
Title	Can problem-solving skills be taught and assessed in the classroom?
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Can problem-solving skills be taught and assessed in the classroom?

Dr Lucille Lee Kam Wah

Introduction

A recent review of research on problem solving in chemistry during the last decade shows that many students solve chemistry problems using algorithms and do not understand the chemical concepts on which the problems are based. They search for the formulae they know and plug numbers into the one that seems most appropriate. In order to help improve students' problem-solving performance, teachers have to know the factors that contribute significantly to successful problem solving. In a study undertaken in Australia, six cognitive variables, namely, Concept Relatedness, Idea Association, Problem Translating Skill, Prior Problem Solving Experience, Specific Knowledge, and Non-Specific but Relevant Knowledge, were found to be valid as determinants for problem-solving performance. The study was replicated in Singapore in 1993.

The Study

Six junior colleges ranging from high to average in terms of students' A-level external examination results were invited to participate in the study. Two hundred and seventy-nine Pre-University Two chemistry students from twelve classes and their eight teachers were involved. Seven instruments on electrochemistry were administered to the students in three tutorial periods. A set of questionnaires was also administered to the teachers.

In this study, the effects of two kinds of predictors on problem-solving performance in electrochemistry were compared. The two kinds of predictors used were the A-type and the B-type predictor variables. The A-type predictor variables consisted of four cognitive variables, namely, Idea Association (IA), Problem Translating Skills (PTS), Specific Knowledge (SK) and Non-specific but Relevant Knowledge (NSRK), multiple-choice test (VKIST). These four instead of the six cognitive variables were chosen for this comparison because they were found significant in determining the success of problem-solving performance and also because they are teachable in the classroom set-up. The B-type predictor variables consisted of Teacher's Perception of Students' Electrochemistry Prior Knowledge, Linkage Skill, Problem Recognition Skill, and General Problem Solving Performance, which were assessed by asking the teachers to answer a set of questionnaires. Ten-point scales were provided for the teachers to indicate their students' strengths. The definitions of the A-type and B-type predictor variables are summarised in the footnote below.

Results And Implications for Teaching Problem Solving

Multiple regression analysis was used for comparing the A-type and B-type predictor variables for their contribution to the problem-solving performance variables. The results suggest that the four cognitive variables in problem solving: idea association, problem translation skills, non-specific but relevant knowledge and specific knowledge are important problem-solving ability and skills for solving electrochemistry problems. Idea association emphasizes the external linkage between an existing cognitive structure and the new learning content, or the cues from the problem statement, and the activation of a particular part of cognitive structure for problem solving. On the other hand, problem translation skills are used for processing the information obtained from problem statement to operate on

comprehending, analysing, interpreting and defining a given problem. Besides teaching the prior knowledge required for improving problem-solving performance, it is believed that the teaching and training of linkage and problem translation skills are important. As a consequence of this finding, the assessment of linkage and problem translation skills is necessary to encourage competent conceptualisation in problem solving.

Teachers who wish to know more about this study may refer to the following research reports which are available in the National Institute of Education (NIE) Library:

Lee, K. W. L., Goh, N. K., & Chia, L. S. (1995). *Assessing students' problem-solving skills in chemistry*. Paper presented at the 9th Annual Conference of Educational Research Association, Singapore.

Lee, K. W. L., Goh, N. K., Chia, L. S., Chin, C., & Phang, L. P. R. (1996). *Problem-solving variables and the assessment of problem-solving ability and skills in electrochemistry*. National Institute of Education, Nanyang Technological University.