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Home Chemical Experiment - A Means of Increasing Motivation to Study Chemistry

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Abstract. *This article analyzes the relevant literature on the experience of using a home chemical experiment abroad and in our republic, on the role of a home experiment in the development of experimental skills along with laboratory work, practical exercises and a demonstration experiment, as well as the results of a study on this issue.*

Key words: *Home chemical experiment, laboratory work, practical lesson, demonstration experiment, independence, non-standard conditions, a set of reagents, requirements for organizing a home experiment.*

Introduction. The whole world consists of over a hundred elements. Currently, a person, along with many natural compounds, comes into contact with various polymers, household items, food products, clothing, perfumes, vehicles, building materials, and various soft drinks of synthetic origin. This fact shows the vital need for the effective formation of chemical knowledge, skills and abilities in secondary school students.

Today, work is underway to improve educational standards, programs, textbook content in the field of general secondary education. But one aspect - the attitude towards chemical experiment remains unchanged. Chemistry was, remains and will be an experimental science, which is impossible without mastering the minimum knowledge and skills in chemistry, without laboratory studies and practical work. Therefore, the development of home chemistry experiments based on the curriculum to enhance the motivation of students to study chemistry, increases their natural science literacy is one of the primary tasks.

The aim of the study is to develop home chemical experiments that can serve to understand the practical application of the theoretical knowledge of the chemistry course assimilated by students, to develop skills in working in non-standard conditions, creative thinking, and to improve natural science literacy.

Research methods. To achieve the goal and solve problems in the course of the study, sociological methods (questioning, conversation, question-answer), modeling, pedagogical observation,

mathematical and statistical analysis of the results of a pedagogical experiment and methods of summarizing the results were comprehensively used.

Scientific significance of the article. The scientific significance of the research results lies in the fact that the proposed methodological support makes it possible to implement the important scientific task of increasing awareness and reducing the formalism of knowledge, as well as enrich the scientific and methodological ideas about the peculiarities of using the principle of linking education with practice in the process of teaching chemistry in secondary schools using the example of using home experiment.

Literature review. The question of home experimentation attracts the attention of our and foreign researchers.

At this time, scientific research in chemistry is widely carried out in many scientific centers of Uzbekistan, especially in the departments and laboratories of the institutes of the Academy of Sciences and universities, unfortunately, there are few such works in the field of teaching chemistry. Examples include H.T. Omonova, E.L. Dratva, M.I. Umarova, Sh.Sh. Begmatova, B.M. Dumanov [1-5].

In foreign countries, popular literature on home experimentation appeared at the beginning of the mid-19th century. Many such books have been translated into Russian, for example [6-7].

They tried to make the process of home experimentation controlled with the help of special sets of tools. So, for example, in the United States in the mid-30s of the XX century, specially produced laboratory kits for conducting experiments at home became very widespread. For example, the "Chemkraft" kit contained 17 reagents, various accessories and chemical glassware. The kit was accompanied by a booklet explaining how to carry out about 100 experiments using the data in the kit of reagents and equipment. Another set is “Jilberf”. In this set, the equipment is richer: a small microscope is attached. The set of experiments allows for the simplest experiments in biochemistry. The entire set and preparations are selected with a view to productive practices with a microscope. Similar kits were produced in Germany and Great Britain [8].

Very interesting is the experiment of the Polish teacher Knishtef Marek [9], who uses home experiments when teaching a chemistry course to seventh-grade students. Home experiments are organized in order to interest the student in the subject or in the case when the experiment takes a long time, for example, when growing crystals, corrosion, fermentation. But, unfortunately, as further stated in the article, home experiments in chemistry are set up episodically and are not planned in advance.

A teacher from Germany Hans Scholz [10] considers student assignments in terms of solving problems of agricultural production, in terms of the connection between the study of chemistry in agriculture. He emphasizes that these assignments are an important communication tool in teaching chemistry with life.

It should be noted that the level of home experimentation is somewhat higher in foreign countries than in our country. But the experiments they offer for students in popular science literature, from our point of view, cannot be called home experiments. For example, the experiment "Chromatography on a T-shirt" [11] uses very specific reagents.

A lot of interesting experiments designed to be performed at home are published in scientific and methodological literature, for example, the rapid growth of silicate crystals [12], the production of skin creams by schoolchildren [13].

In our country, a translated book by E. Grosse [14] is well-known, containing similar experiments. But, despite numerous publications of home experiments, this type of activity is rarely used. Publications about the value and importance of this type of activity also periodically appear in print. For example, the journal (Chemie in der Schule // 1983, No. 2/3. S. 79-86) talks about increasing the educational and upbringing effectiveness of chemistry lessons due to its connection with the everyday experiment of students.

And as an option, it is proposed to use the knowledge of students, obtained from everyday observations, when performing independently experiments. But the authors of the article do not write how often or on what topics such experiments can be used. The journal Science and children [15] points out the need to teach students of American elementary schools to scientific activity, active independent observation of the environment and setting up independent home experiments, but the methodology of this activity has not been disclosed. There are a lot of specific home experiments in many disciplines, including chemistry, developed by Janice Van Cleave [16] (one of her books was published in Russian). But her experiments are intended for children only up to 12 years old, who have not studied chemistry yet.

Turkish researchers Muammer Calik, Alipasha Ayas focused on the difficulty of understanding the relationship between knowledge of chemistry in school and the chemistry of everyday life for students when studying the difficulties that arise in the study of "Solution and Dissolution".

Greek researchers Panagiotis Sarantopoulos and Georgios Tsaparlis studied the effects of using analogies in chemistry in their work “Analogies in teaching chemistry as a means of attainment of cognitive and affective objectives: a longitudinal study in a naturalistic setting, using analogies with a strong social content” and propose to use everyday situations as analogies in teaching chemistry. They call such analogies ‘analogies with a strong social context’. Since the analogy field is familiar to learners, this is an effective analogy requirement for teaching.

In their work, these authors argue that the use of situations from everyday life can increase the attention and interest of students in studying the topics of the chemistry course [18]. Thus, from the analysis of the content of research carried out in our Republic and publications in foreign publications, it can be concluded that it is necessary to introduce home experimentation (independent experiments).

Research Methodology. In order to show the place and significance of a home experiment, you need to consider it in the system of a school chemistry experiment.

V.G. Afanasyev defines the system as a set of objects, the interaction of which causes the emergence of new, integral qualities that are not characteristic of separately taken components that form a system [19].

The system is not just the sum of its constituent components, but a holistic formation of a higher order.

A school chemistry experiment should be viewed as an objectively existing system with all connections and relationships. It is part of the system of pedagogical work of a chemistry teacher, which, in turn, is part of the system of pedagogical work of a school.

Let's dwell on the definition of "experiment". P.E. Sivokon analyzed the concept of natural science experiment in the most detail from the general philosophical positions. “A natural-scientific experiment is nothing more than a real process of the practice of scientific research, namely:

1) reproduction and recreation of objects of natural phenomena in "pure form", in other words, in the necessary conditions;

2) the deliberate creation of new artificial objects and objects that do not previously exist in nature in their natural form;

3) fixation, observation, comparison, measurement of experimental data of the results by means of special instruments, apparatus, devices with a specific scientific or practical purpose”[20].

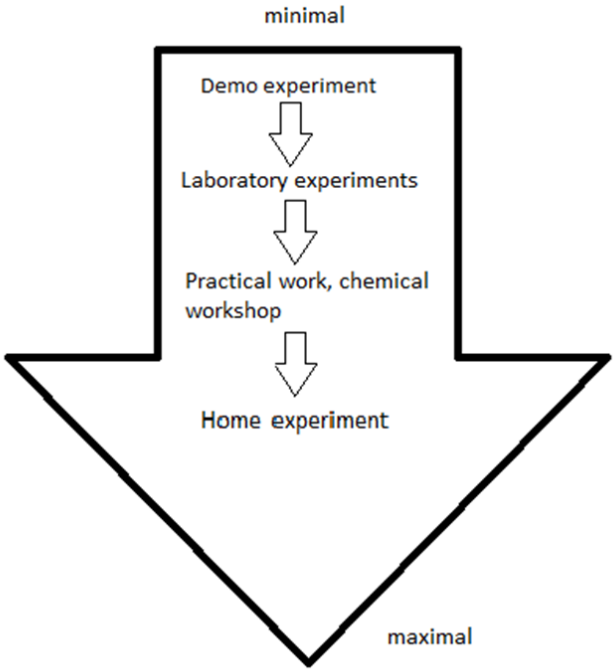
In the structure of the experiment, the central place is occupied by the deliberate, purposeful transformation of the objects of research. Experiment includes observation, comparison, measurement.

Science experiment and school experiment have a lot in common. What is essential for a scientific experiment is essential for a school chemistry experiment.

Table 1. Differences between scientific and school chemistry experiment

Signs	Science experiment	School experiment
Tasks	Source and criterion of the truth of scientific knowledge	Development, education and upbringing of students
Terms	Specific	Typical
Activities	Establishing objective truth based on the knowledge of the methodology of scientific knowledge	Establishing subjective truth using a limited number of transformed methods of scientific cognition

The didactic structure of a school chemistry experiment can be represented as follows:



Picture 1. Didactic structure of a school chemistry experiment

In this structure, each subsequent type of school chemical experiment differs from the previous one by an increase in the degree of independence. The connection between the elements as a whole lies in the fact that they all implement such a method of cognition as experiment in teaching.

In the structure of the school chemistry experiment, a home experiment took place. Let us prove that the place of a home experiment in the structure of a school chemical experiment is quite justified. To do this, let us dwell on the characteristics of the main types of school chemical experiments.

A demonstration experiment is the most accessible and takes less time than other types of experiment. It allows you to quickly accumulate empirical material. But even the most ideal formulation of demonstration experiments does not make it possible to create vivid ideas about substances and their properties in students, teach them how to independently acquire knowledge, and form experimental skills.

The laboratory experiments accompanying the teacher's presentation give, with appropriate guidance, vivid and visual representations. But these experiments are less accessible than demonstration ones: not every experiment can be passed into the hands of students; at present, not every school has the necessary reagents and equipment for frontal work. Laboratory experiments do not sufficiently form independent work and experimental skills in students. according to their purpose (to visually acquaint with the material presented by the teacher) are carried out as quickly as possible so as not to lose the

thread of presentation, and therefore simplified, with the expense of a minimum amount of time and using the simplest experimental technique.

Practical work and workshops are carried out mainly after studying the relevant issues of the program (before studying these issues, in many cases it is pointless to carry out practical work) and serve to consolidate, improve, concretize knowledge, and form experimental skills. When performing practical work, chemical workshops, the proportion of students' independence is high, but still not 100%. this type of activity is carried out with the direct participation of the teacher.

A logical continuation of the structure: demonstration experiment → laboratory experiments → practical work is an experiment that is carried out by students completely independently, i.e. home experiment.

A home experiment is an individual, practical, independent work that is carried out using substances and household items under the indirect guidance of a teacher. The home experiment that objectively exists in the practice of teaching is an extremely important and useful activity.

The features of home experimentation include the following:

First, a valuable feature of a home experiment is its individual performance. By individual performance, we mean that the student, in his own way, individually approaches the task, which can contribute to the manifestation of his abilities and the development of skills, both general educational and experimental. Students have the opportunity to modify or suggest their own variants of the experiment.

Secondly, home experiments are not limited to a strict time frame, students can redo the experiment if it does not work out.

Thirdly, home experimental work has some advantages over other types of school chemistry experiment (demonstration experiment, practical laboratory work). In home experimentation, students learn to plan their activities on their own, to come to conclusions on their own, which takes more thought effort than observing demonstrations or performing practical work and laboratory experiments under the direct supervision of the teacher.

Fourth, no matter how well the process of performing an independent experiment in the classroom is organized, it is less than a home experiment that promotes the manifestation of students' creativity and personal initiative.

Fifth, it allows schoolchildren to overcome the misconceptions that one can acquire knowledge in chemistry only in chemistry lessons.

The isolation of teaching chemistry from life, the removal of chemistry from everything that is familiar, understandable and customary by students, affects their perception and is one of the reasons for the formal attitude to chemistry as a subject. Students conducting chemical experiments in his home environment, completely independently, is the very methodological technique that can better solve many of the above problems.

Thus, a home experiment is an element of the school chemistry experiment system.

Analysis and results. During 2019-2020, in a number of secondary schools of our republic, a pedagogical experiment was conducted to determine the effectiveness of the developed home chemical experiments for students in grades 8-9 [21, 22] on the research topic “Improvement of experimental chemistry skills based on a home chemical experiment”. Research objectives for organizing home experimentation are as follows:

1) Planning of the upcoming work. When planning the educational process in chemistry, due attention should be paid to homework (including experimental). In lesson planning, it is necessary to provide for what experimental tasks can be given to students when studying this topic. The place and the specific methodological goal are determined by the teacher's lesson plan. One of the requirements for using a home experiment system is not to overload students with homework.

It should be noted that using the system of experimental assignments in order to normalize the volume of homework it is possible to replace some types of assignments with experimental ones, by independently conducting experiments and observations, which will bring no less benefit to students in cognitive and educational terms. In addition, home experimental assignments are not completed for every lesson. They can be set in advance so that students can prepare and find what they need to complete the experiment.

2) Working with parents. At the class parent meeting at the beginning of the school year, when the study of chemistry in grades 8-9 begins, you should talk with parents about organizing a home laboratory, buying some substances for home experiments. They are told about the meaning and role of independent experiment in studying the subject, about the need for students to comply with safety rules. Parents need to be convinced that home experimentation is a very rewarding and necessary form of work.

3) Providing students with assignments is important in organizing experimental homework. Ensure that all students have assignment texts. They should think in advance for which experiments printed instructions will be needed, for which it is enough to tell the name of the experiment and its purpose. Some short texts of assignments are recommended for students to write down in notebooks under the teacher's dictation. The formulation and explanation of the home experimental assignment should take no more than 5 minutes. Home experiments are made out in a special notebook.

4) Working with students. In one of the first lessons, students should be told the meaning and need for home experimental work, to acquaint them with the requirements, progress and features of this type of homework. You can tell students that many famous chemists began their journey into science precisely from the home laboratory.

The main classes of inorganic compounds

Oxides

The purpose of the experiment:

A) Educational goal: Strengthening knowledge, abilities and skills in the class of oxides, their types, some properties;

B) Developmental goal: Development of mental and practical skills of students through home chemical experiments on the topic "Oxides";

C) Didactic goal: To teach students to draw conclusions about the meaning of concepts on a given topic in everyday life, which will contribute to the formation of an ecological culture.

Equipment and substances: gas hose or cocktail tube, carbonated drink, lime water

Methodical instructions: The teacher, must first of all, give instructions on safety measures when working with lime water. You can use plastic cocktail straws as a vent pipe. Oral instructions are given for performing the experiment and drawing up a detailed report with the equations of the corresponding reactions, drawings of the assembled device.

Lime water interaction with carbonated drinks

Take a carbonated beverage and use a gas outlet to run the evolved gas through the lime water. Explain why the solution becomes cloudy at first, and then the solution becomes clear?

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3\downarrow + CO_2 \rightarrow Ca(HCO_3)_2$

lime water sediment dissolution of sediment

Draw up the equations of the phenomena occurring and write a detailed report on the experiment. Make a drawing of the assembled device for the experiment.

The effectiveness of the developed home chemical experiments using household items for the assessment, development and consolidation of chemical knowledge, experimental skills and abilities has been revealed by formative experiments.

The analysis of our research showed that the use of home chemical experiments in extracurricular activities effectively affects the assimilation of chemical knowledge, skills and abilities on the topics covered in the corresponding courses of 8th grade of secondary schools.

Conclusions and Recommendations. Based on the above-given data, it can be concluded that the use of a home chemical experiment in grades 8-9 of secondary schools serves for the effective development of theoretical knowledge, practical skills in chemistry, awareness of the practical role of chemical concepts in everyday life, the role of chemistry and chemical production in the development of modern society. Along with this, our research makes it possible to gradually form and develop an ecological culture, natural science literacy of students.

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