

# PROBLEMS IN TEACHING CHEMISTRY IN UZBEKISTAN AND THEIR SOLUTIONS

Ixtiyarova Gulnora Akmalovna

Tashkent Technical University is after named Islam Karimov,  
Tashkent, Republic of Uzbekistan  
(<https://orcid.org/0000-0002-1687-682X>)

Qo'chqorov Shaxzod Begali o'g'li

Tashkent Technical University is after named Islam Karimov,  
Tashkent, Republic of Uzbekistan  
(<https://orcid.org/0009-0001-0293-1605>)

Sharopov Jahongir Mustaqim o'g'li

Tashkent Technical University is after named Islam Karimov,  
Tashkent, Republic of Uzbekistan  
(<https://orcid.org/0000-0001-9528-1690>)

## Abstract

In this article, we have considered the current problems in the teaching of chemistry in Uzbekistan and offer innovative solutions to improve the educational experience. Analyzing the current educational system and the specific socio-cultural context, the article is about how to motivate students, improve lesson design and include laboratory experiments in the curriculum, use virtual laboratories, artificial intelligence, AR and VR technologies in the classroom. proposes strategic measures.

**Keywords:** Chemistry education, Uzbekistan, student motivation, chemophobia, laboratory training, problem-based learning, educational innovation, interdisciplinary teaching.

## Introduction

The importance of quality education as the foundation of nation-building cannot be overstated. There are several problems in the teaching of chemistry in Uzbekistan, such as lack of motivation, insufficient laboratory equipment, and insufficient number of hours per week in the curriculum. We begin by examining these issues and their implications for future professionals in the study. We propose strategic measures to improve lesson design and the inclusion of laboratory experiments, virtual labs, and artificial intelligence AR and VR technologies in the classroom into the curriculum.

We prefer to start with the inscription on the facade of the University of South Africa: "To destroy any nation, it is not necessary to use atomic bombs or missiles, it is enough to lower the quality of education and turn a blind eye to cheating in exams." patients do not die in the hands of doctors. It is because of such engineers that buildings are comfortable. It is



precisely because of such economists and accountants that funds disappear. It is precisely because of such lawyers and judges that the word "Justice" is worthless. "The poverty of education is the poverty of the nation." [1] Today, a lot of attention is paid to the education system in our country. Taking into account the above facts. We are researching the introduction of an innovative approach to the teaching of chemistry and the application of modern methods to the teaching process. As a result of our research, we analyzed the existing problems in the education system in Uzbekistan in the teaching of chemistry.

The stage of creating a problem situation in the lesson requires great skill from the teacher. In the organization of problem-based learning, the teacher needs to choose the greatest problems of interdisciplinary importance, that is, problems that are interesting to students in various future professions [2].

New teaching approaches differ from classical methods in encouraging active learning. New approaches to teaching increase the motivation and achievement of students and serve to increase the level of knowledge and critical thinking of students.[3] Motive (in psychology) is a factor that causes the fulfilment of a certain goal in human activity, the reason why people and other animals start, continue or stop the behaviour at a certain time. Motivational states are generally understood as forces acting within an agent that create a propensity for goal-directed behaviour. Often different mental states compete with each other, and only the strongest state determines behavior.[4]

*Table 1* Problems in teaching chemistry:

<i>Problem 1:</i>	<i>students' inability to form motivations for studying chemistry and the emergence of chemophobia</i>
<i>Problem 2:</i>	<i>inability to organize interesting experiments in classes and lack of laboratory training</i>
<i>Problem 3:</i>	<i>the shortness of the weekly class hours, the abundance of information, and the fact that chemistry teaching is wrapped in a certain shell</i>
<i>Problem 4:</i>	<i>Little time is devoted to problem-solving in the textbook, and methods of solving complex problems are not given in the sources</i>

The results of the study showed that chemophobia among students is moderate, and students' attitudes toward chemistry are high. The results of the study also showed that there was a moderate, negative significant correlation between the three factors of chemophobia and students' attitudes towards chemistry. Based on multiple regression analysis, there was a factor of chemophobia (anxiety about chemistry assessment) that had a significant effect on students' attitudes toward chemistry. Chemophobia among students must be overcome to develop a positive attitude toward chemistry, and thus lead to improved academic achievement and student participation in chemistry and science-related fields.[5]

Studies have shown that it is true that science teachers and students face challenges in teaching and learning science due to the lack of a well-equipped science laboratory, and studies have also shown that many Science students cannot learn science without laboratory



experiments. From the obtained results, it can be concluded that teaching and learning practical work in the absence of a well-equipped science laboratory can not only hinder the learning process but also prevent the learning process from failing. Many chemistry teachers have found it difficult to facilitate inquiry for their students,

Textbook authors have their own views on content and teaching methods, which should lead to a high level of scientific thinking. However, the textbook alone does not guarantee good results, because the personal and social relationship between the teacher and the students greatly influences the teaching. Therefore, the teacher's study of the textbook before the textbook facilitates the teaching process. One upper secondary level course in teaching chemistry involves the use of learning strategies in analysis. The national goals were related to the content of knowledge, social relevance, focus on experimental chemistry, and inspiring students to further study. Most of the textbook tasks apply knowledge belonging to higher-order categories characterized by knowledge structures that involve making inferences or inferences. It is important that a good classroom activity is also social and includes several experimental tasks. The quality of the textbooks is further improved with modern content. All of the above qualities are associated with high learning motivation.[7]

### Methods:

The paper employs a mixed-methods approach, including qualitative interviews with teachers and students, analysis of pedagogical materials, and a review of current chemistry education practices in Uzbekistan. This approach allows for a comprehensive understanding of the multifaceted problems within the educational system. The stage of creating a problem situation in the lesson requires great skill from the teacher. In the organization of problem-based education, the teacher must choose the greatest problems of interdisciplinary importance, that is, problems that are interesting for students in various future professions.

*Table 2* The following measures are taken to arouse interest among students:

<i>Solution 1:</i>	<i>Developing measures to motivate students;</i>
<i>Solution 2:</i>	<i>Correct design of the organizational part of the lesson;</i>
<i>Solution 3:</i>	<i>Organize a lesson by asking problematic questions;</i>
<i>Solution 4:</i>	<i>Expanding interdisciplinarity;</i>
<i>Solution 5:</i>	<i>Increase the number of interesting experiments and laboratory work</i>
<i>Solution 6:</i>	<i>Introducing experiments that can be done at home into lessons;</i>



Table 3

<i>When motivation is aroused and in the opposite position in the pupil observable indicators</i>			
<i>If we can motivate on in the student</i>		<i>If the student is unable to form motivation</i>	
1	<i>10% effort of the teacher is enough</i>	<i>90% effort of the teacher</i>	1
2	<i>90% achieve average mastery</i>	<i>Mastery is about 10% on average</i>	2
3	<i>Prepares for the next lessons</i>	<i>It is not prepared independently</i>	3
4	<i>He is always wanted</i>	<i>not sought</i>	4
5	<i>Chemistry is interesting</i>	<i>Chemistry is not interesting</i>	5

We organize the lesson as follows! We will implement the educational goal as follows!“Thousand and One Night’s method” A story is a teaching method that presents the educational material through personally relevant stories and is connected with the personal experience of the teacher and the student. This method teaches the skills of working with information, teaches to analyze situations and evaluate alternative options, connects the studied theoretical material with practice, and develops the skills of solving practical problems. Pedagogical storytelling types and narrative construction were considered. The use of storytelling in higher chemistry education is discussed. Literature and scientific literature, media publications, art, chemical history,

*the organizational part of the class*

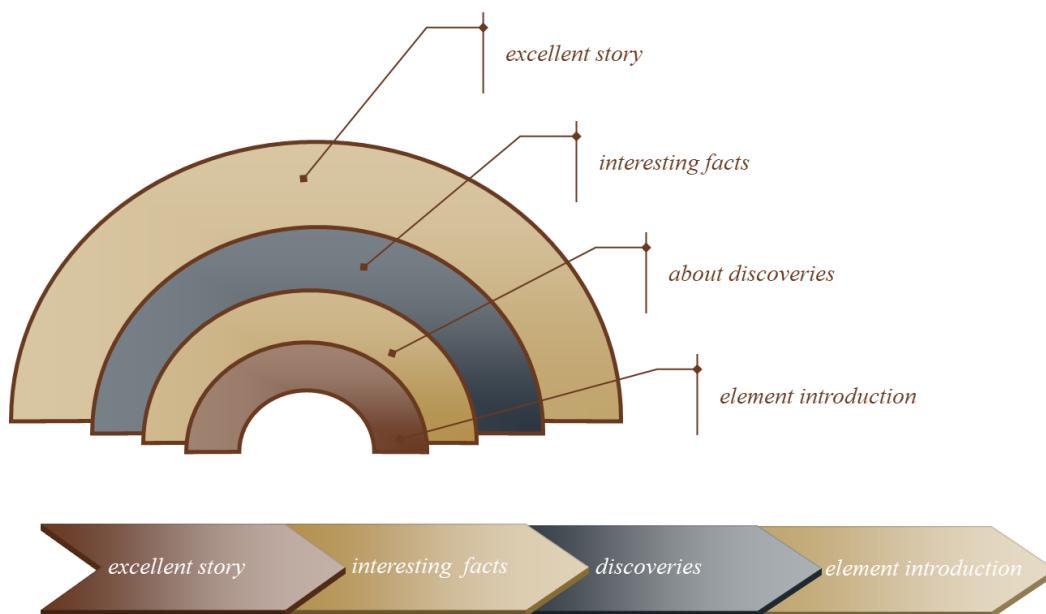


Figure 1 Organizational part of the lesson



The results of the interviews of teachers and students on the use of popular scientific articles and interesting facts in the process of teaching chemistry show that popular scientific articles are useful not only for students of chemistry but also for students of other specialities, as well as for future biologists and ecologists. contains data. The articles are effectively used by teachers in chemistry classes to arouse students' interest in this subject.[9]

1- It is necessary to make it a daily habit to start the lesson with an instructive story that affects the psyche of the students and arouses pride. This causes students to be motivated. For example One day, the owners asked Amir Temur: "What helped you to reach the level of the owner of such a great kingdom from an ordinary servant?" The great ruler answered: "I did not despair in any case. In this regard, I took an example from an ant. One day I ran away from my enemies and hid in a ruin. When I lost hope in everything and was depressed, my eyes fell on a strange ant. He carried a grain of wheat almost twice the size of his body. There was a piece of wood or a piece of wood... in his path. An ant tries to climb on it, but due to the weight of his load, he could not get out until the end, his load, heavier than himself, would fall to the ground. A grain of wheat would roll up and fall under the wall, and the ant would come back down and try to take away its food. This situation was repeated more than fifty times. Finally, the ant reached its goal. Seeing the determination of this little creature, I felt hope in my heart. I told myself that if I didn't have an ant's intensity... After that, I was not afraid of any obstacle until I reached my goal".[10] A hope appeared in my heart. I told myself that if I didn't have an ant's intensity... After, I was not afraid of any obstacle until I reached my goal".[10] hope appeared in my heart. I told myself that if I didn't have an ant's intensity... After that, I was not afraid of any obstacle until I reached my goal".[10]

2- The use of interesting facts in the course of the lesson is very useful in increasing the attention of students.

Nowadays, you can find a lot of interesting facts on the Internet. The following are examples of Internet sources with interesting facts:

- <https://100-faktov.ru/100-interesnyx-faktov-o-ximii/http://muzey-factov.ru/tag/chemistry>
- [http://www.decoder.ru/list/all\\_1/tag\\_312\\_1/topic\\_264/http://factopedia.ru/tags/khimiya](http://www.decoder.ru/list/all_1/tag_312_1/topic_264/http://factopedia.ru/tags/khimiya)

3- Telling the history of the creation of the most widely used inventions in our lives also plays an important role in making the lesson interesting and meaningful. For example: Did you know that iodine was discovered by a cat? Bernard Courtois' favourite cat spills a container of sulfuric acid and sodium iodide in the laboratory where he is conducting experiments. As a result, when they mix, a purple gas is released, which is the iodine element.







- 1 Start the lesson with an instructive story that affects the students' psyche and awakens pride.
- 2 Tell interesting facts about science during each lesson
- 3 Telling the history of the creation of the most widely used discoveries in our life

Figure 2 We organize the lesson as follows! We will implement the educational goal as follows!  
"A Thousand and One Nights" method

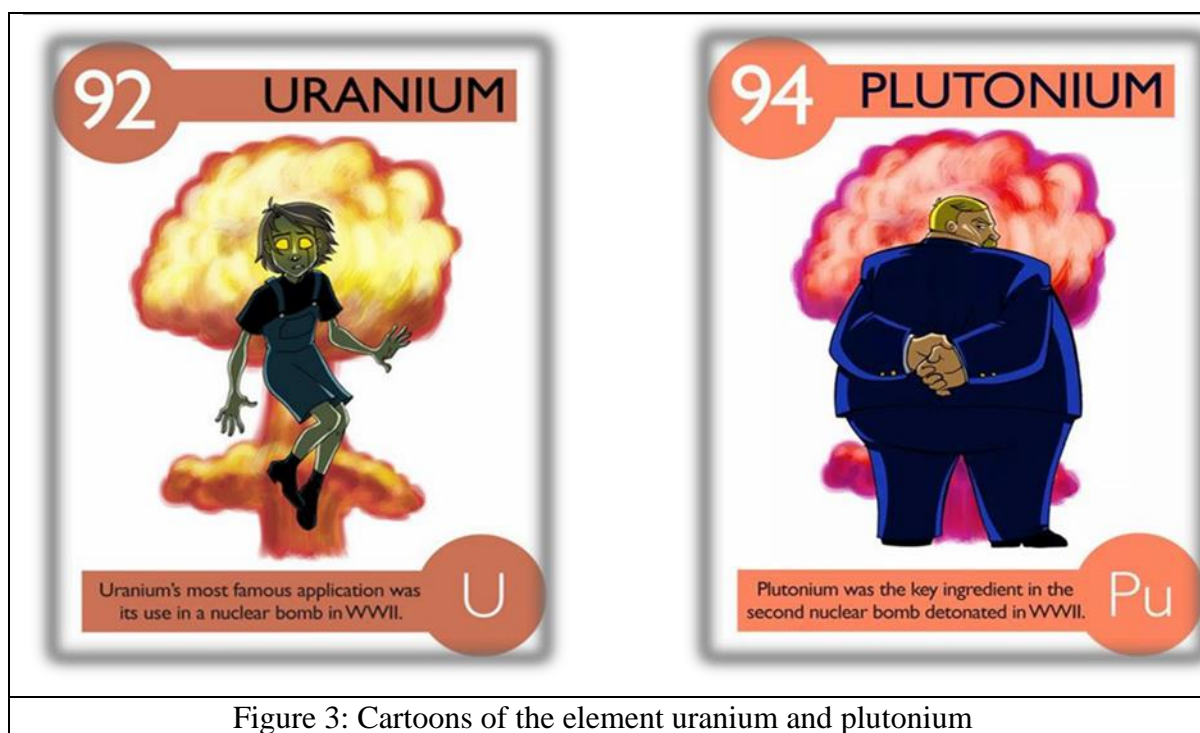


Figure 3: Cartoons of the element uranium and plutonium

The use of interesting cartoons in the lessons also leads to effective results. Currently, cartoons of 112 elements have been developed and can be downloaded from the following web page: <https://www.buzzfeed.com/donnad/cartoon-elements-make-learning-the-periodic-table-fun>. Uranium is a radioactive element mainly used in nuclear reactions. It was widely used as a source of energy in nuclear power plants in the production of nuclear bombs.



Organizing the lesson by asking problematic questions helps to increase students' reflection and critical thinking. For example:

- How did life appear on Earth?
- What would the atmosphere be like if carbon dioxide were visible?
- Why did DiMendeleev think that burning oil is equivalent to burning money?

Interdisciplinarity is of course of great importance for education because students have different interests. That's why interdisciplinarity should be effectively used in every lesson. For example, learning chemical elements in connection with the English language. In this, a word game is played, as a result of which the student remembers English words and elements. Communicative competence is approached.

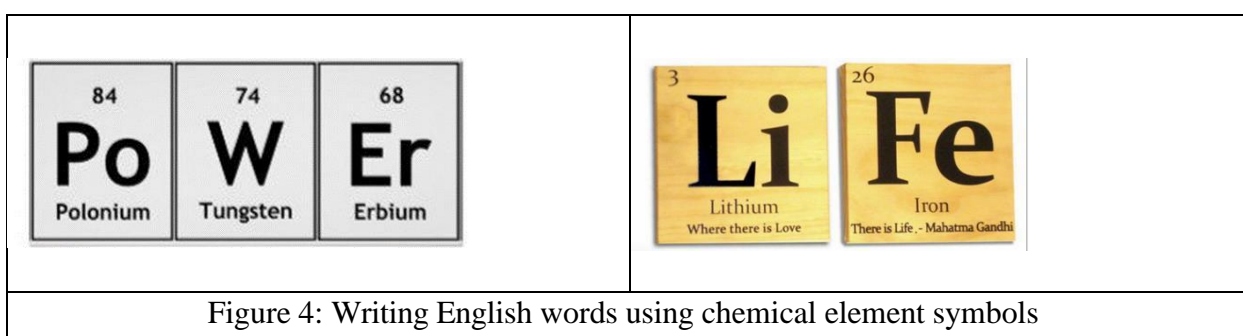


Figure 4: Writing English words using chemical element symbols

We use different substances in our lives. It is quite difficult to remember the formulas in which field they are used in life. It is important to use flashcards to make this process interesting.

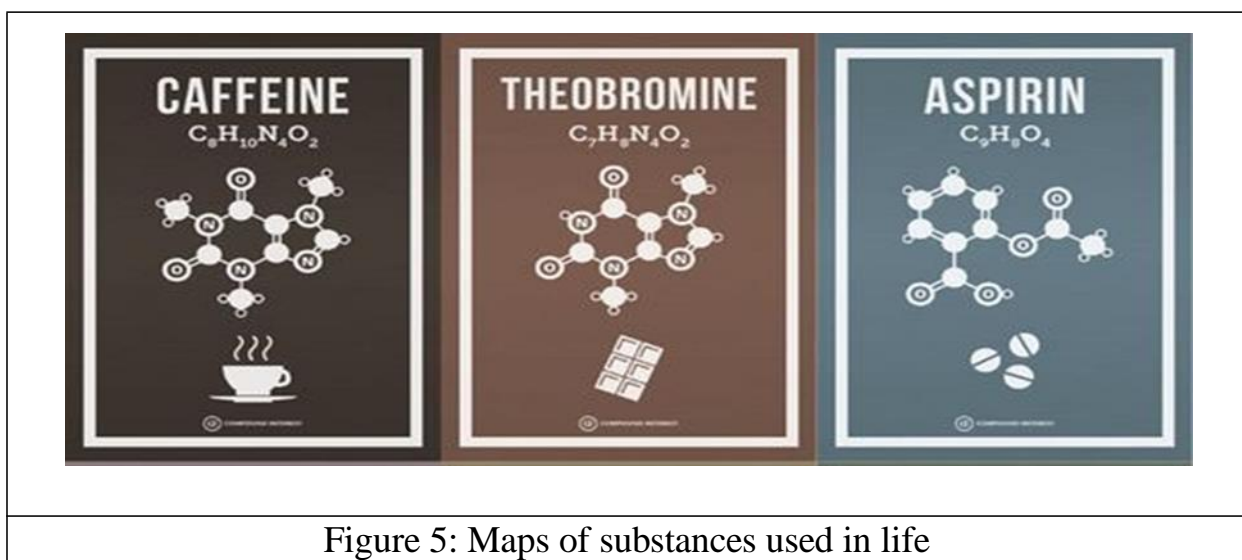


Figure 5: Maps of substances used in life

Apart from that, scientists and their discoveries can be taught through maps, maps can be found on Internet sources.

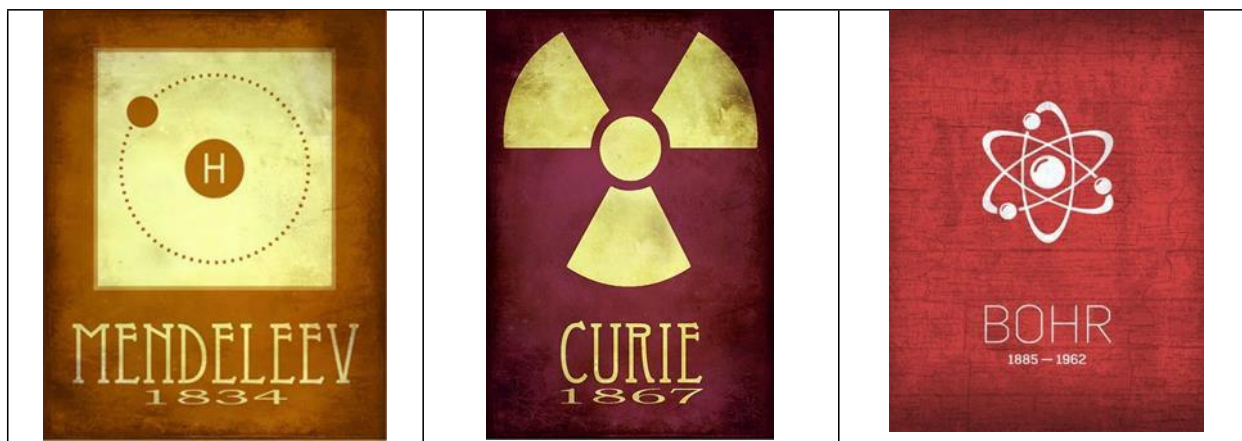


Figure 6: Scientists and their discoveries

The use of unusual exhibits, cartoons, and multiplications is an important tool in increasing the interest of students. American pedagogue, lecturer, writer, and motivator Dale Carnegie in

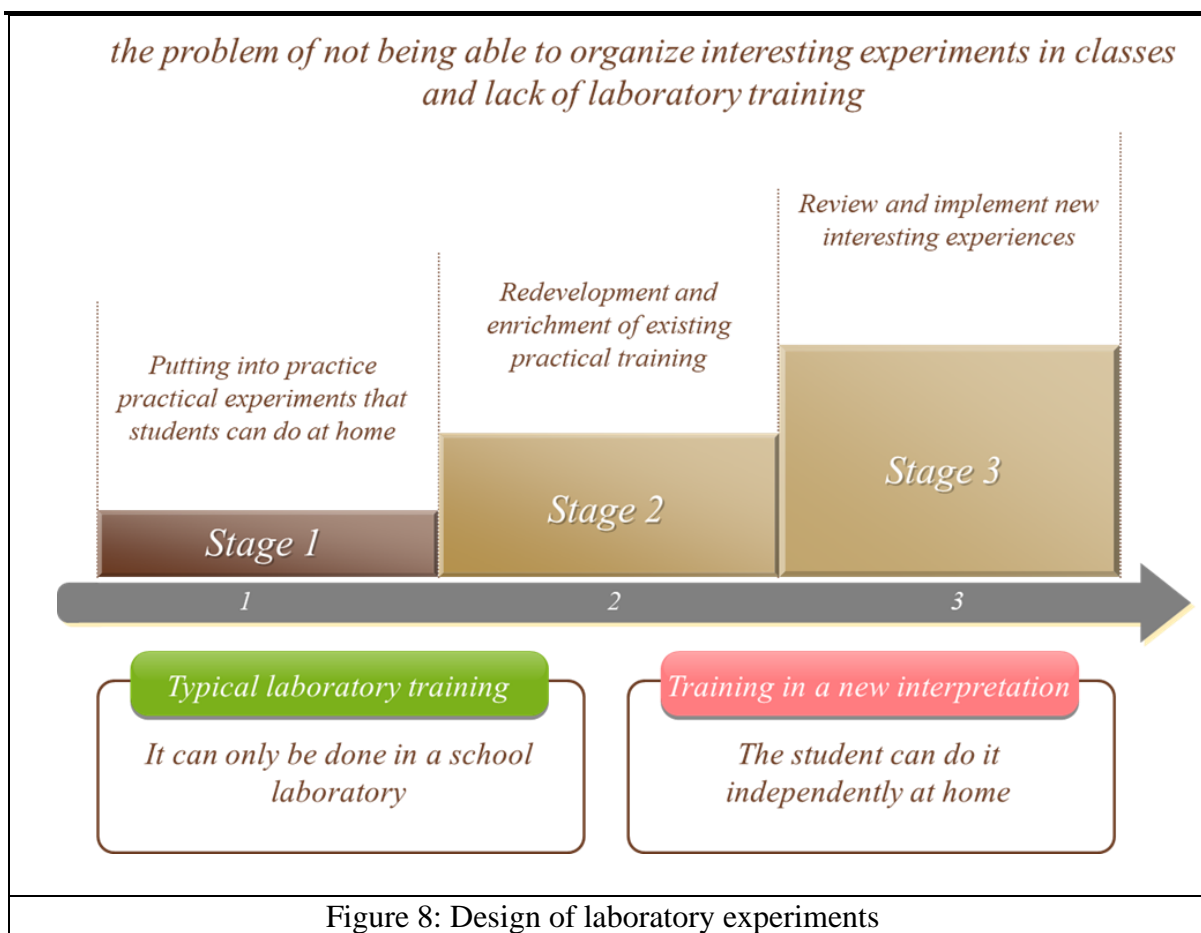


Figure 7: Unusual exhibitions

his book "On making friends and influencing people. The art of self-confidence and public speaking. The secrets to overcoming anxiety and starting a new life." In his book, he emphasized that unusual information takes place in people's brains much faster than usual things.

Problem 2: inability to organize interesting experiments in classes and lack of laboratory training





Think about what experience would be more interesting if you were in the student's shoes. The 3rd problem and its solution are the shortness of the weekly class hour, the abundance of information, and the fact that it is wrapped in a certain shell in the teaching of chemistry. To assimilate a lot of information, the following measures should be implemented with students.

Little time is devoted to problem-solving in the textbook, and methods of solving complex problems are not given in the sources. For this purpose, it is possible to organize video lessons and it is advisable to put them into practice.

Currently, there are different interpretations of the term virtual reality. But in this article, we will use the following concept of virtual reality (VR) - it is an artificial world created with the help of software and hardware, consisting of interactive 3D objects and spaces. Its main feature is that the user can not only observe the ongoing processes and events but also actively participate in them [11].

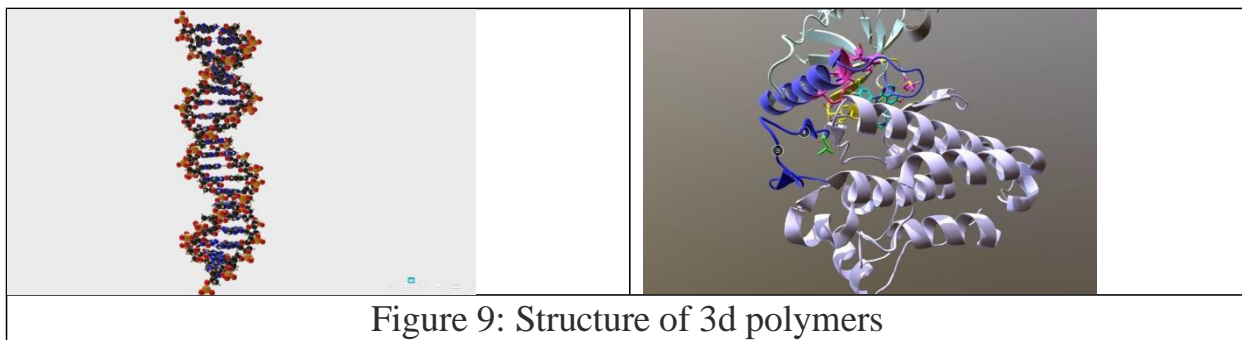
Augmented reality (AR) is an environment that fills the physical world as we see it in real-time with digital information using any devices - tablets, smartphones or others - and software. Through AR, you can apply a virtual object in the real environment where you live[12].

In futurism and science fiction, a metaverse is a hypothetical iteration of the Internet as a single, universal, and immersive virtual world facilitated by the use of virtual reality (VR) and



augmented reality (AR) headsets. Colloquially, a metaverse is a network of 3D virtual worlds focused on social communication [13-16].

Currently, we are conducting research on the creation of an electronic textbook based on a new methodological approach using interactive 3D models in the science of polymer chemistry.



### Research initiative on web resources for chemistry education

As part of our ongoing research at Tashkent State Technical University, our doctoral candidates are currently developing several websites aimed at enriching the educational landscape for chemistry. These websites are designed to provide comprehensive resources and innovative tools for both teachers and students in the field of chemistry.

#### Sharopov. uz: Instructional methods for chemistry teachers

Sharopov. uz serves as a hub for chemistry educators, offering a range of pedagogical advice and teaching strategies. This site compiles best practices and methodological recommendations to aid teachers in delivering engaging and effective chemistry lessons. It is a valuable resource for educators seeking to enhance their instructional techniques and student engagement.

#### 3dpolimer.uz: 3D visualization of polymers with AR and VR technology

The website 3dpolimer.uz is at the forefront of educational technology, providing 3D visualizations of polymers through Augmented Reality (AR) and Virtual Reality (VR) platforms. This immersive resource allows for a deeper understanding of polymer structures and their properties, giving students and professionals alike a cutting-edge tool to explore complex molecular formations more interactively and tangibly.

#### Piimachemist. uz: specialized educational resources for chemistry

Piimachemist. uz is dedicated to specialized schools with a focus on chemistry education. The site offers a wealth of educational resources, including advanced study materials, interactive experiments, and scholarly articles that cater to the needs of students pursuing in-depth knowledge in chemistry. It is an essential repository for aspiring chemists to delve into their subjects with rigour and passion.



### **Umumkimyo. uz: comprehensive chemistry portal**

As a one-stop destination, umumkimyo. uz contains everything related to chemistry for all levels of learning. The website hosts a comprehensive collection of study materials, from introductory concepts to advanced theories. It is designed to support learners at various stages of their educational journey, providing access to literature, experimental protocols, and a community forum for discussion and collaboration.

Each of these websites encapsulates a unique aspect of chemistry education, collectively contributing to a richer, more versatile learning environment. Through these platforms, we aim to foster a robust educational community that not only imparts knowledge but also inspires innovation and a deep appreciation for the science of chemistry. In turn, we launched the 3dpolimer.uz website based on the WordPress platform.

The electronic textbook is being designed using Ispring Suite and Articulate storyline programs. 3d models of natural and synthetic polymers are posted on the website 3dpolimer.uz, and it is possible to scan the model through the QR code in the electronic textbook. In addition, it is possible to view directly through the HTML application. The part of the textbook based on augmented reality is displayed through a mobile application, and the part based on virtual reality is displayed through an HTML page.

QR codes <http://qrcoder.ru/is> being created through the platform. The mobile application <https://www.appypie.com/> and <https://www.builder.ai/> is planned to be created through the web platform.

### **Results and Discussion**

By analyzing the results of this research, we will show several important issues in teaching chemistry in Uzbekistan and offer innovative solutions to solve them. One of the main concerns identified is chemophobia among students, which is characterized by a moderate level of anxiety about chemistry. This issue is important because it can hinder students' interest and performance in chemistry, lead to a lack of interest in science, and affect their future career choices in academic and science-related fields.

The lack of laboratory activities and interesting experiments in classrooms is another issue highlighted in the study. The importance of practical laboratory experience in teaching natural sciences cannot be ignored, as it allows students to apply theoretical knowledge, develop practical skills, and engage in scientific research. We recommend increasing the number of research lab sessions and incorporating experiments that can be done at home to make learning more accessible and engaging.

The study also examines the limited class hours and intensive curriculum devoted to chemistry. We suggest the use of multimedia resources such as exploratory video lessons, virtual reality (VR) and augmented reality (AR) technologies to ensure that students can effectively absorb large amounts of information. These tools can provide an immersive and interactive learning experience that makes complex concepts more understandable and memorable.

Furthermore, through research, we highlight the importance of storytelling and the use of fun facts and cartoons in teaching chemistry. These pedagogical methods attract the attention of students, arouse their interest and make learning more interesting. Integrating learning English



through chemical elements and using flash cards to memorize formulas are also recommended as innovative strategies to increase student engagement and learning outcomes.

**Conclusion.** In conclusion, in this study, the current problems of teaching chemistry in Uzbekistan were comprehensively analyzed and several innovative solutions were proposed to improve the educational experience. By overcoming chemophobia, enhancing laboratory activities, incorporating interdisciplinary approaches, and using multimedia resources, research aims to increase student motivation, engagement, and achievement in chemistry. The proposed strategies are not only relevant to Uzbekistan but can be adapted and applied in other contexts to improve chemistry education globally.

### References

1. <https://www.goodreads.com/quotes/10047038-destroying-any-nation-does-not-require-the-use-of-atomic>
2. Problem teaching at lessons of chemistry in high school. Abdibaeva MM, Sabdinova WO, Djumashev AB, International Journal of Applied and Fundamental Research. – 2016. – No. 12 (part 8) – P.1509-1511
3. Effects of new teaching approaches on motivation and achievement in higher education applied chemistry courses: A case study in Tunisia Kaouther Ardhaoui, Marina Serr Lemos, Susana Silva Education for Chemical Engineers 2021Pages 160-170
4. Wasserman T, Wasserman L (2020). "Motivation: State, Trait, or Both". Motivation, Effort, and the Neural Network Model. pp. 93–101.
5. The storytelling: an effective tool in the teaching of high-level chemistry. Elena Vasilevskaya, Natalia E. Boboriko Journal: GAMTAMOXLINIS UGDYMAS / NATURAL SCIENCE EDUCATION (Vol.18, No. 2) Page: 93-104
7. EFFECTS OF TEACHING SCIENCE SUBJECTS IN THE ABSENCE OF SCIENCE LABORATORY: A CASE STUDY OF COMMUNITY SECONDARY SCHOOL MOROGORO MUNICIPAL. Frank Nyanda. Technical Report · July 2011. See discussions, stats, and author profiles for this publication at:<https://www.researchgate.net/publication/318101220>
8. TEXTBOOK ANALYSIS IN THE SERVICE OF CHEMISTRY TEACHING. Aija Akhtineva. June 2005Universitas Scientiarum 10(Edición Especial I). See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/238587051>
9. Level of Chemophobia and Relationship with Attitude towards Chemistry among Science Students. Noor Hidayah Binti Ibrahim, Zanaton Binti Hj. Ixan. July 2018. JOURNAL OF EDUCATIONAL SCIENCES 2(2):52
10. Popular Science Articles for Chemistry Teaching.Ketevan Kupatadze.July 2017 Orbital – The Electronic Journal of Chemistry 9(3):197-203.
11. "Irfon" calendar, 2011, number 1.
12. Belokhvostov A.A. Methodology of education, chemistry and usloviyax informatizatsii obrazovaniya: ucheb. posobie / A. A. Belokhvostov, E. Yes.





- 
- Arshansky. Moscow: Intellect-Center, 2016. 336 p
13. Cipresso, Pietro; Giglioli, Irene Alice Chicchi; Raya, trace; Riva, Giuseppe (7 December 2011). "The Past, Present, and Future of Virtual and Augmented Reality Research: A Network and Cluster Analysis of the Literature." *Frontiers in Psychology*. 9: 2086. doi:10.3389/fpsyg.2018.02086. PMC 6232426
  14. O'Brian, Matt; Chan, Kelvin (28 October 2021). "EXPLAINER: What is the metaverse and how will it work?". ABC News. Associated Press. Archived from the original on 4 December 2021. Retrieved 4 December 2021.
  15. Newton, Casey (2021-07-22). "Mark Zuckerberg is betting Facebook's future on the metaverse". *The Verge*. Archived from the original on 2021-10-25. Retrieved 2021-10-25.
  16. Robertson, Adi (2021-10-04). "What is the metaverse, and do I have to care?".
  17. *The Verge*. Retrieved 2022-03-09. Clark, Peter Allen (15 November 2021). "What Is the Metaverse and Why Should I Care?". *Time*. Retrieved 2021-12-29.

