Teaming In Technical Courses

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Abstract:

The University of Alabama is one of seven schools participating in the Foundation Coalition, a partnership looking at curriculum integration, human-interface issues (active and cooperative learning), and technology-enabled education within the undergraduate engineering curriculum. As a result, the 1994-1995 academic year saw a completely new curriculum being prototyped for a class of 36 volunteer students within the College.

The curriculum in question provides an integrated 13-hour sequence of Calculus, Physics, Chemistry and Engineering Design for the students. One of the central themes to this sequence is the concept of teams and teaming. Students work in teams of four students throughout this course sequence. These teams operate as a unit for all classes, mathematics recitations, physics and chemistry laboratories, and all engineering design projects.

As this is the first significant, large-scale, curriculum-wide implementation of teaming within the College, a number of strategies for how to proceed were identified (and attempted). Concern was placed on ensuring that students gain both the ability to function effectively within a team environment and also demonstrate their own individual ability to perform the task in question.

This paper examines the processes by which teaming is performed within the integrated freshman year of the Foundation Coalition. It looks at successes that have been realized, and also point out techniques that should not be repeated. The authors summarize their opinions about the strengths (and weaknesses) of the process, as well as identifying the principal ‘‘lessons learned’’ for both future semesters of this curriculum and other individuals interested in incorporating teaming into their own courses. In addition, the authors comment on the similarities (and differences) between freshmen students and upper-level engineering students with respect to teams and teaming.

Introduction

The University of Alabama is participating in an NSF-sponsored engineering education reform project, the Foundation Coalition. The primary goals of the Foundation Coalition are to re-vitalize undergraduate engineering education through the incorporation of curriculum integration, human-interface development (active and cooperative learning), and technology-enabled education. This paper looks at the issue of human-interface development, specifically the teams and teaming processes

used in the classroom.

The use of techniques such as teaming and cooperative learning have been recognized by a number of researchers as beneficial to the classroom environment [1,2]. These techniques are fairly well-known today, and will not be re-stated in this paper. Instead, the reader is referred to [3,4,5] for additional information on the benefits of teaming and cooperative learning.

Teaming in the Freshman Curriculum

The University of Alabama has implemented a new prototype freshman engineering curriculum for its students. This curriculum consists of a 13-hour integrated sequence of mathematics, chemistry, physics and engineering, plus an additional three hours of other coursework (normally freshman English). Within the 13-hour integrated block of courses, students work in ‘‘teams’’ on science laboratories and engineering design projects.

The freshman Foundation Coalition (FC) class consisted of 36 students who were all ready for Calculus I. These students worked in teams of four throughout the entire year. Teams were selected by the course instructors, and rotated on a regular basis. During the course of the year, the students ended up working on five distinct teams. These student teams remained constant across all courses, so that the same team worked together on the engineering design project(s), the physics labs, the chemistry labs, and the math recitation drills.

Team selection was not an easy process. The initial selection utilized results from the students’ performance on the Myers-Briggs exam, and other similar measurements. As time progressed, the primary emphasis shifted to placing students on teams with individuals they had not worked with in the past. Throughout the selection process checks were implemented to ensure at least two female members on any team with a female student, and two minority students on any team with a minority student.

A fundamental observation was made within the first few weeks of teaming in the freshman class. It was simply that students did not necessarily trust the other members in their teams. Specifically, the initial FC class composition was made up of ‘‘high quality’’ freshman engineering students. These students often represented the best of the various high schools from which they graduated. As a result, they held their own work ethics and standards in higher regard than they did their classmates. Since the students did not really know each other, it took some time for ‘‘trust’’ to develop within the teams.

During the FC engineering course, considerable time was spent during the first semester discussing issues such as team roles, methods of conflict resolution, sources of power in teams, and other related team issues. In addition, the first few weeks included several ‘‘team-building exercises’’ that were designed to help illustrate to the students the benefits of teaming. Upon reflection, it was felt these issues were not really appreciated by the students at the time, as the students had not yet been in a team environment long enough to see problems develop, and realize their potential ramifications. As a specific example, we discussed a ‘‘code of cooperation’’ for the teams during the first week of the course. It seemed to fall of deaf ears, as the students did not really seem to utilize it at all during the semester. However, during the first week of the second semester, each team was asked to develop their own code of cooperation, based on what they had experienced (both positive and negative) working in their teams during the first semester. This exercise was extremely well received by the students.

All students in the freshman class had direct access to the Internet via the computers in the FC classroom, and this included individual e-mail accounts for each student. As a result, it was possible for students to interact directly with the course instructor using e-mail. This appeared to be an effective mechanism for both querying the students regarding the status of their team (or how the team was interacting), as well as a mechanism for students to ‘‘vent their frustrations’’ regarding other team members. The students were usually extremely honest with the course instructors regarding the performance of the other members of their team. Additional information regarding the effectiveness of an individual team could also be obtained through a student’s journal. Each student in the FC curriculum maintained a journal throughout the year.

Teaming in Upper-Division Courses

The authors also utilize teams in their upper-level courses. J. Parker has worked extensively with teams and team projects in senior-level mechanical engineering courses. D. Cordes has also utilized teams in the senior-level software engineering course, when the team is responsible for the development of a large-scale software project. However, such courses are ideally taught using teams and teaming, and this practice is not uncommon across the country.

Given this, the authors would like to focus briefly on the use of teams in CS 325 (Software Development and Systems). This course is more of a conventional upper-level technical course, focusing on the incorporation of object-oriented techniques into the student’s programming experience. The course looks at two object-oriented languages (Ada 95 and C++) and also transitions the student from the PC environment to the workstation environment.

The basic philosophy utilized was to spend the first half of a lecture going over the basics/fundamentals of a given topic(s). At this point the lecture would stop and they would get into teams (of three or four) and work on some exercises developed around the ‘‘mini-lecture.’’ A few basic observations should now be made regarding the specific organization and structure of these classes:

First, the teams were selected by the students themselves. Each team lasted for approximately four weeks. However, when it came time to pick a new team, they could not select any of the team members that they had been on a team with before. This way, initially they all knew the other members on their team, and as they got more familiar with the class they became more comfortable moving to new teams.

Second, each team was given a specific task (or set of tasks) to discuss and complete each day (same set of tasks to all teams). Some days (not many) this consisted of them giving oral summaries of various pieces of material, other days it was problem-solving exercises, or lists of questions over the material (‘‘What happens if we change X to Y,’’*etc*.), and some ‘‘mini-programming’’ assignments. It was important for the team to have specific deliverables at the end of each day.

Third, a ‘‘reading list’’ was handed out about every 3-4 weeks (roughly the same timeframe as changing teams). On this were specific topics for specific days, along with what material this corresponded to in the book. This way students had a reminder regarding the specifics they were suppose to be covering in the book on a regular basis. Since approximately half the time in class was spent in teams, it was not possible to cover all the material one would normally cover in the class (all

the details of a concept). The students soon picked up on this, and were utilizing the reading list so that they would be prepared for the daily class activities.

Fourth, the instructor made a strong effort to keep moving between teams as much as possible during the teaming. The basic concept was to go over to a team, listen for about 15-30 seconds, interrupt with a question or two (sometimes directed at a specific person, sometimes to the whole team), and if they are on track then move on.

Lessons Learned

The authors are firm believers in the potential benefits of utilizing teaming in their courses. However, they have also identified several key issues that cannot be ignored when you incorporate teaming into a classroom environment. These issues are discussed below.

First, it is vital that each team have some identifiable ‘‘deliverable’’ that is due at the end of the session. If the students do not have a specific deliverable, it is impossible to keep the team focused on the task at hand. It does not have to be a final, polished product, but the teams must turn in something to indicate the progress they made during the session.

Second, it is important for the teams to realize you are interested in their efforts. This normally means that the instructor spends most of the time walking around the room and listening into the team’s conversations. Feel free to interrupt and ask the teams questions. Watch a team for a few seconds, ask some (pretty obvious) questions and (occasionally) some more difficult ones to make sure they knew what they were doing.

Third, only distribute one copy of the task per team. Handing out multiple copies often led to four people dividing up the work and each doing 25%, instead of working as a team on the entire set of problems. It is a good idea of have extra copies available for all students as they leave the class, but only let the team have one copy while they are working.

Summary

The students in both the Foundation Coalition class and upper-division courses seem to truly enjoy the experience of working in teams. When surveyed at the end of the year regarding ‘‘What do you like best about your FC classes and experiences,’’ student answers included the following:

- ‘‘The thing I liked best about the FC was working in teams. It allowed me to work with others on projects. Working in teams allowed me to get used to working with people with different opinions than mine.’’
- ‘‘The thing I liked best was working with the same people for a period of time. It really helped because you get to know the people in your team very well. Teams helped me make my best friends.’’
- ‘‘I developed teaming skills that will benefit me one day.’’
- ‘‘The constant group work that takes place in teams/groups of friends. Working in small groups takes away a little of the boring aspects of homework and design projects.’’

In summary, the authors believe that teaming not only increases student interest and motivation in

their classes, but also provides an effective instructional technique. It is not the most natural concept for faculty who have grown accustomed to traditional lecture. However, the authors firmly believe that faculty members who are willing to ‘‘take a chance’’ and experiment with teaming in their classes will not be disappointed.

References

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Fri Sep 29 16:10:48 PDT 1995