

Using Peer Evaluations for Design Team Effectiveness

Elizabeth A. Eschenbach
Humboldt State University

Abstract

All Humboldt State University Environmental Resources Engineering (ERE) students are required to take ENGR 111: Introduction to Design. The course has no prerequisites and requires students to work in teams of 3 to 5 students on a 10 week long design project. An hour a week is spent on team building skills during the first 4 weeks of the semester. During the fifth week of the semester, the design project and the design teams are assigned.

Three weeks into the project, each student has a 15 minute conference with the class instructor. During the conference, the student presents a team evaluation on a computer disk, discussing the strengths and weaknesses of the team and all team members (including him or herself). Then the student and the instructor discuss ways to improve team productivity. The instructor gives the student hints on how to write a more descriptive evaluation.

At the end of the semester, each team member turns in a self evaluation and peer evaluation of all team members on a disk. The evaluations from all team members are combined and then split into summary evaluations, one for each team member. A summary evaluation is returned to each team member during the final period of the class. The summary evaluation only contains evaluations discussing general team dynamics and the strengths and weaknesses of that one team member.

This paper describes the peer review process used in teaching ENGR 111: Introduction to Design. An example of a midterm peer evaluation is provided. The paper will present how both students and instructor benefit from the peer evaluation process.

Previous Use of Peer Evaluations to Assess Team Work Effectiveness

Though their use has not been well documented, peer evaluations have been used in engineering education as well as other disciplines. Rhinehart [1] provides a description of a junior level chemical engineering transport course, which is team project based. He uses a group member evaluation form to assess team work.

Some other disciplines that have used peer evaluations for enhancing team work include Journalism [2], Business [3] and English [4]. Johnson [2] had a junior level advertising class work in teams to develop an extensive quantitative team evaluation form. The students listed the following categories as the most important: Attendance, Time on Project, Quality of Work, Communication with Team, Team Player, and Shows Initiative. Holter [3] develops a peer evaluation method for implementing a formal method to remove irresponsible team members from a team. Singh-Gupta and Troutt-Ervin [4] review literature on collaborative writing and discuss how peer review techniques can be used in group writing projects.

There are others using peer evaluation for enhancing team work. For instance, the peer evaluation format that is described in this paper is a combination of methods used in a graduate design course of Professor Gregory Deierlein of Cornell University [5] and a first year design course taught at the University Colorado at Boulder [6].

ENGR 111 Introduction to Design

Humboldt State University has one of the oldest and largest accredited programs in environmental engineering in the country. The Environmental Resources Engineering Department was accredited in the 1970's and currently has about 350 majors. Students work in teams throughout the curriculum of the ERE major. All majors are required to take ENGR 111 Introduction to Design, which has no prerequisites, and provides an introduction to the types of skills that students need to be successful in the ERE major. Students are introduced to the design process, by being part of a 3-5 member team that completes a 10 week long design project. In addition to introducing the design process, the course develops students computing skills and communication skills, with an emphasis on team work and writing. For a more complete description of the ERE program and the course, please refer to [7]

Design Team Peer Evaluation Process

There are four course components of ENGR 111 that contribute to team building and the peer evaluation process: four one hour laboratories on team work, emails of weekly team progress reports, midterm evaluations, and endterm evaluations. Each component is described below.

Team Work Laboratories

The course has a three hour lab section per week. One hour is for an activity section and the other two hours are a computer lab. The first four activity sections are devoted to developing team work skills.

In the activity sessions, students are told that they will often work in groups in their engineering classes and later during their careers. Thus, it is important to learn how to work well in groups. The instructor introduces four group work roles that are always assigned during ENGR 111 group work sessions:

Scribe: Records the minutes of the group work.

Facilitator: Engages all members in the group process.

Presenter: Presents a summary of the group's findings to the entire class.

Time and Task Keeper: Makes sure that all group members stay on task and that the tasks are completed in a timely manner.

The class determines that engineers need to be able to take on any of the above 4 roles when working with others. In order to give all students an opportunity to practice all the roles, the roles are assigned randomly during activity sessions.

Team Experience

In the first lab, students discuss their previous positive and negative team experiences in small groups. Each group identifies commonalities in order to determine what makes a team work and what contributes to team malfunction. Each group reports back to the class and lists are compiled on the board.

Learning Styles

The second lab is devoted to identifying the learning styles of each student, using material from "Creative Problem Solving" [8]. The class discusses the ideal set of learning styles one would want on a team. The class discusses the benefits and difficulties of having different types of thinkers on a single team.

Creating and Maintaining a Great Team

In the third lab, groups of students address the following questions:

- How to create a great team?
- What should be the agenda for the first team meeting?
- How does one maintain a great team?
- What should be the general agenda for any productive team meeting?

Team Work Case Studies

The last lab before design teams are assigned is spent working on case studies of team dynamics from previous semesters of ENGR 111. Each group is given a case study and identifies the problems that the case study team is facing and provides possible avenues of solving the problem. Examples of case studies are provided in Appendix A.

Weekly Electronic Progress Reports

Once the design teams have been assigned, each week the team is responsible to email a progress report to the project supervisor (the instructor). The weekly progress report helps the instructor up to date on who is attending meetings and who is completing actions items. Appendix B contains the guidelines for the weekly progress reports.

Midterm Evaluation

15% of a student's final grade is dependent on the endterm peer evaluation he or she receives from his or her team mates. At midterm students perform a practice evaluation. Peer evaluations help create interdependence and accountability among team members (two key attributes needed for cooperative learning [9]). Appendix B contains a copy of the midterm evaluation form. (Much of the content of the peer evaluation was borrowed from materials presented by Professor Gregory Deierlein in the Spring 1991 Class of ENG 600 Teaching Engineering [5].)

Each student in the class has a 15 minute conference with the instructor. The instructor and the student review the contents and when necessary discuss ways of improving the student's or the team's performance. In addition, the instructor indicates ways to improve the quality of the evaluation itself, by pointing out where the student could provide more specific information or more constructive information. For example: "Joe is a great team member" provides little information. While the following example provides more specific feedback. "Joe is a great team member because he always comes to meetings prepared and contributes creative ideas. He also has lots of enthusiasm for the project". When offering criticism, students are encouraged to differentiate between personality conflicts and lack of performance. Students also discuss and identify examples of constructive criticism.

Some students feel uneasy completing peer evaluations for some of the following reasons: "It is the instructor's job to assign grades" or "I do not like saying any thing negative about my team mates". Class time is spent discussing the benefits of learning to write insightful evaluations and of receiving insightful evaluations. A tone is set in the class that every person is in the "process of becoming", meaning that everyone can continually find ways to improve his or herself.

In order to help the course and instructor continually improve, each *team* is required to complete a midterm evaluation of the course and the instructor. Appendix D is a copy of the midterm course and instructor evaluation form. Each team is required to discuss the answers to the questions and try to reach consensus. If consensus is not reached then the team makes it clear that the answer does not reflect the entire team. Each team submits its evaluation electronically, so that the team remains anonymous. This method of requiring the team to reach consensus helps precipitate the most widely perceived positive and negative aspects of the class and the instructor. (This course evaluation method of using team consensus is similar to one used at the first year engineering course at the University of Colorado [6].) The instructor responds to the midterm feedback in the next classroom session. Examples of constructive criticism are highlighted and the instructor models professional responses to the constructive criticism.

Endterm Evaluation

At the end of the semester, each student is again required to complete a peer evaluation. The evaluation form is that same as the midterm evaluation found in Appendix B with the two following questions added:

1. If your team was paid \$10,000.00 for this design, how would you distribute the money among your team mates?
2. List how each of your team members (including yourself) has grown or improved, or what each of you has learned this semester.

The following is provided at the top of the final evaluation. *Please carefully consider the questions below. Your fair and honest input will influence 15% of your team members' final grades for the course. Unless you state otherwise, each team member will receive an anonymous copy of your comments along with other team members' comments.*

Students submit the final evaluations on disk, so that the evaluations for one student can be cut and pasted together from his or her teammate's evaluations. The instructor reads the evaluations for all team members and assigns a grade to each student using the following criteria:

- If most team members agree that a given team member contributed substantially, then the student receives a score between 90-100.
- If most team member agree that a given team member contributed, but not as much as he or she should have, then the student receives a score between 70-90.

The course does not have a final exam, so the final period is used for "The Final Party". At the Final Party, the students have a potluck and receive their graded projects and the class grade. They also receive their peer evaluations. A student's peer evaluation contains each team member's comments about what worked best for the team and how the team could be improved. The evaluation also contains each team member's comments about that particular student. At the

Final Party the students and the customer(s) review all the team design reports. The customer(s) take their copies at the end of the party.

Student Benefits of Peer Evaluations

The following list describes the student benefits of peer evaluations.

- Students become more aware of the team building process, as they are asked to assess the process twice during the semester. They become more aware of the responsibility they have to themselves and their team mates to maintain good team rapport.
- Some students become more motivated to contribute to their teams after the midterm evaluation. This motivation may stem from the fact that a student learns that his or her peers do not approve of his or her contributions, or that the student knows that the instructor is aware of the poor quality of his or her work.
- Before “Introduction to Design”, many first year engineering students have not been asked to describe the quality of another person’s work clearly and objectively. Students are encouraged to become clearer thinkers, as their midterm peer evaluations are critiqued by the instructor for clarity.
- Many students find receiving the summary of their peer evaluations at the end of the semester to be very rewarding. After an intensive team experience, it can be more rewarding to read a description of one’s contributions to the project, rather than only receiving a letter grade.

At the end of the 1997 Spring semester, about 200 students will have completed peer evaluations in 5 different classes of ENGR 111. A voluntary survey will be used to find out if the students found the evaluations useful. Results from this survey will be reported at the 1997 Annual Meeting of ASEE.

Instructor Benefits of Peer Evaluations

The peer evaluation process has a number of benefits to the course instructor.

- The midterm evaluation is an assessment method for determining the quality of team functioning. The midterm evaluations provide data for early intervention when a team is malfunctioning.
- The midterm evaluation provides motivation for students that might be slow starters.
- The endterm peer evaluations provide information for assigning design team grades.
- Reading the evaluations is often enlightening, allowing the instructor to get a better understanding of the learning process and team dynamics (i.e. it is a lot of fun!).

Drawbacks of Peer Evaluations

Meeting with each student at midterm and preparing the evaluations at the end of the semester is very time consuming, but the time is well spent. Many students will not visit a faculty member during office hours unless they are forced. This required meeting time may help some students become more comfortable visiting faculty. Preparing the evaluations at the end of the semester can be partially mechanized, possibly by using the World Wide Web or email.

Some students are uncomfortable with the peer evaluation process. Information from the survey at the end of the 1997 Spring semester will help determine to what extent students feel uncomfortable with the process.

Conclusions

Peer evaluations have worked well in ENGR 111, because students have reflected on the team process and have realized that they have learned skills in the class that will help them in their careers.

References

- [1] Rhinehart, R. R. (1989) *Experiencing Team Responsibility in Class*, Chemical Engineering Education, Vol. 23, No. 1, pages 38-43.
- [2] Johnson, K. F. (1993) *Team Peer Evaluations: A Student-Generated Quantitative Measurement of Group Membership Performance*. Proceedings of the 76th Annual Meeting of the Association for Education in Journalism and Mass Communication held in Kansas City, MO. August 11-14.
- [3] Holter, N. C. (1994) *Team Assignments Can Be Effective Cooperative Learning Techniques*. Journal of Education for Business. Vol. 70, No. 2, pages 73-74.
- [4] Singh-Gupta, V. and E. Troutt-Ervin. 1996. *Preparing Students for Teamwork through Collaborative Writing and Peer Review Techniques*. Teaching English in the Two-Year College. Vol. 23, No. 2, (May), pages 127-136.
- [5] Deierlein, G. (1991) *Guest Lecture Notes from ENG 600: Teaching Engineering*, taught by Sansalone, M., Beebe, P. and Carlsen, W. Spring, Cornell University.
- [6] Sullivan, J. (1994) *GEEN 1400 - Engineering Projects*, University of Colorado Boulder CO.
- [7] Eschenbach, E. (1996) *WWW Page Design: Projects for Introduction to Design for Environmental Engineers*, Proceedings of the Frontiers in Education Conference held in Salt Lake City, UT. November 6-9.
- [8] Lumsdaine, E. and M. Lumsdaine, (1995) *Creative Problem Solving: Thinking Skills for a Changing World*. McGraw Hill, Inc. New York
- [9] Johnson, D. W., Johnson, R. T. and Smith K. A. (1991) *Active Learning: Cooperation in the College Classroom*, Interaction Book Company, Edina, MN.

Appendix A: Team Work Case Studies

Combating Personalities I

Your team has two headstrong personalities. Each person has a different approach to work. One approach is to finish as soon as possible, doing adequate (but not great) work. The second approach is to do the very best possible job, even if it is deleterious to one's health.

- Predict a worst case scenario of team dynamics for this team
- If you were on a team with two such individuals, how would you work with this team?

Combating Personalities II

Your team has two headstrong personalities. These two people have significantly different values. One person is anti-establishment, while the other is fairly conventional. Both people are highly motivated and some what competitive.

- Predict a worst case scenario of team dynamics for this team.
- If you were on a team with two such individuals, how would you work with this team?

Appendix B Progress Report Guidelines

Each team is to submit a weekly memo via email to the project supervisor. The memo will contain the minutes of one or more team meetings that occurred that week. An electronic copy of the memo should go to **all team members**, as well as the project supervisors. The role of memo writer (scribe) will be rotated each week. *Clear and consistent communication with the project supervisor will be 5% of your final project grade.* Suggested email memo guidelines are below.

1. The name of the group, date, time, and location of each meeting should be included in each memo.
2. Record each member that attended the meeting and their role for that meeting (scribe, presenter, facilitator, or task and time keeper.)
3. Discuss old business by listing progress on each team member's action items that were assigned in the previous week.
4. Discuss new business and assign new action items. List each action item with a suggested completion date and who is assigned that task.
5. Schedule next meeting and record adjournment time.

Appendix C: Midterm Peer Evaluation

Your Name Here

Your Team's Name Here

Please carefully consider the questions below. Be sure that all criticism is constructive. This information will only be viewed by yourself and Beth Eschenbach.

What is the best thing about how your team works?

What would you like to change about how your team works?

Team Member Evaluations (Range 0 to 4):

Each team member's contribution will be evaluated by you based on three criteria:

1. Time and Effort
2. Technical Expertise
3. Overall Contribution

In each category, a rating between 0 and 4 should be assigned, where 1 implies the lower rating and 4 the highest. Aside from the obvious, the time and effort rating should include the energy and enthusiasm with which one takes on work and the team member's reliability in terms of showing up for team meetings, etc. The technical expertise should reflect the depth of understanding of the material and the willingness to learn and grapple with new ideas. Finally, the overall contribution should be a general measure of each team member's effectiveness in "getting the job done". The overall contribution should include considerations as to how effectively each student works as a group member and helps in the organization and direction of others.

For each of your team members and yourself do the following:

1. List your team member's name (or your name)
2. List your team member's strengths (or your strengths)
3. List your team member's weaknesses (or your weaknesses)
4. Rate your team member (or yourself) in the three categories listed above

Please note any additional thoughts regarding the peer review process.

Thank you for your input.

Appendix D: Midterm Course and Instructor Evaluation

Please carefully consider the questions below. Your fair and honest input will influence the future direction of ENGR 111 and will help me improve my teaching skills.

These first questions ask you to evaluate the content of the course.

1. What is the best thing about this course?
2. What would you change about this course?
3. What skills are you learning in this course?
4. What skills do you wish you were learning in this course?

Below you will find a list of the first weeks of the semester. Please refer to your Course Schedule and indicate if a particular lecture or activity should be repeated next semester or if it should be changed. If it should be changed, then indicate how it should be changed.

Week 1

Comments:

Week 2

Comments:

Week 3

Comments:

etc....

The following questions ask you to evaluate the instructor.

1. What are the instructor's strengths?
2. How could the instructor improve her teaching?
3. Any comments on mechanics (voice, writing, organization) or teaching style?

Please note any additional thoughts regarding the evaluation process.

ELIZABETH A. ESCHENBACH

is an Assistant Professor of Environmental Resources Engineering at Humboldt State University. As an undergraduate, she started as a Civil Engineering major, but received a B.A. from University of California Santa Cruz in mathematics and psychology, with honors in mathematics. She received her M.S. and Ph.D. in Environmental Systems Engineering from Cornell University. She spent a year as a postdoctoral research associate at the Center for Advanced Decision Support in Water and Environmental Systems at the University of Colorado at Boulder. Her research interests are water resources, decision support systems, and developing instructional support software. She has won a number of teaching awards, including the Apprentice Faculty Grant from the ERM division of ASEE.