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DETERMINATION OF SECONDARY SCHOOL STUDENTS' ALTERNATIVE CONCEPTIONS ABOUT IONIZATION ENERGY

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Abstract: The topic of ionization energy is one of the important topics of the secondary school curriculum of many countries. In this study, it was aimed that to determine the secondary school students' alternative conceptions about ionization energy. For this purpose, a true/false diagnostic instrument was used to obtain data. The instrument which contains 20 questions was translated in Turkish firstly. After then to provide content validity, the instrument was examined by seven chemistry teachers. To provide reliability, the instrument was applied to 38 students twice. The final instrument was administered 956 students who are attending at 9th grade (269 students), 10th grades (253 students), 11th grade (236 students), and 12th grade (198 students) from nine different secondary schools in Balikesir, Turkey. At the end of the study, it was found that the students had two alternative frameworks that are the full outer shells explanatory principle and/or the conservation of force conception.

***Keywords*: Secondary school, students, ionization energy.

Introduction

In many countries' secondary school curriculum contains the periodicity of atomic properties such as ionization energy, electronegativity, electron affinity and atomic radius. All of them are essential to interpret many chemical phenomena and concepts. Previous studies have indicated that students have the learning difficulty and the alternative conceptions in ionization energy topic. Taber (1999) developed an instrument to determine first-year A-level students' understanding of ionization energy in the UK. He found that a significant proportion of the students based their explanations of ionization energies on the full outer shells explanatory principle and/or the conservation of force conception rather than on Coulomb electrostatics. As Taber (1999) expressed that prerequisite knowledge needed by students to successfully understand ionization energy and patterns of ionization energies across a period/down a group of the Periodic Table includes the electronic structures of atoms and how they relate to the Periodic Table. Although this chemical knowledge is very important for explaining patterns in ionization energies, it is not sufficient. Students also need to apply basic electrostatic principles that they learned in physics to explain the interactions between an atomic nucleus and electrons (Taber, 1999). Although the students' conception concerning ionization energy in many countries such as UK, Singapore, China, New Zealand and Spain has been examined by researchers (Tan, Goh, Chia & Treagust, 2002; Tan, Taber, Liu, Coll & Lorenzo, 2008), there is no work concerning Turkish students. The topic of ionization energy is placed in both 9th and 11th-grade secondary chemistry curriculum in Turkey. From this departure point, the aim of the present study relate to following research question:

Do Turkish secondary school students base their explanations of ionization energies on the full shells explanatory principle and/or the conversation of force conception rather than on electrostatic principles?

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Methods

The Diagnostic Instrument

The original English language version of the diagnostic instrument “Truth about Ionisation Energy” by developed Taber (1999) which is a simple line diagram and 30 statements that were to be judged as true or false. The refined 20-item version of the instrument was used in the Turkish study reported here. The instrument was first translated into Turkish by author CN and was then checked by an English lecturer.

Content Validity and Reliability

To establish the content validity of the instrument, firstly both the secondary school chemistry curriculum and textbooks were examined by the authors. After then the instrument was validated by nine experienced chemistry teachers. To provide reliability, the instrument was re-administrated to 39 students after eight weeks. The correlation value obtained between the two measurements 0.4%. The final version of the instrument applied to 200 students and it was decided to provide establish of reliability.

Participants

The final instrument was administered 956 students who are attending at 9th grade (269 students), 10th grades (253 students), 11th grade (236 students), and 12th grade (198 students) from nine different secondary schools.

Results and Findings

The first question of the test is about the definition of ionization energy and it is a correct expression as "Energy is required to remove an electron from an atom." 97.80% of the students said that this is true. It is seen that a significant part of the students knows the definition of the ionization energy correctly. The second question is a question based on electrostatic interaction. 78.97% of the students answered correctly. In the third question, 37.45 % of the students gave the wrong answer. This question reflects octet thinking. It can be said that a significant proportion of the students have the alternative conception in this regard. The expression in question 4, "Only one electron can be removed from the atom, as it then has a stable electronic configuration.", only 39.54% of the students answered correctly. More than half of the students (56.49%) responded incorrectly. Another three questions concerning octet rule thinking are the questions 12, 18 and 20. %67.68 of the students answered the question 12 incorrectly. The question 18 is an incorrect expression as “The atom would be more stable if it ‘lost’ an electron”. However, 80.23% of the students said that this is the true expression. The question 20 is an also an incorrect expression as “The atom would become stable if it either lost one electron or gained seven electrons.” 80.02% of the students said that this is a true expression.

Conclusion

It was concluded that students had “electrostatic interaction thinking”, which is expected to learn from them, in part. On the other hand, the students seem to understand the principles of electrostatic interaction at some point, they cannot fully apply it to their explanation of ionization energy. As explained by Taber (2003), this may be related to the fact that the electrostatic attraction law is the subject of both physics and chemistry. Electrostatic attraction law is taught by both physics and chemistry teachers separately for the same group of students in both chemistry and physics classes. In fact, this can be expected to be useful again. However, teachers 'different tendencies and approaches can confuse the students' minds. As you can see here, although the students use this law correctly in their explanations on ionizing energy, they have a very common alternative framework, octet framework.

Recommendations

The following suggestions can be made in line with the results obtained in the study. First of all, the students should be aware of the fact that it is not right to explain each event with the full shell stability. It will be more accurate and meaningful for the students to be given the reasons for the change of the periodical properties rather than the patterns. Finally, a special way for teaching subjects taught in both physics and chemistry lessons such as electrostatic interaction should be followed.

References

Taber, K. S. (1999). Ideas about ionisation energy: A diagnostic instrument. *School Science Review*, *81*(295) 97-104.

Taber, K.S. (2003). Understanding ionisation energy: Physical, chemical and alternative conceptions. Chemistry Education: Research and Practice, 4(2), 149-169.

Tan, K.C.D., Goh, N.K., Chia, L.S. & Treagust, D.F. (2002). Development and application of a two-tier multiple choice diagnostic instrument to assess high school students' understanding of inorganic chemistry qualitative analysis. *Journal of Research in Science Teaching, 39*(4), 283-301.

Tan, K. C. D., Taber, K. S., Liu, X., Coll, R. K., Lorenzo, M., & Li, J., et al. (2008). Students' conceptions of ionisation energy: A cross-cultural study. *International Journal of Science Education, 30*(2), 263–283.