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REIMAGINING ORGANIC CHEMISTRY EDUCATION FOR MEDICAL STUDENTS: A CASE STUDY

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Abstract: *Organic chemistry, the study of organic compounds, forms the bedrock of modern chemistry with profound implications for our daily lives. This discipline investigates the structure, composition, physical and chemical properties, synthesis methods, and real-world applications of organic compounds, making it a vital branch of chemistry. Virtually all aspects of our existence, from clothing to medications and industrial materials, are inextricably linked to organic chemistry. The study of organic compounds is a cornerstone in various industries, including the development of life-saving drugs, durable materials, and essential production components. In the context of medical education, organic chemistry holds a pivotal role, especially for medical-related majors. This mandatory course establishes a fundamental theoretical framework that underpins subsequent medical studies. The human body, a complex and intricate system, predominantly comprises organic compounds, with critical roles in metabolism and health. Understanding the chemistry of organic matter is indispensable in comprehending drug interactions, efficacy, and safety within the human body. The stability and conformation of drug structures, for instance, are intricately tied to organic chemistry principles.*
This abstract underscores the integral role of organic chemistry in the modern world, particularly within the realm of medical education and the broader landscape of human health.

Keywords: *Organic chemistry, Medical education, Organic compounds, Drug interactions, Human health*

Introduction

Organic chemistry is a discipline that studies the structure, composition, physical and chemical properties, synthesis methods, and applications of organic compounds. It is a relatively important branch of chemistry. Organic chemistry is closely related to human production and life. For example, the knowledge of organic chemistry can be used to manufacture various indispensable products in daily life and production. The clothes we wear, the medications we take when we are sick, the gasoline, diesel, rubber, plastic, paint, dyes used in industry, some additives in food, and pesticides, herbicides, etc. used in production are all organic compounds. It's hard to imagine what our world would look like without organic chemistry, and this close relationship is clearly reflected in this rich course.

Among all medical courses, organic chemistry, as one of the mandatory basic courses for medical related majors, plays a crucial role in the entire training process of medical related students. The study of organic chemistry lays a certain theoretical foundation for subsequent related courses. As is well known, the main purpose of medical research is to prevent and treat diseases, and its research object is the human body. The components that make up the human body are extremely complex, except for water and some

inorganic salts, the vast majority are organic matter. For example, nutrients in the human body are stored in glycogen and fat, enzymes, hormones, and vitamins closely related to body metabolism, and proteins that make up human tissue are composed of amino acids. These organic compounds undergo a series of complex changes in the human body to maintain a balance of metabolism. In order to prevent and treat diseases, in addition to studying the etiology, it is also necessary to understand the changes of drugs in the body, their structure, efficacy, and toxicity. For example, drug structures are relatively stable in dominant conformations, which are closely related to organic chemistry.

As a basic course in medical related professional courses, organic chemistry provides necessary basic knowledge for subsequent courses such as cell biology, biochemistry, genetics, immunology, and clinical diagnosis and medication. In addition, the close cooperation of organic chemistry is also indispensable in the treatment drugs, diagnostic equipment, reagents, and artificial materials used in treatment.

The knowledge points of organic chemistry courses are diverse and complex, making it difficult for students to systematically master all the knowledge points during the learning process, and to combine the knowledge points they have learned with specific practices. Therefore, it is difficult to apply the knowledge points they have learned to practical work and life. Therefore, it is particularly important to enable medical students to master organic chemistry knowledge. This article explores the teaching mode of organic chemistry courses, with the aim of improving students' learning efficiency and teaching quality, and also providing certain research value for the future teaching of organic chemistry in medical related majors.

1. Clarify Learning content based on talent development goals

The main purpose of studying organic chemistry in medical related majors is to enable students to become familiar with the naming, structure, and physicochemical properties of organic compounds through theoretical courses, so that they can identify and distinguish organic compounds, master the differences and connections between organic compounds, and lay a solid theoretical foundation for students to learn subsequent courses in chemistry; Through comprehensive training in practical courses, students can master the basic operations of organic chemistry experiments and cultivate their practical and knowledge application abilities; Through the knowledge learned, cultivate students' ability to independently analyze and solve problems, master more scientific ideas and methods for future medical work, and possess innovative thinking abilities. Due to limited class hours, students should have both depth and breadth in learning organic chemistry, and different teaching contents should be allocated with reasonable class hours. Taking medical related majors of Chifeng University as an example, the total class hours of organic chemistry are 48, including 32 theoretical credit hours and 16 practical credit hours. The specific learning content and corresponding class hours are shown in Table 1.

Table 1: Learning Content and Credit Hours.

Organic Chemistry Learning Content	Credit Hours
Stereochemistry	2
Alkane and Cycloalkane	3
Alkene and Alkyne	3
Aromatic Hydrocarbon	2
Halohydrocarbon	2
Alcohol, Thiol and Phenol	2
Ether	2
Aldehyde and Ketone	2
Carboxylic acid and Substituted carboxylic acid	2
Carboxylic acid derivatives	2

Amine and Alkaloid	2
Heterocyclic compound	2
Lipid	2
Saccharides	2
Amino acid, Peptides and Proteins	2
Experiment 1: Determination of melting point	2
Experiment 2: Determination of Boiling Point	2
Experiment 3: Synthesis of Ethyl Acetate	6
Experiment 4: Extraction of Caffeine from Tea	6

2. Continuously improving practical teaching content

The teaching of organic chemistry experimental courses, as one of the basic experiments in medical related majors, provides students with basic experimental skills and theoretical knowledge reserves in chemistry [1], which is particularly important in the selection of experimental content. For students majoring in medicine in Chifeng University, we selected four experiments, as shown in Table 2. From basic experiments to design experiments, students can not only master basic experimental operations and skills, but also further explore on this basis.

Table 2: Organic Chemistry Experiment and Experimental skills.

Organic Chemistry Experiment	Experimental skills
Experiment 1: Determination of melting point	The principle and operation of capillary method for determining the melting point of solid organic compounds.
Experiment 2: Determination of Boiling Point	The principle and application range of atmospheric distillation and boiling point determination, the basic operation of atmospheric distillation.
Experiment 3: Synthesis of Ethyl Acetate	Organic synthesis operations such as reflux, distillation, extraction, and liquid organic matter drying, as well as the principles and methods of product separation and purification
Experiment4: Extraction of Caffeine from Tea	The basic operation of sublimation method for purifying organic compounds, and the method of separating and purifying compounds from natural substances.

3. Continuously improving teaching design and actively exploring different teaching methods

The traditional teaching mode is mainly lecture based, and students may find it difficult to learn. In addition, the organic chemistry course itself has many knowledge points, and over time, students may inevitably develop a sense of boredom. In order to enhance students' enthusiasm and initiative in learning, it is necessary for teaching teachers to continuously improve teaching design and actively explore different teaching methods.

In the process of teaching to students of medical related majors in Chifeng University, in addition to the traditional teaching method, heuristic teaching is also used. For example, when teaching the content of one chapter of grease, students are shown some pictures of lard, soybean oil and Peanut oil and asked

questions about the state of these substances at room temperature. Students are actively guided to answer and introduce the concepts of oil and fat; When teaching the process of rancidity, what is the taste of expired oil and what substances may this taste be, and then introduce the concept and process of rancidity.

In the teaching process of organic chemistry, case analysis teaching will also be used. For example, when teaching the chapter of Stereochemistry, students were first shown some pictures of "seals", telling students the whole story of the event: many women will have nausea, vomiting and other early pregnancy reactions in the early pregnancy, which seriously affected the health of pregnant women. In the 1950s, a pharmaceutical company in West Germany sold Thalidomide, a drug that can significantly inhibit pregnant women's pregnancy response. Once launched, it immediately received a huge market response, and pregnant women have chosen to use this drug to alleviate the pain of pregnancy reactions. However, in the 1960s, doctors found a significant increase in the birth rate of malformed babies. Babies born without arms or legs, with hands directly attached to their bodies, resembling seals, are known as "seal babies", and the mortality rate of such malformed babies is over 50%. Finally, the study found that Thalidomide has two chiral molecules and is an enantiomer. As shown in Figure 1, R type molecules and S type molecules have the same physical properties, but their pharmacological effects are significantly different. R type molecules have sedative and hypnotic effects, while S type molecules have strong teratogenic effects. The introduction of this case has sparked a strong interest and impression among students in their understanding and learning of concepts such as chiral molecules, enantiomers, R, and S configurations.

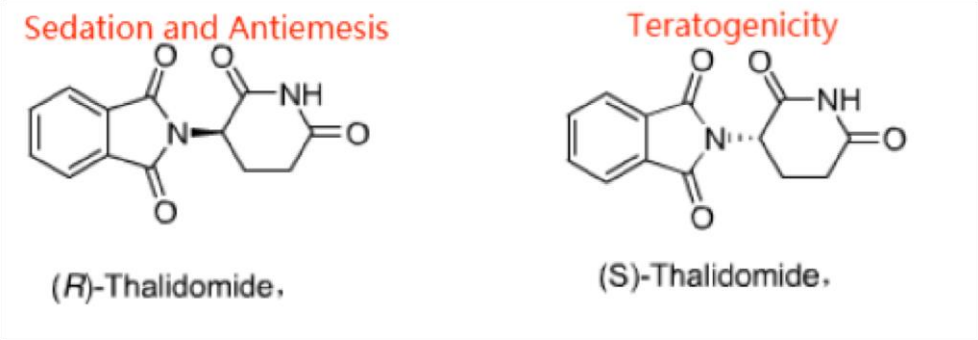

Figure 1: Two Molecular Structures of Thalidomide.

4. Deeply explore the ideological and political elements in the curriculum

Curriculum ideological and political education is essentially an education aimed at achieving the goal of cultivating morality and cultivating people. It has always been a fine tradition in China's education to prioritize moral education and emphasize the organic unity of preaching, receiving knowledge, and educating talents [2]. Ideological and political education is the work of being a person, solving the problems of "what kind of person to cultivate" and "how to cultivate people". It is the fine tradition of our party and country and the lifeline of various work. It always adheres to the principles of moral standing, moral education, and moral education, emphasizing the strengthening of education on students' worldview, outlook on life, and values, inheriting and innovating excellent traditional Chinese culture, and actively guiding contemporary students to establish correct national, ethnic, historical, and cultural views, in order to cultivate more talents with comprehensive development of morality, intelligence, physical fitness, aesthetics, and labor for society, Cultivate qualified builders and reliable successors for the cause of Socialism with Chinese characteristics. The main form of ideological and political education in the curriculum is to integrate elements of ideological and political education, including theoretical knowledge, values, and spiritual pursuits, into various courses. It is not directly about teaching ideological and political education in the curriculum, but rather has a subtle impact on students' ideological consciousness and behavior.

Taking the students of medical related majors in Chifeng University as an example, when teaching terpenes, we introduced the structure of artemisinin as Sesquiterpene lactones, introduced Tu Youyou, China's famous pharmacist and the first Nobel Prize winner in medicine, "tested the medicine by example," and the story that artemisinin developed saved the lives of millions of malaria patients, guiding students to continue to carry forward the old generation of scientists who are not afraid of difficulties and dangers, are not afraid of failure, are willing to contribute, persevere The scientific spirit of daring to explore.

In the teaching process, fully tap into the ideological and political elements contained in organic chemistry courses, impart knowledge while also guiding students to establish correct outlooks on life, society, and values, supervise classroom behavior, improve students' moral literacy, promote environmental conservation, cherish public property, and cherish the achievements of others' labor in experimental teaching.

5. Adopting different assessment methods

The traditional assessment and evaluation method of teaching mainly focuses on exams, often neglecting the entire learning process of students. Actively exploring different assessment methods is also to establish a more comprehensive, reasonable, and scientific evaluation method. As shown in Table 3, taking the students of medical related majors in Chifeng University as an example, the organic chemistry course adopts different assessment methods, including classroom performance, personal work, and writing of experimental reports, periodic tests and final tests. The final exam accounts for 50% of the total, which avoids the situation where one exam is guaranteed to win or lose, and also avoids students' contempt for the final exam.

Table 3: Assessment method and Proportion.

Assessment method	Proportion (%)
Class participation	5
Individual assignment	5
Experiment Report	20
Periodical achievement tests	20
Final test	50

In addition, different scoring mechanisms have been developed for different assessment methods. When assessing students' classroom participation, homework, and experimental reports, relevant standards have been established, as shown in Table 4. Each assessment method has five levels, and is graded based on students' performance and completion of various tasks, reflecting the principle of fairness and justice.

Table 4: Assessment method and registration.

Assessment method	Excellent	Good	Moderate	Pass	Failed
Class participation	Have a positive learning attitude, actively participate in interactions and discussions, operating experiments in a standardized	Having a positive learning attitude, participate in interactions and actively discuss, operating	Having a positive learning attitude, able to participate in most interactions and discussions, operating	Having a positive learning attitude, able to participate in interactions and discussions more actively, the experimental	Improper learning attitude, lack of active participation in interactions and discussions,

	manner, and use reagents reasonably	experiments in a standardized manner, and use reagents reasonably	experiments in a standardized manner, and using reagents reasonably	operation is basically standardized, and the use of reagents is basically reasonable	non-standard experimental operations, and inability to use reagents reasonably
Individual assignment	Complete all independently, with high accuracy and complete on time	Complete all independently, the accuracy is relatively high and complete on time	Most of them are completed independently with high accuracy and on time	Most of them are completed independently, with average accuracy, and can be completed on time	Copying homework, Low accuracy, Not completed on time
Experiment Report	Independently completed on time, with complete content, standardized formatting, and good experimental results	Independently completed on time, the content is relatively complete, the format is standardized, and the experimental results are good	Independently completed on time, with complete content, simple format, and basically correct experimental results	Completed on time, the content is basically complete, the format is basically standardized, and there are deviations in the experimental results	Plagiarism experiment report, incomplete content, nonstandard format, no experimental results

6. Actively utilizing online resources and platforms

Since the outbreak of the COVID-19 in 2020, under the policy of ensuring that the epidemic is not relaxed, we also need to ensure the quality of teaching [3]. Many courses in our school have been transferred from offline to online, mainly using learning general construction courses. In combination with the excellent curriculum resources on China MOOC, we use Tencent conferences and nails to carry out live classes. After the end of the epidemic, we will continue to use Learning Pass as a carrier for online teaching. In addition to establishing courses, uploading teaching plans, syllabuses, courseware and other teaching documents on Learning Pass, we will also upload some related videos, articles and other expanded materials related to the course content to Learning Pass for students to learn independently. In addition, some activities such as check-in and classroom testing are also carried out through Learning Pass. During classroom testing and other stages, students can automatically analyze their learning situation, facilitating teachers to further adjust their teaching situation. At the same time, the application of modern technological means has greatly increased students' participation and interest.

7. Actively improving the feedback mechanism

Teaching a course is not just about teaching. In the teaching process, students' participation and feedback mechanisms are insufficient, and teachers are often the imparters while students are the

receivers. Lack of interaction and cooperation can easily lead to passive learning and thinking patterns among students[4]. So a reasonable and scientific feedback mechanism is essential throughout the entire teaching process. In the process of teaching to students of medical related majors in Chifeng University, we will analyze each individual assignment, experimental report, periodic test and final test, and give feedback to students face to face, pointing out problems with more errors, praising what everyone has done well, and adopting strategies that encourage criticism, Enable students to understand both their shortcomings and the areas they have learned well, so that they have a clear understanding of the knowledge they have learned.

8. Conclusions

In short, for medical related majors, traditional teaching concepts and methods can no longer meet the teaching requirements of organic chemistry courses in today's society. In order for students to master the differences and connections between organic compounds, master the basic operations of organic chemistry experiments, cultivate their practical and knowledge application abilities, and cultivate their independent ability to analyze and solve problems, In order to master more scientific ideas and methods, and possess innovative thinking abilities in future medical work, we need to conduct in-depth exploration of the teaching of organic chemistry.

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