The Relevance of Health and Environmental Education in Chemistry for Pupils of Czech Secondary Schools and School-leavers

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KEYWORDS Czech Curriculum. Obligatory Outcomes. Pupils´ Interest. Subject Topics

ABSTRACT The aim of the authors of this article was to find out how much importance Czech pupils and school-leavers who are not professionally engaged in chemistry attach to those topics of Health and Environmental Education included among the obligatory outcomes in Chemistry for Lower Secondary Schools. The research was carried out by means of a questionnaire administrated to 576 pupils aged 14-18 years and 122 school-leavers (people with finished education). The conclusion was that as for subjective respondents' opinion on the importance of learned skill outcomes, the respondents preferred topics of Health Education to those of Environmental Education. Moreover, the authors have found that the interest in prevention and first aid increases with growing age of the respondents. The pupils' interest in environmental topics is very low. On the contrary, school-leavers show an overwhelming interest in chemistry of nutrition and in environmental protection. This discrepancy should probably be solved by better motivation of pupils in the future.

INTRODUCTION

In the contemporary Czech educational system, it is not necessary for some subjects (including Health Education and Environmental Education) to exist as separate disciplines at secondary schools. In this case, pupils are exposed to the relevant subject matter within other subjects. The environmental and health issues are especially involved in science subjects. But science education goes through changes in the Czech Republic similarly as in other European countries and the USA as well – see Osborne and Dillon (2008). The reason of these changes is the fact that education is even more critical today, in the face of economic, environmental, and social challenges. As written in Pellegrino and Hilton (2012), it is necessary to prepare today's children for their adult roles as citizens, employees, managers, parents, and entrepreneurs. Therefore educators transform their opinions on importance of acquired skills and knowledge. This new attitude to science education involves not only science skills and knowledge but especially skills and knowledge which are necessary for everyday life. Knowledge and skills in the area of environmental education and health education belong indisputably to them. Czech educators try to focus on this way of science education but there is inertia of the old teaching/learning. According to Rocard et al. (2007), the way of teaching science experts is considered the reason why young people are not interested in natural science. The results of the research reported here indicate that teachers and pupils are still focused on classical knowledge and skills. The aim was to find out how much importance Czech pupils and school-leavers who are not professionally engaged in chemistry attach to those topics of Health and Environmental Education included among the obligatory outcomes in Chemistry for Lower Secondary Schools stated by Ministry of Education, Youth and Sports (2006).

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METHODOLOGY

The method used for this research was a questionnaire survey. It was carried out among pupils and school-leavers.

Respondents

The total amount of respondents was 698. The sample of respondents consisted of 576 pupils of Czech secondary schools aged 14-18 years and of 122 school-leavers. More information about them is given in Table 1.

Table 1: Groups of respondents

Group of respondents' description	Number of respondents	Group designation in this article
4th grade of lower secondary school	306	I
1st grade of upper secondary school	136	II
3rd grade of upper secondary school	134	III
School-leavers	122	IV

The respondents were chosen from 4 following groups:

I   4th grade of lower secondary school (the last grade of compulsory school attendance)

II   1st grade of upper secondary school

III   3rd grade of upper secondary school (the end of chemistry study)

IV   The last group of respondents (marked IV) consisted of school-leavers who are not professionally engaged in chemistry. The average age of respondents of this group was 40.97 years (which is the average age of the citizens of the Czech Republic at the time of research) in the age range 19-83 years. This group included all levels of finished education: elementary, grammar, tertiary – for example, university.

Questionnaire

The respondents answered a questionnaire that contained among others two questions as follows from Table 2:

Table 2: Questions for pupils and school-leavers

Questions for pupils	Questions for school-leavers
Question No. 1: In your opinion, what should a pupil of your school, in your school year, be able to do in chemistry? Select all the proposals with agree with.	*Question No. 1: Which chemical skills do you use in your everyday life? Highlight them in the following list.*

Respondents of both groups were offered 40 obligatory outcomes in Chemistry for Lower Secondary Schools including 4 topics of Health Education (in this paper marked H1-H4) and 8 topics of Environmental Education (in this paper marked E1-E8) – see below.

Topics of Health Education
H1   To be able to work safely with chosen available and commonly used substances
H2   To be able to assess the danger of available and commonly used substances
H3   To have a basic idea of the reactants and products of biochemical processes of proteins, fats, carbohydrates
H4   To be able to give examples of sources of proteins, fats, carbohydrates and vitamins

Topics of Environmental Education
E1   To be able to use knowledge of the principles of fire extinguishing to solve model situations from practice
E2   To be able to give examples of pollution of air and water caused by households and by industry
E3   To be able to suggest the best prevention and ways to eliminate air and water pollution
E4   To be able to assess the effects of chosen oxides, acids, hydroxides and salts on the environment
E5   To be able to explain the formation of acid rains
E6   To be able to explain the effects of acid rains on the environment and to be able to suggest the ways of their prevention
E7   To be able to assess the use of primary and secondary raw materials in terms of sustainable development on Earth
E8   To be able to suggest possibilities of preparation and use of some of the most important organic and inorganic substances in practice and their influence on the environment and on human health

Question No 2: What would you like to learn in chemistry?	*Question No 2: Concerning chemistry, what are you interested in today?*

Responses to this question were free, without suggestions.

RESULTS AND DISCUSSION

Question No. 1.

The respondents could choose any number (that is, 0-40) of 40 topics suggested. The total number of marked suggestions did not have to be 100 %. As the initial evaluation of the results showed that respondents of different groups (I-IV) chose quite different numbers of suggestions, the authors decided to evaluate the responses within each group of respondents in relative terms, as follows.

For each suggestion the authors counted how many times this suggestion was chosen by respondents of given group (I-IV). Subsequently, based on the data for each group of respondents (I-IV), the authors determined the order of frequency of choice of the suggestions. For results concerning Health Education see Figure 1, for results concerning Environmental Education see Figure 2.

Health Education topics

It follows from Figure 1 that topics H1 (to be able to work safely with chosen available and commonly used substances) and H4 (to be able to give examples of sources of proteins, fats, carbohydrates and vitamins) are considered by all groups of respondents to be important in comparison with other topics. As for H2 (to be
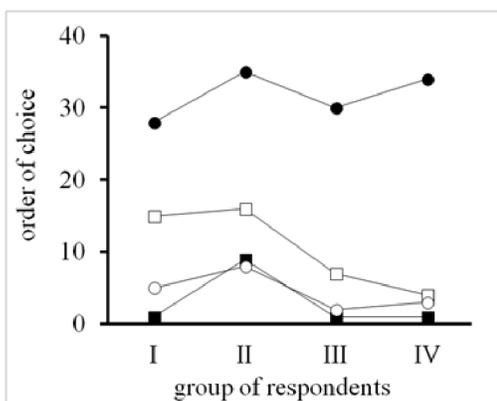
able to assess the danger of available and commonly used substances), its importance grows together with growing age of the respondents. The topic H3 (to have a basic idea of the reactants and products of biochemical processes of proteins, fats, carbohydrates), on the other hand, was ranked among the least important issues by all groups of respondents including school-leavers. This is largely inconsistent with the fact that in the question No. 2 Food Chemistry belonged to the most frequently proposed topics by school-leavers (see below) because Food Chemistry can hardly be explained without at least basic knowledge of biochemistry.

It is interesting that the group II considers all these issues (H1-H4) as less important than the other groups (I, III, IV). These are pupils in the first year of upper secondary school. The researchers believe that it is related to the traditional view of Czech society in science education and the method of teaching/learning. Students in the first year of upper secondary school expect to deal with specialized science topics. According to the findings of this research students change their opinion during school attendance and they begin to consider the Health Education topics to be more important consequently.

Environmental Education Topics

Among environmental topics (Fig. 2) the suggestion E2 (to be able to give examples of pollu-

Fig. 1. The responses to the question No. 1 concerning Health Education.
Meaning of symbols: full square ... H1, empty square ... H2, full circle ... H3, empty circle ... H4. For groups of respondents I – IV see Table 1. For H1-H4 see Table 2.
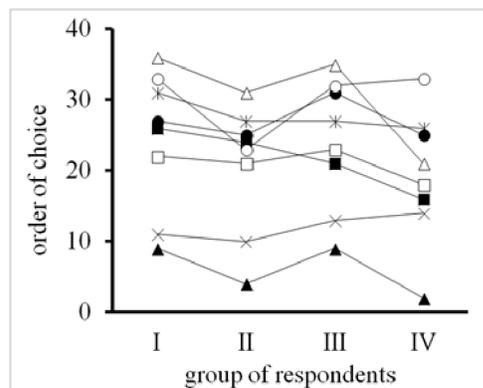

Fig. 2. The responses to the question No. 1 concerning Environmental Education.
Meaning of symbols: full square ... E1, full triangle ... E2, full circle ... E3, empty circle ... E4, cross ... E5, empty square ... E6, empty triangle ... E7, asterix ... E8.
For groups of respondents I – IV see Table 1.
For E1-E8 see Table 2.

tion of air and water by households and by industry) belonged to frequented ones; this fact is due to the crucial role of water for life totally understandable. The topic E5 (to be able to explain the formation of acid rains) gradually shifted to less important with increasing age of respondents.

With increasing age of respondents, however, topics E1 (to be able to use knowledge of the principles of fire extinguishing to solve model situations from practice) and E7 (to be able to assess the use of primary and secondary raw materials in terms of sustainable development on Earth) and partially also E6 (to be able to explain the effects of acid rains on the environment and to be able to suggest the ways of their prevention) gain in significance.

The remaining environmental topics were evaluated in the second half of the ratings of importance.

A divergence of group II of respondents in opinion on the environmental issues can be observed again. They consider them to be more important at the beginning of upper secondary school than at the end. There are more possibilities how to explain this finding. One of them could be the fact that environmental issues are addressed in lower secondary school and in the media; that is why students perceive them as important. The researchers will focus on divergences of group II of respondents in their future research.

On an average through all respondents of all groups (I-IV), the issues of Environmental Education were rated as less important than problems of Health Education: the topics of Health Education were rated on 12th position, whereas topics of Environmental Education gained 23rd position among 40 suggestions. But, on the other hand, it should be noted that none of issues of Health Education or Environmental Education was perceived by respondents so "foreign" within Chemistry that it would be rated by a significantly lower importance than purely chemical issues.

Question No. 2.

Although respondents could also answer by means of selection of suggestions given in question 1, this option was used only by 10 school-leavers and by no pupil. Hence, these 10 answers were treated as the rest of answers as free ones. When evaluating, the responses were divided into groups containing similar kinds of suggestions. Afterwards, percentage of giving each kind of suggestion was calculated within each group of respondents (I-IV). For the suggestions connected with Health Education and Environmental Education see Table 3.

As it follows from Table 3, the interest in the issue of prevention and first aid grows with growing age of the respondents. Pupils' interest in environmental issues is relatively low (they prefer chemical issues). In contrast, school-leavers show an overwhelming interest in environmental protection and the chemistry of nutrition. Thus, as it results from answers to both questions of the questionnaire, Czech pupils are much less interested in environmental problems than school-leavers. This discrepancy should probably be solved by better motivation of the pupils in the future.

Table 3: The most frequent kinds of answers to the question No. 2 concerning health or environmental problems. Clearly chemical suggestions are not mentioned because Chemistry is not the object of interest of this article

Suggestion of respondents	Percentage of the suggestions (100 % is the number of respondents in each group I-IV)			
	Group I	Group II	Group III	Group IV
Health Problems				
Prevention and first aid	0.3	4.4	6.4	7.4
Food chemistry	0	0	0	13.9
To be able to prepare pharmaceuticals	2.3	6.6	4.3	0
To know more about toxic substances	0	0	0	1.6
Environmental Problems				
Environmental protection	3.6	2.9	0.7	13.9
Water resources. water types and their use	0	0	0	3.3
Problems of fuel	0	0	0	3.3
Chemistry of plant growing	0	0	0	1.6

CONCLUSION

It turns out that if the issues of Health Education and Environmental Education included in the mandatory outcomes of the educational field of study Chemistry for Lower Secondary Schools are considered, both Czech pupils and school-leavers are more interested in health education problems. The average interest in both fields (Health Education and Environmental Education) increases with growing age of the respondents. A more detailed analysis of the responses shows that both pupils and school-leavers prefer practical learning outcomes to theoretical foundations. This appears for instance in problems such as H3; there is not too much interest in bases of the metabolism of essential components of food, but the school-leavers state that they would like to know more about the chemistry of food. According to findings of this research the interest of Czech pupils in environmental topics is smaller than that in health topics. It is connected with their different opinions on relevance of Health and Environmental Education.

RECOMMENDATIONS

As both pupils and school-leavers prefer practical learning outcomes to theoretical foundations, it would be good to encourage focus of educational process not only to presenting theoretical information, but also to receiving practical skills. The interest of Czech pupils about environmental issues is significantly smaller than that of school-leavers. This discrepancy should probably be solved by better motivation of the pupils in the future and, to solve this problem, science teachers should integrate environmental issues into chemistry in a better way in order to support their relevance for society.

ACKNOWLEDGMENTS

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