

Teaching Reform and Practice of Digital Empowered Analytical Chemistry under the Background of New Engineering

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Abstract: Analytical chemistry is a crucial course of inorganic non-metallic materials engineering major in our academy. However, the monotonicity and lack of practicality of traditional education patterns are difficult to meet the requirements of teachers and students for establishing an ideal classroom. On the basis of the background of new engineering course construction, this paper proposes a new teaching reform and practice project of analytical chemistry of digital empowering materials. The program is committed to innovative talent cultivating patterns, update and optimize the teaching content, innovate teaching patterns, so as to provide a new approach for cultivating applied talents. At the same time, it will lay a solid theoretical foundation for the teaching reform of analytical chemistry course in the future.

Keywords: Analytical Chemistry; Teaching Reform; New Engineering Course; Cultivation of Innovative Talents

1. Introduction

With the prosperity and development of society and the continuous progress of science and technology, we are facing the need press for in-depth reform of engineering education.[1,2] In order to innovate the talent cultivating pattern and improve its quality, the Ministry of Education first put forward the concept of "new engineering course" establishment in 2017, which provides a new direction for local universities in talent cultivating and teaching study.[3] With the inclusion of "promoting the digitization of education" in the part of "conducting education to the satisfaction of the people" and the proposal of "promoting the digitization of education and setting up a learning mode

society and a learning mode country with lifelong learning for all", a digital transformation on the scope of education is taking place. This transformation is not only a technological innovation, but also an alternation in educational concept.

Analytical chemistry is a science of characterization and measurement, and it is also one of the compulsory basic courses of inorganic non-metallic materials engineering in our academy. As a compulsory basic course of inorganic non-metallic materials engineering major in our academy, it is very practical, and also the theoretical basis of raw material analysis technology for subsequent professional courses. It is very crucial for cultivating students' scientific literacy and problem-solving ability, and provides us with the golden key to explore the material world. Under the guidance of this key, we deeply explore the essence and laws of the material world. By means of conducting accurate measurement and analysis, we can have the knowledge of the composition, structure and properties of materials, and further understand the characteristics of materials at the micro level and their relationship with macro properties. This process not only gives us a deeper understanding of the material, but also lays a solid foundation for our professional course study and research subsequently.

Chaozhou, a city with profound historical and cultural heritage, is renowned for its profound cultural heritage and unique industrial characteristics. Its ceramic industry is unique and closely connected with our inorganic nonmetallic major. Learning analytical chemistry well can lay a solid foundation for the study and research of related professional courses and the practical work of related industries, so as to provide strong support for the innovation and development of Chaozhou ceramic industry.

2. Reform Background

Although the traditional teaching pattern of analytical chemistry has made some achievements in imparting knowledge, it is difficult to develop the ability, interact and stimulate the initiative of students. Teachers often try their best to explain, but students still understand little about it and fail to achieve their teaching purposes. This exposes some deficiencies of the teaching pattern, which requires us to seek new solutions to better cultivate students' comprehensive quality and self-learning ability. However, with the continuous development of science and technology and the continuous updating of educational concepts, we have more methods and tools to optimize the teaching of analytical chemistry.

Among them, the project-based teaching method is a kind of teaching approach on the basis of the actual project, so that students learn and apply knowledge in practice. In analytical chemistry teaching, we can design a series of practical projects related to material science, such as material composition analysis, etc. By taking part in these projects, students can not only deeply understand theoretical knowledge, but also cultivate practical ability and innovative ways of thinking. This teaching approach emphasizes the initiative and practicality of students. Compared with the traditional teacher-centered teaching pattern, the project-based teaching method conforms to the concept of modern education more.

At the same time, the introduction of information technology has also led to great changes for the teaching of analytical chemistry. By adopting information tools such as online learning platforms and mobile applications, we can provide students with more flexible and convenient learning approaches. These information tools can not only assist students in better understanding and mastering knowledge, but also promote students' self-learning and personalized development. For example, by means of the learning online learning platform, students can learn anytime and anywhere, and can also make self-learning plans in accordance with their own progress and interests. This kind of teaching method focuses more on students' individual difference and autonomy, which is an important trend of modern education.

By combining project-based teaching methods

with information technology, we can put new vitality into the construction of key programs in the combining teaching of analytical chemistry for engineering materials major. This combining teaching pattern can not only improve the comprehensive quality of students, but also cultivate their innovative ways of thinking and improve the quality of teaching. In this pattern, students can combine theoretical knowledge with practice by means of practical projects to better understand and master knowledge. At the same time, the application of information tools also makes students' learning more convenient and flexible, and can better meet their individual requirements. This combining teaching pattern can not only improve students' learning effect, but also cultivate their innovation ability and problem-solving ability, which is an important direction of modern education.

By means of introducing project-based teaching methods and information technology, we can achieve a comprehensive innovation in analytical chemistry teaching. This new teaching pattern can not only improve students' comprehensive quality and self-learning ability, but also cultivate their innovative ways of thinking and improve the quality of teaching. In the future, we hold the opinion that this combining teaching pattern will be more and more paid attention to and applied, and make greater contributions to the cultivation of high-quality talents.

3. Reform Ideas

In recent years, with the quick development of information technology, the scope of education has also ushered in the digital age. In this reform, the analytical chemistry course has introduced the concept of digital teaching, deeply integrated information technology and teaching, and set up a three-dimensional teaching system of "teaching material + learning by means of learning platform course and practice application" (as indicated in **Figure 1**). On the basis of consolidating the basic knowledge of analytical chemistry, with the assistance of outstanding figures, major engineering cases, social hot issues and specific cases in the history of discipline development, we will deeply explore the elements of explicit and hidden curriculum from the perspective of discipline, and integrate strong elements such as native land

emotion, scientific and technological innovation spirit, excellent cultural inheritance and social responsibility. At the same time, by means of the typical professional characteristics of the case, the discipline frontier case, etc., to better cultivate students' comprehensive quality and social responsibility.[4] The purpose of this kind of teaching reform is to optimize the teaching process, reconstruct the knowledge system, realize teaching students in accordance with their aptitude, comprehensively cultivate students' comprehensive quality, and promote the development of personalized intelligence. We hold the opinion that by means of the combination of online and offline, and the combining teaching approach inside and outside the classroom, we can better meet the learning requirement of students and improve the quality and effect of teaching.

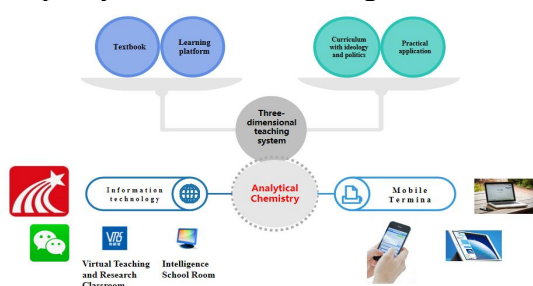


Figure 1. Three-dimensional Teaching System

3.1 "Integrated Design, Modular Curriculum, Three-dimensional Teaching" Curriculum Construction Ways of Thinking

It not only focuses on the local characteristic industrial ceramics in Chaozhou, but also combines the multi-disciplinary content such as raw material analysis technology to optimize the course content comprehensively. We have constructed knowledge modules such as basic knowledge, acid-base titration, coordination titration, redox titration and precipitation titration. In addition, we have gradually added real-sample analysis training programs and analytical chemistry in life, aiming to establish a curriculum system that is close to production and life practice, rich in content and a combination of learning and application.

3.2 "Student-centered, Ability Cultivated as the Purpose, Teaching and Practice as a whole" Project-based Teaching Pattern

By means of using the learning platform, we have adopted a project-based teaching pattern that is student-centered, ability cultivating as the purpose, mission-driven, online and offline integration, and combination inside and outside the classroom. This pattern can stimulate students' interest in learning, play their main role in learning, and cultivate their ability and habits of self-learning. Many academies and universities adopt the combining teaching pattern on the basis of online learning platform to reform and explore the traditional teaching methods [5-10], which provides a good reference value. In this way, students can gradually form a way of thinking in analytical chemistry and improve their ability to analyze and solve problems. Our purpose is to create a combining teaching pattern that is conducive to continuous learning for students, and gradually establishes a four-year consistent learning system.

4. Current Problems

Although we have achieved certain results in the construction in the past few years, we are also aware of some problems. First of all, some students show dependence on the traditional teaching pattern in the learning process, and require a certain period of adaptation for the new teaching pattern. Secondly, information-based teaching resources require to be further integrated and optimized in order to better serve teaching. Finally, the cultivation of students' self-learning ability and habits needs to be further enhanced in order to realize the development of real personalized intelligence.

5. Follow-up Rectification and Continued Construction Plan

In response to the problems mentioned above, we plan to implement the following rectification and construction:

In view of the adaptability of students, we will enhance guidance and training to assist students in adapting to the new teaching approaches more quickly. We will adopt a step-by-step method to gradually guide students from the traditional teaching pattern to the digital teaching pattern. By means of training and practical operation, assist students in better mastering new learning approaches and methods; improve learning efficiency and self-learning ability.

In view of the problem of information-based teaching resources, we will further integrate and optimize teaching resources to improve teaching quality and efficiency. We will combine the characteristics of the subject and the requirements of students, carefully design information-based teaching resources, including multimedia courseware, online courses, experimental videos, etc., to provide more abundant, practical and convenient learning resources. At the same time, we will also update teaching resources in time to guarantee the continuous improvement of teaching quality and efficiency.

In view of the cultivation of students' self-learning ability and habits, we will enhance guidance and motivation to promote students to gradually form good learning habits and ways of thinking. We will stimulate students' initiative and motivation for self-learning in a variety of ways, such as mission-driven, group discussions, case studies, etc., to assist students in mastering learning approaches and skills. At the same time, we will also focus on the cultivation of students' independent ways of thinking ability and innovative spirit, encourage students to find and solve problems in their study, and constantly improve their comprehensive quality and ability level.

6. Conclusion

In view of the deficiencies of analytical chemistry teaching, the reform of teaching pattern was implemented. The application of project-based teaching methods to cultivate students' team spirit and cooperation consciousness, improve students' self-learning, independent analysis and problem-solving ability. The information Internet technology is integrated into the teaching of analytical chemistry. On the whole, we will continue to explore and practice new teaching methods and approaches, enhance the construction of teaching resources and student learning guidance, and continuously improve teaching quality and efficiency. By means of the promotion and application of digital teaching pattern, we can provide better education services for students and cultivate more high-quality talents with independent learning ability and innovative spirit.

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