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Chapter 18: ADAPT: A View from a Distant Campus

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Chapter Eighteen
ADAPT: A View from a Distant Campus

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> "Andrea who showed only concrete reasoning ability at the beginning blossomed as the experiments progressed. One could actually witness her improved thought processes. She seemed to develop better lab technique over the course of the two and one- half months and with each new experiment, she approached it in a much more scientific manner."

Lucy Brooks, a chemistry teacher at West Central Boone High School, wrote this paragraph after using four Learning Cycles developed by the author in her high school chemistry class.

These particular Learning Cycles were formulated and tested during the time that I was a National Science Foundation Fellow at the University of Nebraska-Lincoln in 1980. My association with the ADAPT Faculty convinced me that the Learning Cycle can be used to develop the laboratory technique and to enhance the reasoning ability of the student. And so a set of experiments suitable for the introductory college chemistry laboratory were written in the Learning Cycle format. The idea to use them with a high school class grew out of the realization that the average, entering college freshman and the college-bound high school junior do not vary greatly in their reasoning abilities. In addition, any experience that emphasizes reasoning, offered at the high school level, will ease the academic transition from high school to college.

A listing of the experiment titles, their chemical purpose, and their cognitive purpose follows.

A CHEMICAL DILEMMA is a one-period (three hour) exercise that requires combinatorial and correlational reasoning. A study of precipitation reactions allows the student to identify certain solutions.

INDUCTIVE REASONING FROM CHEMICAL EXPERIMENT is a two-period exercise that emphasizes combinatorial, correlational reasoning, and demands an original experimental design. Precipitation and filtration techniques permit the student to devise and test a scheme of qualitative analysis.

THE PLOT THICKENS is a two-period exercise that stresses graphical interpretation and propositional reasoning. Using the technique of fractional crystallization the student

attempts the separation of a mixture of equal weights of sodium chloride and potassium dictromate.

THE GREAT TITRATION MYSTERY is a three-week exercise that demands propositional reasoning, correlational reasoning, and proportional reasoning. An equimolar mixture of two acids is titratred and the amounts of each in the mixture is ascertained by the student. Preceding the final titration procedure, the student empirically investigates the titration behavior of strong and weak acids and the behavior of various indicators toward their titration.

THE FORMULA: THE CHEMISTS BEST FRIEND is a four-period exercise which emphasizes correlational reasoning and proportional reasoning. The student synthesizes a compound, $Ni(NH_3)_6Cl_2$, and analyzes the salt for Ni, Cl, and NH_3. From the results an empirical formula for the salt is calculated.

THE TRUTH IN ADVERTISING is a three-period optional experiment that requires propositional and correlational reasoning as well as experimental design. The student empirically studies pH, the hydrolysis of salts, the idea of an equilibrium constant, and designs an experiment to determine the effectiveness of an antacid remedy. Copies of these experiments may be obtained from the author.

My association with the ADAPT faculty brought home the idea that in order to be effective in the classroom, the instructor must ascertain the cognitive level of the students. Teaching formal concepts to concrete operational students is useless; hence, diagnosis of student weaknesses is imperative if the student is to progress up the cognitive ladder.

One of the graduation requirements of DePauw University is that every student must be certified as "Q" competent, i.e., every student must demonstrate some minimum competency in the area of Quantitative Reasoning. To demonstrate this ability the student passes a Q course, which is defined as any course in the University that has a significant quantitative component. Entering freshmen are tested for their quantitative reasoning abilities using an "in-house" instrument which consists of a 25 item reasoning test--similar in form to the Whimby Analytical Skills Inventory--and a 25 item algebra skills test which is used for calculus placement.

During the past two years (1981-82 and 1982-83), sixteen percent of the freshman class did not achieve a satisfactory score of at least 12 out of 25 on the quantitative reasoning skills inventory. They were required to enroll in a "Q" developmental course, "Introduction to Quantitative Reasoning," which is designed to develop their math skills to a point where they are eligible to enroll in a "Q" course. I was in charge of teaching one section of this remedial course. Since each student had failed a test to get into the course, I felt the traditional instructional methods would fail; consequently, I organized the course using the Keller model, Personalized System of Instruction.

The formal content was directed toward strengthening arithmetic and algebraic skills and was handled by undergraduate tutors. I met with the class weekly in small groups to provide "enrichment." The topics that we looked at included math anxiety, cognitive development and Piaget's model, and the interpretation and the solving of word problems. Over one hundred

students enrolled in the course during the two years. All but five improved sufficiently on the "Q" or quantitative reasoning instrument to qualify for a "Q" course. The average score increased from 9 to 17. The Keller course focus was algebraic skills improvement; however, the retest results were somewhat disappointing since the average score increased from 5 to 10.

In closing I want to thank those in the ADAPT program for altering my view on the teaching-learning experience. Without their philosophy and their concern, I would still be teaching formal concepts to concrete students and wondering why they couldn't grasp these concepts. Now I am aware of these learning differences and try to spot that person who isn't quite ready, and whenever possible, attempt to suggest ways that the student can increase his or her cognitive abilities.