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Enigmatics in Chemistry lessons – a means of increasing interest in studying Chemistry in 7th grade

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Abstract: *In the last several years, a decreasing interest in Science is observed among students. Chemistry lessons aren't excluded from this trend. Creating a permanent level of interest in the subject, overtaking the students' ignorance and convincing them to believe that the knowledge given to them has a practical use is achievable by activating, pragmatizing and diversifying the process of studying. This can be achieved by inserting new methods of teaching along with traditional ones. Enigmatics here is seen as an innovative tool for increasing interest in the subject while teaching Chemistry. The goal of this research is increasing both motivation to learn Chemistry among students and interest in the subject by using specific enigmatic tasks in the process of education.*

Keywords: *enigmatics in chemistry, cognitive interest, motivation*

Introduction

In past years, enigmatics is proven to be efficient in a range of subjects related to studying and self-improvement. It's a recommended means of both increasing interest in a given subject and curing different pathologies related to self-improvement and health. The term *enigmatics* means “riddle, mystery, puzzle” (greek: “αίνιγμα”). A number of authors have created enigmatic mind-bogglers for helping with gaining knowledge in different cultural and social disciplines. According to Beneva and Todorov, „There are unsuspected possibilities for a lot of people to personally partake in a fun and helpful activity“, which they call „brain exercise“ [1]. Authors of a textbook for 8th grade give a lot of enigmatic challenges to students in order to increase interest in chemistry as part of the mandatory schooling in secondary school education [2]. Although new, engaging and challenging enigmatic puzzles keep appearing on the Bulgarian market, their creation and use for attracting students' attention and creating interest in studying Science is a challenge [3].

Everything said above defines the goal of the research: *increasing both motivation to learn Chemistry among students and interest in the subject by using specific enigmatic puzzles in studying.*

Theoretical layout

In a modern school, the question of motivation for learning can be called central since the motif is the source of the activity and acts as incitement and the formation of meaning. Activity without motivation could either be impossible or extremely unstable. The amount of effort a student puts in studying depends on the way he's feeling in a given situation. It is therefore important that the entire process of education provokes an intense insight into knowledge and tense mental work inside students' minds. One of the main conditions for implementing an activity and reaching a certain goal is motivation. And since the needs and interests of the student are the basis of motivation, it is perfectly logical to conclude that in order to succeed, the student needs to make training a desirable activity. The motif is seen here as the student concentrating to separate parts of schoolwork, related to his regard to the subject.

An important factor for keeping students' attention during the education process and the main reason for learning is interest. Interest is seen by pedagogic-psychological literature as:

„A relatively permanent direction of the student on certain subjects and phenomena in the world, which is shown by regular, systematic and rhythmical focus of attention and mainly their cognitive interest on them.” [4].

“Such focusing of thought on a certain subject which induces seeking knowledge of the subject and to explore deeper into it”.

„A powerful stimulator of activeness and the personality, under the influence of which all psychological processes go tense and intense and the activity becomes interesting and productive.” [5].

In didactic terms, the cognitive interest is particularly important for the formation of positive motivation for learning.

“Cognitive interest is characterized as the student's complex regard of subjects and phenomena, in which his seeking of serious and deep learning and knowing their essential properties” [4].

A peculiarity of cognitive interest is its ability of enriching and activating not only the process of learning, but also every act of the person. Interest is usually selective in regard to different activities.

Knowing is a human activity which is directed to studying reality. The process of learning is a means of satisfying the needs of knowledge. In order to activate one's learning, you have to induce the cognitive interest. This can happen only when the environment is organized in such a way that satisfies one's needs, i.e. when it's diverse, new, interesting, emotional, etc. In this situation, there is a cognitive interest that activates and stimulates the process of learning.

The process of learning includes: needs of knowledge → cognitive interest → cognitive activity → cognitive development [6].

The wide range of cognitive interests provokes a more active process of knowing, which contributes to the student's improvement.

To develop the cognitive interest, you need to use education and manners as factors for organizing the environment.

The stages of development of such an interest are [5]:

- curiosity – a basic stage of orienting;
- entertainment – an aiming of going outside the boundaries of the visible world. The emotions, the astonishment and the joy of knowledge are the most important. When it becomes a feature of the character, it affects the personality;
- cognitive interest – its most characteristic feature is to explore causative links. The center of attention of students is not the study material, but the activity, the question and the problem. The interest becomes the starting point of curiosity, in seeking to find evidence, to search for additional sources of information, to interpret and model.

Results and discussion

Students' interest in the subject and the use of enigmatic problems in teaching Chemistry was studied with the help of two surveys. The first one was held in the end of the previous schoolyear and the main reason for it was to give preliminary orientation about students' attitude towards the subject and their

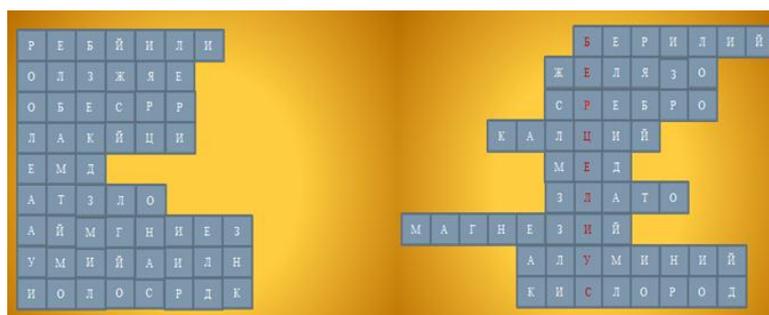
motivation for studying. 96 students were surveyed. To justify further work, we'll show the answers to 4 questions which are directly related to the theme of this study. When asked the question "Which subjects do you prefer in school?", only 30% of students include Chemistry and only 20% feel well prepared for the lessons. Only 39% of students have answered "Yes" to the question "Do you enjoy Chemistry classes?". This result shows the decrease of interest in the subject and the studying of it among students. When asked the question "How would you want Chemistry classes to be taught so you could learn the most out of them easier?", 58% of students have answered "An implementation of different games and tasks".

The summed up results of the surveys have defined the content and the process of this experiment. The experiment was held during the '17-'18 schoolyear in the High School of Mathematics "D-r Peter Beron" and Secondary School "Zachari Stoyanov" in Varna with 7th grade students. In order to realize the set goal of the first stage of the experiment, an analysis of the order and content of lessons in 7th grade Chemistry was made and the possibilities of usage of enigmatic problems and separate methodical units were defined. During the second stage of the experiment, specific enigmatic problems were developed, which were implemented along with the traditional ones. A selection of them is shown and the problems are arranged in an order, analogic to the one they appear in Chemistry coursebooks.

All of the including in this study enigmatics were created and they have meaning in Bulgarian language.

Chemical anagram

You'll get the names of elements from the Periodic table by moving the letters. Letters have to be filled in the empty boxes. If you answer correctly, you'll get the name of the Swedish scientist that proposed the most rational system of naming chemical elements.



Chemical crossword

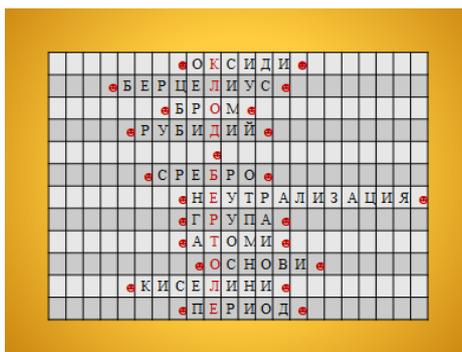
Find the names of the following structural formulas: H_2O , O_3 , Zn, Na, NH_3 , Cl_2 , O_2 , CuO, NO_2 , N_2 , H_2SO_4 , Cl_2O , H_2 , S, $AgNO_3$, CO, HCl, SO_2 , HNO_3 , Na_2S , NaCl. You can find them horizontally, vertically, proper or reverse order of letters. The remaining letters in the boxes, taken by rows, will help you find the name of a famous scientist.



Chemical crosswords No.2

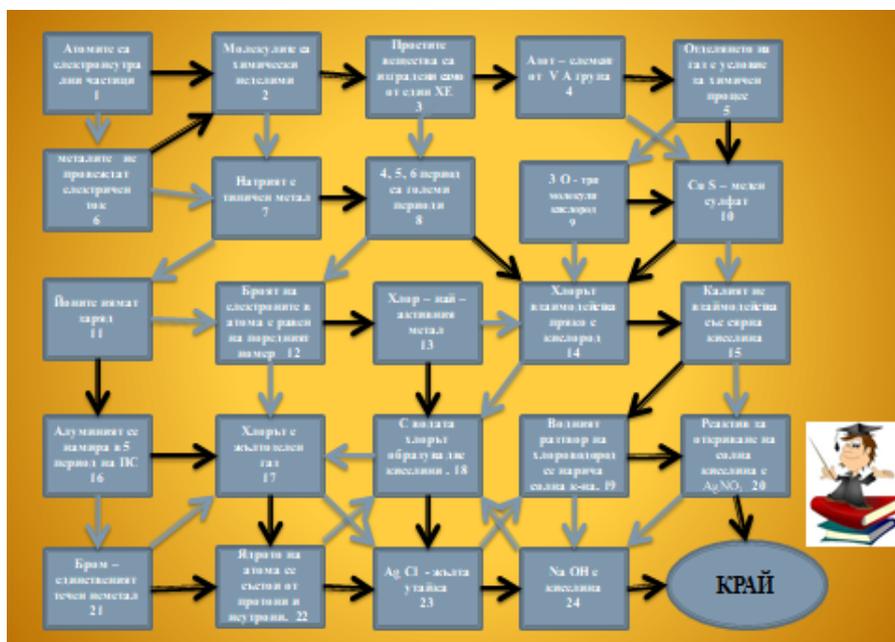
Answer the questions and write the answers in the crossword. When you've done it correctly, you'll get the name of the French scientist who created the theory of chemical similarity of compounds.

1. Compounds made of two elements, one of which is oxygen.
2. Swedish scientist who created the system for naming the elements we use today.
3. The only liquid non-metal.
4. Element from group IA, period 5.
5. Element from group IA, period 5.
6. The process which occurs between a base and an acid and the results of which are a type of salt and water.
7. A column of elements which starts with an element from a small period.
8. Electroneutral particles.
9. Compounds which change the color of PPT to magenta.
10. Compounds whose aqueous solution turns litmus paper red.
11. A row of elements which starts with an alkaline metal and ends with an inert gas.



Chemical labyrinth

The chemical labyrinth includes questions which you have to answer and find the path to the end. If the statement in a box is correct, you take the black “yes” path, otherwise you take the blue “no” path. You need to find the only path to the end by marking it with numbers, starting from 1. (Answer: The number of moves you have to take is 9.)



Labyrinth solution:



Conclusions

This experimental work and the results of the pedagogical research gives us a reason to conclude that using enigmatic puzzles (word puzzles, crosswords, anagrams and labyrinths) increases students' interest and motivation and their activeness in classes, stimulates the process of searching for knowledge and provides conditions and opportunities for all students to take part in the teaching process.

Enigmatic puzzles contain information which takes the development of students to a higher level of intellect. They provide an environment for forming personal abilities like curiosity, tolerance, empathy, responsibility, communication, etc.

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