Design of scientific argumentation centered unit about hydrocarbons

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The practice of scientific argumentation is novel to the new Latvian state standards in lower secondary school science. There is not only a lack of tasks dedicated to scientific argumentation in Latvian textbooks and learning materials, but also a lack of methodological material to support and deepen teachers understanding about scientific argumentation. The goal of the study was to design and test in practice a set of tasks to promote the skill of scientific argumentation in 9th grade chemistry unit about hydrocarbons. Research questions: 1) how to design the unit and its lessons to promote student's scientific argumentation? 2) was the design of the unit and its lessons successful?

The lesson and unit plans were designed according to Toulmins argument pattern (Erduran, 2004) and learning progression for argumentation in science (Osborne, 2016). Each lesson plan included a context related task to promote student's scientific argumentation. The preferred students outcome in scientific argumentation at the end of the unit was planned at level 1d, according to the learning progression mentioned above. The quality of student's arguments was evaluated on a 0-to-8 scale according to the modified version of the methodology described in the literature (Osborne, 2016). The level of argumentation within the activities grew from level 0d to 1d throughout a cycle of three lessons. The quality of student's arguments was evaluated against the planned argumentation level at the end of the cycle of three lessons. A survey containing closed and open questions was designed to learn about students' attitude towards scientific argumentation. The teacher who piloted the designed unit made a written reflection after each lesson.

The developed unit took place in a 9th grade classroom of 45 students. At the beginning of the unit, students were introduced to Toulmin's argument pattern. Parallel to learning about hydrocarbons students engaged in argumentation activities. The teacher who piloted the unit gave positive feedback about the lesson plans but noticed that the unit plan can be further improved with an extra lesson in the middle of the unit, focusing on epistemic knowledge about scientific argumentation. 44% of students' arguments reached the desired argumentation level after three lessons, after six lessons this amount reduced to 37%. At the end of the unit 46% of students' arguments reached the desired argumentation level. 77% of students admitted that the skill of scientific argumentation is important. 73% of students admitted, that they would like to engage in scientific argumentation activities in other science subjects.

The main conclusion that can be drawn is that the learning progression for scientific argumentation can be used to plan units to teach scientific argumentation in lower secondary school science. The designed unit is a starting point for implementation of scientific argumentation into Latvian science classrooms. The design of similar units has started in biology and geography.

References:

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2. Osborne, J. F., Henderson, J. B., Macpherson, A., Szu, E., & Wild, A. (2016). The Development and Validation of a Learning Progression for Argumentation in Science, *53*(6), 821–846.