

CHEMISTRY

DOI: <https://doi.org/10.36719/2707-1146/45/20-26>**Gulnara Ismaylova**

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**CHEMISTRY EXPERIMENTATION IN SECONDARY SCHOOLS AS A WAY TO
BUILD COMPETENCE IN STUDENTS****Abstract**

This article is devoted to the description of competencies as one of the important issues in developing and forming the student's personality in modern times. The article shows the types of chemical experiments, the possibilities of their application and their direct role in the development of competencies. Conducting experimental experiments and their conscious use in the development of competencies has a positive effect on the acquisition of new knowledge, skills and habits.

Keywords: *student, competence, chemistry experiment, laboratory experience, quality education, knowledge, skill, habit, learning, teaching process*

Introduction

In modern times, people are faced with a demand for the acquisition of a number of new and, most importantly, excellent qualifications. This is not only a priority in a globalized world, but also plays an important role in the formation of the student's personality, in the process of self-development, as well as in the promotion of productive activity in students. An interesting fact is that recently the nature of the competencies expected of people has changed. **Competence is the combination of knowledge, skills, habits, qualities and values.**

Currently, the list of qualifications that people should acquire was presented by the Council of Europe in 2006 (Taim, 2024: 23):

- Literacy competence
- Multilingual competence
- Maths, science and engineering competences
- Digital literacy
- Personal, social and learning competence
- Citizenship qualification
- Entrepreneurial competence
- Cultural awareness and self-expression

Building common competences creates opportunities for students to build their future lives, careers and take their place in life.

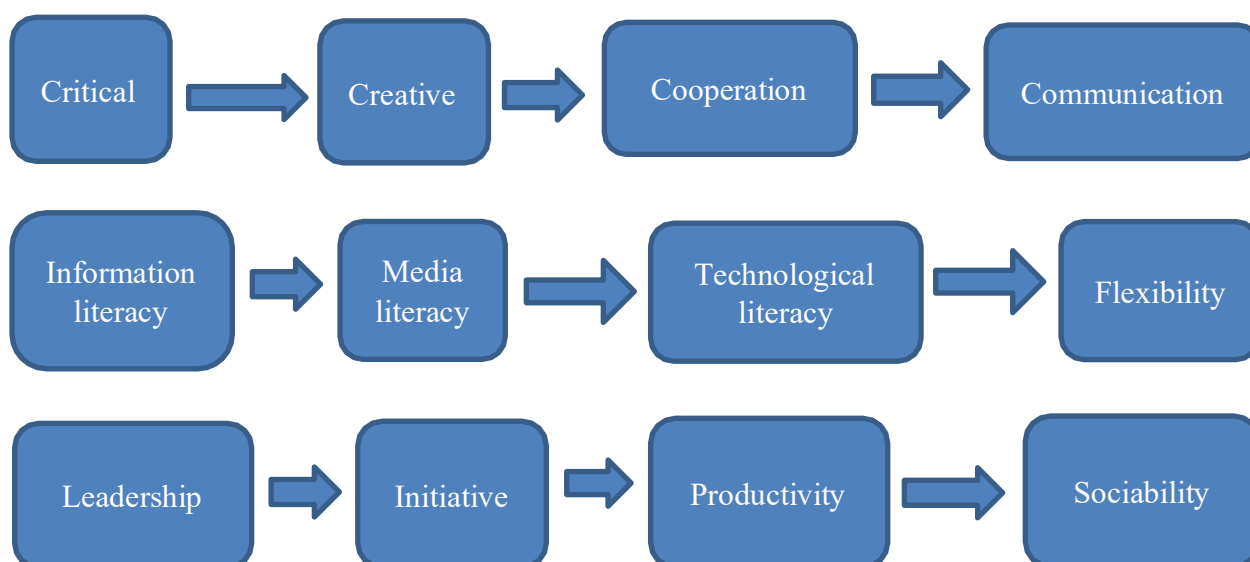
Since chemistry is closely related to many subjects, it has the ability to create integration opportunities in the teaching of any subject. The competences listed above can also be specialised by making reasonable use of opportunities to create interdisciplinary links.

In order to realise a radical reform in chemistry courses and to gain competences, the following problems need to be solved (Guliyev, Aghazade, 2018: 4-11; 9).

- Principles and methods of chemistry teaching and the use of modern didactic principles, especially chemistry experiments;
- Using trials educational possibilities of chemistry teaching and their application;

- Organisation and implementation of experiments to make chemistry lessons interesting and high level;
- To strengthen the practical aspect of chemistry through experiments;
- Activation of students and development of cognitive activity in chemistry lessons using experiments;
- Associating chemistry teaching with production.

The qualifications defined in the document on “state standards of general education in the Republic of Azerbaijan ” (2020) are based on these competences and skills. The basic skills that 21st century people need are defined as follows: (Taim, 2024).



The formation of these skills in students serves to develop their metacognitive knowledge, meta-thinking and meta-skills.

Among these, one of the qualifications that is particularly relevant to our professional orientation and of particular interest to us is the learning to learn qualification.

Learning skills are based on the 4K (4C learning skills) scheme. Critical thinking is one of the most important of these. The following skills are available to develop critical thinking:

1. Analysing - learning by breaking a whole into several parts and breaking it down. Determining the relationships of small parts to each other.
2. Making an argument - it is a judgement based on evidence and serves to reach a conclusion.
3. Classify - to identify features to distinguish categories from each other.
4. Comparing - the identification of different and similar features between two or more events, processes, situations.
5. Explain - is the ability to explain when any process took place and what it resulted in. The main thing in this case is to explain the idea to the other side.
6. Evaluate - compare the new decision with the existing decision and assess its effectiveness to propose a different solution.
7. Problem-solving - Investigating the cause of the problem, determining the result and ensuring that the problem is eliminated.

Today, the new educational reform in our schools serves the acquisition of quality knowledge by pupils (students) (Mammadova, Bakı 2012). In the normative legal documents on education adopted in recent years, it is stated as an important condition to educate mentally, morally, ethically, aesthetically developed, physically healthy, life-skilled students.

Today we live in a world where events, science, technology and technology around us are changing rapidly. Such changes impose new demands on the development of the student's personality. In order to adapt to constantly changing conditions, man needs to have the necessary

life skills, flexible thinking, readiness for self-development and self-development, and strive to realize his potential. Of course, these qualities are transmitted to students in general education schools.

In the process of chemistry teaching, besides the development of students' theoretical knowledge, the development of practical skills, which is the basis of empirical thinking, has always been of special importance (Vakhtiyarova, Minnulin, Galoin, 2014). Laboratory studies have a special importance in the development of empirical thinking in students and the formation of theoretical propositions.

The skills acquired in carrying out laboratory work and practical work in chemistry help to solve problems encountered in life. Depending on the nature of the laboratory work, it can be organized in school laboratories, subject offices, school gardens, and industrial establishments.

Chemistry, which is taught as a course in general education schools, has wider opportunities than other courses in terms of developing both practical skills and theoretical knowledge of students and shaping existing knowledge. Empirical knowledge of objects and events is acquired with the help of sense organs and expressed in concepts (declarative knowledge). Empirical thinking is based on methods such as observation, comparison, description, experimentation, and systematization, and the life skills acquired through these methods develop and improve. In contrast to empirical thinking, theoretical thinking is based on methods of analysis, modeling, idealization, abstraction, drawing conclusions, analogy - and similarity.

The ethical knowledge and skills acquired by the students are checked with the help of an experimental assessment tool. At the same time, through this assessment, students gain conceptual knowledge and acquire certain skills. The algorithm of performing demonstration and laboratory experiments in students is created through assessment with experimental content. (Khalilov, Azizov, 2008).

The organization of chemistry experiments is fundamentally different from chemistry lessons in terms of direction, content, character, and methods of implementation. Experiments are organized and carried out in various ways in accordance with the forms of work independent of chemistry, the creative wishes of the students, their interest in chemistry. Experiments in chemistry serve not to eliminate the missing aspects of the knowledge gained from chemistry, but to create the ability of students to apply the knowledge they have acquired. The role of chemistry teachers when conducting chemistry experiments should be completely different. The chemistry teacher gives the students the right advice during the chemistry practical course, helps them when necessary, guides them in their independent work, and directs them to get the right results in laboratory work.

The main purpose of laboratory work in chemistry is to examine new materials and to acquire new knowledge (Aliyev, Zulfugarova, 2015, 70-91).

Chemistry laboratory experiments are carried out in the following ways.

- 1) In the individual method, students carry out the experiments individually.
- 2) In the group method, a group of students who fulfill different functions do the same work at the same table.
- 3) In the collective method, different groups of students sitting at the table report the results obtained, i.e. they carry out the laboratory work collectively.

The methodology of the practical work (laboratory experiments) is as follows.

1. The interview.
2. Problem encountered and solving problems with experiments.
3. Oral and written instructions for doing laboratory work in chemistry.
4. Teachers' responses to students' questions about the rules of laboratory work in chemistry.
5. Independent work of students during the experiment.
6. Depending on the teaching, the quality of the students' performance during the realisation of the laboratory work should be clear.

Chemistry experiments have a great role in increasing the interest in the subject in the process of chemistry teaching in high school. In chemistry programmes, which are one of the components of

the educational process, annual programming should include instructions for conducting experiments (demonstration experiments, laboratory experiments, practical exercises and experimental problems). Chemistry experiment - helps to implement the didactic function with the help of various forms, methods and teaching aids. As a whole, it reflects the direction of independent acquisition of knowledge by students: from observation of experiments carried out by the teacher, and preliminary laboratory work to practical work and solution of experimental problems.

Chemistry experiment not only helps to develop independent thinking abilities in students and increase their interest in chemistry but also serve to increase their cognitive activity (Aliyev, 2003). It has been confirmed many times that students' acquisition of abstract concepts and knowledge is a difficult process. The systematic conduct of chemical experiments is a key tool in the formation of knowledge, skills and habits. Usually chemistry experiments are carried out in stages (table 1).

First phase	Second phase	Third phase.
Collection of resources and equipment necessary for the implementation of experiments, a set of theoretical knowledge about the course of work.	Conducting experiments in active-interactive conditions in accordance with the rules of safety techniques.	Analysis, evaluation and assessment of the results obtained.

The first phase of the experience is based on the theoretical foundations of the knowledge acquired by the students. Making observations, putting forward hypotheses and explaining the results based on arguments are taken as the main elements in the process of conducting the experiment. Several methodological requirements are imposed on the conduct of school chemistry experiments.

Based on the aforementioned information, it is very important to evaluate the role of chemistry experiments in the realisation of opportunities for students to gain knowledge, skills and habits and to develop competence in them.

The competences listed above can be gained by performing chemical experiments during chemistry teaching in secondary education institutions.

For this purpose, we consider it appropriate to examine various laboratory experiments:

Experiment 1. Required resources: plastic container, 150 ml hot water, yeast, sugar, small spoon, balloon.

Procedure: 1. Add three teaspoons of dry yeast and two spoons of sugar to a plastic container. 2. Then gradually pour warm water over the mixture. 3. Attach the ball to the neck of the plastic container and wait 25-30 minutes.

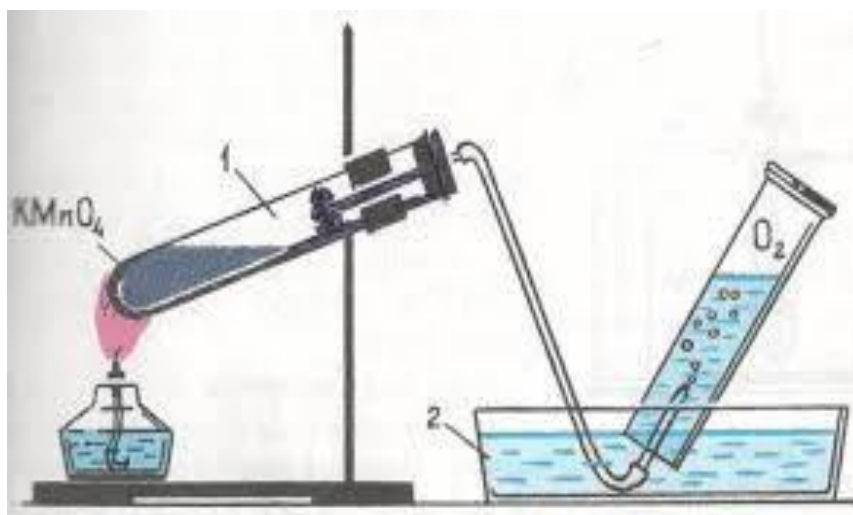
Observe the result. The liquid will first begin to foam and fill the balloon.

Explanatory phase: Yeast consists of a collection of microscopic fungi. They feed on sugar and release carbon dioxide (carbon dioxide). A large number of gas bubbles are collected and separated to fill the balloon with gas.

Observations and results are recorded by the students in their notebooks (Aliyev, 2006: 39-72).

Experiment 2. Obtaining sodium peroxide.

In this experiment we begin to explain in advance the method of obtaining and collecting oxygen in the laboratory (Zulfugarova, 2017, 58-62).



To do this, install the device shown in the picture and check its tightness.

Prepare the necessary resources for the experiment. Place the test bottle filled with water in a container of water with the spout facing downwards, covered with a glass dish. Add potassium permanganate salt (a little) to another dry test bottle. Close the mouth of the test bottle using a stopper with a blowpipe. Insert the end of the boiling tube into a test tube containing water. Set aside the glass plate that you have inserted into the mouth of the test tube. Heat a test tube containing potassium permanganate. The release of oxygen gas is recognised by the formation of gas bubbles. As soon as the test flask containing water is filled with oxygen, cover it with a glass dish. Save the oxygen collected for use in the sodium peroxide extraction experiment. In the second stage of the experiment, after thoroughly cleaning the sodium in the porcelain mortar, cut off a small lentil-sized piece. Dry the sodium between filter paper. Place a piece of cloth in a metal spoon with a long handle. Then put the sodium in it, hold the spoon over the fire and heat it until the sodium melts. Place it in the cylinder filled with the oxygen obtained in the experiment above. Pour some distilled water into the cylinder and shake it.

Task 1. Why was oxygen collected in a test bottle filled with water?

Task 2. Write the equation of the reaction that occurs when heating a test flask containing potassium permanganate.

Task 3. How to check the presence of oxygen in a test bottle?

Task 4. When collecting oxygen in a test bottle, what safety techniques should be observed when collecting gases on water in general?

Task 5. Write the equation of the reaction between sodium and oxygen.

Task 6. Write the equation of the reaction when distilled water is poured into a cylinder and shaken.

Task 7. Describe the physical properties of alkali metals.

Except for some demonstration experiments in the chemistry laboratory, the rest of the work should be done individually by each student if possible. Due to the complexity and lack of equipment and materials, some practical work can be done in teams of 2-4 students under the instruction of the teacher.

Since the above experiment is a bit complex, it can be carried out collectively with the participation of a teacher or laboratory assistant.

By dividing the students into groups, they are taught to freely observe and work on the results of the tasks. After discussions among themselves in the group, the students come to a common opinion and conclusion, one person gives the answer.

Answer to question 1: Students make a general judgement and express their opinions. One of them answers. Since oxygen gas does not react with water, it can be squeezed out and collected in a test tube.

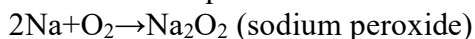
The answer to question 2:



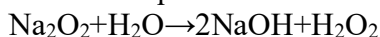
Answer to question 3: The presence of oxygen can be checked by placing a red-hot stick in the test flask. The stick is then observed to catch fire.

Answer to question 4: When gas is obtained by heating solids or by collecting gas on water, the end of the gas tube must be removed from the water before the reaction test tube is stopped heating. Otherwise, water may be drawn into the test tube and the solid will fill the heated test tube and the test tube will explode.

The answer to question 5:



Answer to question 6:



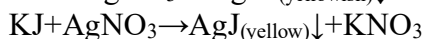
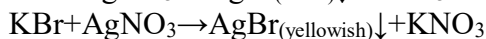
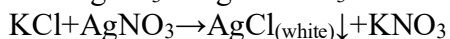
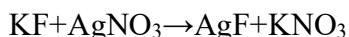
Answer to question 7: Alkali metals are soft, lighter than water, easy to cut, silvery-white (cesium is yellowish-golden) metals that conduct electricity well. Of these, lithium is the lightest metal. They are stored in kerosene or aromatic hydrocarbons because they oxidise quickly in air. They have a metallic lustre and low melting point. From lithium to cesium, their density usually increases and their melting temperature decreases. It is important to carry out experiments of an empirical nature to acquire new knowledge.

Experimental work 1.

The teacher adds a solution of potassium halides to four test bottles (Taghiyev, Zülfüqarova, 2015: 23-28). Ask the students to identify which salt is in which test tube. Students discuss their knowledge about halogens among themselves. After determining which reagent will be used to carry out the detection reactions, it starts. The groups use silver nitrate solution for the determination of halides. Add 2-3 drops of silver nitrate solution to four test bottles. A test bottle containing potassium fluoride does not precipitate. This is because the reaction forms potassium nitrate and silver I-fluoride. Students observe the formation of a white precipitate in the second test tube, a yellow precipitate in the third test tube and a yellowish precipitate in the last test tube. As a result of the co-operation in group work, the students determine the composition of the precipitates and develop their ideas.

Conclusion

A white precipitate is chloride, a yellow precipitate is iodide and a yellowish precipitate is bromide. Reaction equations are written on the board by the group members under the guidance of the teacher.



Students record their observations and results in their workbooks.

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Received: 07.02.2024

Accepted: 08.05.2024