The Application of Anchored Teaching Method and Case Teaching Method in Organic Chemistry

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Abstract: The present study was designed to determine whether new teaching methods can significantly improve the teaching effect of organic chemistry. This article describes the contents and steps of the anchor teaching method and the case teaching method and applies these two teaching methods to the teaching of Organic Chemistry. In the teaching practice of three semesters, the teaching quality has been improved successfully. This study summarizes the great significance of this teaching practice: these two methods can effectively solve the problem existing in teaching, improve students' interests in learning, cultivate students' innovation ability, and realize the effective construction of students' knowledge network of organic chemistry. At the same time, it can improve the teaching level and ability of chemistry teachers. The conclusion showed that the teaching mode of students as the main body and teachers as the guide is very suitable for the teaching of organic chemistry.

1. Comparison between Traditional Teaching Method and Anchored and Case Teaching Method

Organic Chemistry is a subject studying the structure and properties of organic compounds. To learn it well, the most important thing is to master the reaction principle, process, law and essence. In traditional teaching, teachers play the role of disseminator of knowledge and students just accept knowledge passively. Students lack the process of exploring knowledge; they fail to establish an effective connection between knowledge. It is difficult to achieve the ideal teaching effect. At the same time, students lose interest in Organic Chemistry. It is a workable and effective guarantee in realizing the educational aim to use such teaching methods as the experience of situation and the amalgamation of knowledge. Therefore, anchor method and case method are introduced in the teaching of organic chemistry. Flexible teaching methods are adopted to promote students' knowledge construction and develop their thoughts.

2. Contents and Steps of Anchored Teaching Method and Case Teaching Method

2.1 Content of Anchored Teaching Method

Anchor teaching method leads students to experience in the real environment by establishing a situation related to life [1]. In the situation, teachers put forward the questions which closely related to the curriculum, from which it establishes the "anchor" to be studied as the context background. Teachers use flexible "anchoring" to carry out learning and "anchoring" as the center to stimulate students' independent inquiry. This teaching mode is helpful for students to grasp the knowledge they have learned. Moreover, students learn to use "anchors" to transfer knowledge to other situations and cultivate knowledge transfer ability.

The anchored teaching method can be done in several steps. First of all, before the beginning of the course, teachers should analyze the teaching content deeply, analyze students' learning situation and ability, and choose an appropriate teaching mode-taking into account each student's knowledge level and understanding ability. Secondly, teachers should determine the teaching objectives, which are divided into three levels: knowledge and skills objectives, process and method objectives,

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emotional attitude and values. Thirdly, it's crucial to create a situation related to the knowledge and skillfully integrate the new knowledge into the situational stories, so as to stimulate students' enthusiasm for learning and improve their initiative to explore problems [2]. Fourthly, identify the core issues to be solved in the context. Fifthly, guide students to study independently. Sixthly, the group members discuss the problems that encountered in the process of independent inquiry, and put forward different opinions on the problems. In this process, the teacher should play a role of inspiration and leader, control the pace of discussion, and adjust the classroom learning atmosphere. Finally, the teacher evaluates the results of the students' discussion, points out the shortcomings, puts forward the requirements for improvement in the future, and summarizes the key and difficult points of this lesson.

2.2 Content of Case Teaching Method

Case teaching method guides students to integrate into real background, the core of which is to analyze the cases [3]. Through specific cases, teachers leave space for students to analyze and solve problems. From phenomenon to essence, it is easy for students to understand abstract knowledge, stimulate their enthusiasm for learning and improve their ability to solve practical problems.

The case method can be done in several steps. First of all, teacher analyzes the content of the course before class, and prepares a real case closely related to the key knowledge of the course. Secondly, students extract the key points of the case and mark them by reading the case, summarize their own ideas and opinions on the problems by previewing book, so that students have a preliminary understanding of the content to be learned, and make full preparation for the analysis and discussion of the case in class. Only in this way can we guarantee the effectiveness of learning. Thirdly, teacher should lead students to review the knowledge related to the content they have learned through multimedia and other ways, and deepen their understanding of the theory. Fourthly, in the process of discovering and solving new problems, students cultivate practical application ability, improve knowledge transfer ability, and realize the transformation from cognitive object to cognitive subject.

3. The Practical Application of Anchored Teaching Method and Case Teaching Method

3.1 Clearing Implementation Object

The implementation objects of anchor teaching method and case teaching method are all freshmen majoring in forestry, agronomy, facility agricultural science and engineering, environmental science, food science and engineering, and bioengineering. The reason why freshmen are chosen as the objects of implementation is that freshmen often have a common feature that they are full of curiosity about the new learning environment, atmosphere and knowledge of the University, full of enthusiasm for learning, and have the initiative to explore problems. They can adapt to the teaching method of anchored teaching method and case teaching method with students as the main body and teachers as the guide. These two teaching modes are helpful for teachers to carry out teaching work and improve teaching quality. Of course, it is necessary to teach students in accordance with their aptitude because there are differences in their interest and potential. Combining all the factors, the anchor teaching method and case teaching method are introduced into the teaching practice. The experimental period is three semesters. The following two cases are the specific implementation and application of anchor teaching method and case teaching method.

3.2 The Application of Anchored Teaching Method

3.2.1 Teaching Analysis

Let's take aldehyde as an example. Aldehydes are one of the oxygen-containing derivatives of hydrocarbons in organic chemistry. From the acids, phenols and alcohols mentioned in previous lessons, we can know that the properties of the oxygen-containing derivatives of hydrocarbons are determined by their functional groups. The focus of this lesson is to understand the properties of aldehydes and their use in production and life. As a raw material for organic synthesis,

formaldehyde is widely used in building materials. Formaldehyde is contained in paint and adhesive, which is toxic. In recent years, the output of formaldehyde in China is increasing year by year, which shows that formaldehyde is still the pet of industry in the next few years. Through the study of this lesson, students can understand why it is seriously harmful to health and widely used in furniture materials.

3.2.2 Teaching Objectives

The teaching objective of this lesson is to understand the main properties of aldehydes. By analyzing the chemical properties of aldehydes, students can master the methods of identifying organic substances and the application of aldehydes in life.

3.2.3 Creating the Situation in The Course of Teaching.

There is a line in “my true friend” in the popular TV series: formaldehyde in all our boards is seriously exceeding the standard, which causes indoor decoration pollution. There is always a very pungent smell in the new house, which has a great impact on pregnant women and children. Before moving in, windows must be open for a long time.

Diabetes is a common disease. It is mainly marked by hyperglycemia. Its clinical manifestations are hyperglycemia and glucose in urine. Through the study of this lesson, students will learn that the chemical reaction principle of aldehyde can test diabetes.

3.2.4 Settings for “Anchors”

The pungent smell of formaldehyde can be dissipated by opening the window, it can be speculated that formaldehyde has volatility. Furniture board contains formaldehyde, which is harmful to human health, why should it be added artificially? This inference aroused the students’ strong interest in knowing the reason. How to test diabetes through the chemical reaction principle of aldehydes? Why can it be used to test diabetes? What phenomenon will be seen?

3.2.5 Elimination of “Anchors”

There are reductive aldehyde groups in aldehydes. Thus, aldehydes can react with oxidants. Such as, acid potassium permanganate solution, silver ammonia solution and the new copper hydroxide solution. The urine of diabetic contains glucose, which is a reducing sugar and contains aldehyde group. The red cuprous hydroxide precipitate can be seen after the aldehyde and the new copper hydroxide suspension are heated in the water bath in the test tube. After the aldehydes and the new silver ammonia solution are heated in a water bath in a test tube, students can see the silver substance adhered to the tube wall. The phenomenon of oxidation-reduction reactions between aldehyde group and above weak oxidant can be used to test diabetes. Urea formaldehyde is the product of condensation reaction between formaldehyde and urea. It is a common industrial adhesive. Formaldehyde is cheap, and it is easy to buy and produce. Thus, formaldehyde is widely used by decoration material manufacturers. Formaldehyde is irreplaceable in wood processing industry.

3.2.6 Situation Transfer and Effect Evaluation

The improvement of people’s living standards and the development of human society are inseparable from organic compounds. Aldehydes are also closely related to human life. This lesson discusses the properties of aldehydes. The phenomenon of oxidation-reduction reaction between aldehyde and weak oxidant can reasonably explain that aldehyde can be used to test diabetes in medicine. Formaldehyde, as the raw material for the synthesis of organic compounds, is widely used in the construction and furniture making. Students can understand that chemistry and life are closely linked. This class can cultivate students’ ability of thinking diffusion, finding and solving problems, which fully embodies teachers’ awakening, encouragement and inspiration to students. Teachers take “anchor” as the center to stimulate students’ independent inquiry, make the boring knowledge vivid, and make students keep a high degree of attention to the “core problems” in the classroom, so as to improve students’ learning ability and scientific literacy.

3.3 The Application of Case Teaching Method

3.3.1 Teaching Analysis

Let's take electrophilic Addition Reaction of Olefins as an example. Electrophilic addition of carbon double bond is one of the important reactions in organic chemistry [4]. There are many kinds of electrophilic reagents in this reaction. Different substituents on the double bond also affect the reaction products. The reaction mechanism of electrophilic addition is related to the electronic effect, the electronegativity in the conclusion of hybrid orbital theory, and the stability of carbon positive ions. The connection between knowledge makes the electrophilic addition reaction complex and abstract, which makes students unable to understand. Only when students master the essence of the reaction mechanism can they establish an effective relationship between knowledge. The course takes the introduction of Markovian rule as a teaching case to inspire students to think about the influencing factors of the addition orientation of olefins and halogenated hydrocarbons.

3.3.2 Prepare Case

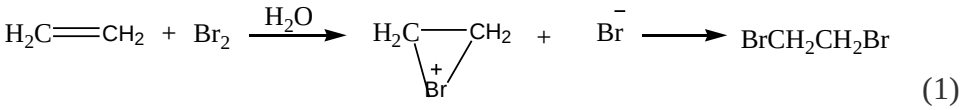
Markovnikov's most famous achievement is his Markovian rule on the electrophilic addition reaction between hydrohalic acid and asymmetric olefin. When the electrophilic addition reaction occurs, the positive group in the electrophilic reagent is always added to the carbon atom with the most hydrogen, while the negative group is added to the carbon atom with the least hydrogen. It is very important to predict the products of olefin addition reaction. What puzzles many people is that the addition products of alkene and hydrogen bromide in the presence of peroxide are contrary to the rules of martensite. It was not until 1933 that M. S. Kharasch discovered that this "abnormal" addition was caused by peroxides, a phenomenon known as peroxidation.

3.3.3 Preview Case

Before class, the teacher arranges students to read the case. Meanwhile, teacher put forward thinking questions: how to explain the Markovnikov Rule, what the relationship between the Markovnikov Rule and the mechanism of learning the electrophilic addition reaction of olefins is, and what the mechanism of anti Markovnikov Rule is. Then the students should extract the key problems in the case and mark them by previewing book. They can have a preliminary understanding of the reaction mechanism of the electrophilic addition through autonomous researching.

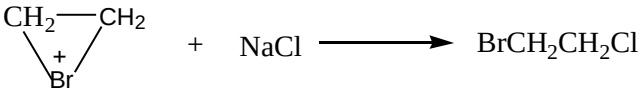
3.3.4 Implementation in Class

In this lesson, the teacher should guide the students to review the induction effect and the stability of carbon positive ions. Firstly, according to the Markovnikov Rule, when the hydrohalic acid reacts with asymmetric alkenes, the hydrogen is added to the double bond carbon atom with more hydrogen, and the halogen is added to the double bond carbon atom with less hydrogen. There is an important conclusion in hybrid orbit theory: electronegativity $p< sp^3 < sp^2 < sp < s$ [5]. The methyl carbon atom is sp^3 hybrid and the double bond carbon atom is sp^2 hybrid. When methyl in propylene is directly connected with double bond carbon atom, methyl shows the property of supplying electrons to double bond carbon atom. As a result, the double bond carbon atom connected with methyl shows positive charge and the other double bond carbon atom shows negative charge. For example, when the addition of hydrochloric acid to propylene it tends to yield 2-chloropropene instead of 1-chloropropene. The hydrogen ions dissociated from hydrochloric acid are first added to the doubly bonded carbon atom with obvious negative charge, while the chloride ions are added to the doubly bonded carbon atom with less hydrogen, so the product 2-chloropropane is generated. Secondly, the teacher gives the chemical reaction equation of the reaction between ethylene and sodium chloride containing bromine step by step, students can see the reaction mechanism more directly. According to this chemical reaction equation (1), the first step is to add a bromine ion to the double bond carbon to form a bromonium ion.



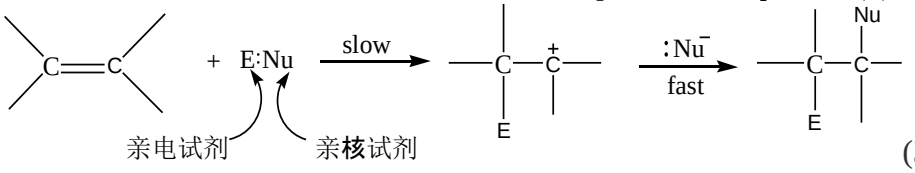
(1)

Then the nucleophilic group chloride ion competes to add another carbon atom of the double bond as equation (2).



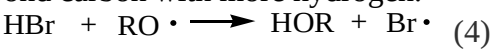
(2)

It can be inferred that the electrophilic addition reaction is divided into two steps, that is, the electrophilic reagent attacks the double bond to form the reaction intermediate, and then the nucleophilic reagent combines with the intermediate to form the addition product as equation (3).

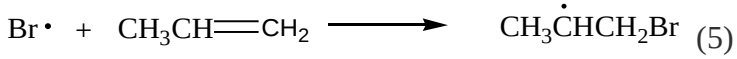


(3)

But it is also mentioned in the case that Markovnikov Rule cannot solve all problems. In the presence of peroxide, the addition products of olefin and hydrogen bromide are contrary to the Markovnikov Rule. M. S. Kharasch found that this “abnormal” phenomenon was caused by the peroxide effect, which led students to think about how to explain the Anti Markovnikov Rule? Teacher shows the free radical addition reaction of propylene and hydrogen bromide in the presence of peroxide as equations (4) (5) (6). The stability of free radicals is: the third-order carbon radicals > the second-order carbon radicals > the first-order carbon radicals > the methyl radicals. Therefore, in the second step of the reaction, more stable free radicals are formed. Finally, products of Anti Markovnikov Rule addition are formed [6]. Then the reaction mechanism of Anti Markovnikov Rule can be got: in the presence of peroxide, the addition product of alkene and hydrogen bromide is contrary to Markovnikov Rule, that is, hydrogen addition to double bond carbon with less hydrogen, while halogen addition to double bond carbon with more hydrogen.



(4)



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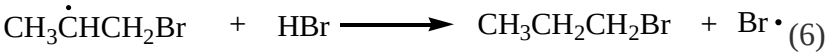

(6)

The Table 1 gives examples of other applications of anchored teaching method and case teaching method.

Table 1. The application of two teaching methods in other chapters

The anchored teaching method	The case teaching method
1. Alkanes: Teachers start teaching with alkane in cosmetics as context. Cosmetics are closely related to life and well known to students. The establishment of this situation will stimulate students’ interest in learning. They master the physical and chemical properties of alkanes in the process of active exploration. Students recognize the importance of organic compounds in life, and then attach importance to the study of Chemistry. 2. Aromatic hydrocarbon: Hygiene ball is a daily necessity. The teacher introduces its properties and the role of preventing moths from eating the clothes, and guides students to explore the core problem of this lesson that is the nature and structure of naphthalene. 3. Trans fatty acids: The teacher introduces trans fatty acids and artificial trans fatty acids, and introduces them into the topic by using the trans	1. The concepts of optical isomerism and chiral structure in the study of isomers: The teacher tells the case of “thalidomide” which is caused a sensation in Europe in the 20th century, and guides the students to explore the factors that the drug causes infant teratogenesis. Two isomers of thalidomide, R-configuration and S-configuration, were introduced to deepen students’ understanding of optical isomers and grasp the abstract concept of chiral structure. 2. Organic chemistry is closely related to science. Scientists have made great achievements in the process of exploring the mystery of organic chemistry, which is closely related to their diligent and rigorous learning attitude and the spirit of innovation and exploration. This can also be used as an “inspirational case” when giving a lecture. Such cases can not only make students realize the

fatty acids contained in college students' favorite food. Students can explore the chemical structure of trans fatty acid.	importance of this lesson, but also improve their scientific literacy, and help students build up the confidence that they can learn organic chemistry well as long as they work hard [7].

4. Conclusion

In the three semesters of teaching practice, teachers observed the learning performance of six major students in organic class, and analyze their final grades. The anchor teaching method and case teaching method are introduced into the teaching of organic chemistry, which effectively improves students' learning attitude and emotional attitude towards organic chemistry. The heuristic and guiding teaching mode realizes the goal of improving teaching efficiency, improves the practical application ability of students, cultivates the ability of independent learning and arouses students' innovation consciousness. These two kinds of teaching methods meet the needs of quality education and ability training in today's society.

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