Providing the Team Experience to Human Factors and Ergonomics Students

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The importance of the team experience to human factors and ergonomics students is discussed. Three faculty members describe different approaches to providing the team experience.

Van Cott and Huey (1992) provided a detailed examination of the education and utilization of human factors specialists in a report to the National Research Council. They reported frequent interaction between both human factors and ergonomics (HF&E) personnel, and specialists from other areas including: computer programming, engineering, marketing, systems analysis and system users. Some of this interaction occurs as members of a team.

This requirement was repeated in Science by Kaiser (1995) "But today in industry, Ph.D.s need to be ready to learn new disciplines, work in teams, explain their research to non-specialists, and understand the business impact of their work (p 133)." While Kaiser's comments are focused specifically on the Ph.D., the emphasis extends to HF&E professionals at all academic levels. Borchardt (1996) also emphasizes the importance of a team-orientation in engineering. Shapiro (1994), speaking specifically to the HF&E community, is very direct when he states simply "teamwork is survival."

The ability to work as a team member appeared repeatedly as a requirement, at all levels and across industry, government/ military and consulting positions, in the placement positions analyzed by Moroney and Adams (1996), and among the internship positions analyzed by Moroney, Sotile, and Blinn, (1996). The sections which follow describe teamwork experiences provided by three educators, who represent the areas of industrial engineering, psychology and industrial and operations engineering. The final paper in this symposium (Stone, 1996) reviews the literature on team dynamics and building and provides references for use by interested educators.

The Teamwork Experience in an IE Program By Stephan Konz

The Industrial Engineering Advisory Council at Kansas State University has emphasized the importance of teamwork to the faculty for many years. I have taught a required "senior design project" course (Facility Design) for approximately 25 years. In the "lab" (50% of course grade), students completely designed a factory, starting with a product, selection of machines (including feeds and speeds), material handling, utilities (lighting, climate, noise control), energy, waste, quality policies, labor policies, etc.

There were 4 to 5 students/team. Each report took 10-20 h so

there were 15 h x 13 weekly projects = 200 h; in the semester, the lab took about 50 h/student. With each report, the students submitted a peer rating. They did not rate themselves. The procedure was as follows:

- * Each team member received a "grade multiplier".
- * The average of the multipliers had to equal 1. That is, if someone received a .8, then the others might receive 1.1, 1.05 and 1.05.
- * The instructor then averaged the multipliers of the team members.

* No rating was submitted if everyone was graded as "1"; this was to encourage using "1"s and discourage using the "club" (i.e. ratings less than 1). The instructor graded the report (giving say 45 out of 50), and multiplied that grade by the average rating to get the final grade for that student's assignment.

In a typical year, there would be 13 reports turned in by 6 or 7 teams--80-100/year. Generally only 1-2% would not give a 1 for everyone. However the students used the peer rating with non-ones as a threat "if you don't shape up." When "non-ones" ratings were given, they often severely penalized the "goof off"--cutting the grade to say 50%. Usually this was sufficient warning and it occurred only once in a team. However, twice in the last 10 years, we had to have a group meeting, including the instructor, to "talk it out". The group then resumed giving "ones" but there were hard feelings in the group about the slackers.

Our students knew each other well from previous classes. The groups were formed in two different ways. In some years, the instructor let students pick their own groups at the start of the term. This generally resulted in one or two groups of "leftovers". It was quite a shock for these students during the semester not to have someone else do their work; these groups are those which had the rating conflicts.

The other approach was to have the instructor pick the members of each group. This makes the teams more equal and protects the "slackers" from the "cruel world" as the good people in the group would carry them. My recommendation is to let students pick their own groups.

The Teamwork Experience in a Psychology Program (W. F. Moroney).

Students are exposed to a team building exercise as part of the Human Factors in Systems Development graduate level course at the University of Dayton. Usually, eighty percent of the students are psychology majors, while the remainder come from areas such as engineering, computer systems and mathematics. The course is built around redesigning a Terminal Radar Approach Control (TRACON) station in response to a simulated Request for Proposal (Moroney & Cameron, 1995). The course, which makes heavy use of simulation, emphasizes both the process involved in product development and the final products.

Early in the course, the students are introduced to industry's emphasis

on teamwork by the use of some of the material presented in the introduction to this article. In addition, they are exposed to "lessons learned" and problems encountered by students who had previously completed the course. Finally, the various roles (coordinator, procedure developer, critic, etc) that team members can play are briefly discussed. Wilson and Hanna (1986), and Stone (1996) provide useful material in this area.

Students are required to: determine their group structure, assign responsibilities, specify deliverables, develop schedules, etc. The only constraint is that they meet the deadlines specified in the simulated RFP. Since, performance evaluation is the center of human factors, students are also required to specify how they want the group performance to be evaluated. This provides an interesting learning experience. In addition, students are required to determine how to allocate bonus points to the team member(s) who contributed most to the final product. This is accomplished by students allocating a predetermined number of points among their team members (they cannot allocate any points to themselves). For example, 100 points could be distributed among 10 team members. Thus, a top performer very well might receive 15 points, while a poor performer might receive 5 points. These points are collected by the faculty member after the completion of the design exercise and the predetermined bonus is awarded to the team member(s) with the highest number of points. To facilitate the process of point allocation, students are provided with an evaluation form used to evaluate the performance of Civil Service personnel. The form utilizes a five point scale to evaluate individuals on 14 characteristics including: initiative, dependability, accuracy of work, acceptance of criticism, originality, etc. The group completing the course this year elected to exchange the evaluation forms among the team members midway during product development, so that individuals could be aware of how their performance was perceived by the group and make adjustments as required. This evaluation process is internal to the group and the faculty member does not get involved. Unfortunately, time constraints precluded the mid-term review this year, but the end-of-project evaluation forms were distributed to the team members at the end of the course. Thus the students were informed of the number of points that they received and provided with a diagnostic rating of their performance.

Requiring the students to determine how they will be evaluated and to evaluate the performance of their team members, personalizes the evaluative process. It also allows them to experience, in a relatively benign environment, the difficulties associated with evaluation and being evaluated. While, the team project and evaluation process are well received, they do require considerable explanation and monitoring by the faculty member.

The Teamwork Experience in a IOE Program (Paul Green)
to be retitled

Using "Outward Bound-like" Activities to Teach Engineering Students Teamwork

I have taught a one-credit introductory laboratory course (4 sections,

enrollment cap of 16) at the University of Michigan (Industrial and Operations Engineering (IOE), Ergonomics Laboratory) for the last 16 years. All sections are typically full. Undergraduate Industrial and Operations Engineering students are required to complete the laboratory and an associated three-credit lecture class.

The laboratory course teaches students how to use equipment available to ergonomists, teaches them how engineers approach problems, enhances the quality of their technical writing, provides applications of the lecture material, and fosters working in groups. The course involves six major experiments covering (1) the measurement of sign lighting and legibility, (2) response time to speedometers, (3) industrial workplace sound measurement and audiometry, (4) work physiology (oxygen consumption and heart rate for a manual materials handling task), (5) anthropometric measurements of classmates, and (6) a survey of symbols. With the exception of the lighting experiment, each group of three to four students submits a report summarizing each exercise. Reports must be written in a format consistent with scientific journals (e.g., Human Factors). Students are provided with a short guide (Green, 1991) that includes a sample report. The most unique aspect of IOE 334 is its use of the University of Michigan Challenge Program ("Ropes Course") to foster teamwork.

The Ropes Program, taken by the class as a group, is an "Outward Bound-like" activity conducted at the University's outdoor recreational facility (in the winter, a gym is used). The initial exercise is a game in which students learn the name of every other classmate. Prior to IOE 334, students have only been enrolled in large lectures, so opportunities to meet classmates have been limited. After the name game, a trust exercise is typically scheduled.

Subsequently, students work together to solve a series of engineering problems. Challenges include (a) getting the class across an imaginary chasm using timbers that can be placed on piers, (b) passing classmates through an extended badminton net with large holes, such that no two people go through the same hole, (c) getting the entire class on and off a teeter-totter while it remains level, and so forth. (See Rohnke, 1984, 1989.) To foster bonding with the class, the instructor and the graduate teaching assistant participate, but as silent followers. The final exercise involves getting the entire class over a 14-foot wall without ladders or ropes, a task that seems impossible to complete. The solution usually requires the class to form a human chain. During the exercises, students realize that they all fail if one person fails, and each individual must be included in the planning and execution of every exercise. Each exercise is followed by a briefing given by a trained facilitator in which students are asked questions to provoke discussion of the group problem solving process. (Was this activity a success? Can you point out something someone did that was a positive achievement? What would you do differently next time?)

Initially, students have great misgivings about participating in this

exercise. Concerns include the time (Sunday afternoon), potential physical demands, and the unconventional nature of the program. However, when students leave this five-hour program, they know every other member of the class (and trust them). They have a sense of each person's strengths and weaknesses, and they understand the give and take required for successful group work. Student reaction is invariably very positive. In end-of-the-semester evaluations, students have commented that the afternoon spent at the Ropes Program was more beneficial to them than most of their three-credit classes. It is not unusual for lab teams to schedule all of their classes together the following semester because of the camaraderie. In addition, students report that they find the University a more welcome place, as they now know at least four or five other students in any Industrial Engineering class they might elect.

Conclusion

Incorporating a teamwork learning experience into an already crowded syllabus is difficult but rewarding for both students and faculty. Hopefully, some of the approaches described above will encourage other educators to incorporate such similar experiences into their syllabi.

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