

# Cooperative Learning Strategies for Effective Teaching and Learning Science Courses in Large Classes

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## INTRODUCTION

Cooperative learning involves students working in groups on problems or projects such that it fosters positive interdependence, individual accountability, leadership, decision making, communication, and conflict management skills (Johnson, Smith, & Smith, 1991). Felder and Brent (1983) indicate that cooperative learning also enhances short-term mastery, long-term retention, understanding of course material, critical thinking, and problem solving skills. Recent literature suggests a number of cooperative learning strategies; however, many of these strategies may not be as effective or practical in large classes because of the larger number of students. Teaching a large class itself is challenging. Introducing cooperative learning strategies in large classes is even more challenging. Felder has described some innovative techniques including cooperative learning strategies for effectively teaching large classes. This article describes some other cooperative learning strategies that were used in large classes and provides results of student feedback on those strategies. The second section describes the results of a local survey on large class offerings in science education in some institutions in the western part of Nigeria. The third section describes cooperative learning strategies that were used inside or outside of a classroom. The results and conclusions are given in the fourth and fifth sections, respectively.

## LARGE CLASS OFFERINGS IN SCIENCE EDUCATION

A survey was conducted to determine the prevalence of large class offerings in science education. The survey

polled the school/faculty of science representatives to determine large science class offerings on their respective campuses. Campus representatives from six institutions responded to the survey. While the definition of a large class varies, 100 students were set as the threshold for a large class. Responses indicated that 98% of the responding institutions offer one or more science classes with 100 or more students. The class sizes ranged from 75 to 1000 with an average of 150 students. The largest class size in the other 2% of schools ranged from 18 to 75 with an average of 45. While only 98% of the institutions offer large science classes ( $n > 100$ ), the percentage of total students who attend such classes is much larger. Based on survey data, over three-fourths of students at reporting institutions attend large classes. Also, most of these large classes are offered in courses like general courses for computer science, mathematics, physics, integrated science, biology, and so forth.

This survey indicates that a majority of undergraduate science students attend large classes. Thus, improving the teaching-learning process in these large classes would have a significant effect on science education. Recent studies have confirmed that attrition rate among science students is higher during their initial years in college. Hence, improving large first and second year classes has potential for increasing science students' retention rates.

## COOPERATIVE LEARNING STRATEGIES

Cooperative learning, as indicated earlier, involves group work. Groups may be organized along informal or formal lines. Wankat and Oreovicz (1994) define

that informal cooperative learning groups are formed on the spur of the moment for a particular short term task and then dissolved. Such groups are useful in the middle of a lecture, to assign students a task such as solving a problem, answering a complicated question, or developing a question for the lecturer. Engendering a more cooperative class atmosphere, these groups serve as a break when the students' attention falters, and gives them a chance to practice team work. For the instructor, informal groups are a good way to start experimenting with cooperative learning.

After discussing a concept for about 15 to 20 minutes in a class, a multiple choice question is written on the board or displayed on the screen with a multimedia projector. Students discuss an answer to the question in an informal setting with neighboring students. The voice level during this one or two minute period goes up, reflecting the level of interaction and collaboration going on in the classroom. At the end of this period, all students are requested to raise a flashcard displaying a letter corresponding to an answer to the multiple choice question. The flashcard method allows active learning, collaborative learning, and 100% participation in large classes. It also allows students to assess how much they have understood and gives an instant assessment to the instructor about student understanding of the concepts just discussed. The multiple choice questions can be easily formulated to test knowledge and comprehension aspects of student learning as defined by the taxonomy in Bloom (1956). The taxonomy (knowledge, comprehension, application, analysis, synthesis, and evaluation) provides a useful structure in which to categorize questions. A useful handbook on designing and managing multiple choice questions at all levels of the taxonomy was developed at the University of Cape Town, South Africa, and can be accessed over the Internet (Carneson, Delpierre, & Masters, 1997). Additional details on the basic flashcard method, without group activities, are given in Mehta (1995).

With the author's practical scenario experience with informal group activities, formal group activities were introduced in a large computer class. At the beginning of the semester, students were requested to provide their cumulative GPA, their grade in Calculus I (prerequisite class), the number of course credits they have registered for, and so forth. A composite index was determined based on the above information and was used to divide the class into three categories: top, middle, and bottom. Every student was given a letter

code (x, y, or z) depending upon the category they belonged to. The students were not informed as to what the letter code represented or how the group codes were determined. This was done so that students do not feel either superior or inferior. In one of the class periods, in the last five minutes, students were asked to gather in three corners of the room depending on their codes, and groups of three students were formed by randomly selecting one student from each corner. This in itself proved to be a fun activity in the large class.

The students were assigned four group projects during the semester. Assigning three to four projects in a semester is ideal. Assigning more projects makes it difficult for students to meet often, as their schedules are usually full with several activities. The projects were chosen, so they can get acquainted with each other, recognize and appreciate their strengths and weaknesses in different areas, develop positive interdependence, collaborate to achieve a common goal, learn from each other, and also have fun. The four projects were:

- Performing throws of dices targeting six and determining their percentage success rate;
- Finding their learning styles and discussing similarities and differences in their learning styles;
- Generating a creative item like a joke, cartoon, or poetry, and coming to a consensus about which is the best item from their group, and
- Designing a optimum sorting technique algorithm.

The formal groups were encouraged to study together and prepare for examinations. The group members also took collaborative quizzes in the class. During such a quiz, the group members discussed how to solve a given quiz problem in the first three to four minutes. At that time, no writing was permitted. This activity greatly enhances their capabilities in problem solving, critical thinking, teamwork, and communication skills. In the next 15 minutes, they solved the quiz problem individually, just as in a regular quiz.

## **RESULTS**

The students in the large computer class were asked for their opinion on integrating soft skills like cooperative learning (teamwork), active learning, problem solving, and critical thinking in all their courses. The

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