NEAR TRANSFER IN PH CALCULATION: THE ROLE OF MATHEMATICAL KNOWLEDGE AND CONCEPTUAL UNDERSTANDING

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The problem of knowledge transfer between mathematics and chemistry has an at least three decade long history in the literature. Early seminal works by *Brown*, *Collins* and *Duguid* (1988), *Perkins* and *Salomon* (1992) and *Lave* (1995) introduced the concepts of situated learning, near and far transfers and transferability of mathematical knowledge.

In the current study an empirical investigation on different knowledge components necessary for pH calculation is presented. According to Watters and Watters (2006), two distinct things are needed for meaningful pH calculation: understanding the pH concept and the mathematical foundations. They argue that it is the deficiency of mathematical skills that seriously hinders pH calculations. According to *Park* and *Choi* (2013) the concept of logarithm is not properly understood among high school students.

In our investigation the connections between four phenomena related to pH calculation have been investigated: (1) definitions, (2) one-step quantitative answers, (3) multi-step calculation in chemistry, and (4) related mathematical knowledge. The first two points represent the conceptual understanding of pH, while the other two represent the mathematical foundations of pH calculation. The first three types of knowledge were assessed in the chemistry part of the test each student solved, while at the end of the test the mathematical knowledge items and attitude questions were placed. The Cronbach-alpha reliability of the test proved to be .78 .68 10^{th} grade students from two classes of a high school participated in the study.

The results suggest that the mathematical foundations needed for pH calculation are significantly correlated with performance on multi-step chemistry items ($r=.44$, $p<.001$) but not with the definitions and one-step quantitative chemistry items. Within these mathematical items, especially important were those which required students to change different numbers to their standard index form.

By means of regression analysis, we investigated the explained variance provided by the four main parts of the test for the total score as dependent variable. The 100% explained variance was distributed as follows: 21% chemistry definitions, 33% one-step quantitative items, 30% multi-step chemistry items, 15% mathematical foundations.

As for the background variables, the attitude towards chemistry was significantly correlated with performance on the one-step chemistry items, and, as expected, the attitude towards mathematics was significantly correlated with performance on mathematics items.

Further analyses are now being conducted to reveal patterns of individual differences in the connections among the four parts of our pH calculation test. Our results may contribute to the understanding of near transfer possibilities between mathematics and chemistry.