
MODERN APPROACH TO TEACHING PHYSICAL AND COLLOIDAL CHEMISTRY AT UNIVERSITY

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Abstract

This article explores modern methods of teaching physical and colloidal chemistry in higher education. Innovative approaches aimed at increasing the effectiveness of learning and active interaction of students with educational material are highlighted. Methods are considered that promote the development of critical thinking, the practical application of theoretical knowledge and the formation of skills in physical and colloidal chemistry. Attention is paid to the use of modern educational technologies, interactive forms of learning and student collaboration in the educational process.

Keywords: Modern teaching methods, physical chemistry, colloidal chemistry, innovative approaches, active interaction of students, development of critical thinking, practical application of knowledge, modern educational technologies, practical skills, integration of knowledge.

Introduction

Physical chemistry is a branch of chemistry that analyzes the fundamentals and principles of chemical processes using the laws of physics. At universities, teaching physical chemistry plays an important role in developing the professional skills of future chemists and researchers. With the passage of time and the development of technology, approaches to teaching physical chemistry are also undergoing changes aimed at making them more effective, interesting and in line with modern requirements. A key element of the modern method of teaching physical chemistry is the active use of the latest technologies. The use of interactive demonstrations, virtual laboratories, and simulation programs allows students to visualize complex concepts and conduct virtual experiments [2].

This is not only exciting for students, but also promotes deep learning of the material.

Another important aspect is the integration of interdisciplinary knowledge. Modern physical chemistry is closely interconnected with physics, mathematics and computer science. Teachers encourage students to study not only chemistry, but also related disciplines, expanding their understanding and helping them see the connections between different fields of science. Particular attention is paid to the development of practical skills. Students apply theoretical knowledge in practice by performing laboratory work, modeling chemical processes and analyzing the results. This not only deepens your understanding of the material, but also develops research and analytical skills useful in your future career. Another important element of the

modern approach is support for individualized learning. Students have the opportunity to choose specialized courses and use a variety of learning methods to suit their preferences and learning styles. This ensures that each student maximizes their potential and prepares them for professional careers in their respective fields. The purpose of this study is to thoroughly analyze and evaluate the current approach to teaching physical chemistry at university. Through a comprehensive examination of the latest methodologies and technological innovations applied in the educational process, the study aims to determine the effectiveness of such approaches and their impact on the level of education in the field of physical chemistry.

Key research objectives include:

1. Research of modern educational technologies: Analysis of available methods of teaching physical chemistry, including virtual laboratories, interactive demonstrations and simulation programs, in order to identify their impact on student learning and motivation.
2. Exploring an interdisciplinary approach: Assessing the integration of physical chemistry with other scientific disciplines such as physics, mathematics and computer science, and identifying the benefits of such an approach in developing an integrated vision of scientific knowledge.
3. Analysis of practical aspects of training: Consideration of the role of practical classes, laboratory work and the use of real research methods in the development of students' skills and their application in future professional activities.
4. Evaluation of individualized learning: Testing the effectiveness of individualized educational programs, including students' choice of specialized courses and a variety of teaching methods, in order to achieve the best results in the study of physical chemistry.
5. Identification of promising areas of development: Formulating recommendations for further improvement of approaches to teaching physical chemistry based on identified problems and successful practices. The purpose of this study is not only to summarize current trends in the teaching of physical chemistry at the university, but also to develop constructive proposals for improving the educational process in this field.

According to psychologists, new information is absorbed and remembered better when knowledge and skills are “imprinted” in the visual-spatial memory system. Thus, presenting educational material in a structured form allows you to quickly and efficiently assimilate new systems of concepts and methods of action. Modern approaches to teaching science in higher education are significant in many respects:

1. They make it possible to present material to students more effectively and interestingly, using new technologies and techniques, including interactive textbooks, visualization of material and electronic platforms for communication and knowledge exchange, which promotes a deep understanding of the subject and takes into account the individual characteristics of each student.

2. Visualization of material when teaching chemistry has its advantages:

- * Easily understands complex material, especially abstract and complex concepts such as atomic structure or molecular reaction mechanisms.

- * Helps students remember material better as pictures and graphs can be more memorable than text.

- * Increases student interest in the subject, making the learning process more interesting and attractive, and also improves communication between the teacher and students. Thus, visualization is an important tool in teaching chemistry to students. A modern and convenient way to teach natural sciences is the use of virtual laboratories, where students are given the opportunity to conduct experiments and practical exercises in a virtual space. This approach reduces the need for equipment and materials costs, and also opens up the possibility of conducting experiments that might not be available in a real laboratory. Virtual laboratories also promote student safety by simulating dangerous scenarios that may occur in a real laboratory environment [1]. Additionally, students

may be working with expensive or complex equipment that may not be available at their institution. Virtual laboratories in physical chemistry have a number of advantages:

1. **Accessibility:** they are accessible to all students regardless of the presence of a physical laboratory, which is especially important in educational institutions with limited resources.
2. **Safety:** Virtual chemistry learning provides a safe learning environment without the risk of dangerous situations, which is especially important for beginning students.
3. **Cost savings:** the use of virtual laboratories allows you to gain access to expensive equipment without the need to purchase and maintain it.
4. **Quality of Learning:** Virtual laboratories allow students to explore physical chemistry in greater depth and breadth by conducting experiments and research that may not be possible in a real environment due to limitations.
5. **New technologies:** The use of virtual laboratories provides the opportunity to use the latest technologies and software, which helps to expand the skills and experience of students.

E-education is also highly accessible, allowing you to study anywhere and anytime, making education more flexible and convenient.

This helps to expand the audience of education and its accessibility to various segments of the population.

An important aspect of modern education is the use of electronic platforms for knowledge exchange, which improves accessibility to information [3].

1. The ability to obtain information through online courses, video lessons, forums and groups on social networks gives students access to learning at any time and anywhere in the world.

This is especially valuable for those who cannot physically attend classes due to distance, work or health.

2. The use of electronic platforms increases students' motivation to study.

They can obtain additional information, interact with teachers and other students, and exchange knowledge and experiences, which helps to maintain interest in learning science.

3. Communication between students and teachers improves.

The ability to ask questions and receive answers in real time, as well as receive feedback from teachers on your work, creates a more effective learning environment.

4. Motivation for independent learning appears.

Students use the platforms to search and explore scientific articles, journals, books, and other materials that contribute to a deeper understanding of chemistry. For students of pedagogical universities, independent work becomes a key point in the educational process.

5. Modern approaches contribute to the development of critical thinking and analytical skills. Students learn to analyze, evaluate and compare different sources of information, which helps them make informed decisions and approach problems creatively. However, it is worth noting that e-education requires greater self-discipline and self-motivation on the part of the student.

* Providing students with the opportunity to independently study and analyze scientific articles and research in the field of chemistry contributes to the development of their critical thinking and ability to analyze information.

* Conducting discussions and debates in class, where students can express their opinions and justify them, helps develop skills in analyzing and evaluating different points of view.

* The use of problem-based learning methods is aimed at developing students' analytical skills and the ability to apply their knowledge to solve real-life problems.

* The development of physical and chemical skills among students includes work in groups, where they jointly perform both theoretical and practical tasks.

This promotes interaction, exchange of views and joint problem solving.

Discussion of material in physical and colloidal chemistry lessons plays an important role in the educational process, contributing to a deeper understanding of the topic and the development of key skills in students.

This approach provides unique opportunities for interaction and knowledge sharing, enriching the educational experience.

Here are a few aspects that highlight the importance of discussing material in physical and colloidal chemistry lessons:

1. Interactive learning: Discussion of material in physical and colloid chemistry lessons activates the learning process, providing students with the opportunity to express their thoughts and questions.

This promotes interactive learning, where students become active participants in the process, rather than just passive listeners.

2. Development of critical thinking: Discussion of the material stimulates students to develop critical thinking.

Through the process of analyzing and sharing complex concepts in physical and colloidal chemistry, they develop the ability to evaluate information, highlight key aspects, and formulate their own point of view.

3. Promotes practical application of knowledge: Discussion in class allows students to better understand how to apply theoretical knowledge in practice. They can discuss real-world examples, solve problems and scenarios, which promotes deeper learning.

4. Creating a learning environment: Discussion creates a learning environment in which students can freely share knowledge and experiences. This atmosphere promotes collaborative learning and mutual support, which is important in the study of complex scientific subjects.

5. Stimulating the exchange of experience: Discussion of material in physical and colloid chemistry lessons provides an opportunity for students to share their experience and knowledge. This exchange of experiences can complement formal training and bring practical aspects to the learning process.

6. Formation of communication skills: Discussion develops students' effective communication skills. Students learn to express themselves clearly and persuasively, and to listen carefully to the points of view of their peers. Personalize learning: Discussion allows teachers to more accurately assess students' understanding of course material. This helps tailor the approach to the individual needs of students and ensures more effective learning. Discussion of material in physical and colloidal chemistry lessons is a powerful tool for enriching the educational experience, creating an interactive learning environment, and developing the key skills needed to successfully master complex scientific concepts. In general, modern approaches to teaching natural sciences in higher education provide high quality education and form qualified specialists ready for the challenges of the modern world. The educational process must adapt to new conditions and use modern technologies to improve the quality of education.

This approach to teaching physical chemistry in higher education is aimed at developing not only theoretical knowledge, but also practical skills, critical thinking and student independence.

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