

# Teaching Reform of General Chemistry for “Curriculum Incorporating Ideological and Political Education” in Agricultural Universities of China

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**Abstract:** Under the background of reform of curriculum incorporating ideological and political education, this paper explores the ideological and political education elements contained in general chemistry courses to realize the transformation from the main channel of the ideological and political course to the three-dimensional education pattern of the curriculum incorporating ideological and political education. Based on general chemistry course as an example, this paper expounds the feasibility, implementation and effect of the reform of "ideological and political curriculum". Fully integrate the new ideas of the new era into the curriculum construction, into the syllabus, teaching plan and classroom. Through the reform, no matter from the students' mental outlook, words and deeds, classroom performance, the students' response is positive. Also questionnaires were used to evaluate the effect of "curriculum thinking and politics". The combination of explicit education and implicit education can improve students' ideological and political quality, strengthen their ideals and beliefs, cultivate their scientific spirit, set up their ecological civilization thoughts, and cultivate their scientific outlook on environment and resources, enhance their awareness of environmental protection and sense of responsibility, strengthen self-worth affirmation. The teaching reform has made full use of the moral education in the specialized courses and achieved certain results.

**Keywords:** General Chemistry, Ideological and Political Education, Teaching Reform, Agricultural University

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## 1. Introduction

Curriculum ideology and politics is a new long-term operating mechanism and collaborative innovation mechanism. Under the complex background of intertexture and infiltration of multi-social values, the traditional ideological and political education in colleges and universities faces with various impacts and challenges, which make the content of ideological and political education have a revolutionary. Since 1994, China's ideological and political education has been 10 years of practice and development, from initial exploration to take the initiative to build into an in-depth development period. In 2004, Shanghai took the lead in initiating ideological and political education reform. Many university teachers have begun the investigation on

transformation of curriculum incorporating ideological and political education into General Chemistry (or Inorganic Chemistry) [1-4] and achieved some encouraging results [5, 6]. The transformation of curriculum incorporating ideological and political education can overcome the disadvantages of traditional ideological and political education and establish a new learning atmosphere for college students. In this case, the teaching of enzyme catalysis and kinetics in general chemistry was taken as an example to demonstrate the idea and method of curriculum incorporating ideological and political education into teaching, as well as the corresponding teaching effect.

## 2. The Feasibility of Ideological and Political Education Reform in General Chemistry

### 2.1. Government Support

Chinese President Xi Jinping, also general secretary of the Communist Party of China Central Committee and chairman of the Central Military Commission, stressed the importance of using the thought of socialism with Chinese characteristics to educate and guide students to strengthen their confidence in the path, theory, system, and culture of socialism with Chinese characteristics and to promote students' patriotism [7]. Since 18th, Xi has attached great importance to the development of China's higher education and ideological and political education in colleges and universities, and has published a series of important statements about: "The ideological and political work in colleges and universities is related to the fundamental problem of what kind of people colleges and universities cultivate, how to cultivate people and for whom"; "In order to make good use of the main channel of classroom teaching, ideological and political theory courses should be strengthened through improvement, so as to improve the affinity and pertinence of ideological and political education and meet the needs and expectations of students' growth and development"; "Each other course should keep a canal and plant a good responsibility field, so that all courses and ideological and political theory courses go together, forming a synergistic effect" [8]. Xi stressed that "efforts should be made to strengthen ideals and beliefs", "to cultivate patriotism", "to increase knowledge and insight", "to cultivate the spirit of struggle" and "to enhance overall quality".

In 2008, the ministry of education issued the implementation outline of the project to improve the quality of ideological and political work in colleges and universities, and some opinions on strengthening the construction of "situation and policy" courses in colleges and universities in the new era, and deployed and promoted "ideological and political courses" nationwide. The general offices of the Communist Party of China Central Committee and the State Council have issued a guideline on strengthening reform and innovation of ideological and political theory courses. Therefore, the reform of ideological and political education has a clear background of the time and a practical necessity.

### 2.2. The Advantages of the Course

General chemistry is a comprehensive introduction to the whole picture of chemistry, the branches of chemistry, the basic principles of chemistry and the frontier of modern chemical research, etc. In agricultural colleges and universities, general chemistry is an important basic course for learning agricultural knowledge, such as physical chemistry, analytical chemistry, plant physiology, biochemistry, animal physiology and biochemistry, soil science, fertilizer science and water chemistry, etc. Many principles and methods of common chemistry are used in the courses of feed analysis, food analysis,

fruit and vegetable processing and storage. Though the study of general chemistry, it can cultivate students' abilities of cognition, observation, thinking, experiment and self-study. General chemistry contains rich ideological and political education elements and can carry and play the function of ideological and political education. Therefore, the reform of "Curriculum incorporating ideological and political education" in general chemistry is in line with the background of The Times and it has important practical significance.

### 2.3. The Advantages of the Students

In agricultural colleges and universities, the courses of general chemistry are offered to more than 1000 students every year. It is of great significance to carry out the ideological and political aspects of curriculum. General chemistry is the first course related to chemistry for college students. Freshmen are experiencing the transformation from high school to college, the change of teaching methods, the transformation of psychology, morality and ethics, and also facing the new requirements of interpersonal relationship and social adaptability [9]. Freshmen are young and in the formation period of outlook on life and values. They are energetic, energetic, capable of accepting new knowledge, courage and emotional, but their psychological, thoughts and development are not yet mature. So it is more favorable for general chemistry teachers to carry out ideological and political education. Therefore, in teaching, we should strengthen the function of ideological and political education, integrate the ideological and political elements into the course teaching, and guided the students to learn how to behave, work, and get along with others, and so lay a solid foundation for the future towards the society and serving the society.

## 3. The Way to Implement "Curriculum Ideology and Politics" in General Chemistry Teaching

### 3.1. To Improve Teachers' Awareness of "Curriculum Ideology and Politics"

Abandoning the idea that ideological and political education is only the primary responsibility of counselors and teachers of ideological and political theory. All kinds of courses in universities should go together with ideological and political theory courses. In the new era of highly developed society, the problems caused by relying solely on teachers and counselors of ideological and political theory course to guide college students' thoughts have become increasingly significant [10]. It is an important task to strengthen the consciousness of ideological and political education in the teaching of non-ideological and political courses and to promote the teachers of specialized courses to participate in the great practice of ideological and political education consciously. Teachers should stand on the strategic height of "ideological and professional" to train people, rather than teaching professional courses as simple knowledge imparting.

From the height of ideological and political education, teachers also should set high standards for themselves, cultivate morality and cultivate morality, and keep the right direction and the overall situation and consciously integrate the idea of ideological and political education into professional courses. Only when teachers realize the importance and necessity of ideological and political education, can they form the inner demand of developing ideological and political education, actively improve the ideological and political literacy and ability of ideological and political education, carefully study the teaching materials, strive to excavate the ideological and political elements in the teaching materials, organically combine teaching with ideological and political education, and form an effective self motivation mechanism [11].

Our general chemistry course is taught by eight teachers, so there must be professional teaching team spirit. Teachers have limited personal ideological and political skills, so we should play a team spirit and jointly explore the ideological and political elements of common chemistry courses, so as to better realize "preach, impart knowledge and solve doubts"

### 3.2. Explore the Ideological and Political Elements of General Chemistry Curriculum

General Chemistry contains rich educational elements, which not only has great intellectual value, but also has great spiritual and moral value, and it shows the unity of science, knowledge and thought. While learning scientific knowledge, proper application will enable students to enhance ideological and political literacy, improve ideological and moral level, establish a correct outlook on world, life and values, and promote the coordinated development of students' moral governance. Chemistry teachers are required to excavate the ideological and political elements in the general chemistry curriculum.

For example, the properties, vapor pressure lowering,

freezing point depression, boiling elevation, and osmotic pressure, are known as the colligative properties of solution. When it comes to the colligation of dilute solutions, osmotic dehydration technique can be introduced. Osmotic dehydration technology plays an important role in the food industry. It has a long history to pickle vege and meat, honey and sugar of fruits by osmotic dehydration technology. With the mature understanding of osmosis theory, dehydration technology has been transferred from the traditional method to the combination of drying, freezing, sterilization, pot storage and other methods, so as to better maintain the quality of processed fruits and vegetables and reduce the processing energy consumption. With the development of science and technology, the combination of traditional technology and modern technology can achieve complementary advantages. By learning this knowledge, students can be trained to have the vision of development, respect the development of science and technology, and become scientific, technological and management talents in the manufacturing industry in line with the trend of the times and China's national conditions. In this part of knowledge, poor milk powder events can also be introduced, one is to let students better understand the phenomenon of osmotic pressure; the other is to improve students' sense of morality and responsibility. The Chinese nation has a fine tradition of honesty since ancient times. Zeng Zi once said, "Words must be followed, deeds must be followed". We can't forget our interests and integrity. In the history of China's chemical development, many famous people emerged, such as Professor Xu Guangxian, Yuan Longping, etc. Through the introduction of historical figures, students' patriotic enthusiasm, learning motivation and cultural self-confidence are stimulated. The following is a list of the fusion points of some contents and ideological politics in the general chemistry textbook (Table 1), which is made by the teachers of our general chemistry group.

Table 1. Integration points of Ideological and political elements in general chemistry textbooks.

Chapter	Content	Integration points of ideological and political elements
The introduction	The history of chemistry	Four great inventions in China; China's leading metal smelting technology in the world, etc. Enhance students' national pride and cultivate students' patriotic spirit.
Thermodynamic basis	The concept of process and approach	As long as the initial state and the final state are fixed, the change in the state variable is the same regardless of the path. All roads lead to Rome! Encourage students to set goals.
	The first and second laws of thermodynamics	The first and the second kind of perpetual motion machine cannot be made. To seek truth from facts, understand science, respect science, arm scientific mind!
	Spontaneous change and entropy	Personal desire is the tendency of natural development, that is, the process of increasing entropy. We need to increase negative entropy by cultivating ourselves, exercising our bodies, and consciously doing things that make disorder become order, so does society.
Chemical equilibrium	Factors that affect equilibrium movement	The principal contradiction and the secondary contradiction; the movement of balance, or even the reversal of direction, reflects the law of mutual transformation between the two sides of the contradiction [3].
Dynamic basis	Gibbs free energy criterion and catalyst action	Professor Qian Yitai, an expert in the chemical preparation of nonmaterial at the university of science and technology of China, whose research results were published in Journal Science, and were highly praised by scientists around the world as "straw turns to gold" [12]. The students' ideals and beliefs are enhanced, and a new pattern of collaborative innovation between Marxist theory and specialized course teaching can be constructed [1].
	Pauling approximate energy level diagram	By introducing the " $n + 0.71$ " rule proposed by Chinese chemist Professor Xu Guangxian, its role in determining the energy level of the ground state multi-electron atomic orbital is demonstrated. At the same time, the glorious history of professor Xu Guangxian's can be introduced for his hard study, successful return and dedication to the motherland to inspire students to carry forward the national spirit with patriotism as the core and the spirit of the times with revolutionary innovation as the core [13].

Chapter	Content	Integration points of ideological and political elements
Periodicity of element	Development of atomic structure models	From Dalton's theory of the atom to quantum mechanical models, the structure of the atom has been known for more than 100 years. There is no royal road in life, and there is no royal road in scientific research. Students should not be discouraged in the face of setbacks and not be complacent in the face of honors.
	Periodic table	Materialist dialectics and scientific epistemology, universality and particularity. Train students to recognize regularity and find particularity [3].
	Superconducting material	Enhance students' ideal and belief by introducing the outstanding contributions made by Chinese scientists in improving the transition temperature of various superconducting materials, which is the world record of "China's artificial sun" [14].
	Precipitation and dissolution equilibrium	Introduction to constructed wetland. Starting from the development concept of "green water and green mountains are golden mountains and silver mountains" and the classic discussion of General Secretary Xi Jinping's ecological civilization thought, enlighten students' ecological civilization ideas, and make students further enhance their awareness of environmental protection and ecological civilization ideas.
Molecular structure	Precipitation formation	By displaying the works of Liang Yan, a Chinese student studying abroad, and appreciating the beautiful blockbusters in the chemistry laboratory, we can turn the dull chemical reaction equations into art appreciation and increase students' interest in learning and cultivate their artistic feelings.
	Precipitation formation	The relationship between quantitative change and qualitative change. As the concentration of the ions that make up the insoluble strong electrolyte increases, the ion product gradually increases, and precipitation will be formed when it exceeds the solubility product. Borrow things to describe people, whether it is to study or exercise, put them into action, over time, it will change from quantity to quality.
	The solubility product rule	The same particle effect and the salt effect
	The same particle effect and the salt effect	Main contradiction and secondary contradiction.
Properties of solution	Crystal type	"Allotrope of carbon". By changing the connection between carbon atoms, materials with different properties can be obtained. For example, graphite, diamond, carbon nanotubes, graphene have different properties. This example tells students that even though the composition is the same, it can have different properties after being forged [15].
	Crystal type	In 1996, three scientists won the Nobel Prize for chemistry for the discovery of fullerenes. In medicine and skin care, C60 fullerene has been proven to be a powerful free-radical scavenger, a powerful antioxidant. Since 2005, Japanese media began to report about the skin care ingredient "vitamin C60 free radical sponge" developed by using C60 fullerene, which is also the skin care products containing fullerene began to appear one after another. Learning knowledge is not limited to the subjects we have learned. We should learn and use the theories and methods of other subjects boldly and actively, and move forward to interdisciplinary subjects.
	Crystal type	By introducing the story Cao Yuan, a 22-year-old doctor, who was in the list of the world's top scientific figures in 2018, it inspires young people's spirit of scientific research and encourages students to be self-affirmation and self-motivation.
	Valence bond theory	Through the development of valence bond theory, we can see that when the existing hypothesis contradicts with the new experimental results, it will promote the formation of a new hypothesis. Cultivate students' ability of active learning, scientific thinking and innovation.
Acid-base equilibrium	Intermolecular forces-hydrogen bonds	The beautiful snowflakes are formed by hydrogen bonds of water molecules, which reflect the symmetrical beauty of material form. Students' aesthetic education and art can be cultivated [1].
	Intermolecular forces-van der Waals forces	Introduce the theory of similar dissolve mutually, and borrow things to describe people: "No common goal, no common cause to cooperate."
	One of the colligations of a dilute solution-Raoult's law	Raoult's law is an empirical formula summed up through a large number of experimental studies, which teaches students not to relax, not to give up, and learn to insist.
	One of the colligations of a dilute solution - osmotic pressure	Ocean salinity gradient energy. International leaders in salt-energy generation are the United States, Norway, the Netherlands and Israel. In 2008, Norway completed the world's first osmotic differential energy power plant [16], and plans to build a full scale demonstration by 2020. Motivate students to lay a good professional foundation for the future to overcome technical reserves of energy.
Redox balance	One of the colligations of a dilute solution-saturated steam pressure drop	Principle of Marine salt differential generation by vapor pressure. One of the bottlenecks, will there be a butterfly effect chain reaction? Any scientific problem requires a rigorous attitude and careful consideration. No development should be carried out at the expense of environmental problems.
	Ionization theory	Introduce the story of Arrhenius' unremitting efforts to establish the ionization theory, and his courage to challenge authority without being afraid of cynicism. It demonstrates the role of innovative thinking to challenge authority in scientific discovery [3].
	Buffer solution	The soil has a certain buffering effect. However, impurities in discipline of the United States have reported that since the early 1980s, the pH of almost all soil types found in China has decreased by 0.1 to 0.8 units. This scale of soil acidification "usually takes hundreds of thousands of years". Everyone has the responsibility to protect the environment, to arm him with knowledge and to contribute to environmental protection.
	Structure of primary battery	In 1991, Chinese scientists pioneered a new battery made of aluminum-air-sea water, which is used as a navigation marker lamp. Through the introduction of the navigation sign lamp, the students' ideal and belief can be enhanced.
Coordination equilibrium	Redox reaction	Introduce the phenomenon that rice often encounters black root and rotten root in the process of cultivation, which leads to short seedling, and the problem needs to be solved by redox knowledge. Introduce Mrs. Green's tooth story, etc and emphasize the importance of learning and understanding knowledge.
	The development of coordination theory	Introduce the story of professor Dai Anbang, the pioneer of coordination theory in China, who studied rigorously and brought up the younger generation. Praise scientists rigorous spirit of scholarship, spirit of inquiry, lofty scientific quality, cultivates students' scientific spirit and scientific attitude.

### 3.3. Enrich Teaching Methods and Means

#### 3.3.1. Take the Method of Combining Theory with Practice

We combine the textbook knowledge with the actual situation. For example, when it comes to the knowledge that the freezing point of dilute solution is reduced in the dependence, examples such as snow road salt spreading and anti-skid, automobile antifreeze, ice bag cooling principle, etc, can be introduced.

#### 3.3.2. Introduce the Latest Scientific Research Achievements

We introduce some scientific frontier and current hot researches, which can stimulate students' spirit of patriotism, love of science and love of scientific research. For example, when it comes to the introduction of molecular structure, the story of Cao Yuan, a 22-year-old doctor [17], who was in the list of the world's top scientific figures in 2018, can be introduced. Cao Yuan created a new research field in physics,

which is expected to improve the efficiency of energy utilization and energy transportation. Introduce the latest scientific research achievements of young people to encourage students to carry out scientific research and exploration and stimulate their learning motivation.

#### 3.3.3. Enrich the Teaching Courseware

We make courseware for each page carefully. The introduction of animation and video enhances the sense of image, beauty and logic, making it easier for students to understand and absorb new knowledge. When the equation of precipitation is given, the beautiful pictures formed by precipitation are inserted, which can be easier to attract the students, and also cultivate the students' artistic aesthetic ability. When it comes to the theory of hybrid orbit, the animation of hybrid process is introduced, which makes the abstract and complex knowledge easy to understand.

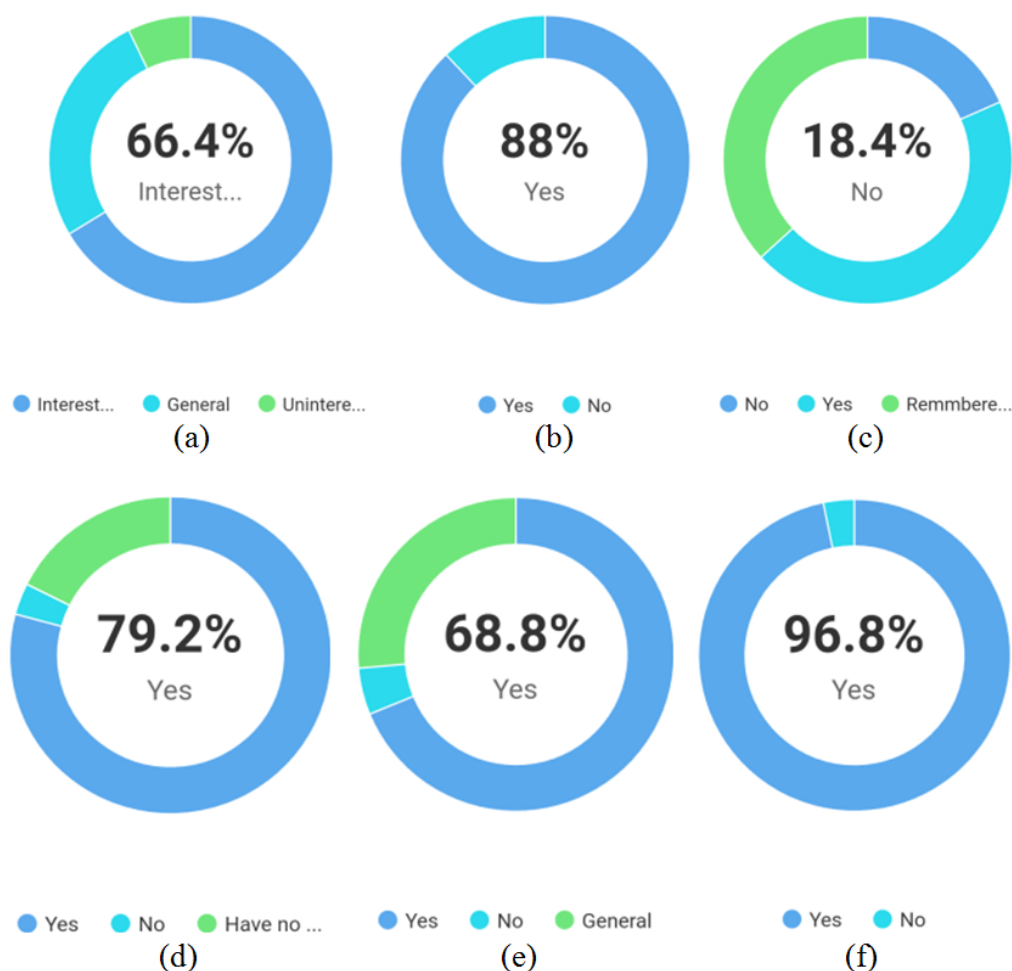


Figure 1. Questionnaire results.

(a) "Were you interested in learning chemistry in middle school?"

(b) "Have you increased interest in chemistry after a semester of study?"

(c) "In general chemistry (Inorganic Chemistry) course, the way of Ideological and political learning is introduced, such as the introduction of common sense of life, scientific frontier, excellent scientists and other cases into the chemistry classroom. After one semester of learning, are you impressed with the cases?"

(d) "Have the ideological and political cases in class improved your scientific attitude?"

(e) "Does the introduction of Ideological and political cases improve your ability to analyze and solve chemical problems?"

(f) "Are you motivated to be a responsible, useful person with responsibility and action?"

## 4. Result of Ideological and Political Reform

The evaluation of the teaching effect of ideological and political education is not a simple and quantitative thing. It has both the short-term and long-term aspects, both the explicit and the implicit aspects [18]. After the reform, we carried out a questionnaire survey on the ideological and political teaching of the general chemistry course. The students who participated in the questionnaire survey were 125 students in four classes, i.e. the 19 level environmental major and the applied chemistry major. When asked "Were you interested in learning chemistry in middle school?" There were 66.4% students answered "Yes" (Figure 1 (a)), and 88% students answered their interest in chemistry after a semester of study increased (Figure 1 (b)). Through ideological and political integration into the classroom, the vast majority of students can remember the cases that the teacher told in class (Figure 1 (c)), 79.2% of the students think it is helpful to form a serious scientific attitude (Figure 1 (c)), and 68.8% of the students think it can help to improve their ability to solve and analyze chemical problems (Figure 1 (e)). 96.8% students are motivated to be a responsible person, a responsible and useful person (Figure 1 (f)).

Teaching effect of ideological and political education also can be reflected by students' words, deeds, gods and feelings in class. Through the reform, no matter from the students' mental outlook, words and deeds, classroom performance, the students' response is positive. Through this kind of imperceptible and penetrating way of ideological and political education, moral education and intellectual education can promote each other and improve students' enthusiasm and initiative in learning this course.

## 5. Conclusion

Curriculum carries ideological and political education and ideological and political education resides in Curriculum. General chemistry, like all others, is the main field of education. The duty of a teacher is to teach and cultivate. In the course of ideological and political education, on the basis of grasping the connotation of ideological and political education, teachers internalize the concepts of teaching and educating people in their hearts, excavate the ideological and political elements, and integrate the elements of ideological and political education into every link of teaching, so as to achieve the goal of cultivating morality, cultivating people and nourishing things silently.

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