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ABSTRACT

This is a study on the effectiveness of the modified network approach on the enhancement of problem-solving skills of first-year college students in chemical equilibrium. Ashmore *et al.*'s network approach was modified using diagramming and scrambling exercises which were aimed at developing and training students in combinatorial and correlational thinking skills which students can use to enhance their problem-solving skills.

A comparison of scores in three problem-solving tests was used to measure the effectiveness of the modified approach. Qualitative analysis of the solutions of students to the problem-solving tests was used to characterize the first-year chemistry problem solvers. A rubric scoring scheme was developed to identify the problem-solving skills demonstrated by problem-solver as it was equated to scores obtained in the problem-solving tests. The study also characterized the first-year problem solver before and after treatment through a qualitative analysis of the students' solution papers, the protocol of small group discussions, interviews and think-aloud sessions. Students in both experimental and control groups were administered Lawson's Classroom Test of Scientific Reasoning to determine their cognitive level before and after treatment.

Findings show that first-year problem solvers do not like to guess when faced with problem they do are not familiar with; possess concept, mathematical as well as communication skills deficiencies; most often showed a wrong use of algorithms and basic algebraic operations; wrong choice of heuristics and lack of checks. The freshmen problem solvers also show carelessness in execution of solutions with haphazard erasures and superimposed answers. After treatment, the students exposed to the modified network approach were shown to be more attentive to given data, instead of leaving their papers blank. They have become more organized in presenting their data, showed more attempt using a variety of approaches even if they arrived at the wrong final answer because of their conceptual deficiencies.

Identifying and defining the problem, identifying relevant data, judging the gathered or given data is adequate for establishing relationships, recording of data in a form that facilities correct interpretation, seeing relationships given in a set of data and interpreting data were the problem-solving skills shown to be enhanced in the experimental group. Although the first three skills were also demonstrated by the control group, these skills were not consistently shown in all three tests.

A significant difference was found in the mean scores of students exposed to the modified network approach compared to those students exposed to the original network approach in favor of the experimental group.

Both the experimental and control groups showed a significant difference in their respective pre- and post-Lawson's test scores. The experimental group, however, had a higher post-treatment mean score than the control group. This difference though was not enough to cause a change in the cognitive level (e.g., shift from concrete to transitional or from transitional to formal as defined by Lawson's Test).

Results of the study also revealed that students find conceptual or qualitative questions more difficult than the quantitative type, thus they tend to ignore these and concentrate on the numerical ones. If there were answers, these were not clear because of grammatical errors and lack of communication skills. Interviews also revealed that scrambling exercises were found to be appealing to some students because they provided a 'game-like' atmosphere to an otherwise mentally taxing lesson.