Peer Evaluation Experiences

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Peer learning is an effective teaching tool and is appropriate for group projects. However, students may be tempted to get a free ride in the group or may fear that they will carry more than their fair share of the load. Although peer evaluation is an effective motivational tool for stimulating group participation, students may be reluctant to provide critical evaluation of peers. A matrix-based algorithm for anonymous peer evaluation with variable degree of instructor control can be adapted for multiple groups and rubrics in a hands-on laboratory project to simplify the process for the instructor. This paper discusses the authors' experiences in implementing peer evaluations in a class which uses a scale model reinforced concrete structure as an active learning model. Among the topics discussed are group size, grading rubrics, and proposed changes in the evaluation process.

Key Words: Peer Evaluation, Active Learning, Model Building, Group Projects, Rubrics

Introduction

Group projects are great for construction management students. The team concept develops necessary career skills. Group projects also encourage peer learning. Students may learn better from another student than from an instructor. Naturally, students working on group projects should be expected to evaluate the work of other students in the group. However, peer grading can be frustrating for the instructor for several reasons. Students tend to be lenient when evaluating the work of other students. This lack of critical evaluation was observed in the peer evaluations performed by students that worked in teams to construct scale model reinforced concrete buildings in a reinforced concrete and formwork course (Bray & Manry, 2007). The amount of time required for grade calculation discourages instructors from using peer review with large classes. Many schemes are in use for distributing group grades. Grades may be weighted in various ways. Some algorithms do not allow the student to evaluate themselves. This paper is not intended to endorse any particular algorithm for distributing grades. The main purpose is to show how a system can be devised to overcome some of the obstacles faced in peer grading in a fairly large group. The project used an existing simple but robust peer grading scheme (Feigenbaum & Holland, 1997). The chief addition was a computerized data collection method.

Background

A hands-on, active learning approach to teaching reinforced concrete and formwork design by building a scale model of a reinforced concrete structure has been shown to be effective in motivating construction management students to learn structural design concepts (Bray & Manry, 2007). Figure 1 shows a scale model reinforced concrete building. The scale is 1" = 1 foot. Students constructed the model in semiautonomous groups over a six-week period of a semester course. The student project represented almost 50% of the course grade and became a reference for design examples and calculations for the remainder of the course. The project grade included group grading and peer evaluation. The fall 2007 semester was the fourth cycle for the group project.

The group selection and grading process was refined in both fall 2006 and fall 2007 to better model actual construction processes. The project was organized as close as practical to an actual construction project with four groups as shown in Figure 2. Each student in the class completed a questionnaire to determine their construction experience, understanding of the construction process and their area of interest. Key staff positions were assigned by the instructor. Students performed the remaining group selections as described below. A management team of seven students was led by a student acting as the project manager. This student was selected by the instructor using the

questionnaire responses and interviews. The instructor used the same process to select a student for the role of assistant owner's representative to act as the instructor's primary contact on the project. Both of these students used questionnaire data and interviews to select their subordinates shown inside the dashed line in Figure 2.

Figure 1: Scale model reinforced concrete building

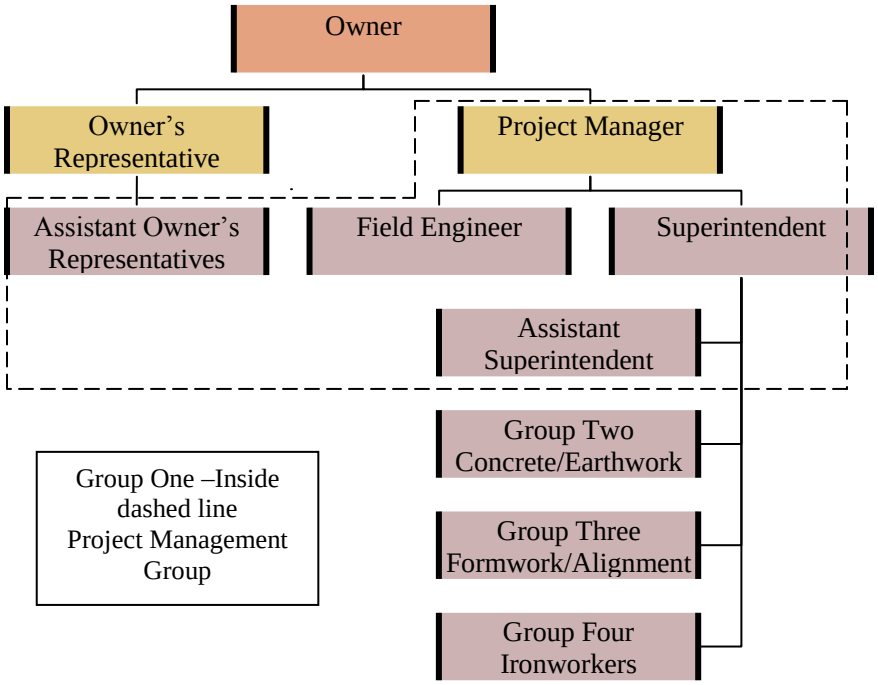

Figure 2: Project organization chart and peer graded groups

In addition, the project manager selected a foreman for each of the labor crews shown in Figure 2. This includes a concrete/earthwork crew, a formwork/alignment crew, and an ironworker crew. The foremen of the crews divided the remainder of the students among the labor crews in a closed meeting. The questionnaire responses were used in this selection process.

The instructor's primary contact on the project was the assistant owner's representative. The project was managed as if the project manager and subordinates were the general contractor. The concrete/earthwork crew, formwork/alignment crew and the ironworker crew functioned like subcontractors.

Peer Evaluation Method and Grades

The peer grading scheme had four groupings as shown in Figure 2. Each group was provided with a specific grading rubric. An example rubric is included in Appendix A. This rubric was used to assign a grade to the project management team. Only a portion of the rubric is shown due to space limitations. The dotted line in Figure 2

encloses group 1, the project management team. The first step in the peer grading process was for the instructor to evaluate the work of the four groups and assign a grade to each group. The group grade assigned by the instructor to the group at the end of each phase is shown in Appendix B as the average grade.

The next step was for the members of each group to determine how the group grade would be distributed to members of the group. The peer grading scheme allows group members to assign a lower portion of the group grade to those members not seen to be doing their part. This helps address the "free rider" problem often present in groups.

In order to distribute the group grade in the group, members of the group completed an evaluation matrix assessing themselves and the other members of the group (Feigenbaum & Holland, 1997). The group members were guided in their peer evaluations by the criteria shown in Table 1. Note that this criterion is different from the rubric used by the instructor in determining the group grade. The reason for this approach was simplicity.

Table 1.

Peer evaluation of members of the project management team

Criteria	**Points**
Leadership-*Showed individual leadership in the form of preparation, enthusiasm, commitment, organization, and communication to the degree appropriate to the position within the group by taking initiative.*	20
Cooperation-*Willingness to work together to accomplish the job of the group.*	20
Communication-*Shared information with the group, particularly in written form.*	20
Participation-*Did the appropriate share of work.*	20
Attendance-*Present and on time for work.*	20
TOTAL	100

Figure 3 shows the mathematical algorithm for distributing the group grades (Berryman, 1999). The Individual Evaluation Ratio (IER), a weighting factor, is calculated from the points assigned to individuals and the total number of points assigned. Figure 3 shows the calculation of the individual score using the IER. In this equation, the weight given to the peer evaluation versus the instructor can be controlled by varying the percent of grade controlled by the student as shown in Figure 3. The results of the peer evaluation calculations are summarized in Appendix B.

$$\text{IER} = \frac{\sum \text{Points Assigned to An Individual in the Group}}{\sum \text{Points Assigned}}$$

$$\begin{aligned}\text{Individual Score, \%} = &\left[\ \%\ \text{of Grade Controlled by Students} \times \text{Group Grade, \%} \times \text{IER}\ \right] \\ &+ \left[\text{Group Grade, \%} \times \left(1 - \%\ \text{of Grade Controlled by Students}\right)\right]\end{aligned}$$

Figure 3: Individual score calculations

Data Collection Method

In the fall 2007 cycle, an innovative method was used to assist in the collection of and calculations for the peer evaluation data. A spreadsheet was developed to collect the group evaluations. Figure 4 shows the user interface of the spreadsheet. By using Visual Basic for Applications (VBA) in Microsoft Excel, the student performing a peer evaluation first selects their name from a pull-down menu. The data input screen shown in Figure 4 is generated. The VBA code causes the form to be populated with the names of the group members. The student is prompted to evaluate each member according to the rubric. In Figure 4, each tab corresponds to an item in the rubric. The value of the slider bar is relative to the value of the rubric item. For example, in Figure 4, each rubric item is actually worth 20 points. However, the slider bar works on a percentage scale, so selecting a value of 75 on the slider bar will assign 15 points for this rubric item. The student uses the slider bar controls or the text box to rank each student. The student returns the saved spreadsheet to the instructor. VBA code facilitates completing the calculations as described above. The generated file cannot be opened without a password. This keeps data confidential even if the file is left on lab computers.

Results

The method used to collect the student evaluations was easy for the instructor, considering the amount of time needed to perform calculations for 53 students. In this class the process required 786 separate peer evaluations. This is a fairly large burden on the instructor.

Students tended to hurry through the evaluations unless the instructor-assigned group grade was low. This was due in large part to having rather large groups. This was another lesson learned about group projects. The next cycle will use more but smaller groups with only four to six members.

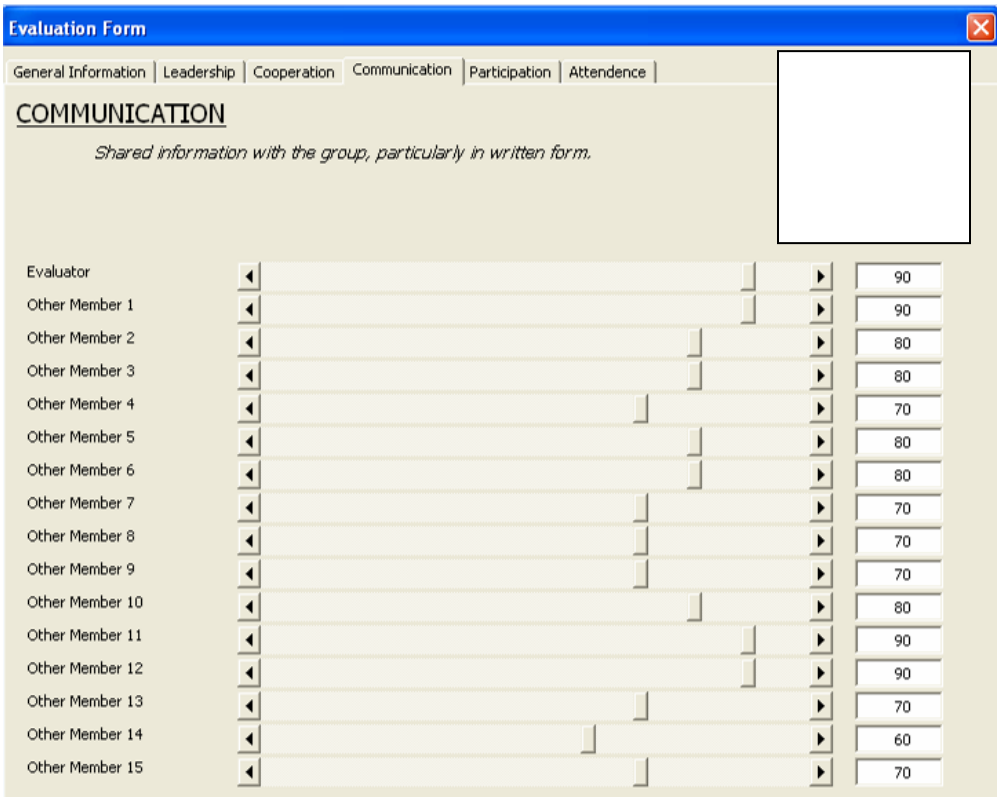

Figure 4: Screen shot of input form for peer evaluations

The peer evaluations were performed on three separate occasions and accounted for nearly 50% of the course grade. No statistical analysis was performed on the data in Appendix B. However, anecdotal examination of the data shows

that in general, the lower the assigned group grade the greater the range of the peer assigned grades. The notable exception in the concrete crew was for a student that dropped the class but was included in the peer grading.

In summary, the lessons learned were:

- Determine the weight desired for the peer grading. It is the authors' opinion that 10% or less of the course grade is probably reasonable.
- Develop a good rubric for assigning group grades. It is desirable to have a rubric that will distinguish between various levels of quality in the work. Amid all the enthusiasm to improve the efficiency of collecting data for peer evaluation, it is important not to neglect the rubric for distribution of the group grades. It was found that the rubric for the ironworkers was not adequate to appraise the efforts of the ironworker crew on phase one.
- Take care in developing the rubric group members will use for peer evaluations. If it is too lengthy students will grow weary in assigning group grades.
- Use more and smaller groups. Limit group size to six students. Appendix C shows the revised organization chart planned for the fall 2008 project. The expanded organization will include a survey crew for layout, a research and development team (R & D), a batch plant crew, an information and technology group (IT), a testing lab, a tool crib crew and a crew to set pans for a pan and joist floor system as shown. The ironwork crew will be split into a fabrication crew and a placement crew.
- Evaluate algorithms for distributing the group grade. Other methods such as forced ranking or setting a minimum grade distribution for the evaluators may work.
- Develop an efficient method for collecting the data and automating the calculations.

References

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Appendix A

Engineer's Evaluation

Engineer's Evaluation of Project Management Team	
Criteria	**Points**
The project is on or ahead of the scheduled progress.	10
Project clean up was performed according to the Engineer's instructions.	10
The project webcam collected project photos according the Engineer's instructions.	10
The project site plan for tools and storage was followed.	5
The Owner's Representative kept a daily log of the Contractor's activities.	5
A concrete yield test was performed and initial test cylinders were made according to the Engineer's instructions.	5
Test cylinders were made for each concrete pour. The cylinders were made and stored according to the Engineer's instructions.	5
The progress was indicated on the project schedule.	5
The Owner's Rep was given 24 hours notice to check alignment before concrete pours.	5
Concrete cylinders were tested and a control chart of breaking strength was maintained according to the Engineer's instructions.	5
Owner's Rep had supervision on site when work took place on site.	3

Appendix B

Statistical Abstract-Peer Evaluations

PHASE	1	2	3		1	2	3
CONCRETE CREW	88.29	95.29	86.55	FORMWORK CREW	85.00	91.09	89.25
	88.32	95.29	86.50		84.25	92.06	91.02
	88.28	95.26	86.52		83.38	91.54	91.78
	88.32	95.30	86.38		87.11	94.04	95.09
	88.32	94.95	86.69		71.59	75.79	76.80
	88.32	94.91	86.15		80.92	87.38	86.26
	88.32	95.26	86.34		83.03	90.38	90.92
	88.32	94.93	86.42		72.18	76.24	76.16
	88.19	95.30	86.28		81.84	90.45	88.57
	88.32	95.25	86.55		86.74	94.51	95.00
	88.32	94.83	86.47		86.79	94.49	95.06
	88.32	94.95	86.58		86.81	94.56	94.85
	88.29	94.59	86.34		76.82	84.26	84.32
	85.27	92.81	83.23		87.24	94.15	94.96
	86.54	64.13	66.31		86.82	94.50	94.91
	88.30	94.95	86.69		87.47	94.56	95.04
RANGE	3.05	31.17	20.38		15.89	18.77	18.94
AVERAGE	88.00	93.00	85.00		83.00	90.00	90.00

PHASE	1	2	3		1	2	3
IRON WORKERS	103.06	79.98	100.37	PROJECT MANAGEMENT	86.34	87.27	78.08
	102.32	78.71	100.03		90.57	90.34	89.78
	102.77	79.92	100.40		83.45	85.54	83.23
	103.15	80.07	98.66		83.43	85.97	83.37
	102.80	79.73	100.76		90.31	90.26	87.97
	97.22	73.11	92.19		86.34	87.19	84.81
	91.56	64.66	88.83		88.55	89.44	87.76
	103.38	80.10	98.39	RANGE	7.14	4.80	11.70
	102.03	78.55	97.72	AVERAGE	87.00	88.00	85.00
	94.00	58.06	81.09				
	102.23	79.92	99.69				
	103.20	79.81	98.61				
	93.49	66.34	81.22				
	103.13	80.10	100.86				
	95.66	65.93	86.16				
RANGE	11.82	22.04	19.77				
AVERAGE	100.00	75.00	95.00				

Appendix C
Organization Chart