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Constructing an Organic Chemistry Teaching Model that Integrates Ubiquitous Learning

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Abstract: In response to the current situation of organic chemistry education, a teaching model based on the concept of ubiquitous learning has been proposed in this study. This model deeply integrates ubiquitous learning with organic chemistry teaching, aiming to cultivate students' innovative spirit, scientific thinking, and inquiry skills. It establishes a "Four links" learning system that includes pre-class, in-class, post-class, and tutoring sessions, along with a comprehensive and process-oriented assessment evaluation, that is the "Five concerns" of evaluation. By using this strategy that should be modified in ture, students achieve grades with a significant improvement. The goal is to provide new ideas and experiential references for the reform of organic chemistry education in higher education institutions.

1. Introduction

With the development of society and the advancement of technology, internet technologies with multimedia technology as the core have profoundly changed the ways people learn and live. Online tools such as WeChat, Weibo, and online videos enable learners to access information and complete their studies anytime and anywhere, giving rise to the concept of ubiquitous learning [1]. Ubiquitous learning not only breaks the limitations of time and space but also effectively transforms people's learning methods, allowing learners to obtain information, engage in learning, and communicate at any time and place [2].

As a foundational course in the Environmental Engineering program, the study of organic chemistry provides students with a broad disciplinary framework that lays a solid foundation for subsequent engineering courses. However, the traditional teaching model of organic chemistry has many drawbacks, leading to issues such as low student interest and weak participation [3]. To address this, the author has developed an organic chemistry teaching model that integrates the principles of ubiquitous learning. This model aims to improve the quality of organic chemistry instruction while enhancing students' abilities for autonomous learning, scientific thinking, and inquiry. It seeks to cultivate high-quality talents endowed with innovative spirit, scientific thinking, and strong inquiry skills.

2. Issues and Solutions

The content of the organic chemistry course primarily covers the classification, nomenclature, composition, structure, properties, preparation, and reaction mechanisms of organic compounds. It emphasizes the processes of elucidating molecular structures and transformations, products formation and separation, as well as analysis and application at the molecular level [4]. The characteristics of organic chemistry present certain challenges in the teaching process, such as complex concepts and extensive content, which often leads to low student interest and insufficient motivation for learning. The traditional teaching model mainly relies on lectures, lacking adequate interaction and personalized instruction, which fails to meet the diverse learning needs of students. Additionally, the connection between organic chemistry theory and practical applications is not sufficiently emphasized, resulting in students' limited ability to apply knowledge in real-world contexts. Under the traditional teaching model, it is also challenging for teachers to effectively monitor each student's learning progress and to promptly identify and address their difficulties [5]. Therefore, in the context of digital education, it is imperative to reform the organic chemistry teaching model based on the current teaching situation [6]. Our university has achieved full coverage of Wi-Fi signals, and learning platforms such as Chaoxing and WisdomGarden have become increasingly mature, enabling students to engage in seamless learning anytime and anywhere using devices like tablets and smartphones. This creates favourable conditions for implementing ubiquitous learning.

Based on the current state of course instruction and student needs, this study aims to explore a new model for improving teaching quality and enhancing teaching efficiency, grounded in the fundamental principles and concepts of ubiquitous learning. This model takes into account the characteristics of the subject matter and course content, with the goal of fostering students' scientific thinking and innovative abilities. It implements a “Four links” learning system that includes pre-class, in-class, post-class, and tutoring sessions, along with a comprehensive assessment and evaluation process. This approach deeply integrates ubiquitous learning with the teaching of organic chemistry.

2.1. Independent Preview before Class

Students are required to independently prepare for class by engaging with the course materials through reading textbooks and researching relevant resources beforehand [7]. They should come to class with questions to lay a solid foundation for classroom learning. Students can utilize online platforms, such as Chaoxing and WisdomGarden, to facilitate their independent preparation of the learned content. Teachers can assess students' preparation levels to identify weak areas in their pre-class studies and provide explanations and demonstrations on those topics. Additionally, teachers can evaluate and give feedback on students' preparation efforts. This approach not only enhances students’ motivation for pre-class learning but also allows teachers to promptly understand students’ learning conditions and adjust the teaching content accordingly. Independent preparation before class is a crucial way to improve students' learning abilities and cultivate their scientific thinking, serving as a prerequisite for teachers to tailor their instruction to individual student needs.

2.2. Flipped Classroom in Class

The flipped classroom approach shifts the time for student self-study to before class, allowing teachers to post the teaching calendar, course materials, and relevant videos online in advance. This enables students to review these resources and complete their learning tasks [8]. Through this process, teachers provide the essential knowledge required for the course while guiding students in

discussions and critical thinking to address any issues they encounter during class. After class, students can further study key concepts and analyse cases online or independently complete extracurricular assignments. Teachers can also use online platforms to offer real-time guidance and answer questions. The flipped classroom represents a novel teaching model that transforms traditional instruction from a teacher-cantered lecture format to a more interactive one where students take an active role in their learning. This model aligns with the principles of ubiquitous learning and maximizes students' initiative and creativity.

2.3. Review after Class

The content mastered in class needs to be reinforced and reviewed afterward. To help students promptly grasp what they learned, teachers can provide supplementary review materials and exercises. For instance, when discussing organic synthesis methods in class, teachers can assign tasks for students to complete before the next session, encouraging them to research relevant materials and share their findings with peers through online communication. This approach can enhance students' motivation to learn organic chemistry. Additionally, teachers can create a course WeLink or WeChat group on an online platform for further review, sharing relevant literature, teaching resources, and case analyses. This enables students to study independently, empowering them as active learners while boosting their confidence and initiative. It also provides more opportunities for interaction and collaboration among students.

2.4. Tutoring Sessions

In classroom teaching, promptly addressing students' questions helps them quickly grasp key concepts and fosters mutual growth in teaching and learning. During the tutoring sessions, the teacher's primary responsibility is to collect and categorize students' questions before class, using these questions as a basis for the discussion. To enhance student engagement, teachers should compile and classify all questions ahead of time, grouping them by topics such as chemical formulas, organic structures, compound naming, and chemical reactions. Additionally, teachers can categorize questions based on their types, such as calculation problems, structure-related questions, and experimental issues. This pre-class Q&A activity enables students to identify the key points and difficulties in their learning, deepening their understanding of the material. To encourage interaction among students, teachers should address questions from different groups during class. They can also introduce appropriate classroom discussions based on question types to promote communication and enhance the overall learning experience among various groups.

2.5. Comprehensive Assessment and Evaluation Process

The assessment results reflect students' overall performance, including attendance, the quality of preparation and review, classroom engagement, interaction with the teacher, and the quality of homework completion, which accounts for 20% of the total score. This is supplemented by four online quizzes, contributing 5%, 5%, 10%, and 10% respectively, and the final exam, which constitutes 50% of the total grade. Throughout this process, we focus on five concerns: 1) the quality of students' preparation and review, 2) their classroom performance and interaction, 3) common learning issues, 4) the quality of completed assignments, and 5) the results of online tests. This "Four links" approach effectively stimulates students' motivation to learn and enhances the quality of evaluation in relation to the "Five concerns". The outcomes from the "Five concerns" also inform improvements in the "Four links" of teaching, thereby facilitating the implementation of a comprehensive and process-oriented assessment system, as illustrated in Figure 1.

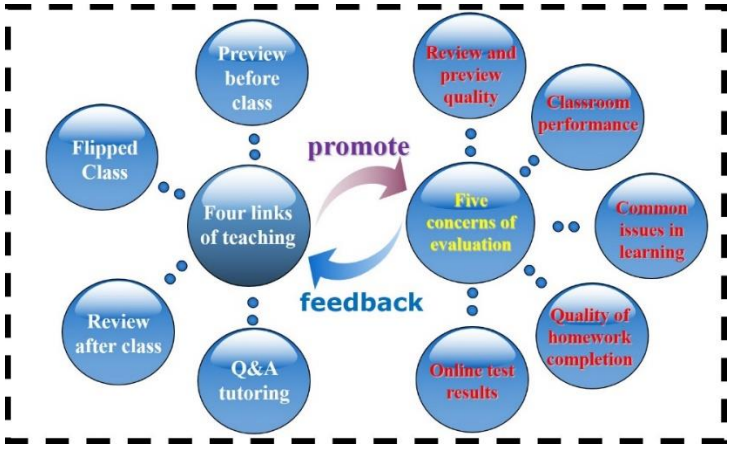

Figure 1: The description and relationship of "Four links" of teaching and "Five concerns" of evaluation

This comprehensive assessment encompasses the entire learning phase of the Organic Chemistry course. Such an evaluative approach encourages students to shift from passive acceptance to active participation in completing learning tasks, fostering habits of proactive and independent learning. For instance, when tasked with preparing for the section on "Alcohol Oxidation", students not only studied various oxidation reactions beforehand but also explored related materials and literature to understand the significance and applications of alcohol oxidation reactions. They were able to provide examples of practical applications, such as the use of breathalysers in drunk driving scenarios.

By using this teaching model, students are able to engage in self-directed learning through various channels, significantly enhancing their motivation and initiative while fostering a strong interest in the knowledge they acquire. Their course grades shown in the following Table 1 are obviously improved in comparison to those as before. As it should be, such model should be further modified to better serve the class and students.

3. Conclusions

The continuous development of internet technology has made ubiquitous learning possible. By integrating the concept of ubiquitous learning, we have reformed the teaching of the organic chemistry course, establishing a "Four links" learning system comprising pre-class, in-class, post-class, and tutoring sessions, along with a comprehensive, process-oriented assessment evaluation. Through these reforms, students can engage in self-directed learning through various channels, significantly enhancing their motivation and initiative while fostering a strong interest in the knowledge they acquire. Furthermore, the principle of ubiquitous learning permeates the entire teaching process, effectively leveraging the teacher's guiding role and the student's active participation in the classroom. This paper presents an organic chemistry teaching model that incorporates the concept of ubiquitous learning and corresponding learning methods, aiming to provide a reference for organic chemistry instructors at universities.

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