Author	Locaylocay, Jocelyn R.
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ABSTRACT

This is a case study on the conceptual evolution of chemical equilibrium of selected chemistry students as they go through learning activities using an instructional design based on a constructivist view of learning. The study was carried out in two General Chemistry classes at a university.

Lawson's Test of Scientific Reasoning was administered to determine the students' cognitive level. The sample students in the study were chosen to represent the empirical-inductive level, transitional and hypothetical-deductive level.

The study was a combination of qualitative and quantitative research. The qualitative part involved following the conceptual evolution of selected students through the use of written documents such as activity sheets, learning journals, assignments, post-test and the use of oral interviews, audiotapes and videotapes of group discussions. The quantitative part involved the two intact classes and pre-test and post-test gains for both classes were determined. The correlation between the students' cognitive level and the pre-test, post-test and gain scores were also looked into.

Prior to the intervention, students' conceptions about chemical reactions and rates of reactions were determined through their answers to the readiness test, pre-test and initial interviews. The study looked into the effect of these preconceptions on students' understanding of chemical equilibrium. Results indicated that many students had the preconception that reactions go in only one direction. This caused difficulties in students' understanding of the dynamic nature of chemical equilibrium. Most of the students recognized that the rate of a reaction depends on the concentration of the reacting substances. However, they could not relate changes in volume of a container containing the gaseous system to a change in concentration of the reacting substances. A common misconception of students prior to the intervention was that the rates of reactions increased as the reaction proceeds. The use of experiments showing discrepant events contributed to students' dissatisfaction with their preconceptions about complete chemical reactions.

The conceptual evolution of most students' conceptions showed patterns of competing conceptions and a series of progressions and regressions. Their preconceptions of complete reactions competed with their concept of reversible reactions and chemical equilibrium. In some aspects, they used their concept of reversible reactions and for other aspects, they reverted back to the use of complete reactions. The use of the analogy helped in the students' understanding of the characteristics of a system as it approaches equilibrium and when it is at equilibrium. However, even after the treatment, many misconceptions were found to be resistant to change. The more persistent misconceptions are a) the rate of the forward reaction increases

as the reaction proceeds, and b) the value of the equilibrium constant changes with a change in the initial concentrations of the reacting substances.

The students were found to have more problems with changing conditions for equilibrium systems, especially heterogeneous ones. Many of the students could identify which reaction is favored by a change in concentration of reactant/product and a change in temperature. However, they are not clear about the meaning of the term “favored.” They have the misconception that the favored reaction increases in rate and the opposite reaction decreases in rate. This led them to believe that when the temperature is increased, the endothermic reaction increases in rate while the exothermic reaction decreases. They do not consider the shift in the equilibrium position due to the change. Results also showed that many students have the misconception that the addition of a solid reactant to a heterogeneous system at equilibrium will shift the position of the equilibrium. They do not consider that the concentration of the slid does not change when the amount of solid is changed.

Only a few of the students in the classes were in the hypothetical-deductive level (formal). Most of the students were in the concrete and the transitional cognitive levels. The average gain scores between the pre-test and the post-test were highest for those in the formal level, followed by the transitional and lowest for those in the concrete. Pearson Product Moment Correlation values show that the result of Lawson’s Test of Scientific Reasoning is significantly related to the results of the pre-test, post-test including gain scores. The students’ cognitive level was significantly correlated with their learning gains.