Opportunities to Teach Teamwork, Collaboration, and Interpersonal Communications in Mechanical Engineering Technology Courses

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Employers of Engineering Technology graduates look for experience working together in teams, ability to collaborate on projects and the ability to effectively communicate technical matter in both oral and written forms. Opportunities to expose the students to these areas abound in the six associate degree MET courses taught by the author. Three of these courses have labs where the limitations of space and equipment force the students to work in teams and to engage in inter-team cooperation. Two courses have problem solving sessions which give the students experience in sharing solutions of technical problems and practice in presenting their findings both in writing and orally. The sixth course presents the opportunity to collaborate doing a feasibility study of a project and then writing a formal report of the semester long project. This paper details how these activities are accomplished.

Introduction

Purdue programs are located in southern Indiana near Louisville Kentucky. This is a large metropolitan area; The Southern Indiana Chamber Of Commerce recently conducted a survey recently of area companies to determine what priority areas of training were needed in their workplace. 300 companies were sent the questionnaires, 30% responded. The data pertinent to this paper where as follows:

Interpersonal Communications	88%
Team Building	85%
Leadership	76%

Anecdotal data from various employment counselors reinforces these results plus the need for communication skills to advance to supervisory positions. ABET (Accreditation Board for Engineering and Technology) considers training in oral and written communication to be a necessary achievement of a college graduate. Thus collaboration, cooperation, interpersonal communication and teamwork are essential parts of the education of the Engineering Technology student.

First a few definitions from Webster's Intercollegiate Dictionary.

Collaborate: to work together especially in some literary, artistic or scientific undertaking.

Cooperate: to act or work together with another or others for a common purpose.

Teamwork: joint action by a group of people in which individual interests are subordinated to group unity and efficiency.

Communicate: to convey knowledge of or information about

The author teaches six courses during the academic year which present excellent opportunities to expose the students to all three of these areas. These courses are listed as follows:

1. Materials I
2. Manufacturing processes I
3. Statics
4. Dynamics
5. Strength of materials
6. Machine elements

Materials I is the first technical course that the majority of students take. This is an introductory course dealing with the nature of metals, plastics, and ceramics. There are nine lab exercises, which present an excellent opportunity to introduce the students to teamwork and cooperation, especially due to the constraints of space and lab equipment. For example, the first exercise is meant for students who have been out of high school many years and for those recent graduates who have had limited lab experience. It is and introduction to using equipment to determine the specific gravity of 8 irregularity shaped objects such as the cylinder head of a leaf blower and the tailing of a copper-smelting furnace. There are four scales each for heavy items and for lighter items. The volumes are determined by displacement of water for which there are four large graduated cylinders, four small cylinders and four large beakers. A common tendency of the students is to take as many items of equipment to their table as they can along with several of the objects at one time without regard for the needs of the other students. (a typical class has 15 to 20 students) Here the need for cooperation and teamwork are stressed. Once these needs are specifically made known to the students the lab runs very smoothly. When one team finishes with an object they return it to the front table so that others may avail themselves of it. The second lab exercise gives the same opportunities. This is a lab to measure the hardness of several metals and plastics and to determine the specific gravity of three objects by loss of weight in water. Again there is limited equipment which must be shared among the students. One each of Rockwell C and Rockwell B hardness testers are available along with a Brinell tester. There are 2 each of Shore A and D testers for plastics and elastomers. Four sensitive balances provide means of determining S.G. Again teamwork and cooperation are required of the students in order for all to complete the lab in the time allowed. One added feature of this lab is that once a few students are shown how to use the hardness testers they in turn have a chance to practice oral skills in teaching others how to use them. (the testers are manual types)

Tensile tests of various metals are also part of this course. With one universal testing machine teamwork is essential. Three students work together on each test, one operates the UTM and reads the elongation, one reads the load and a third records the data on the board. The rest of the class records the data at their seats. Timing and teamwork are required to obtain meaningful

results. A number of such tests are conducted during the semester which gives all the students a chance to participate on the team conducting the test

Other exercises give more experience working together. Heat treating steel and aluminum is done with one furnace, which is done with the instructor operating the furnace and the students observing and recording what was done and doing the hardness tests necessary. Two students do the hardness testing and must insure the rest of the class hears and records the results and know which specimen is being tested. There are seven aluminum samples and two steels.

Manufacturing Processes I covers various forming processes for metals and plastics i.e. casting, welding. explosive forming, rotational molding. The lab is held in a local high school shop, which can handle about 10 students doing casting and 8 doing welding. There is one rotational molding station, one forging device and one explosive forming apparatus. For safety, particularity doing casting and welding, each student must be aware of his/her surroundings and what other students are doing. The first time the author participated in this lab there were nine students who eased the crowding and time waiting to get to use a particular device. After being shown how to do specific tasks, the students worked together to share equipment and procedures giving opportunities for oral communication practice concerning technical subjects. When a student had a difficulty with device, other students would show leadership skills helping that student.

Statics and Dynamics are taught with a problem-solving lab during which student's work together doing exercises and sharing techniques. It is an excellent time for the students to practice communication both orally and in writing dealing with technical subjects not only in the course subject matter but in a review of mathematical procedures also. The reticence of some students to ask questions disappears when all are working together, the better students helping those having difficulty with a particular problem. They share solutions and methods and even point out possible errors they run across while working the problems. It should be noted that this activity takes place while the students are seated around the room as contrasted to the traditional "put the problem on the board "format. At the beginning of the semester students tend to work alone but when they are specifically told to work together to improve teamwork and communication skills they readily work together.

The key to all the opportunities covered in this paper is telling the students that these are skills sought by employers and that they are to avail themselves of the chance to practice these skills. Such notice breaks down the aversion some students have to working with fellow students and increases the flow of information among the members of the class.

Strength of Materials is a heavily lab oriented class with one set of each of the lab equipment required being used. Some exercises such as beam bending and torsion testing take two lab sessions to complete. Fall 99 was the first semester the author taught this course and the enrollment was such that the students were told verbally and in writing how to conduct the exercise and then turned loose to organize themselves into a functioning team. The students would rotate tasks giving each student a chance to operate different types of equipment used. They quickly learn that they must work together and depend on each other as some of the labs such as beam bending and punching shear involve handling heavy equipment with demanding mounting procedures. Take for example the lab to measure the strain on the surface of simply

supported beams. The beams are aluminum one inch thick and with heights ranging from 1 inch to four inches. They are 3 feet long. They must be mounted in a fixture, which loads them at four points. Care must be taken not to disturb the strain gages during the mounting operation, which takes physical, and verbal communication. Teamwork is a must for successful completion of this task. One particular event stands out from these labs; A student who has difficulty solving textbook problems took the lead in setting up and operating the equipment

Machine Elements is the course, which presents an opportunity for students to collaborate on a project to determine if it is feasible. One such project was to determine if it was possible to design a gear reduction system under size constraints to transmit a given horsepower with a specified reduction ratio. No lectures are given on gears or gear drives leaving the students to educate themselves on the necessary topics. They could use any resources available with the stipulation that if they used a gear catalog they must verify the catalog data and present such verification as part of their report. The usual arrangement is for the students to work in pairs. The report must be presented in a specified format done using word processing and spreadsheets and must be readily readable for ease of review. This task forces the students to work together toward a common goal toward which they must help each other understand the design procedures to follow in studying the gear box and to work together in the presentation of a written report. One student may be better with computer skills and do the major part of the report writing while the other contributes more to the design calculations. They are given four weeks to accomplish this task and must arrange time when they can meet requiring communication and time management skills. The usual comments upon completion is that it was difficult but one well worthwhile.

Summary

The success of such assignments toward the goals of teamwork, collaboration, leadership and interpersonal communications is judged by following the students from their first technical course to one of the final technical courses they take. This is a span of 4 to 8 semesters. At the beginning some are a reluctant to participate but as they work together through out the years they become more comfortable communicating with their fellow students until at the end they are almost enthusiastic in doing so. They readily work together with little supervision. Quite often no one leader appears but all work together as a group.

Bibliography

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