COMPREHENSION OF SECONDARY SCHOOL STUDENTS ABOUT THE CONCEPT „AIR POLLUTION"

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Introduction. Environmental problems are outstanding both in Latvia and in the World. Environmental items are part of our daily life, acquirement and comprehension of them facilitate rising of interest about chemistry, makes this subject more interesting and understandable to the students. To be aware of the reasons of environmental problems and to find solutions for them in the teaching/learning process there is formed comprehension about concrete environmental concepts such as acid rain, global warming, changes in the atmosphere composition, air quality and pollution, chemical processes in atmosphere etc. In the scientific literature frequently there is published data giving evidence about society (including students) awareness, knowledge and comprehension regarding different environmental items. Several

examples: about global environmental problems [1], about global warming and depletion of ozone layer [2], about general environmental items [3]. In relation to above mentioned there should be divided separately range of studies characterizing approach and results regarding to that how environmental items are actualised in education curricula in particular learning/teaching subjects and chemistry among them. There should be mentioned some studies performed in Latvia regarding items of environmental education curricula [4, 5, 6]. The acquirement of environmental concepts is included in chemistry subject standards for basic school [7].

The Structure of the Research and Characterization of Respondents. The aim of the study was to find out knowledge and comprehension of secondary school students regarding the concept „air pollution". Air pollution is the general concept to whom the concepts „acid rain", „greenhouse effect", „ozone depletion". According to that questions of knowledge test were grouped.

In the study there were involved 243 Latvian secondary school students from 10th and 11th grades of secondary schools and gymnasium. Testing was performed in the beginning of the school year in 1st term. All answers of respondents were compared and analysed in three groups: G1 – secondary school students (N=84), G2 – gymnasium students (N=79), G3 –State gymnasium students (N=80). Examination test was compiled according to chemistry subject standards for basic school. In the initial approbation of the test students of one 10th grade and one 11th grade class (N=48) from two town secondary schools took part. As a result of approbation content of the test was corrected, the questions received only right answers were omitted, as well as those questions without any right answers. In the final version of examination test students should give answers to 18 questions totally, from which 9 questions were closely related to the concept „air pollution". In each question there should be selected one right answer among the four given versions. For each of the test questions there was calculated coefficient of mastery (C_m), as well as average coefficient of mastery (C_{am}) in the each group of questions. Answers of the students selected for analysis were ranged according to the size of the coefficient of mastery.

Results and analysis. By summarising answers of respondents regarding questions about composition of atmosphere it is ascertained that knowledge of students is mediocre. Most part of respondents from group G2 gave the right answer that the most common gas in the atmosphere is nitrogen (C_m = 0,72), in their turn only about the half of respondents from groups G1 and G3 were able to give the right answer to this question (G1 C_m = 0,46 and G3 C_m = 0,55). Difficulties for all of the respondents caused the answer to the question: „Which among the mentioned gasses is a component of atmosphere as well as pollution?" The right answer - ozone was known by less than half of the total number of respondents (G1 C_m = 0,29; G2 C_m = 0,35, but G3 C_m = 0,36).

The same is for the question group about acid rain where most of the students have only mediocre knowledge. Quite low level of knowledge about the fact that acid rain is precipitations with $pH \geq 5$ showed respondents of group G3 (C_m = 0,21) (in comparison: G1 C_m = 0,40; G2 C_m = 0,43). Most part of respondents wrongly consider that acid rain is not influencing buildings built from marble (G1 C_m = 0,45; G2 C_m = 0,57; G3 C_m = 0,51). In the test question, where the equation of chemical reaction of acid rain formation should be recognised, proportion of right answers was similar (G1 C_m = 0,45; G2 C_m = 0,44; G3 C_m = 0,43); most characteristic mistake: respondents took as reaction of acid rain formation the reaction characterising influence of acid on limestone.

In the question group about greenhouse effect results are not quite different from

those acquired in the previous questions. Students of groups G2 and G3 answered the question about consequences of greenhouse effects comparatively good (G2 C_m = 0,46; G3 C_m =0,54), worse knowledge was shown by students of group G1(C_m = 0,30). Similar results were obtained by summarising answers of the students regarding question: „Which of the given gasses could hold up the warmth reflected from the surface of Earth? In the groups G1 and G3 (G1 C_m = 0,21; G3 C_m = 0,30) the most popular answer was „vapour of water and oxygen". Answers of group G2 were similar (C_m = 0,33).

Analysing answers in the answer group about the depletion of ozone layer it was recognised that most part of students know that freons cause decrease of ozon layer (G1 C_m = 0,54; G2 C_m = 0,59; G3 C_m = 0,45). If in the variants of answers the word „freons" was substituted by „halogen containing hydrocarbons", the number of the right answers decreased (G1 C_m = 0,31; G2 C_m = 0,32; G3 C_m = 0,36). It gives evidence that students do not know the chemical composition of freons. Totally in all the questions the best knowledge (optimal level of knowledge) was shown by respondents of groups G2 and G3(C_{am} = 0,47; C_{am} = 0,42). Lowest level of knowledge (sufficient) was detected to respondents of group G1(C_{am} = 0,34).

Summary. Results of our study demonstrated that knowledge of examined students about the concept "air pollution" is rather superficial. Analysis of results gives evidence that students involved in the study better know general things and facts: that nitrogen is the most distributed gas in atmosphere; that ozone depletion is caused by the use of freons; that the consequences of the greenhouse effect is rising the average temperature of the surface of Earth. Main problems to students caused finding of concrete item of chemistry. Students do not know which equation shows formation of acid rain, what is the chemical composition of marble, do not know that freons are halogen containing hydrocarbons. Acquired results allow presuming that in the teaching/learning curricula of chemistry greater part should be allocated to explanation of chemical nature of environmental concepts.

References

1. Erduran Avci D., Darcin E. S. Investigation of Eight Grade Students' Knowledge Level about Global Environmental Problems. *Eurasian Journal of Physics and Chemistry Education,* 2009, Vol.2, N°2, 93-98.

2. Grima J., Filho W. L., Pace P. Perceived Frame works of Young People on Global Warming and Ozone depletion. *Journal of Baltic Science Education,* 2010, Vol.9, N°1, 35-45.

3. Guven S., Sener A., Bugday E.B., Yildirim B. Elementary School Students Knowledge about Environmental Issues in Turkey. *International Journal of Business and Social Science,* 2011, Vol.2, N°4, 144-149; www.ijbssnet.com [skatīts 110.02.2013].

4. Gedrovics, J., Cedere, D., Mozeika, D. (2009). Latvian students` understanding the principles of substance changes: longitudinal research 1998 – 2008. *Journal of Baltic Science Education, 8 (2), 79-87.*

5. Priede D., Krumina A. The assessment of different age students' comprehension about environmental chemical processes in Latvia. Monograph: Research in Didactics of the Sciences Pedagogical University of Krakow, 2010, 307-312.

6. Gaidule A., Lasmanis A. Integration of environmental chemistry problems into the secondary school general chemistry program. *Chemia-Dydaktyka-Ekologia-Metrologia.* 2010, Vol.15, N°1-2, 1-6.

7. Regulations on national standards in basic education and subjects standards for basic school. http://www.likumi.lv/doc.php?id=150407 [15.02.2013] (Latvian).