TECHNOLOGY FOR ENHANCING THE EFFECTIVENESS OF COGNITIVE ACTIVITY IN A CHEMISTRY COURSE

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Abstract. *One of the main tasks of education, in accordance with modern ideas, is to create conditions for the formation and development of creative thinking among students in the learning process. Effective organization of cognitive activity is the primary task in solving this problem.*

From the perspective of a systems approach, the learning process itself is a complex dynamic system that obeys the laws common to systems. The system control mechanism is cyclic feedback (recursion). We learn through repetition. Learning is making decisions and changing actions in response to feedback received.

There is a distinction between simple learning - a balancing feedback loop, it is aimed at adaptation and gaining stability. In terms of functioning, it includes procedures, technologies, one or another system of work, trial and error, and rote memorization.

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Today, in most textbooks, the system-forming concept that allows one to compose formulas for inorganic compounds is the concept of "valency". Valence is understood as "the properties of an atom of a given element to attach or replace a certain number of atoms of another element (N.S. Akhmetov, [5]). Valence is determined by "the ability of atoms of elements to form a certain number of chemical bonds [13]. It is usually stated that the hydrogen atom always forms only one bond, so its valency is taken to be one; similarly, oxygen is defined as an element with a constant valence of two.

This idea does not reflect modern scientific views and is difficult to apply, as it has many exceptions. For example, it has been proven that "in the overwhelming majority of inorganic compounds (due to their unique polymeric nature), the "number of bonds" does not correspond to the established measure of valence and therefore cannot serve as a criterion for this measure" [11]. There is another difficulty faced by the valency problem, which is revealed by modern crystal research tools [99]. In some cases, a lattice is formed containing atoms of the same elements in two different positions. Thus, in the lattice of thallium selenide, half of the thallium atoms are located at the vertices of a large octahedron, and half are at the vertices of a tetrahedron (solid state chemistry). Chlorine atoms in some crystalline modifications are found in nonequivalent positions [8]. It is clear that such facts indicate a different state of bonds between atoms of the same elements.

These and other reasons inevitably cause difficulties in students' understanding of educational material and the difficulty of its systematization. Therefore, it is proposed to use the concept of "oxidation state" as a system-forming concept.

By definition, the oxidation state is the formal charge on an atom resulting from the displacement of the electron involved in the formation of a chemical bond towards a more electronegative element. A positive oxidation state occurs if an electron is displaced from a given atom, a negative oxidation state occurs if an electron is displaced towards the atom in question. Possible and characteristic oxidation states of elements of the main subgroups can be easily determined from the electronic structural formulas of the atoms. The characteristic oxidation states correspond to three stable electronic configurations of valence orbitals: ns°np°, ns2np6, ns2np°. Knowledge of possible and characteristic oxidation states, as well as the relative electronegativity of atoms, provides a fairly correct way to compile reaction equations for simple substances and formulas for binary compounds.

The acid-base properties of elemental hydroxides, as well as the redox properties of compounds, are systemically related to the degree of oxidation. Based on this concept, it is possible to predict the composition and basic properties of inorganic compounds. Its use in combination with knowledge of the acid-base properties of compounds is also very productive in drawing up equations for redox reactions.

Another specific feature of the content is that the subject of study is not the actual material, but the nature of the genetic connections between the structure of the element's atom and the oxidation states it exhibits, on which the composition and properties of the compounds formed, in turn, depend, as well as the universal method of mental activity, which allows obtain a significant part of factual information by deduction.

The ability to predict oxidation states is confirmed by analysis of actual material. All material in the basic core of the discipline is divided into the following sections - information blocks (according to the diagram, 1. Basic concepts of chemistry.

2. The theory of atomic structure. Characteristic oxidation states of elements.

3. Composition of compounds:

• binary compounds, nomenclature, equations of reactions between simple substances

• composition of hydroxides of non-metals and metals, dependence of their acid-base properties on the degree of oxidation of the element, dissociation equations, nomenclature.

4. Drawing up equations of chemical reactions:

• acid-base interaction; composition and nomenclature of salts;

• redox reactions.

These sections cover a very significant part of the entire course material in inorganic chemistry. Students become familiar with the physical properties of specific compounds during the educational experiment provided in each section. There you will also receive additional information about the distribution, application and biological role of the relevant substances. It should be noted that the idea of creativity in chemistry as an experimental study of students is quite widespread in methodology (R. Kunert, V.D. Legal (cited by P.A. Orzhekovsky, [8], p. 35). According to R.G. Ivanova [7], the use of the heuristic method helps to strengthen the strength of knowledge and, on the contrary, without systemic knowledge, the organization of research work is not possible. R.G. Ivanova connects the development of students' creative abilities mainly with the use of the research method.

The peculiarity of the technology is the formation of theoretical thinking in students through the special construction of an academic subject and the special organization of cognitive activity. During the learning process, the teacher does not present basic knowledge, but organizes students' mastery of the genetic relationships of objects.

Students master a universal method of mental activity, which allows them to obtain a significant part of factual information by deduction. Theoretical material is presented only in the scope of general provisions.

The program material is organized into a special, strict system of tasks, so that each previous level is necessary for mastering the next one. Thus, the corresponding material is repeated with the need for the student's activity each time at a new level and in new connections. In this case, new knowledge is firmly assimilated without memorization, that is, involuntarily.

Studying the theory of atomic structure makes it possible to independently predict the possible and characteristic oxidation states of elements, which in turn determine the composition of the binary compounds and hydroxides they form.

To organize cognitive activity, tables 3-5 below are used as handouts. They propose an algorithm that allows students to build genetic connections between

the structure of the atom and the oxidation states it exhibits. Cognitive activity is organized in such a way as to minimize the amount of information intended for rote learning. Memorization occurs involuntarily, during the performance of tasks (first of the reproductive and then of the productive type).

The formulas of hydroxides are derived independently using the algorithms contained in tables 6, 7. The proposed algorithm allows us to trace the dependence of the acid-base properties of hydroxides on the degree of oxidation of the element.

All work on studying the composition of inorganic compounds is organized in a similar way. Students do it easily, very quickly and with pleasure.

The acquired knowledge and skills are consolidated with the help of exercises to compile formulas of hydroxides of various elements and equations of their dissociation. Above is a handout for organizing these activities. Completed options are in Appendix 2.

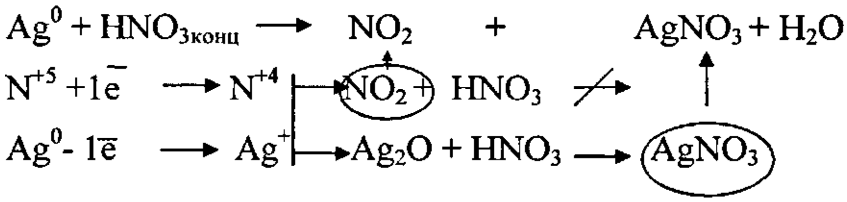
The composition of hydrogen compounds is studied by filling out Table 8, which proposes an algorithm for mental activity to describe the dependence of the composition and properties of hydrogen compounds on the degree of oxidation of elements. Additional factual information is added after completion with the help of the teacher.

Drawing up equations of acid-base reactions with preliminary small explanations is mastered in the process of active work using information and logical diagrams, in which the material is presented in the most condensed, generalized, systematized form, making them compact and informative.

When compiling equations for redox reactions, product formulas are obtained from the electronic balance diagram using the algorithm: element in a positive oxidation state -> its corresponding oxide.

—> the product of interactions of this oxide with the substance of the medium in which the reaction takes place, or with water. If the oxide does not interact with either the medium or water, then it is recorded unchanged. The application of the algorithm is clear from the following example:

+HN0$_3$



At the end of the course, students complete a final thesis.

To carry out research work on predicting the properties of elements and theoretical and experimental verification of the prediction, students are provided with the necessary reference material in addition to literary sources.

On the other hand, the hidden but objective goal of society is endless development, and the goal of the existing educational system is the transfer of accumulated knowledge, experience and skills. This contradiction inevitably led to the need to change the educational paradigm, according to which updating the content of education should be considered not only as a change in the ratio of sections of curricula and their content, but also as a structuring of these programs that would ensure the formation of systemic knowledge and systemic thinking. One of the most important goals of the educational process is the intellectual development of the individual, in which knowledge is considered as a source of personal development and as a means of endless knowledge of oneself and the world.

With this approach, the idea of continuity of education is really feasible, which provides, in particular, for mastering the ability to self-education.

Trends in changes in the content of education have been noted by a number of domestic researchers. So, P.G. Shchedrovitsky noted that "Greek pedagogy was the transmission of moral norms, medieval - knowledge culture, and we live in a period of transition to modern - ways of knowing the world" (G.P. Shchedrovitsky, [2]). It should be noted that the idea underlying the change in the educational paradigm is not new. The philosophical foundations of the new methodology were laid in the works of Pythagoras, Plato, who was looking for the rule of applying the "universal to being," Leibniz, Bernoulli, Kepler, who wrote that "The Universe is organized on the basis of the principle of minimal action" (quoted by K. Colin, [7]). L.N. Tolstoy noted that knowledge is only knowledge when it is acquired through the efforts of thought, and not memory.

Along with this, one of the main methodological problems of modern science is the "fragmentation of scientific knowledge" (I.R. Prigozhin, [7]). This fragmentation occurs both in science as a whole and in different subject areas of knowledge. Consequently, the trend towards the integration of science is impossible without systematizing knowledge and generalizing it at a new, higher level.

A necessary condition for the formation of systemic knowledge is the implementation of a systematic approach to the content of education, which involves identifying a basic initial concept for each individual subject, from which the system of concepts of a given academic discipline is derived.

This attitude to the subject is the implementation of a systematic approach to the content of education.

Theories based on this principle can be assessed according to three criteria (Ivantsova V.I., [6]):

□ simplicity of the theoretical design;

□ size of the circle of competence;

□ correspondence to experience.

Many authors are working towards the implementation of a systematic approach when studying a school chemistry course (N.S. Akhmetov , A.E. Gurevich et al., O.S. Gabrielyan, L.S. Guzey, , S.T. Satbaldina, R.G. Ivanova,

A change in the educational paradigm is impossible without the implementation of innovative educational technologies, which have recently been actively developed and implemented in educational practice (Harutyunyan E.B. Guzeev V.V., , Dyachenko V.K. , Tretyakov P.I., Sennovsky I.B., I.Yu. Sokolova, Erdniev P.M., Erdniev B.P. , Catterick D. . However, an analysis of the deep essence of communication processes has shown that the process of knowledge transfer is a fundamentally non-linear process, the individuality of the cognition process has been proven (K. Colin, [6]). Therefore, to implement a systematic approach, only those technologies are needed that involve the student's involvement in solving problematic problems through his own activities.

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From the perspective of a systems approach, the learning process itself is a complex dynamic system that obeys the laws common to systems. The system control mechanism is cyclic feedback (recursion). We learn through repetition. Learning is making decisions and changing actions in response to feedback received.

There is a distinction between simple learning - a balancing feedback loop, it is aimed at adaptation and gaining stability. In terms of functioning, it includes procedures, technologies, one or another system of work, trial and error, and rote memorization.

For change and renewal (development), another type of learning is needed - generative learning. Generative learning is the process of facilitating feedback to change mental models of a given situation. Such learning leads to new strategies and new classes of actions that were not available before. Examples: mastering ways of thinking, checking one's own assumptions, taking a new look at the situation.

The idea of enhancing cognitive activity is closely related to

the idea of the need to introduce a new methodology into the process of cognition. It is known that "communication processes, including processes of knowledge transfer, are fundamentally nonlinear. This means that knowledge, unlike material objects, cannot be directly transferred to each other. Such transfer cannot be carried out in principle, since each time new knowledge is born in in a person's head anew. This process proceeds on the basis of analyzing the information he receives from the outside and comparing it with existing knowledge. In the process of communicating new information to a person, one can only create the necessary prerequisites for the birth of new knowledge, a kind of "discovery" of a new idea. about the world. Only he must make this discovery himself. Thus, the process of cognition is purely individual" (K. Colin, [7]).

The solution to this problem, therefore, lies in the organization of individual activity in the learning process. Moreover, not any activity is important, but only those that create conditions for the development of scientific thinking skills in the student and at the same time correspond to his level of development. "Therefore, the task of pedagogy is to find optimal ways of adequate activity and organize its management" (Teregulov F.Sh., [13], p.4). The organization and management of cognitive activity is extremely important, since the ineffectiveness of the organization of the educational process and the selection of the studied material, which often contains an unreasonably large volume of weakly interconnected facts, according to domestic and foreign researchers, is one of the reasons for the decline in schoolchildren's interest in learning (Babansky Yu .K., [9]). Thus, one of the conditions for the effective organization of cognitive activity is the strict selection and systematization of educational information.

On the other hand, the learning process itself is an activity. Forms of activity: material, external speech and mental. These three main forms of activity characterize it not from the objective, but from the subjective side - the degree (or level) of the subject's mastery of this action.

The qualities being formed are designed in advance and included in the learning goal. These include: rationality, consciousness, generalization, criticality, mastery, and therefore reliability of action.

REFERENCES

1. Torres V. M., Posa M., Srdjenovic B., Simplício A. L. Solubilization of fullerene C60 in micellar solutions of different solubilizers. Colloids and Surfaces B: Biointerfaces 2011; 82(1):P. 46-53
2. Cioslowski J. Electronic Structure Calculations on Fullerenes and Their Derivatives , Oxford University Press, 1995, 3-53.
3. Krusic P.J., Wasserman E., Keizer P.N., Morton J.R., Preston K.F. Radical reactions of C60.Science 1991; 254(5035): 1183-1185
4. Krusic P.J., Wasserman E., Parkinson B.A., Malone B., Holler Jr, E.R., Keizer P.N., Preston K.F. Electron spin resonance study of the radical reactivity of C60. Journal of the American Chemical Society 1991; 113(16): 6274-6275
5. McEwen C.N., McKay R.G., Larsen B.S. C60 as a radical sponge. Journal of the American Chemical Society 1992; 114(11): 4412-4414
6. Walbiner M., Fischer H. Rate constants for the addition of the benzyl radical to fullerene C60 in solution. The Journal of Physical Chemistry 1993; 97(19): 4880-4881
7. Zeynalov E.B, Allen N.S., Salmanova N.I. Radical scavenging efficiency of different fullerenes C60, C70 and fullerene soot. Polymer Degradation and Stability 2009; 94(8): 1183-1189
8. Dimitrijevic N.M., Kamat P.V., Fessenden R.W. Radical adducts of fullerenes C60 and C70 studied by laser flash photolysis and pulse radiolysis. The Journal of Physical Chemistry 1993; 97(3): 615-6189.
9. Zeinalov E.B., Koβmehl G. Fullerene C60 as an antioxidant for polymers. Polymer Degradation and Stability 2001; 71(2): 197-202

10. Zeynalov E.B., Magerramova M.Ya., Ishenko N.Ya. Fullerenes C60/C70 and C70 asantioxidants for polystyrene. Iranian Polymer Journal 2004; 13(2): 143-148
11. Troitskii B.B., Troitskaya L.S., Dmitriev A.A., Anikina L.I., Novikova M.A., Denisova V.N., Khokhlova L.V. Fullerenes and synergistic mixtures on their basis as high-temperature antioxidants of polymers. Molecular Materials 2000; 13(1-4): 209-212
12. Shibaev L.A., Egorov V.M., Zgonnik V.N., Antonova T.A., Vinogradova L. V.,Melenevskaya E.Y., Bershtein V.A. An enhanced thermal stability of poly (2,6-dimethyl-1,4-phenylene oxide) in the presence of small additives of C60 and C70 fullerenes. Polymer Science.Series A, Chemistry, Physics 2001; 43(2): 101-105
13. Cataldo F. On the reactivity of C60 fullerene with diene rubber macroradicals. I. The case of natural and synthetic cis-1, 4-polyisoprene under anaerobic and thermooxidative degradation conditions. Fullerene Science and Technology 2001; 9(4): 497-513
14. Yumagulova R.K., Medvedeva N.A., Yakupova L.R., Kolesov S.V., Safiullin R.L. Freeradical chain oxidation of 1,4-dioxane and styrene in the presence of fullerene C60. Kinetics and Catalysis 2013; 54(6): 709-715
15. Zuev V.V., Bertini F., Audisio G. Fullerene C60 as stabiliser for acrylic polymers. Polymer Degradation and Stability 2005; 90(1): 28-33
16. Zeynalov E.B., Allen N.S., Salmanova N.I. Radical scavenging efficiency of different fullerenes C60-C70 and fullerene soot. Polymer Degradation and Stability 2009, 94(8), 1183 –1189.