Stepwise Inquiry into Hard Water in a High School Chemistry Laboratory

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Abstract

This study focuses on the design of a learning program to introduce complexometric titration as a method for determining water hardness in a high school chemistry laboratory. Students are introduced to the different properties and reactions of hard water in a stepwise manner so that they gain the necessary chemical knowledge and conceptual understanding of the basic principles of complexometric titration. This approach involves investigating the performance of soap and household laundry detergent in hard water and using a colorimetric method to semiquantitatively determine the concentration of calcium ions in hard water by a test kit. The stepwise inquiry and learning are promoted using coordinated experimental work, logical thinking, and discussion with the aid of demonstrations and explanations. As each inquiry and learning step is completed, students develop models that describe the observed chemical properties and reactions of hard water. Using the simple models that they develop, students finally propose the basic principles of complexometric titration for determining water hardness. Based on their experimental principles, practical titration experiments are performed and the experimental data are analyzed to determine water hardness. Throughout the learning program, students actively apply preliminary knowledge and acquire new chemical knowledge and conceptual understanding from the laboratory exercises. Therefore, the students experience the process of scientific inquiry accompanied by the development of their understanding of chemical concepts. This paper reports that the developed learning program may be introduced as a suitable laboratory learning exercise in high school chemistry courses.

Keywords: High School/Introductory Chemistry, Analytical Chemistry, Environmental Chemistry, Collaborative/Cooperative Learning, Inquiry-Based/Discovery Learning, Aqueous Solution Chemistry, Water/Water Chemistry

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