

# Application of Flipped Class Model in Teaching Elemental Compounds of Inorganic Chemistry-The Example of Teaching Practice on Carbon Group Elements

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## Abstract

The flipped class model is applied to the teaching process of carbon group elements, which fully reflects the effective teaching of "student-oriented and teacher-led". The students complete the "learning first" according to their self-study task list before class. The class's QQ group, wechat group and other social softwares communicate and interact with teachers and students online, and the cloud class topic database is used to detect the feedback effect of learning first. In class, teachers collect the feedback information of students' "learning first", carefully design the teaching process of "fixed teaching" problem inquiry, and encourage students to participate actively. After class, teachers and students can further communicate and interact online. Students can conduct self-awareness, self-reflection, self-evaluation and self-regulation of the learned knowledge unit, complete knowledge construction and improve students' metacognitive ability.

**Keywords:** Flipping class model; Mindmap; Elemental compounds; Inorganic chemistry

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## 1. Introduction

Inorganic Chemistry is a compulsory basic professional course for all kinds of chemistry majors. It is the first professional theory course for chemistry majors, which is closely related to what they have learned in middle school, and also the basis for subsequent courses (such as physical chemistry, analytical chemistry, etc.). Inorganic chemistry courses generally include three knowledge modules, one is the principle of chemical reaction, the second is the basis of substance structure, and the third is the element compound. Among them, the content of element compounds is more and the knowledge is complicated. However, students' high school chemistry learning habit tends to memorize knowledge of element compounds, and they are not good at combining theory with practice, and have little interest in learning, and ignore their integration with the principle of chemical reaction and the basis of substance structure (Fan, et al., 2022; Wei, et al., 2021).

## 2. Problems in the teaching of elements and compounds

### 2.1 Theoretical teaching of elements and compounds is disconnected from experimental teaching

In junior and senior high schools, due to the limitation of experimental conditions or the pressure of admission, there is a phenomenon that teachers teach experiments in class and students memorize experimental conclusions. Some of the better secondary schools have few student experiments and more classroom demonstration experiments. However, the phenomenon that freshmen's overall experimental ability is weak is universal. Knowledge of elements and compounds comes from the summary of experimental facts or life production practices. If middle school can attach importance to the teaching combining experiment and theory, it can improve students' interest in learning chemistry and enhance their ability of learning chemistry. Does the teaching of elements and compounds in college combine theory with practice? There are many college chemistry experiment courses, which are complete, but the element compound part has the phenomenon of experiment before theory (Li, et al., 2022).

### 2.2 Students do not adapt to the teaching methods at university level

In junior high school, elements and compounds account for a small share of the high school entrance examination, teaching hours are relatively loose, and students are basically in a state of zero foundation. Teachers usually use "chewing" to indoctrinate students in batches, and students' learning is relatively easy. In senior high school, with the deepening of curriculum content, the difficulty of various subjects is increasing, and students are nervous about learning, so every minute counts for the college entrance examination. The learning of elements and compounds seems to be simple, blindly using the way of reciting. Although college inorganic chemistry does not have the pressure of further study, it contains more contents. Various chemical reactions, as well as whether theory can be combined with practice in relation to the change law of the nature of elements and compounds, and how to explain the principles of chemical reactions and the theories based on the structure of

substances that have been learned, are the teaching objectives of testing whether the knowledge of elements and compounds has been effectively learned and applied. In the teaching process, a large number of relevant information swarmed in. Teachers were tired of teaching in order to catch up with the teaching schedule, and students tried their best to keep up with the pace. This teaching mode neither fully taught the designed content to students, nor did it have an effective way to teach students to learn this part of content independently. It is the common feeling of inorganic chemistry teachers in our school that both teaching and learning have not achieved a win-win situation.

### 3. Development of flipped class model

#### 3.1 Disadvantages of traditional classroom teaching mode

No matter in middle school or university, teachers still prefer the traditional class teaching mode. The teaching mode of "blackboard writing + explanation + ppt" is mainly adopted in middle schools. Due to the short class hours and complex and comprehensive content, universities tend to adopt the teaching mode of "ppt + explanation". Traditional teaching mode in middle school can improve the efficiency of classroom teaching, "squeeze time" to carry out the tactical training. The traditional teaching mode helps teachers to complete the teaching plan more easily. In addition, in recent years, students majoring in chemistry in different universities come from different provinces, and there are differences in chemistry elective subjects in high school. Students have obvious differences in chemistry foundation, which makes the traditional teaching model of the classroom lack of vitality, and students with weak foundation cannot understand and keep up, and students with good foundation feel that the learning content of middle school is repetitive and boring (Li, et al., 2018; Hu, et al., 2016).

#### 3.2 Reform of teaching model in the era of "Internet Plus"

After the intense college entrance examination, freshmen enter the university with greater freedom, and their learning motivation is temporarily lost. Traditional university classroom teaching mode is difficult to stimulate students' interest in learning, so it is urgent to stimulate students' interest in learning by new teaching mode, cultivate students' innovation, and let students ignite new goals. With the development of science and technology, the classroom teaching mode is changing constantly, from traditional teaching to multimedia teaching, and then to information teaching. Now belongs to the "Internet +" era, focusing on innovation and integration, school education is also facing new changes to adapt to the development of The Times. The demand of individualized development of students, the relationship between teachers and students tends to be equal in classroom teaching, and the change of learning time and space all require a new classroom teaching mode.

#### 3.3 Flipped class model bearing the mission of The Times

From the traditional teaching of "teach before you learn" to the flipped class model of "learn before you teach", the teaching process has realized the flipped teaching time sequence. Flipped class can be regarded as a kind of "Internet +" class teaching model. Flipped class "learn before teach" and commonly known as the three-stage teaching "independent preview before class, classroom teaching expansion, after-class practice consolidation" although there are similarities in appearance, but there are differences in spirit. The Internet, micro-class videos and learning materials provided by teachers are the first carriers of flipped class learning, while the traditional preview of students is mostly limited to teaching materials and auxiliary materials. The post-teaching of flipped class, whether offline classroom teaching or online communication after class, has changed from a single inspection of students' pre-class preview and the effect of lectures in class to equal interaction between teachers and students in class and after class. The needs of students' personalized development are fully reflected, and teaching is determined by learning to realize hierarchical "teaching" and "learning" (Wei, et al., 2022; Akcayir & Akcayir, 2018; Athavan Alias Anand, 2021; Awidi & Paynter, 2019).

### 4. Flipped class teaching design with carbon group elements

#### 4.1 Design should be learned first in flipped class with carbon elements

The inorganic chemical element compounds section introduces the carbon group in the P-zone element (1), mainly involving carbon, silicon, germanium, tin, lead five elements, these five elements and their compounds are involved in the existence, preparation, properties and applications. Junior high school chemistry (human education edition) introduced carbon and carbon oxides, and senior high school (human education edition) studied silicon and its compounds and carbon nanomaterials, paying more attention to the application and development of learning materials. Flipped class should have the foundation of flips, not "flips". It can be found from the mind map of carbon group elements in different learning stages that carbon group elements are involved in middle school and high school, and students have a good knowledge foundation. Record the content related to advanced materials and technological development, such as the application of carbon nanomaterials in lithium-ion batteries, textiles, silicon and silicate in chip industry and ceramics industry, as materials combined

with the knowledge framework of carbon group elements, and upload the relevant literature, self-study courseware, pre-learning task list and self-testing guide case to the cloud class resource library before class. Students are required to complete the corresponding contents according to the pre-study task list before class, and complete the pre-study test on time through the cloud class exercise detection system.

#### *4.2 Online "learning first" is of high quality, while offline "fixed teaching" is guaranteed*

Students in our school come from different provinces and families with different backgrounds. Some students in remote areas are not proficient in using network resources and obtaining information. However, in recent years, due to the epidemic, many middle schools have been exposed to online teaching, and the vast majority of students have basically learned how to use computers and search online resources. Before class, the cloud class exercises test students' understanding and memory of knowledge points, reflecting students' lower-order thinking ability. "Learning first" is the first step of flipped class, in which teachers and students complete role transformation. Before class, teachers evaluate and predict students' low-order thinking ability based on the collected test results of questions and exercises raised by students in the process of independent learning. College students' knowledge base and learning ability must be different. How to ensure the quality of "learning first" before class is the guarantee of realizing effective "teaching determination" after class.

#### *4.3 Complete "learning before teaching" and effectively realize after-school internalized learning*

Prior to the study of elemental compounds, students have studied the principles of chemical reactions and the fundamentals of the structure of matter. When learning the change rule of the nature of elemental compounds, such as the thermal stability of carbonate and the change rule of the melting and boiling point of halogen hydride, it is necessary to analyze and judge the basic knowledge of the material structure. Through the mind map, the complex and disordered knowledge points of elements and compounds are connected by structural lines to guide students to complete them before class, show their achievements in class, supplement and improve them, and further internalize the knowledge points.

#### *4.4 Promote teaching by evaluation, promote learning by evaluation, teaching and learning*

Evaluation of regulating the teaching process and stimulating students' learning initiative. Teachers make quantitative evaluation on students' pre-class testing, in-class tests and homework, and qualitative evaluation on students' ability to raise, analyze or solve problems in flipped class activities, teamwork spirit, and various demeanor captured by students. Teacher evaluation and student mutual evaluation, as well as formative evaluation combined with terminal evaluation, make students participate in teaching activities with stronger confidence. Online and offline scientific evaluation of students' learning effects, promoting students' self-awareness, self-reflection, self-evaluation and self-regulation of knowledge units, and completing knowledge construction, is conducive to students' improvement of their metacognitive ability and realization of the teaching goal of deep learning. Students are encouraged to participate in classroom exploration activities, display their works of mind maps of elements and compounds online, and guide students to carry out mutual evaluation, which helps students to further process the knowledge they have learned and realize the internalization of knowledge structure. Students can also evaluate the "pre-learning" materials provided by teachers before class, such as whether they can effectively link up the basis of chemistry learning in middle school and whether they can lead students to independently learn new knowledge. According to the evaluation structure of students, teachers further optimize the design of "fixed teaching" classroom teaching activities, so as to realize teaching and learning.

## **5. Conclusion**

The knowledge module of elemental compounds involves a wide variety of elemental compounds and their compounds, and the knowledge points are scattered. To master this part of knowledge, it is necessary to have a large memory capacity of rote memorization, and the learning effect is not good. Knowledge of elements and compounds is closely related to daily life and industrial production. Flipped class teaching design should focus on pictures and videos related to life and production as materials for students to learn micro-class videos first, so as to stimulate students' learning interest and responsibility. Learning elements and compounds well can realize the unity of personal value and social value and realize the application of knowledge. In addition to the internalization of knowledge points, flipped class teaching should also introduce cutting-edge achievements and latest research trends of modern inorganic chemistry, enhance interactive learning between teachers and students offline, add discussion teaching online, and integrate various teaching strategies to improve students' enthusiasm.

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