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FORMATION OF THE COMPREHENSION OF ENVIRONMENTAL BASIC CONCEPTS IN CHEMISTRY AND BIOLOGY

WYJAŚNIANIE PODSTAWOWYCH POJĘĆ W CHEMII I BIOLOGII ŚRODOWISKA

Abstract: In the background of successful acquiring of every learning subject there is comprehension of the basic concepts and problems of the corresponding field of science. Precise explanation of the basic concepts from the teacher's side facilitates the corresponding development of student's knowledge and comprehension. There are several substantial problems every teacher facing during learning process in chemistry and biology lessons. Students are defining the basic concepts/ideas not precisely because there is different explanation or even this explanation is lacking in different teaching aids. It is difficult for student to find definitions and explanations of concepts learned in preceding years without assistance. As for student as well for teacher there is lack of concise, clear source of information to be used both for self-education as well to prepare for examinations. And finally the actualities are changing in the long run. Obvious example is inclusion of actual environmental items in the chemistry course. Since the approval of new National Education standards in Latvia in 2006 environmental items were regarded mainly during biology lessons. Though there is the need to elaborate contemporary teaching aids assisting to solve the mentioned problems. The serious attention should be paid to the process of the formation of the basic concepts. Actual paper provides principles for the formation of the basic concept „acid rain”.

Keywords: acquiring of chemistry and biology, comprehension of the basic concepts, basic concept, acid rain

The task of teacher when starting to teach every new learning subject is to raise interest of students regarding this new subject. Both in biology as well in chemistry the teacher shows demonstrations accompanied by exciting narration. Quite often the teacher to be carried away by demonstrations and experiments forget that he should set the background for knowledge starting from the very first lessons. Starting on that how good the student will acquire the basic concepts of biology and chemistry there will be dependent his following success during the acquiring of the whole biology or chemistry course as students are learning with deeper interest those issues understandable or at least partly understandable to them. To provide that during learning process student obtain qualitative knowledge teacher should ensure effective organization of student's thinking being systemic, logical and consequent.

In the studies of chemistry and biology the acquiring of the basic concepts is the background for successful acquiring of the themes related to surrounding environment, even more because according to the National standards in chemistry and biology students should acquire issues related to the environment [1]. Up to the approval of new National Education standards in Latvia in 2006 environmental items were regarded during biology lessons mainly where only the small part from the whole number of lessons were devoted to ecological items. To acquire the environmental items in the chemistry lessons there are not quite ready nor teachers nor students as the environmental items in the chemistry textbooks are viewed in general way or even the themes concerning environmental issues are missing.

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Though there is the need for teaching aid to facilitate the work of the teachers and students during acquiring environmental items.

Theoretical background of the methodology

The studying of chemistry and biology is cognitive process resulting in development of stable, practically applied knowledge founded on the acquiring of the basic concepts.

The basic concepts are knowledge in generalized way reflecting the crucial features of objects (substances) as well as the rules. Only gradually formed and developed basic concepts conceived complete and deeply by the students are suitable for characterization of already known facts by them as well as to allow them to use these basic concepts as effective cognitive tool [2]. Though when developing the basic concepts it is not possible to stay only with the description of definition of the basic concept or to stay with that the student knows concerning the object or phenomenon what it simply is. Teacher should develop knowledge (skills) allowing revealing the real substance of the basic concept, to allow view interconnections (contiguity between the basic concepts).

Formation of the basic concept is going on gradually. In the process of studying chemistry and biology there are two levels discerned - empirical and theoretical. The empirical basic concepts formed at empirical level allow arranging diversity of qualities of the studying object according to the unsubstantial features, though alleviating cognitive process. In the theoretical level the basic concepts are formed by extracting the substantial inner connections and connecting them together, though allowing the basic concepts became more concrete.

Some authors provide several models to form the basic concepts, though the differences between these models are minimal.

Table 1

Stages of the development of chemistry basic concepts [4]

Stage	Content of action	Result of action in the mind of student
I	Observation of several equal objects or phenomenon, revealing of equal external features. Primary synthesis as a result of comparison. Discovering the substance and way of cognition of the basic concept	The notion is forming The model of the basic concept is forming, the initial plan for development of basic concept
II	Study (analysis) and extraction (synthesis) of the substantial features of objects (phenomenon) or their structural parts	There is forming empirical basic concept
III	Inclusion of new facts in the content of the given basic notion. Detection of new connections and attitudes between given basic concept and other concepts (analysis and synthesis). Use of concept	Concretization and fastening of the empirical basic concept
IV	Detection of the site of given basic concept within the whole system of knowledge	Formation of the theoretical basic concept

For instance Russian scientists provide the following model to form the basic concepts [3]:

Stage 1 - there is gathered information obtained (received) by senses - hearing, sight and touch;

Stage 2 - formation of notions;

Stage 3 - generalization of notions results in formation of the basic concepts.

In the given scheme of classification first two stages corresponds to the empirical cognitive level but last one stage - to the theoretical cognitive level.

There are authors dividing 4 main stages in the development of the basic concepts [4].

In this case first three stages correspond to the empirical level, but fourth in its turn - to the theoretical level.

If comparing the models of formation of basic concepts it could be seen that in the formation of the basic concepts there is dominating principle - from the general towards concrete, substantial.

Methods and materials

In contemporary world even more popular become the educational aids allowing the interested persons to acquire basis of respective science field in concise way. These are handbooks, small glossaries of definitions, tables and assignments for calculations, not addressed to any particular class. They could be successfully used both in lessons as well as at home preparing for lessons. They could be used both by students and their parents as well as by teachers. Thus we regard that elaborated teaching aids in chemistry and biology could be important [5]. The basic concepts included in teaching aids are based on requirements of National Education standards of Latvia in chemistry and biology. Explanation of the basic concepts is based on principle - from the general towards concrete, more characteristic. Teaching aid is approbated and tested in practice in schools. Initial approbation is wide because the material is available for all of the students in Latvian schools; it is used by students, teachers, parents and applicants, as well as lecturers in universities for comparison aspect to be informed about what the students should know. One of the aspects of the teaching aid application is its use to form (develop) the basic concepts.

To form the basic concepts following scheme consisting of three stages could be used:

Stage 1 - gathering of experience, specification;

Stage 2 - formation of notions;

Stage 3 - division of most important features of the basic concept.

Results and discussion

Development of the basic concept "acid rain" in chemistry and biology

Development of the basic concept "acid rain" could be performed in three stages:

- Gathering of experience (What the students know already about the acid rain?)
- Formation of notions (What the acid rain really is?)
- Division of the most important features of the basic concept (How the acid rain forms? How it influence the surrounding environment?)

In the process of the development of the basic concept there could be used diverse studying methods. During the stage of the gathering of experience brainstorm will be useful. For the formation of notions there could be used experiments and demonstrations [6], for example, demonstration of sulphur reaction with oxygen and solving of obtained sulphuric(IV) oxide in water. Educational films [7] as well as pictures and presentations could be shown. When dividing the most important features, in biology the laboratory work, for example, "Observing the Influence of Acid Rain on Plant Growth" [8] could be

performed, but in chemistry - "Forming of Acid Rains" [9] or Acid Effects on Metals [8]. Both in biology and in chemistry it is suggested to perform solving of problem situations by using real facts.

Development of the basic concepts in the elaborated chemistry and biology teaching aids

In the elaborated chemistry and biology teaching aids the basic concepts and regularities are reflected by the models and schemes comprehensive to students, basic concepts are explained in the language easy understandable to students, based on principle from the general towards concrete, coinciding with the stages of formation of the basic concepts. As an example there is given formation of the basic concept "acid rain" from the elaborated teaching aid (see Fig. 1).

Acid rain	Precipitations polluted by great amounts of sulphuric and nitric oxides.
Formation of acid rain	<p>Sulphuric oxides reacting with water vapour in the air are making sulphuric acid drops.</p> $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3 \quad (\text{sulphuric(IV) oxide} + \text{oxygen} \rightarrow \text{sulphuric(VI) oxide})$ $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4 \quad (\text{sulphuric(VI) oxide} + \text{water} \rightarrow \text{sulphuric(VI) acid})$ <p>Sulphuric oxides are forming by burning of fossil fuels, for instance, coal as well as are discharged during eruptions of volcanoes.</p> <p>The similar process occurs with nitric oxides, which also forming due to burning of fossil fuel.</p> $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$ $(\text{nitric(II) oxide} + \text{oxygen} \rightarrow \text{nitric(IV) oxide})$ $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$ $(\text{nitric(IV) oxide} + \text{water} \rightarrow \text{nitric(V) acid} + \text{nitric(II) oxide})$
Consequences of acid rain	<ul style="list-style-type: none"> • Metallic constructions are rusting; • Architectural monuments are damaged; • Lichens and coniferous trees are perishing; • By increasing soil acidity there are forming solvable toxic metallic compounds; • By decreasing of water pH value in lakes, there are disappearing many fish species.

Fig. 1. Fragment from the teaching aid in chemistry

Development of this basic concept in the teaching aid occurring as follows:

- At first there is given the definition what the "acid rain" is. By reading or learning this definition there is established just general perception what the "acid rain" is, its substance is still not clear.
- Then there are revealed substantial features of the "acid rain" - what are the reasons of forming it and how the "acid rain" influence surrounding environment. By reading this information becomes clear the reasons of "acid rain" and its consequences on surrounding environment.

By using these teaching aids student could fasten his present knowledge as well as to find out unclear items not discussed during lessons.

After the approbation of teaching aid there are received positive references and approving evaluations both from students and their parents as well as from teachers.

Conclusions

1. In the forming of the environmental basic concepts there could be regarded principle of logical sequence - from the general towards concrete.
2. In the forming of the environmental basic concepts it is suggested to use diverse methods both empirical and theoretical.
3. In the process of learning of the environmental basic concepts the teaching aids elaborated by the author and accepted by the target groups could be useful.

References

- [1] Regulations on national standards in basic education and subjects standards for basic school. Viewed 12.08.2009, <http://isec.gov.lv/normdok/mk061027.htm>
- [2] Kuznecova N.: Formation of the systems of basic concepts for teaching chemistry. Prosveschenije, Moscow 1989 (Russian).
- [3] Verzilin N. et al: Development of the biological basic concepts. Publishing House of the Academy of Pedagogical Sciences, Moscow 1956 (Russian).
- [4] Gorskis M. and Rudzitis G.: General chemistry. Methodological aid. Zvaigzne ABC, Riga 2006 (Latvian).
- [5] Kreile S.: Biology. Teaching aid for 7-9 class students. Multineo, Riga 2006 (Latvian).
- [6] Bartusevica A.: Formation of the comprehension about classes of chemical compounds during chemistry experiments. Conference proceedings "Chemistry education at school - 2005". Riga 06.10.2005, 13-19 (Latvian).
- [7] Ziepniece I. and Cedere D.: Promoting understanding of environmental processes in a differentiated chemistry learning process according to learning styles in basic school. Conference proceedings "Chemistry education at school - 2007". Riga 20.09.2007, 116-121 (Latvian).
- [8] Effects of acid rains. Viewed 12.08.2009, <http://www.epa.gov/acidrain/effects/index.html>
- [9] Towards practical life oriented comprehension in chemistry. Edited by A. Bartusevica *et al.* University of Latvia, Riga 2007 (Latvian).

WYJAŚNIANIE PODSTAWOWYCH POJĘĆ W CHEMII I BIOLOGII ŚRODOWISKA

Abstrakt: Podstawą zdobywania wiedzy z każdego przedmiot nauczania jest zrozumienie podstawowych pojęć i problemów związanych z odpowiednią dziedziną nauki. Dokładne wyjaśnienie podstawowych pojęć przez nauczyciela ułatwia odpowiednie przyswojenie wiedzy przez ucznia. Każdy nauczyciel w trakcie procesu nauczania chemii i biologii napotyka na kilka ważnych problemów. Studenci definiują podstawowe pojęcia/zwroty nieprecyzyjnie, dlatego że nie znają innego wyjaśnienia, a także brakuje jeszcze niektórych pomocy naukowych. Studentowi trudno jest bez pomocy podać definicje i wyjaśnienia pojęć poznanych w poprzednich latach. Zarówno w przypadku studentów, jak i nauczycieli brak jest zwięzłych, jasnych źródeł informacji, które mogą być wykorzystywane w procesie samokształcenia bądź przygotowywania się do egzaminów. I wreszcie aktualizacja informacji zachodzi w dłuższym czasie. Przykładem jest uwzględnienie rzeczywistej ochrony środowiska w trakcie nauczania przedmiotu chemia. Od czasu zatwierdzenia w 2006 r. nowych norm krajowych edukacji na Łotwie zagadnienia ochrony środowiska realizowane są głównie podczas lekcji biologii. Istnieje potrzeba opracowania współczesnych pomocy naukowych i szukania sposobów w celu rozwiązania wymienionych problemów. Należy zwrócić uwagę na proces kształtowania podstawowych pojęć. W pracy przedstawiono zasady tworzenia podstawowego pojęcia „kwaśny deszcz”.

Słowa kluczowe: rozumienie chemii i biologii, rozumienie podstawowych pojęć, pojęcia podstawowe, kwaśne deszcze