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Improving Elementary School Pupils’ Chemical Literacy Using Context-Based Approach in Teaching the Unit Alkanes²

Extended summary

Within the development of students’ chemical literacy, due to the omnipresence and great economic significance of organic compounds, a special attention should be paid to the field of organic chemistry. Overall, the results of the previously conducted TIMSS tests show that the chemical literacy of Serbian students is not satisfactorily developed. Among several other factors, this finding could also be related to the fact that chemistry teaching in Serbia is primarily focused on the transmission of academic content. On the other hand, within the context-based teaching approach which was proven to promote the development of students’ scientific literacy, various contexts from everyday life that the students perceive as relevant to themselves and their surroundings, represent a framework for the elaboration of the new content from the field of natural sciences and introduction to the various forms of its practical application.

This paper presents the results of a pedagogical experiment with parallel groups whose aim was to determine whether the context-based teaching approach is significantly more effective in promoting the development of elementary school students’ chemical literacy in the field of organic chemistry, compared to the traditional receptive teaching. The experiment was organized within the elaboration of the teaching unit *Alkanes* and it encompassed 148 eight grade elementary school pupils aged 14-15 years, with 76 pupils forming the experimental and 72 pu-

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pils forming the control group. The instrument of reserach was a test that assessed chemical literacy related to alkanes at all three of its levels (knowledge, appliacion and reasoning), which consisted of four open-ended items. The first two items assessed the students' chemical literacy at the level of knowledge and they referred to the structure and nomenclature of alkanes and products of the reaction of oxidation of these compounds. The third item assessed the chemical literacy at the level of application and it referred to the physical properties of alkanes, while the fourth item checked the chemical literacy at the level of reasoning and it referred to the chemical properties of these compounds.

Although the students from both groups previously learned about the common structural, physical and chemical properties of organic compounds they failed to transfer this knowledge to alkanes and within the initial testing all of them submitted blank tests of chemical literacy. However, after the elaboration of the abovementioned teaching unit, the experimental group achieved a significantly higher mean score ($t(147)=3,82, p=0,0001$), as well as a significantly higher number of correct answers on the three out of four items on the test. The lack of the significant difference in the achievement of the two groups was found only for item 2, which checked the students' chemical literacy at the level of knowledge, in regard to carbon (IV) oxide as a product of the reaction of oxidation of alkanes. This finding can be explained by the fact that this is a relatively simple reaction that regardles of which alkane takes part in it always derives the same end products and carbon (IV) oxide is an inorganic compound that is well known to students from the very beginning of their chemistry education. On the other hand, along with improving the students' chemical literacy at the level of knowledge in regard to the structure and nomenclature of alkanes and the level of application in regard to the physical properties of these compounds, it is of great importance that the implementation of the context-based teaching approach also led to the improvement of the students' chemical literacy at its highest level of reasoning. This is indicated by the significant difference in the achievement of the two groups on item 4 that required the explanation of the outcomes of two chemical experiments and it is especially significant in the light of the results of the previously conducted TIMSS tests on chemical literacy, which showed that solving items of this type was the most challenging for the students from Serbia. Overall, all the abovementioned findings indicate that the context-based teaching approach has the potential to significantly enhance the elementary school pupils' chemical literacy in the field of organic chemistry, in comparison to the traditional receptive teaching.

Keywords: chemical literacy, organic chemistry, context-based teaching approach, elementary school pupils

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