AN INFORMAL APPROACH TO COOPERATIVE LEARNING GROUPS

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Abstract

In order to enhance student learning, engineering faculty have utilized formal cooperative learning strategies, which are especially applicable to problem courses, in their classrooms. This requires an extensive knowledge of the five essential components of cooperative learning: positive interdependence, individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills, and group processing. Another option for engineering educators is to informally introduce these cooperative learning techniques in a less structured way. One such example is the implementation of cooperative study groups at the University of Wyoming. The specific techniques utilized and the associated results that have led to improved student academic success are presented in this paper.

Introduction

Formal cooperative learning (CL) strategies have been incorporated by engineering faculty members with noted successes.[1,2] Felder reports that students have greater intrinsic motivation to learn and achieve and express deeper understanding of course material, they achieve higher grades and greater persistence to graduation, they develop better teamwork and leadership skills, and they enjoy higher self esteem. The methods employed by these educators generally follow a formal, structured approach, involving five essential components: positive interdependence, individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills, and group processing.[3,4]

In a formal approach, students are organized into groups of generally 3 to 4 students for a semester (or a portion of the semester). The instructor ensures homogeneity of the groups, that is each group has a range of abilities, ethnicity, and gender, and structures positive interdependence and individual accountability by assigning roles and carefully monitoring group functioning. The instructor intercedes to develop teamwork skills and to evaluate learning. He/she also assists with group processing for continuous improvement in the CL experience.

Adapting the elements of cooperative learning to the classroom environment may seem daunting to the typical engineering educator. However, an informal approach that does not necessarily incorporate all five of the elements of CL to the level found in activities led by CL experts will still improve student learning. Students benefit from enhanced learning and from increased teamwork skills.

Cooperative learning strategies can be informally introduced in the classroom by asking students to turn to their neighbor and recall the main points from the previous lecture, to do the next step in a problem solution, to think of an example, or to do any of the analytical, evaluative, or creative thinking associated with learning in the classroom. These tasks involve a group of 2-3 students in a temporary assignment that lasts from a few minutes to an entire class period and can be interspersed in a lecture to maintain higher student involvement.

Informal Groups

At the University of Wyoming, cooperative learning groups were initially offered in the Spring 1995 semester to students enrolled in an Introduction to Engineering Computing course. General tenets of cooperative learning were included in the design of the study groups; however, the engineering faculty for the course were not experienced with formal CL techniques.

Students in the Introduction course were invited to participate in the study groups, following the first exam in the course, and were given a small amount of extra homework credit as an incentive to attend the sessions. The objectives for both the intellectual mastery and for teamwork skills, along with expectations for the students, were specifically discussed with the study group participants.

The study groups were held twice weekly and concentrated on developing the students' problem solving skills. Students were randomly assigned to a group of three at each session, ensuring that group membership changed each time. At the session prior to an exam, however, students were able to form their own groups of 3 - 4 members.

Positive interdependence was built into the groups in several ways. At the end of the session a group was randomly picked to present a problem solution. Individual accountability was ensured by randomly choosing the student to make the presentation. The exam review sessions were conducted as contests, with individual students presenting a group's solution and all members of the group receiving a prize. A single set of instructional materials was provided to each group and each member of the group was given a particular role -- coordinator, checker, recorder, monitor, etc.

Team building skills were not specifically addressed in the initial implementation of the study groups. In a more formal approach, with longer group tenure, leadership skills can be incorporated along with decision making and conflict management strategies. In the informal groups, communication by all group members was emphasized during the semester.

Room arrangement was probably the biggest barrier to implementing the cooperative learning groups. Several seating options were tested over the semester, with none being entirely acceptable. The optimum arrangement is a small table that provides seating for 3-4 group members; a round table provides equal access to materials for all members.

Results

The academic performance of students participating in the cooperative study groups has been analyzed, along with their evaluation of the sessions. On a scale of 1 (high) to 5 (low) the students reported that due to the study groups, they:

- Did better on exams 1.6
- Became more confident about computing 1.7
- Were more able to solve problems on own 1.6
- Would attend for enrichment 1.8

Half of the students voluntarily participated in group study for the final exam.

The study groups have excited the students about their engineering coursework; the instructors have seen greatly increased levels of student interaction in their classrooms. Thirty percent of the students coordinated their fall semester registration in order to continue the use of cooperative study groups and eighty-five percent requested similar groups be established in two engineering science courses: statics and dynamics. These results are evidence of the positive impact of the cooperative study groups on students' academic success.

Student performance on examinations (for a single section) is plotted in Figure 1; 26 students belong to the study group, 12 to the non-study group, for a total of 38 students. The first exam was conducted prior to implementing the CL groups, and hence serves as a pretest; the last exam, #5, is a comprehensive final. The average test scores are plotted for the non-study group students, the study group students and the class as a whole. The graph illustrates that the study group average for the pretest was 13 points lower than the non attenders; however both group averages were essentially the same for the final. Some of the irregularities in the graph may be explained by the relatively small sample size. For the same reason, the results from this group of students should not be generalized; however, these results do compare with national longitudinal studies.[1]

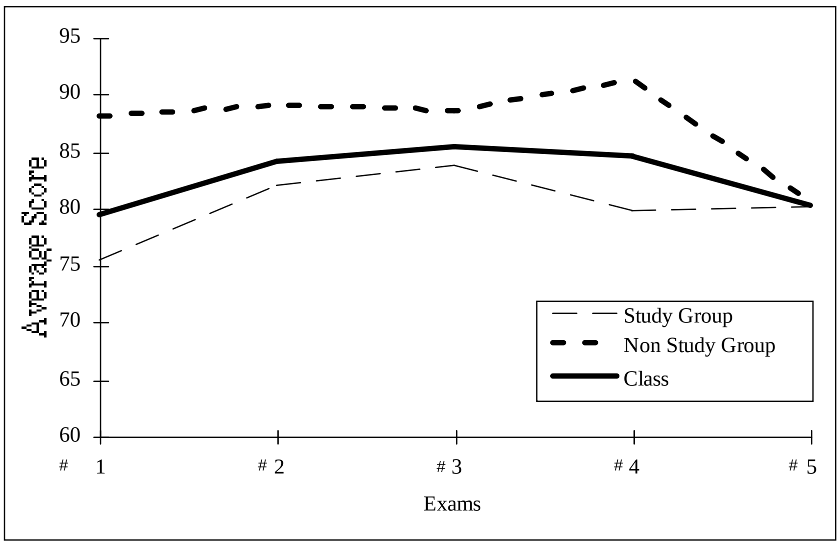

Figure 1

Conclusion

Informal cooperative study groups lend themselves very appropriately to problem courses, the mainstay of engineering curricula. Further, they are an effective mechanism to increase student retention in engineering and are an extremely successful method for increasing individual student academic success.

When cooperative learning groups are implemented for the first time, expect an initial resistance. This can be somewhat alleviated by discussing the objectives with the students, for both the course material and for the teamwork skills, that will be developed through study group activities. Since CL will increase the level of learning acquired by the students, criteria-referenced evaluations are essential; instructors must rethink grading policies that are based on a normal distribution. Students should be introduced to CL early in their college careers, expanding on the level of the cooperative tasks incorporated in classroom activities, to ultimately using formal CL groups for upper level design situations.

Acknowledgment

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References

1. Felder, Richard M. and Rebecca Brent, *Cooperative Learning in Technical Courses: Procedures, Pitfalls, and Payoffs,* ERIC Document Reproduction Service, 1995.
2. Landis, Raymond, "Building Collaborative Learning Communities," *Proceedings ASEE Conference,* 1990 pp. 1204 - 1208.
3. Johnson, David w., Roger T. Johnson, and Karl A. Smith, *Active Learning: Cooperation in the College Classroom*, Edina, MN, Interaction Book Company, 1991.
4. Smith, Karl A., *Cooperation in the College Classroom*, 1991.

Biographical Information

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Dr. Steadman received a B.S. in Civil Engineering from the University of Wyoming in 1969, an M.A. in Mathematics from the University of Denver in 1973, and a Ph.D. in Mechanical Engineering from the University of Wyoming in 1994. She has worked as a structural engineer for the Bureau of Mines and as a computer specialist for the Bureau of Reclamation and the Solar Energy Research Institute (now NREL). She held a faculty appointment at the Colorado School of Mines as Assistant Director for User Services/Computer Center before joining the University of Wyoming College of Engineering in 1984. Dr. Steadman serves as a Senior Lecturer, where she makes use of her interest in engineering computer applications. She is active in the Computers in Education Division (CoED) and is a faculty advisor for Tau Beta Pi.

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