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Problem Solving Workshops in General Chemistry

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A pilot program to restructure the conventional two semester general chemistry lecture course for science and engineering majors was started in September 1991 at the City College of New York. Our main goals were:

- 1) to improve student performance in this course, and
- 2) to increase student interest in chemistry.

A weekly two-hour problem-solving workshop was introduced and the amount of lecture time reduced. Each semester we have made changes in the workshop or lecture, based on our increasing experience.

During the workshop period the class of about 100 students meeting in a single lecture hall is divided into 15 groups of 6–8. An undergraduate student leader is in charge of each group. The students are encouraged to work together to solve a mixture of conventional and unconventional chemistry problems. For example, the workshop on molecular structure includes both a series of questions involving Lewis dot structures and a cooperative effort at molecular model building. Five optional computer workshops are offered; students are instructed in computer operation and the use of the interactive program MathCad for graphing equations, plotting data, and solving numerical problems.

The workshops are lively; although a single lecture hall is used, the sense of everybody working seems to have a positive effect, despite the noise level. An advantage is that only one faculty member need be present to oversee the whole section. Student surveys show strong approval of the workshops with the workshop leaders receiving excellent evaluations. Often the students within a group form smaller study groups that meet outside of class. The performance on examinations is directly related to workshop attendance and the passing rate has been increased substantially. Student surveys show increased interest in chemistry as a possible major. The class itself is a good place to recruit a diverse group of workshop leaders by selecting students receiving a high grade and showing a high degree of workshop participation. The leaders are paid to assist in the computer and problem-solving workshops, to be involved with course development, and to help with record keeping.

Chemistry workshops, following the City College model, are scheduled to be introduced at Brooklyn, Bronx Community, Borough of Manhattan Community and Medgar Evers Colleges.

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Study Groups In General Chemistry

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Many students do not perform well in general chemistry. A variety of reasons is offered to explain their lack of success. However, despite all the rhetoric about their hopelessly inadequate mathematical skills, unwillingness to engage in hard work, and inability to concentrate on anything longer than a few minutes, most students devote considerable study time to their general chemistry course. Yet often that investment of time does not yield the return students expect, because it is spent unproductively. Study conducted in isolation becomes frustrating when an obstacle arises that the student can't surmount. Consequently, students often become discouraged. It doesn't take many such episodes for the initial discouragement to worsen and grow to overwhelming proportions.

The success Uri Treisman (1) achieved with a study-group framework for minority calculus students led us to develop a similar structure for our general chemistry course. Piloted first in a single 16-student quiz section conducted by the course coordinator, the study-group concept was expanded to a 200-student large-lecture section in the Fall, 1992. Roughly one-quarter of all general chemistry students were randomly assigned to that large-lecture section.

The lecture section was divided into twelve quiz sections of 15–18 students each. Each quiz section was further subdivided into study groups of 4–8 students. Meeting outside the formal class hours, the study groups provide structure and some guidance for a small portion of the students' out-of-class study time. At regularly scheduled times, the study groups met weekly in the presence of an undergraduate student monitor to confer about each week's assigned homework problems. The monitor's role was to observe the discussion of the homework problems, guide explanation towards accuracy, and record attendance. (The latter was done for project evaluation purposes only, and was not used in any way for grading purposes.)

All students in each group were instructed to attempt to solve *all* the assigned problems. However, each member of the study group assumed responsibility for a particular problem and agreed to come to the weekly problem-discussion session prepared to explain its solution in detail. These designated "experts" were encouraged to seek any needed assistance from the instructor or the Chemistry Help Center which is open to students on a walk-in basis.

At the formal quiz section meeting, each study group split into two "action teams" of 3–4 students. Since the homework had already been discussed at the study-group meetings, it was not considered during the quiz section. Instead, worksheets with challenging problems and thought questions were given to each team for them to col-