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DEVELOPMENT OF CHEMICAL THINKING BY SOLVING CHEMICAL PROBLEMS IN CHEMISTRY LESSONS

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Learning to solve chemical problems has always been given great importance. The programs that a teacher can follow include a systematic approach to learning how to solve problems, the regular implementation of which allows students to form chemical thinking. However, the small number of hours devoted to studying chemistry, the lack of internal motivation for learning how to solve chemical problems in most schoolchildren, and a number of other reasons do not make it possible to fully implement this approach.

Keywords: *task, psychological and pedagogical foundations, chemical kinetics, thermodynamics, electrochemistry, the law of conservation of mass of matter.*

Introduction

Solving chemical problems in lessons, individual-group, practical and laboratory classes, carried out in accordance with the curriculum, often leads to overload of students, without giving a guarantee that they will acquire skills and develop skills in solving at least typical problems in chemistry. Having not mastered and not sufficiently worked out one type of problem or the way to solve them, students are forced to move on to learning another material. They perceive the next type of tasks as something completely new and unrelated to the already known. As a result, a significant part of students do not form a common approach to solving chemical problems and lack the ability to solve them.

The relevance of the study is the solution of calculated and qualitative problems develops the creative independence of students, contributes to a deeper development of the subject. It is through solving problems of various types and levels of complexity that the course of chemistry can be effectively mastered.

Information technologies play an increasingly prominent role in organizing chemistry training [1]. The use of information technologies for teaching the solution of chemical problems is one of the possible options for overcoming this situation, allows expanding the horizons of students, provides new opportunities for transmitting information, wider use of visual aids, interactive learning mode in combination with individualization of learning and student activity [2].

Solving problems in teaching chemistry has always been considered important not in itself, with the help of tasks, students master the basic concepts and laws of chemistry, get acquainted with the notation system, comprehend the quantitative relationships between reacting substances, gain experience and develop practical skills. Students develop chemical thinking, the ability to independently achieve results in solving emerging problems, and an active life position is formed [3].

The purpose of the study is to determine the optimal methodology for solving problems in inorganic chemistry, as an effective way to improve the quality of students' knowledge in the process of teaching chemistry.

Solving problems takes an important place in chemistry. Firstly, this is one of the methods of training, through which a deeper and complete assimilation of educational material in chemistry is ensured and the ability to independently apply the acquired knowledge in practice is developed. Secondly, it is an excellent way to carry out interdisciplinary and course connections and the connection of chemical science with life. Successful solution of problems by students, therefore, is one of the final stages in cognition itself. To learn chemistry, a systematic study of the known truths of chemical science must be combined with an independent search for a solution to first small and then large problems [4].

Research materials and methods

Training in solving chemical problems has always been of great importance. The programs that can guide the teacher include a systematic approach to teaching to solve problems, the regular implementation of which allows students to form chemical thinking [5,6]. However, the small number of hours allotted for studying chemistry, the lack of internal motivation for learning to solve chemical problems in most schoolchildren, and a number of other reasons do not make it possible to fully implement this approach. Solving chemical problems in lessons, individual-group, practical and laboratory classes, carried out in accordance with the curriculum, often leads to overload of students, without giving a guarantee that they will acquire skills and develop skills in solving at least typical problems in chemistry. Having not mastered and not sufficiently worked out one type of problem or the way to solve them, students are forced to move on to learning another material. They perceive the next type of tasks as something completely new and unrelated to the already known. As a result, a significant part of students do not form a common approach to solving chemical problems and lack the ability to solve them.

Main part

Innovative technologies are playing an increasingly prominent role in organizing chemistry training. The use of innovative technologies for teaching to solve chemical problems is one of the possible options for overcoming this situation, allows expanding the horizons of students, provides new opportunities for transmitting information, wider use of visual aids, interactive learning mode in combination with individualization of learning and student activity [7].

Solving problems in teaching chemistry has always been considered important not in itself, with the help of tasks, students master the basic concepts and laws of chemistry, get acquainted with the notation system, comprehend the quantitative relationships between reacting substances, gain experience and develop practical skills. Students develop chemical thinking, the ability to independently achieve results in solving emerging problems, and an active life position is formed [8].

In our research, we relied on works considering questions of the theory of developmental learning by V.V. Davydov, D.B. El-konin, JI. V. Zankova, psychological works of JI. S. Vygotsky, P.Ya.Halperin, N. F. Talyzina, for research by I. V. Robert, B. S. Gershunsky, T. A. Sergeeva, E.E.Nifantiev, A.K.Akhlebinina. The problems of organizing the interactive interaction of training programs with the user are considered in the works of Yu. N. Tikhomirov, O. K. Tikhomirov, E. I. Mashbitz.

Performing our research, we studied possible applications in the educational process and for self-education of the teacher and the use of the development of the methodology will allow to some extent to resolve the contradictions in the practice of training in solving chemical problems:

- a reduction in the number of teaching hours devoted to teaching chemistry and a high level of requirements for the knowledge of students and the associated increase in their independent work;
- the presence of a large number of electronic publications for the study of chemistry and the lack of functional capabilities in them for training in solving problems;
- the need for students to independently solve complex chemical problems and the lack of their significant part of the ability to solve even the simplest problems;
- increasing possibilities of using EI for training in solving problems and insufficient readiness of most teachers to use them in the educational process.

Tasks in inorganic chemistry, compiled and selected in this work, were used for control and independent work in inorganic chemistry. Schoolchildren of the 9th grade named after Titov (a total of 29 students) took part in the testing. Control work was carried out at the final lesson in inorganic chemistry. Each task was evaluated on a 5-point system according to how fully the solution was presented. The score for the control work as a whole was also given according to the 5-point system adopted in schools.

Practically all pupils coped with tasks (93.8%), including 61.8% on "well" and "perfectly" (fig. 1). And it is valid, most of school students didn't experience difficulties in the solution of tasks. Tasks in inorganic chemistry on a subject solutions were most successfully solved (66.7% of school students, on gas laws – 61.5% completely solved, fig. 2).

We analyzed the results of solving each type of problem. Many students did not receive high marks for test work due to the fact that they did not receive the correct final answers. Indeed, a fairly large part of the guys solved the problems "not completely." As a rule, such students gave correct formulas for calculations, but found it difficult to substitute numerical values.

Specific, most common errors in solving problems are presented in Table 1.

Table 1 – Specific, most common errors in solving problems

Subject	**Control results works, %**			**Remarks**
	Decided completely	**Not solved**	**Decided not completely or with mistakes**	
Calculations by chemical formulas	46,2%	12,8%	41%	Errors are mainly associated with equations of chemical reactions, students forget to arrange the coefficients.
Gas laws	51,3%	8%	30,7%	Errors are associated with a misunderstanding of the essence of the problem, as well as errors associated with incorrect conversion of m3 to liters, and with incorrect use of the mass of the substance instead of the volume of the solution in the formula $C_m = \frac{\nu}{V}$
law of definite proportions	66,7%	7,7%	25,6%	Errors are associated with incorrect finding of mpr and mteor. In the formula, for example, when finding mpr, instead of the formula they write, that is, students confuse the value of the mass of mixtures with the mass of pure substance.
Solutions	56,7%	12,8%	30,2%	Errors are associated with incorrect finding of the equivalent of the element, concentration, mass fraction of solutions.
The law of conservation of mass of a substance	61,5%	7,7%	30,8%	Errors are associated with incorrect determination of the molecular weight of the substance, with incorrect determination substance formulas

Common errors:

1. incorrect determination of the molecular weight of the substance.
2. not knowing the rules for rounding numerical values, which ultimately leads to incorrect finding of the answer.

Fig. 1 – Grades received by schoolchildren in chemistry test

1. Calculation tasks by chemical formulas - 46.2%
2. Objectives for gas laws - 51.3%
3. Tasks for the law of constancy of composition - 66.7%
4. Solution objectives - 56.7%
5. Tasks for the law of conservation of mass of a substance - 61.5%

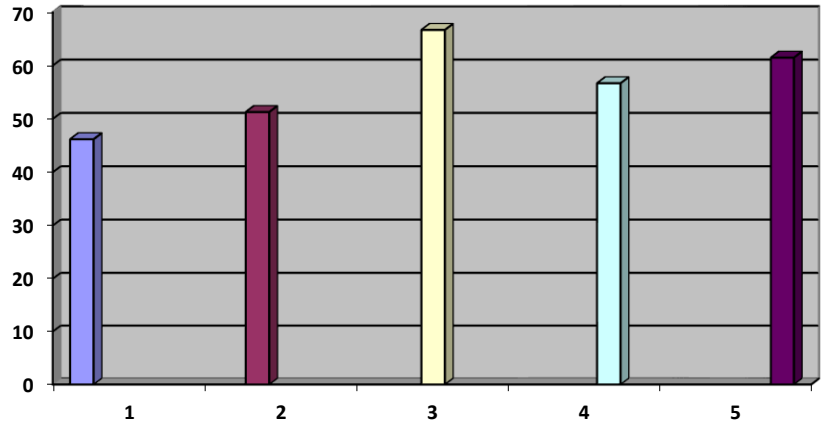

Fig. 2 – The share of schoolchildren who completely solved problems on individual topics, 56.48%

Thus, testing of problems in inorganic chemistry among schoolchildren at control works showed the need to repeat basic topics in chemistry (chemical kinetics, thermodynamics, electrochemistry, etc.) and mathematics (differentiation, integration, etc.) in the course of the basic inorganic chemistry. A real help for self-study of this material, which is actually already well known to students, can be the manual on applied chemistry "Problems on the theoretical foundations of inorganic chemistry," compiled from the materials of the presented work.

Conclusions

At the first stage of the study, scientific and methodological literature was studied and analyzed on the topic of research, curricula and manuals for solving chemical problems, the use of electronic educational means in the study of chemistry. The possibilities of using electronic publications for teaching the solution of problems in chemistry have been studied, approaches to solving the problem have been found. The resulting material made it possible to formulate a research hypothesis, to determine the main goals and objectives. The definition of the educational chemical task was clarified. A low level of skills in solving chemical problems by students was revealed, which determined the relevance of the study.

At the second stage, approaches to the classification of problems were determined, their classification was proposed, which allows students to form skills and skills in solving typical problems in chemistry. The criteria for selecting tasks for learning to solve them using new technologies were determined, its impact on the motivation of educational activities and the emotional state of students was revealed. Based on the accumulated experience, methodological recommendations have been developed on the application of new technologies in the educational process and in independent training in solving problems [9].

At the third stage, the results of the study were summed up, statistical processing was performed and the analysis of the obtained experimental data was completed.

The study was conducted in 2023 on the basis of the Titov secondary school with. Karabulak of the Eskeldinsky district, when studying the disciplines of "Inorganic Chemistry" in lessons, individual group classes, during extracurricular activities, and when independently working at home for individual students.

1.The definition of a chemical training problem has been clarified, which is a model of a specific problem situation that the student must solve with the means available to him. The main goal is not the result of solving the problem itself, but the impact of the decision process on the formation of students' chemical thinking.

2. From the analysis of educational, methodological and scientific literature, it follows that the process of solving chemical problems is of great importance as a teaching method and a means of control. At present, the importance of chemical tasks is increasing, remaining an important method of learning, solving problems becomes leading for the formation of skills, skills and personality development of students.

3. Analysis of existing classifications of chemical problems shows the lack of a unified approach among most researchers.

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РАЗВИТИЕ ХИМИЧЕСКОГО МЫШЛЕНИЯ РЕШЕНИЕМ ХИМИЧЕСКИХ ЗАДАЧ НА УРОКАХ ХИМИИ

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Обучению решению химических задач всегда придавалось большое значение. В программах, которыми может руководствоваться учитель, заложен системный подход к обучению решению задач, регулярное выполнение которых позволяет сформировать у учащихся химическое мышление. Однако небольшое количество часов, отводимое для изучения химии, отсутствие внутренней мотивации к обучению решению химических задач у большинства школьников и ряд других причин не дают возможности осуществить этот подход в полной мере.

Ключевые слова: *задача, психолого-педагогические основы, химическая кинетика, термодинамика, электрохимия, Закон сохранения массы вещества.*

ХИМИЯ САБАҚТАРЫНДА ХИМИЯЛЫҚ ЕСЕПТЕРДІ ШЕШУ АРҚЫЛЫ ХИМИЯЛЫҚ ОЙЛАУДЫ ДАМЫТУ

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Химиялық есептерді шешу жолдарына әрқашан үлкен мәнге ие болды. Мұғалім басшылыққа алатын бағдарламаларда жүйелі түрде орындалуы оқушылардың химиялық ойлауын қалыптастыруға мүмкіндік беретін мәселелерді шешуге оқытудың жүйелі тәсілі. Алайда, химияны оқуға бөлінген сағаттардың аздығы, мектеп оқушыларының көпшілігінде химиялық есептерді шешуді үйренуге ішкі мотивацияның болмауы және басқа да бірқатар себептер бұл тәсілді толық жүзеге асыруға мүмкіндік бермейді.

Кілт сөздер: *тапсырма, психологиялық-педагогикалық негіздер, химиялық кинетика, термодинамика, электрохимия, зат массасының сақталу заңы.*