the context of the new medical science and drawing on the experience of teaching reform at home and abroad, we propose a flexible teaching model and evaluation system in environmental hygiene experimental teaching. This approach uses intelligent teaching platforms and integrates three elements combining: (1) basic and comprehensive experiments,(2) centralized teaching and open laboratories, and (3) experimental reports with demonstration video recording. This approach aims to boost students' interest in learning, enhance their experimental and problem-solving skills, and cultivate research literacy and professional competence.

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2. The Construction of an Elastic Teaching Model and Evaluation System for the Environmental Hygiene Curriculum

2.1 Combining Basic and Comprehensive Experiments

Traditional experimental teaching of environmental hygiene has been predominantly theoretical, lacking cohesive links between the different chapters in the experimental teaching content. Furthermore, constrained by the limited time allotted for laboratory classes, the focus has been on classical confirmatory experiments rather than on comprehensive experiments. To address this, the environmental hygiene faculty, aligned with the training objectives for preventive medicine, has restructured the curriculum to integrate core topics of environmental hygiene, such as air quality, public space sanitation, and environmental assessment. The curriculum is now bifurcated into basic and comprehensive experimental components. The basic experiments aim to equip students with basic knowledge and skills of the subject, such as air sample collection, disinfectant usage, and measurements of illumination and ultraviolet radiation, which are relevant to the Public Health Innovation Experiment Competition. This enhances the course's legacy and the student's competitive edge. Meanwhile, the comprehensive experiments are designed to foster the application of knowledge and technical skills, including comprehensive pollution monitoring along major transport routes, atmospheric sulfur dioxide, and noise level monitoring experiments. Moreover, including interdisciplinary knowledge and research methods such as toxicology and statistics encourages holistic learning and strengthening of fundamental skills. The main core content of environmental hygiene is seamlessly integrated by setting up two-level experimental projects. Through a literature review and group discussions, students designed their experiments, performed standard experimental procedures and methodologies, and analyzed their results, thereby nurturing a progression from basic proficiency to innovative thinking.

2.2 Combining Centralized Teaching with Open Laboratory

The traditional approach to experimental teaching, characterized by instructor-led demonstrations and students following established procedures, often results in a passive learning experience. The constraints of limited laboratory class time and equipment availability further inhibit the hands-on engagement necessary for fostering innovation. In response, the faculty has adopted a "student-centered" philosophy, integrating team-based (TBL) and problem-based learning (PBL) with a flipped classroom model to transcend the traditional temporal and spatial boundaries. This combination of "centralized teaching" with "open laboratory" sessions aims to enhance self-directed learning and innovative thought [7-9]. For instance, in comprehensive experiments: (1) Prior to the laboratory session, the instructor announces the experimental theme. Students, in groups of three, devise research plans through literature review, discussion, and task delegation. (2) An intelligent teaching platform provides access to standardized experimental procedure videos and safety guidelines, enabling students to prepare in advance. (3) Breaking away from the previous single centralized teaching mode, the new model includes two centralized teaching sessions at the beginning and end of the semester with an 8-week open laboratory, encouraging students to independently arrange experimental time and progress, with instructors mainly facilitating and mentoring students. Furthermore, the open laboratory schedule allows motivated students to pursue innovation and entrepreneurship projects or independent research. This reformed, diverse teaching model is designed to cultivate self-learning, enhance experimental teaching quality, and promote the development of practical and innovative thinking skills.

2.3 Combining Experimental Report with Demonstration Video

Training in standardized experimental procedures is essential for cultivating students' innovative abilities and improving the quality of education and teaching. Based on solitary experimental reports, the traditional model does not adequately capture students' proficiency in experimental techniques [10]. In response to the growing demand for advanced expertise in public health, the faculty has recognized the developmental trajectory of students. Consequently, it has reformed the experimental teaching evaluation system, focusing on "mastering methods, improving abilities, and lifelong learning." A diversified assessment approach has been adopted, incorporating both experimental reports and demonstration videos, along with peer and instructor evaluations. Key initiatives include:(1) Students are required to record a five-minute video illustrating crucial steps upon completing an experimental unit. Within each group of three students, roles of experimentation, assistance, and recording are rotated. These videos, together with the experimental reports, are then uploaded to the educational platform for comprehensive evaluation.(2) Assessments are carried out at the group and cross-group levels, as well as by instructors,

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with scores determined by a predefined weighting system to foster transparency and engagement. The final grade composition includes 40% from experimental reports and 60% from demonstration videos, with peer evaluations by student groups contributing 20%, cross-group peer evaluations 30%, and instructor assessments 50%.

This enhanced teaching model allows for meticulous supervision, management, and evaluation, unveiling each student's potential, refining their experimental techniques, reinforcing fundamental skill training, and laying the groundwork for innovative capacity development, thus preparing them for immediate professional engagement post-graduation.

3. Implementation Effectiveness of the Flexible Teaching Model and Evaluation System

Leveraging the "three combinations" concept, the environmental hygiene faculty has addressed integrating theoretical course content. Since implementing the new flexible teaching and evaluation model, there has been a notable increase in student engagement and a significant enhancement of their practical and research skills.

We conducted a questionnaire survey on the recent two senior classes majoring in Preventive Medicine at Qingdao University, focusing on their self-learning ability and satisfaction with course teaching. According to the survey results (Table 1), over 90% of students reported an improvement in their ability to engage deeply with specific issues through the environmental hygiene experimental course; there was an increased willingness to conduct literature searches and devise complex problem solutions using library databases and the Internet; and they developed a more comprehensive approach to solving controversial and complex issues from various perspectives. Moreover, over 95% of students expressed satisfaction with the experimental course's content and teaching methods. They acknowledged that the instructors' use of intelligent teaching platforms and other supplementary methods facilitated understanding. The integration of cutting-edge and related knowledge within the course was also seen as beneficial for keeping abreast of the field's evolving frontiers.

Table 1: Students' self-learning ability and satisfaction with innovative teaching in the curriculum (n=110, %)

Evaluating Indicator	Stongly Agree	Agree	Disagree	Strongly Disagree
Further develop the ability to conduct in-depth learning on a specific problem through learning	45.45	48.18	3.64	2.73
For complex problems, literature searches will be conducted through library databases and the internet	43.64	51.82	2.73	1.82
Can analyze controversial issues from multiple perspectives	39.09	51.82	5.45	3.64
After each course, necessary reflection will be conducted to understand the key and difficult points	52.73	41.82	4.55	0.91
Be able to apply the skills learned in experimental classes to innovation and entrepreneurship projects for college students	40.91	50.91	6.36	1.82
The experimental course content is comprehensive, cutting-edge, and high-order	58.18	38.18	2.73	0.91
The experimental teaching mode helps to understand the teaching content and improve research abilities	56.36	36.36	4.55	2.73
The extended knowledge introduced in the experiment helps to understand the forefront of the development of this discipline	60.91	31.82	3.64	3.64

4. Conclusion

The teaching approach and evaluation system for environmental hygiene experimental courses have been effective in instructing students in the foundational methods, skills, and procedures of core

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preventive medicine experiments. This method not only deepens their grasp of theoretical knowledge but also aids in building a comprehensive professional knowledge framework and synergizing disparate course contents. It addresses the traditional model's shortcomings, including fragmented experimental content, uniform teaching methods, inadequate assessment systems, and a gap between experimental teaching and practical application. This approach has enhanced students' self-directed learning, teamwork, and innovative thinking skills, meeting the initial objectives of developing innovative talents in preventive medicine.

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