Interdisciplinary Miniprojects with Engineering and Occupational Therapy Students

Henry G. Ansell
Penn State Berks Campus

Introduction

Before the spring 1995 semester at Penn State Berks Campus, the coordinator of the occupational therapy program asked this instructor if engineering students might help her students design therapeutic devices.

The occupational therapy program at the Berks Campus leads to an associate degree and prepares students to become licensed occupational therapy assistants. A requirement of a course called Activity Analysis: Therapeutic Devices is that occupational therapy students design and construct a therapeutic device. This course is given in the second semester of the four-semester program.

In the spring 1995 semester this writer taught a one-credit introductory electrical engineering laboratory course, called Electrical Engineering Laboratory, given concurrently with an introductory electrical circuits course. No design project was required. These two courses were normally taken in the fourth semester of a student's electrical engineering program.

It was apparent that encouraging cooperation between the occupational therapy and engineering students would enrich the engineering lab course by inserting a bit of design project experience, as well as providing an unusual opportunity for practicing teamwork. This author encouraged his engineering students to help the occupational therapy students in their projects by offering extra credit for participating engineering students.

Summary of Interdisciplinary Miniprojects

In the spring 1995 semester four interdisciplinary student partnerships were attempted and two materialized. Each team included one engineering student and one occupational therapy student. One project was a device requiring the patient to perform a task needing concentration and dexterity. This project used a digital circuit. The other was a device to teach cause and effect to developmentally retarded children, and used lights and switches. At the end of the semester, the participating engineering students gave a short presentation to their classmates.

Five joint projects were completed in the spring 1996 semester. These were: (1) a "pinch-tree" requiring the patient to perform a task, with feedback to the patient supplied electronically (digitally) to give praise on completion of the task; (2) a device attached to the patient's foot, to passively exercise it with remote control; (3) a device for exercising, using muscles of the arms; (4) a special switch, made by a pair of students, to be used to switch on a dancing-pig toy for a child; and (5) a device to be attached to a bathtub, to sense when the water has reached a certain level and sound an alarm. At the end of the semester, participating engineering students gave a presentation to faculty from various disciplines.

Sophomore engineering students were asked to participate in interdisciplinary miniprojects with occupational therapy students in the spring 1997 semester. That effort is under way at the time of this writing. It was emphasized to the engineering students that their interdisciplinary miniproject experience has three main purposes: *teamwork*, *design*, and *communication*.

Teamwork

Pete Earleywine, Plant Manager of Goss Graphic Systems, Reading Plant, addressed a faculty meeting at Penn State Berks Campus on "Team Building in Industry: Implications for Learning at Berks Campus." He spoke of industrial problem-solving teams involving people with different backgrounds. The impression that this listener gained was that to include diversity of thinking a problem-solving team might include, for example, production workers, a supervisor, an engineer, someone from higher management, and people from other departments who might have some intuition, expertise, or a fresh idea to contribute. Mr. Earleywine encouraged the faculty to recognize the importance of teams, especially teams whose members can bring different points of view to a problem.

In the literature there is praise for teams of engineers having different functions working concurrently. "Cross-functional engineering teams bring product designs to market fast, frugally and right the first time" wrote George Taninecz[1] in *Industry Week*.

According to the draft set of new ABET criteria for engineering programs called "Engineering Criteria 2000" which is being discussed in the engineering education literature[2], "engineering programs must demonstrate that their graduates have:...(d) an ability to function on multi-disciplinary teams;..."

Engineering education leaders[3] have pointed out that "engineering education programs must...be...connected through partnerships and integrated activities with...the full breadth of the university..."

Engineering lab courses involve teams of students working together. Often these students are enrolled in the same or similar programs. By teaming engineering students with occupational therapy students, to jointly design and implement devices useful to someone with a disability, the engineering students gained some interdisciplinary teaming experience. The interdisciplinary teaming aspect was especially challenging because of the difference in backgrounds of engineering and occupational therapy students.

The main difficulties facing these interdisciplinary miniprojects concerned communication. A problem for many teams was the difficulty in finding a common time during which students could meet their teammates. Some engineering students also felt that the occupational therapy students didn't contribute sufficiently to the projects. In addition, in one instance there was a misunderstanding concerning expectations.

One issue for this instructor was whether the participation of the engineering students in these interdisciplinary miniprojects should be voluntary (for extra credit in the course) r a requirement of the course. In the spring 1995 semester it was voluntary. The following year it was first announced that it would be a requirement of the course. However a request for student feedback revealed student dissatisfaction with that policy, with some students concerned that an out-of-class joint project would consume an inordinate amount of time. It was subsequently changed, in the same spring 1996 semester, to be on a voluntary basis, for extra credit in the course. In the spring 1997 semester it was again voluntary, for extra credit.

Another issue was whether the interdisciplinary teams should include one or two engineering students. In the spring 1995 semester the engineering students worked without other engineering student support. The following year it was originally stated that this would again be the situation. However, some engineering students raised concerns that they would not be up to doing a project without some additional technical support from another engineering student. Subsequently, in that same semester, a participating engineering student was given the choice of being the sole engineering student on the team or being one of two engineering students on the team. The students chose their own partners. There were two occupational therapy students per team. In the spring 1997 semester each engineering-occupational therapy team included two engineering students and two occupational therapy students.

In the spring 1997 class, to address problems of communication, teamwork, and bonding, there was scheduled some overlap in the times when the engineering and occupational therapy students attend classes. This permitted a one-hour joint class session in which the students could brainstorm together for ideas for possible projects. This helped four out of five teams get started, but some teams still had difficulty in meeting. at this writing it appears likely that a follow-up joint class session of about 15 minutes needs to be arranged to discuss the projects, improve bonding and, most importantly, establish satisfactory meeting times for those teams that have not yet done so.

This instructor plans to facilitate a discussion among the engineering students concerning teamwork. In teaming engineering students with occupational therapy students it is intended that the engineering students will improve in some teamwork skills: encouraging other team members to contribute their thoughts; listening respectfully to other team members; promoting agreement among the team members; encouraging other team members to do a share of the work; and explaining clearly to other team members what one plans to do.

In 1997 the engineering students who participate in the interdisciplinary miniprojects will have three components of extra credit: for teamwork, for design, and for communication. The design and the oral presentation and written documentation are not unusual components. To obtain input for the teamwork component, this instructor plans to have the occupational therapy students provide feedback at the end of the project concerning the quality of teamwork of their engineering student teammates.

Wankat and Oreovicz[4] in their book *Teaching Engineering* stated: "Many engineers contend that designing is the heart of engineering." They wrote that in teaching design the "first difficulty confronting the professor is the development of good design problems." Among ideas suggested are designs for people with disabilities. This idea was used by Hudson and Hudson[5], in connection with engineering and special-education students jointly designing devices for people with handicaps.

Learning to design requires practice, and even a brief design experience can contribute. The interdisciplinary miniprojects were not used for an engineering design-focused course; they were a design enhancement to a course. In the spring 1996 semester, an engineering student typically reported about five hours of out-of-class time in designing and implementing a miniproject.

The engineering students' design experience in doing these miniprojects with occupational therapy students may involve a touch of realism.. First, in designing and implementing therapeutic devices to aid people with disabilities engineering students can clearly see the connection between their task and real needs of people. Secondly, the occupational therapy students may play the role of customers, in having strong wishes and high expectations concerning therapeutic devices that they want to use with patients. This may be especially true if the idea for a project originated with an occupational therapy student on the team.

Communication

Engineering education leaders[3] cite the need for developing communication skills. At the end of the spring 1996 semester, oral presentations were made by the engineering students to an audience of faculty from various disciplines. This provided a speaking experience for the students.

There was another effect. The engineering students were seen in a favorable light when making their presentations to faculty on devices to aid people with disabilities. The audience understood and appreciated the purpose of the work; they realized that it is possible that some good might come of this to benefit someone with a disability. Through the oral presentation, the recognition that the engineering students received for their wok is believed to have contributed to their self-esteem and their positive view of the course.

An engineering student's self-esteem may suffer in some courses. Johnson, Johnson and Smith[6] wrote that "individuals with low self-esteem tend to...have low productivity due to setting low goals for themselves, lacking confidence in their ability, and assuming that they will fail no matter how hard they try." Helping to restore some of that self-esteem may be useful to the students and to engineering programs.

In the spring 1997 semester the oral presentation by the engineering students to faculty from various disciplines will be continued. The engineering students who participate will also be required to provide a written report, and a summary description. It is planned to have some descriptions of student projects of the spring 1997 semester on the Web, and it is planned to continue this in subsequent years. This is another form of recognition of the students' work. It is

conceivable that at some time this may benefit someone looking for a particular type of therapeutic device, and he students will write their descriptions with this in mind.

Conclusion

Engineering students who participated in miniprojects with occupational therapy students gained an interdisciplinary teaming experience.

Most engineering students experience laboratory teamwork only with other engineering students. But in many jobs in industry, engineers will also be called upon to work with people whose training and expertise may be far different than their own. Employers emphasize the importance of good teamwork skills.

Because of the large difference in backgrounds of engineering and occupational therapy students, the teamwork aspect of interdisciplinary miniprojects is challenging. At the same time, this experience offers an opportunity for engineering students to sharpen their teamwork skills, with guidance and encouragement from the instructor.

In working on miniprojects with occupational therapy students to design and construct devices to help people with disabilities, the engineering students gained a taste of design experience in which they could plainly see the connection to real needs of people. The occupational therapy students fulfilled the role of customers, since they had high expectations concerning the devices (in order to have devices that they could use). This added a touch of realism to the design experience.

The oral presentations to faculty from various disciplines provided the engineering students with a speaking experience. The recognition that the engineering students received for their work is believed to have boosted their self-esteem. This may have contributed to their appreciation of the course.

References

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HENRY G. ANSELL received a Ph.D. (Electrophysics) from Polytechnic Inst. of Brooklyn. He was employed for 25 years as an electrical engineer by AT&T Bell Laboratories. Since fall 1987

he has been teaching at Penn State Berks Campus. He can be reached at **hga1@psu.edu** for questions or comments.