2006-1856: ATTITUDES TO GROUP WORK: GENDERED DIFFERENCES?

Harriet Hartman, Rowan University

Harriet Hartman is Professor of Sociology at Rowan University, and was p.i. on an NSF grant to study gender and engineering at Rowan University. She is lead author on articles in the Journal of Engineering Education and the Journal of Women and Minorities in Science and Engineering on this research. She and Moshe Hartman were awarded WIED and PIC IV Best Paper awards for their joint paper at ASEE in 2005.

Moshe Hartman, Retired

Moshe Hartman is retired Professor of Sociology from Ben-Gurion University of the Negev, and was co-p.i. on an NSF grant to study gender and engineering at Rowan University. His research centers on demography, stratification, and Jewish studies. He is coauthor of articles in the Journal of Engineering Education and the Journal of Women and Minorities in Science and Engineering on this research.

Attitudes toward Group Work: Gendered Differences?

Abstract

Teamwork has been proposed as a "female-friendly" pedagogy because it emphasizes cooperation and equality over competition and hierarchy. However, sometimes teamwork serves to reinforce a gendered hierarchy, depending on the actual experience of the teamwork for each gender. Since the new guidelines for engineering curricula emphasize teambuilding skills, the effects of this emphasis on the experiences of male and female engineering students is important to assess. Much of the expectation about teamwork pedagogy and gender is theoretical rather than empirical. This paper contributes to a more empirical assessment of the relationship. It analyzes the predispositions to group work with which male and female engineering students enter Rowan University and how these attitudes to group work change after their first year in the program. During that year they have all been required to take a core curriculum course, Engineering Clinic. Clinic is required each semester for all engineering students and involves interdisciplinary cooperation around a series of projects often with real-world outcomes. Teambuilding skills are taught and evaluated as part of the curriculum. The research reported in this paper studied the students' affective responses to the teamwork, their preference for group over individual learning, the effect of gender composition of their clinic teams on women's attitudes to group work, and the relationship between their attitudes toward group work and their evaluation of other aspects of the engineering program and their intentions to persist in engineering in the future. Data were collected as part of an ongoing survey initiated as a National Science Foundation funded project and continued under the sponsorship of the College of Engineering and the Department of Sociology.

Introduction

Since 2000, the Accrediting Board of Engineering and Technology has emphasized as one of its 11 program outcomes in Criteria 3 the importance for engineering students to master "an ability to function on multi-disciplinary teams"[1] and hence the need to integrate teambuilding skills into the undergraduate engineering curriculum. This need has arisen because of changes in the workplace, which now develops engineers into specializations, and requires collaboration between specialists and with non-engineers for product planning, design, and completion. Cutting edge engineering programs integrate teambuilding skills and experience into their curriculum (see, for example, www.foundationcoalition.org).

As Rosser[2] notes, there seems to be a match between the needs of engineering education for the 21st century and female preferences for learning when it comes to the importance of teamwork. Team or group work (the two are used interchangeably in this paper) is supposed to be a pedagogy that women prefer, since it involves collaborative rather than competitive learning, interactional negotiations, a peer setting for confidence building and a safer environment for error correction for those unsure of their skills. It also provides the opportunity to learn from each other's strengths. Presumably, the emphasis on teamwork will thus make engineering education more palatable for female students, and has been recommended as a strategy to make engineering (and other math and science) education more "female-friendly".[3-7]

This expectation, however, is based on little empirical evidence about women's preference for teamwork over individual work, or their difference from men in this respect. Further, there is evidence that teamwork in engineering, because males heavily dominate it, may actually work to the disadvantage of females in engineering because they are taken advantage of or isolated. In mixed-sex groups, males may take on dominant roles, while females assume more passive and supportive roles.[8] Female students at Radcliffe College reported that they preferred to study by themselves because their contributions in small mixed-sex groups were not valued.[9] Feldman et. al.[10] found that the women who liked group work tended to do so from points of weakness, i.e., because they believe they are receiving from group work external help and support, which they think they need to succeed. Males, on the other hand, were more likely to think they did more than their fair share of the group work, and seemed to realize an advantage because they learned the material better when they explained it to someone else. Thus, while women may prefer cooperative learning and group work which involves relationship-oriented interaction, their actual experiences in groups may not be as positive as men's.

This paper seeks to provide some evidence about gender differences in engineering students' predispositions toward teamwork and the effect of intensive teamwork experiences in engineering on their attitudes toward teamwork.

The setting for gathering the data is Rowan University, a public state university with an enrollment of about 10,000; the engineering program has grown to about 500 students, including some graduate students. The program was established in 1996, with four main disciplines: civil engineering (since broadened to include environmental engineering), electrical and computing engineering, chemical engineering, and mechanical engineering. Rowan has institutionalized teamwork into its program in an interdisciplinary core course, Engineering Clinic, which is required of all engineering majors every semester (from first-year entry through final semester before graduation).[11-12] In the first year clinic, students are introduced to the various engineering disciplines and to team-building skills. Sophomore clinic incorporates a writing intensive experience focused on developing communication skills and the ability to make effective presentations, presumably to narrow the differences between students in this respect and to foster self-confidence. Junior and senior clinic teams often work on corporate-sponsored projects, which are presented at the end of the year to professionals and faculty.

The clinic itself is team taught with faculty from multiple engineering majors. While the actual running of the classes varies from team to team, each faculty team has the responsibility to decide collectively on the material to be covered, the projects to include, and the procedures to follow, including how groups will be formed. Faculty may segment the course, each taking responsibility for part, or share the responsibility for each section. The faculty have experimented with different methods of placing the students into teams in the first and second years. (In the junior and senior years, students generally self-select their teams.) Some faculty are very committed to ensuring that a female not be placed in an all-male group, especially not in the first-year experience. Other faculty do not think gender should be a factor.

The purpose of this paper is not to provide an extensive evaluation of this Clinic, nor to explore its effectiveness in developing teambuilding skills or in achieving engineering curricular outcomes. Rather, we aim to assess students' perspectives on teamwork in a program that ensures continuous interdisciplinary teamwork experiences for all of its students. We will be focusing on gender differences in attitudes to teamwork, and how these change as the students are initiated into the program.

In particular, we address these questions: (1) Is it valid to assume that women really prefer to work in groups rather than to work individually? (2) Are women as or more satisfied or at least as satisfied with group work than are men? (3) Does the experience of group work change students' orientations to it? Are women's orientations affected in the same way as men's? (4) Does team composition (in terms of gender) affect attitudes to teamwork? (5) How are attitudes to group work related to other aspects of the first-year experience and the probability of persisting in the engineering major?

Data

The data were gathered over a 4-year period at Rowan University, as part of a larger study of engineering students' reactions to the program and orientations toward engineering, initially sponsored by an NSF grant[i] and continued through the auspices of the University.[13] The data come from surveys administered to first-year Rowan engineering students in the years 2002-2004, one survey at the beginning of their first fall semester and one at the end of the following spring semester, followed by a fall survey at the beginning of the sophomore year. Fall surveys for first-year students queried the students' academic and family backgrounds, attitudes toward group learning, attitudes toward engineering, self-confidence in engineering, and commitment to a future in engineering, among other topics. Spring surveys queried students' experience over the year and their evaluation of various aspects of the program as well as repeating many of the attitudinal questions asked in the fall. The subsequent fall survey asked about summer experiences, their current attitudes about engineering and their future in it. This research design enables us to follow changes in the students' reactions as they progress through the program.

For the purposes of this analysis, all first-year students from 2002-2004 were combined (after verifying that there were no major differences between the respective cohorts). Aggregating the data is functional because of the larger sample for analysis, especially when focusing on groups of students who are a minority of the students (such as women).

We look at students' attitudes toward teamwork at the beginning of the first-year, before they have had intensive exposure to the team-building focus in Engineering Clinic. We then look at students' attitudes toward teamwork toward the end of the first-year, after they have had at least a semester and a half of interdisciplinary teamwork. And we follow this up with their attitudes toward teamwork at the beginning of their second year in the program. As more than 93% of the second-year students began the program in the first-year, comparing their attitudes toward teamwork over the three semesters also indicates how these attitudes change as students go through the program.

The following indicators were used as dependent and independent variables:

Predisposition toward group work at beginning of first semester was measured by the extent to which a student agreed to each of four statements on the survey given at the beginning of the first semester: "Studying in a group is better than studying by myself," "I prefer studying alone," "I do not enjoy working in assigned groups in class," and "Working in assigned teams with classmates helps me understand material presented in class." Factor analysis of the responses to these four questions resulted in scores on a single "Group work" factor, which are also used (based on principle components varimax rotation). The mean score on the factor for the total sample of students is .000. Higher scores on this factor indicate more favorable attitudes toward group work. *Attitudes toward group work at the end of the second semester* were measured by

the extent to which a student agreed to the same four statements as above, repeated in the survey given in the last 2-3 weeks of the second (spring) semester. A factor analysis of these responses resulted in a second "group work" factor, with higher scores again indicating more positive attitudes toward group work. *Attitudes toward group work at beginning of third semester* were measured by the extent to which a student agreed to the same four statements as above, repeated in the survey given at the beginning of the third (sophomore fall) semester. A factor analysis of these responses resulted in a third "group work" factor. *Change in attitudes toward group work* of individual students was calculated by comparing the student's responses in the first-year fall semester to their responses on the same questions at the end of the first-year spring semester. Students whose attitudes toward group work became more negative were coded 1, students whose attitudes stayed the same were coded 2, and students whose attitudes became more positive were coded 3.

Evaluation of Engineering Clinic was based on the extent to which a student agreed with a series of 7 statements about the clinic program (whether clinic system provides realistic experiences like in the real world, the clinic projects provide useful hands-on experience in engineering, the interdisciplinary nature of the clinic system enables connection between different disciplines, clinic unifies students from different majors, overall clinic is a beneficial experience, too much work is expected in clinic for credit given, and too much time is spent learning irrelevant material to my major). Students were also asked whether the clinic experience made their views about group work more positive or more negative.

Evaluation of peer relations was indicated by a series of statements about students in the engineering program to which students could agree or disagree (e.g., engineering students are approachable; are friendly; support and encourage each other; help each other out on coursework, projects and ideas; are very competitive; show that they respect me).

Gender composition of Clinic teams was indicated by the student's report of how many males and females were in their fall engineering clinic team and in their spring engineering clinic team (asked in the second semester survey). Where possible, adjustments were made for students who did not include themselves (e.g., reported 0 females, when they were a female themselves; unfortunately, if they reported at least 1 female and were female themselves, there was no way to know if they had excluded themselves or not).

Grades were indicated by a self-reported response about engineering grade on the second semester survey, reflecting grades in the first semester's engineering clinic, as the second semester had not yet ended. In the first year engineering grades are almost always exclusively in engineering clinic, as the students are otherwise scheduled for general education, computer science and math classes but no other engineering classes. Sample programs of study can be found on the College of Engineering's website, www.rowan.edu/engineering.

Persistence in engineering was indicated by whether a student remained a registered engineering student in the fall semester of sophomore year. If a student who took our survey in his/her first year but did not appear on the official list of engineering students (prepared by the College of Engineering, in conjunction with the University's Institutional Research office) were coded as having dropped engineering. This included students who had changed majors but stayed at Rowan, had stayed in engineering but left Rowan, or who had left the university all together. It might also include "stop-outs" who would return at a later date, but at this point there was no

official indication of this. A student who stayed in the Engineering College but changed majors was not coded as dropping engineering.

Students who were more committed to persistence in engineering at Rowan were indicated by students who answered that they were "unlikely" or "very unlikely" to consider changing majors out of engineering, transferring to another college's engineering program, or dropping out of college altogether. Students who answered that they were "unsure", "likely" or "very likely" to do any of these were grouped together for each indicator. It should be noted that in any given semester it is a small minority of students who even consider these actions (averaging 16-20% for each of the indicators). Because of this small number, we are unable to analyze the relationships between group work and indicators of persistence by gender.

Attitudes toward Group Work

As they enter the engineering program, about half of the students are favorably predisposed to studying in groups, but the other half are unsure or prefer studying alone. This is apparent in their answers to the first two indicators in Table 1: almost half agree that, "Studying in a group is better than studying alone." When asked whether they prefer to study alone, 27% disagree, and nearly half agree or strongly agree. They are somewhat more positive toward having assigned groups in class, as evidenced by their answers to the third and fourth indicators in the same table. Only 17% don't like working in assigned groups in class, and over 60% disagree with that statement; about 60% agree that working in groups helps them understand class material.

After experiencing intensive teamwork in at least one class for almost two semesters (the spring survey is given in the last 2-3 weeks of the semester), students are somewhat less positive about the benefits of group work. While about half still agree that group study is better than studying alone, fewer reject a preference for studying alone, fewer reject the statement that they don't enjoy working in groups in class, and a slightly lower percentage agree that working in assigned teams in class helps them to understand the class material. Comparing individual students' responses to the fall and the spring questions, we find that between 25-34% of the responses indicate more positive attitudes to group work in the spring, 42-43% of the responses remain the same, and 25-31% of the responses are more negative in the spring.

Table 1
Percent favorable to group work by semester in the program

	Freshman Fall	Freshman Spring	Sophomore Fall
Group study better than studying alone (% agree)	49.0	52.2	57.7
I prefer to study alone (% disagree)	26.9	20.1	29.4
I don't enjoy assigned groups in class (% disagree)	62.1	54.3	61.5
Working in assigned teams helps me understand class material (% agree)	59.9	55.7	55.8
(n)	(339)	(318)	(285)

Perhaps part of the change is a reaction to the intensive teamwork taking place at the end of the spring semester, as each team scrambles to prepare a professional-level presentation about which they are apprehensive. Asked somewhat more extensively about their experience in teamwork over the academic year than they were in the fall, 42% agree that not everyone does their fair share in groups. But only 10% agree or strongly agree that teamwork slows down the learning process in the Clinic setting, less than 20% agree or strongly agree that too much group work is required in the engineering classes, and nearly 70% agree or strongly agree that they get good teamwork experience working with students of other majors in Clinic. After nearly a year in Clinic, over half of the students believe that their experience in the engineering clinics made them more positive about working in groups or teams, while only 6% think their experience in clinic made them more negative about group work.

After the summer rest from classmates, students' attitudes toward teamwork are as or more positive about teamwork than they were as they entered the program, although fewer are sure that the teams will help them understand class material than they were at the beginning of the previous fall.

Gender Differences in Attitudes to Group Work

As they enter the program, females are more positively predisposed to group work than are males, and the gender differences are statistically significant for three of the indicators (Table 2). Differences are especially notable with regard to recognizing the benefits of studying in groups and groups' contributions to understanding class material. Such findings reinforce the expectations that group work is a pedagogy with which females are particularly comfortable.

In trying to identify reasons for the initial gender differences in attitudes toward group work from the indicators in our survey, we were not very successful. In a multiple regression in which the group work factor for the first semester was the dependent variables (data not shown), we included as independent variables gender, verbal and math SAT scores (as indicators of academic achievement in high school) and participation in high school after-school clubs as an indication of earlier predispositions to working in groups. Together they explained only 6% of the variance in the group work factor scores, and only the SAT scores had statistically significant relationships with the factor scores.

After working in teams over the course of the academic year, gender differences are smaller. In only one of the indicators (enjoying assigned groups in class) are females significantly more positively oriented toward group work than males. In two of the indicators (working in assigned teams helps me understand class material, and group study is better than studying alone), the smaller gender differences result from the women becoming somewhat less enthusiastic about group work than they were before the year began, while males' attitudes changed little. In the one case where gender differences are significant, it is a result of both males and females becoming less enthusiastic about assigned groups in class, maintaining the original gender difference. Both males and females are less likely to prefer studying alone after their year in the engineering program.

Table 2
Percent favorable to group work by gender and semester in program

Semester in Program	Freshman Fall		Freshman Spring		Sophomore Fall	
Gender	Males	Females	Males	Females	Males	Females
Group study is better than studying alone (% agree)	47.8*	57.9	52.3	51.4	55.8*	71.4
I prefer to study alone (% disagree)	26.7	29.0	20.6	16.2	29.5	28.6
I don't enjoy assigned groups in class (% disagree)	61.0*	71.0	53.2*	62.2	61.4	62.8
Working in assigned teams helps me understand class material (% agree)	57.8*	76.3	55.5	56.7	52.8*	77.1
Group work Factor (mean score)	-.017	.132	.010	-.072	-.022	.159
(n)	(301)	(38)	(281)	(37)	(250)	(35)

*T-test between genders significant at $p<.05$.

The overall scores camouflage quite a bit of fluctuation in the attitudes of individual students, as mentioned above. What is clear is that on every indicator a higher proportion of female than male students becomes more negative in the spring than they were in the fall, and a higher proportion of males than females become more positive in the spring or stay the same as they were in the fall.

The gender differences on the factor score sum up the patterns. While the differences are not statistically significant, they show that in the beginning of their first semester, females are more positive toward group work than are males; toward the end of the second semester females are slightly less positive about group work than are males; but as they start their third semester, the differences are again like they were in the first-year fall.

With regard to group work in the clinic setting in particular (asked about in the second semester), both males and females are very positive about the teamwork experience, and females are significantly more positive than males: 68% of the males and 78% of the females agree or strongly agree that the interdisciplinary nature of clinic gives good teamwork experience, only 24% of the men and 16% of the women think teamwork slows down the learning process in clinic, and about half of both males and females felt that the clinic experience made them more favorable to teamwork (less than 10% of either gender felt it made them more negative about teamwork).

By the time they have completed their second semester, however, and even had the summer to mull it over, the students (both male and female) are more positive than ever about group work, with the women being somewhat more positive about group work than males, and being more positive than they were when they started the engineering program. On two of the indicators (studying in groups is better than studying alone, and teamwork helps understand the assigned material), the gender differences are again statistically significant. (It is possible that female expectations of sophomore clinic are more positive than males' are, because they know there will

be more emphasis on communication skills, which the women may enjoy more; however, our data did not speak to this issue.)

Relationship between Attitudes toward Group Work and Evaluation of Engineering Clinic

In this section we consider the extent to which the reaction to group work is intertwined with the reaction to engineering clinic more generally. First we consider the relationship between scores on the factor of attitudes toward group work, and responses to a question asked in the second semester survey, ”Has your experience in the engineering clinics made you more or less positive about working in groups/teams”? Students could answer “More positive,” “Hasn’t changed my opinion about groups/teams,” or “More negative.” Since most of the students are males, the pattern seen for the total usually reflects the pattern for males, but not necessarily for females. A positive predisposition to group work is related to a positive experience with teams in clinic for males but not for females (Table 3). For males, the predisposition is clearly related to a more positive or negative experience with teamwork in clinic. For females, there does not seem to be as clear a relationship, although the small number of women whose experience with teamwork in clinic was negative is too small to make valid conclusions.

Even more striking is the relationship between the perceived effect of clinic on attitudes toward group work, and the scores on the group work factor in the second semester. A positive experience with teamwork in clinics is even more strongly related to a more positive attitude toward group work in the second semester for males, and a negative experience with more negative attitudes. The effect of a negative experience for females is also apparent, although, again, caution because of the small numbers is important to note.

Table 3
Mean scores on group work \factor for first and second semesters by effect of clinic experience on group work attitudes for total, males and females (n in parentheses)

	Effect of Clinic Experience on Attitudes toward Group work		
Scores on Group Work Factor	More positive	Same	More Negative
First semester			
Total	.214 (124)	-.264 (106)	-.477 (19)
Males	.234 (110)	-.293 (93)	-.703 (15)
Females	.047(14)	-.056(13)	.368 (4)
Second semester			
Total	.372 (161)	-.272(130)	-1.028 (24)
Males	.418 (143)	-.324 (115)	-1.008 (20)
Females	-.001 (18)	.123 (15)	-1.127 (4)

Students who expressed positive predispositions toward group work in the fall are more likely to evaluate highly the useful hands-on experience in Engineering Clinic and the connection between different disciplines (Table 4). Much more impressive are the associations between favorable evaluations of the clinic experience and attitudes toward group work after the students have experienced nearly two semesters in clinic. Attitudes toward group work in the spring are

positively correlated with almost all of the evaluations of clinic: that it provides realistic real-world like experience, useful hands-on experience, helps to connect between different disciplines, unifies students from different majors, is an overall beneficial experience. We should note that the pattern of relationships between attitudes toward group work and evaluations of clinic are similar for males and females, although there are fewer relationships that are statistically significant among the females (data not shown).

Table 4
Pearson correlation coefficients between scores on group work factor for first, second and third semesters, and evaluation of experiences in clinic

Pearson Correlation Coefficients	Scores on Group Work Factor		
Clinic experience:	First Semester	Second Semester	Third Semester
Overall beneficial	.168*	.301*	.306*
Realistic, like in work world	.090	.195*	.213*
Useful hands-on projects	.174*	.297*	.189*
Enables connections between disciplines	.171*	.275*	.248*
Unifies students in different majors	.111	.216*	.147*
Too much work for credit given	-.097	-.099	-.073
Spends time on irrelevant material for my major	-.013	-.054	-.118
(n)	(248)	(313)	(229)

*Statistically significant at $p<.05$.

Positive evaluations of clinic also seem to be related to more positive attitudes toward group work in the beginning of the sophomore fall.

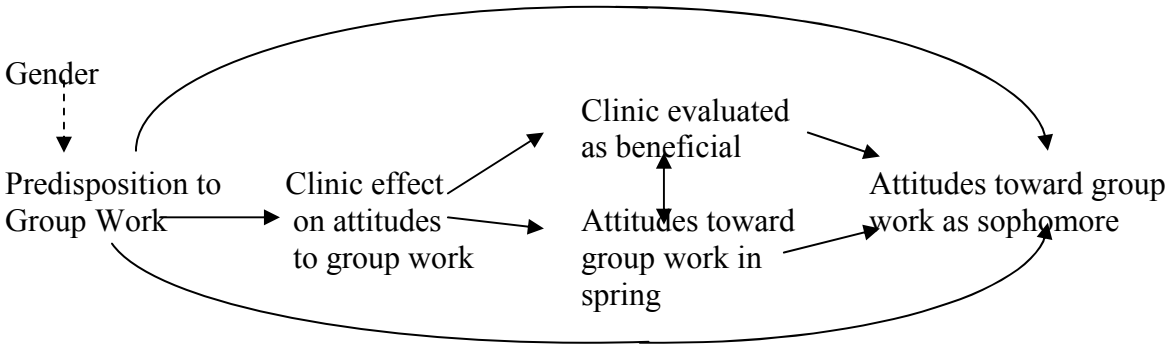
To explore these interrelationships between attitudes toward group work and reactions to clinic in more depth, we performed a series of regression analyses that clarify some of this progression. Using attitudes toward group work when the student enters Rowan as an independent variable, and controlling for gender by using it as a second independent variable, we predicted whether the effect of clinic was more positive or negative on attitudes toward group work (Table 5). In model 1 we see that positive attitudes toward group work are significantly related to clinic having a positive effect on attitudes toward group work, as we saw above. Gender is not related and does not change this relationship. In model 2 we see that students who think that their attitudes toward group work improved as a result of clinic are more likely to evaluate clinic as a beneficial experience, and this more directly affects the overall evaluation of clinic than the student's predisposition toward group work. Women are more likely to evaluate clinic as beneficial than are men, independent of attitudes toward group work or the effect clinic had on these attitudes.

Table 5
Multiple regression analysis of attitudes toward group work and evaluations of clinic at various stages (Standardized regression coefficients, unstandardized regression coefficients in parentheses)

	Model 1	Model 2	Model 3	Model 4
Dependent Variable Independent Variable	Perceived Effect of Clinic on Attitudes toward Group work	Evaluation of Clinic as Beneficial	Attitudes toward Group Work in Spring	Attitudes toward Group Work in Sophomore Fall
Sex	.039 (-.165)	.094 (.224)	-.039 (-.126)	.007 (.020)
Predisposition toward Group Work, First-year Fall	-.254 (-.164)*	.168 (.125)*	.450 (.450)*	.262 (.264)*
Perceived Effect of Clinic on Group work		-.330 (-.380)*	-.314 (-.487)*	-.020 (-.031)
Evaluation of clinic as beneficial				.182 (.258)*
Attitudes toward Group Work in Spring				.405 (.430)*
R (R^2)	.257 (.066)	.372 (.139)	.611(.374)	.649 (.421)

*Regression coefficient significant at $p<.05$.

In model 4 we see that attitudes toward group work in the spring are closely related to the predisposition to group work that the student brought to Rowan, but they are almost as strongly related to whether the experience of clinic affected the student's opinion of group work positively or negatively. There are no significant gender differences in this respect. In the final model, we see that attitudes toward group work at the beginning of the sophomore year are most closely related to the students' earlier predispositions to group work (in the spring, and as they entered Rowan), but they are also significantly related to their evaluation of clinic as a beneficial experience, with realistic and useful hands-on experience. We sum up these relationships in the following diagram:



Attitudes toward Group Work and Grades in Engineering Clinic

In this section we consider the extent to which attitudes toward group work are related to grades in engineering clinic, which are closely related to the teamwork in the course. To study this we analyzed the relationship between attitudes toward group work and self-reported engineering grades. These grades were reported on the second semester survey, and thus reflected grades in the first semester's engineering clinic (the second semester had not yet ended). We considered whether attitudes toward group work were related to higher grades in the first semester of engineering clinic, and whether higher grades in the first semester of engineering clinic were related to attitudes toward group work in the spring.

In neither semester were the correlations between grades and attitudes toward group work statistically significant (Table 6). Predisposition to group work does not seem to facilitate a better grade in first-year Clinic, nor is a good grade in first-semester Clinic related to subsequent attitudes toward group work.

We also considered whether the grades might be related to attitudes toward group work in each gender separately. While again in neither case were the correlations statistically significant, it is noteworthy that women whose attitudes were less favorable toward group work when they entered Rowan got better grades in the first semester of engineering clinic (even though the correlations are not statistically significant, several are substantial and support this interpretation). This relationship between grades and attitudes, however, disappears in the spring semester, with one exception (for both males and females): students who got higher grades in their first semester of engineering clinic were more likely to think that working in teams helps them to understand the class material.

Table 6
Pearson correlations between attitudes toward group work and grades in first semester engineering clinic

	Total	Males	Females
Attitudes in Fall Group study is better than studying alone	.002	.028	-.235
I prefer to study alone	.052	.018	.350
I don't enjoy assigned groups in class	-.038	-.067	.369
Working in assigned teams helps me understand class material	.022	.007	-.171
Group work factor score	.001	.023	-.415
Attitudes in Spring Group study is better than studying alone	.040	.038	.026
I prefer to study alone	.085	.079	.067
I don't enjoy assigned groups in class	-.008	-.007	.031
Working in assigned teams helps me understand class material	-.090	.143*	.289
Group work factor score	-.042	-.054	.101

*Pearson correlation significant at $p<.05$.

Adding grades to the regression equation predicting attitudes toward group work in the spring or fall does not alter the regressions presented in the previous section, and grades do not have a significant effect on either of the dependent variables.

The Effect of Gender Composition of Teams on Women's Attitudes to Team Work

The importance of composition of teams in terms of minority/majority members is an issue that faculty using teamwork often take into consideration. The "rule of thumb" has been not to isolate minority students[14] so they will not feel alienated or overshadowed. Anecdotal evidence suggests that this indeed does happen.[15] Having someone else like them in their teams is expected to be empowering, though there is some evidence to the contrary.[16]

In this section we analyze whether the gender composition of teams has an effect on women's attitudes to team work. In the spring, we asked the students how many males and how many females were in their clinic teams in the fall and in the spring. Looking only at the women in the study, about 40% of the women had no other woman in their Clinic teams in both fall and spring, 11% had another woman in their teams both fall and spring, and the rest of the women had one semester with another woman on their team and one semester without. We combined the women who had experienced teamwork with at least one other woman on their team either semester, and compared their attitudes toward group work with the attitudes of women who were the single female in their team in both fall and spring.

First it should be noted that none of the differences in attitude between the groups were statistically significant (using a t-test for the variables dichotomized into favorable toward group work or negative/unsure about group work) (Table 7). This suggests that any effect of gender composition on attitudes toward teamwork is not very large.

The pattern that can be discerned is also not in the expected direction. In three of the four indicators, the women who were the only woman in their team were more favorable toward group work than were the women who shared teamwork with at least one other woman. Only for the indicator of whether "group work helps me to understand the material", were women sharing teamwork with another woman more favorable than women who were the only woman in their group.

Table 7
Attitudes toward group work by gender composition of clinic teams (Women only)

	Only woman in Clinic team	Had another woman in Clinic team	T-test Significance
Group study is better than studying alone (% agree)	58.3	51.5	.572
I prefer to study alone (% disagree)	16.7	16.0	.961
I don't enjoy assigned groups in class (% disagree)	75.0	56.0	.262
Working in assigned teams helps me understand class material (% agree)	41.7	64.0	.224
(n)	(12)	(25)	

However, when we look at the change from fall to spring, we see another pattern. Remember that we calculated the change in attitude toward group work by comparing the student's answers in the fall to the same student's answers to the same questions in the spring. Below we show the percentage of women who became more favorable to group work over the course of the academic year (Table 8). For three of the four indicators, women who shared teamwork with at least one other woman were more likely to have become more favorable toward group work over the course of the academic year than were women who were the only woman on their teams. This indicates that having another woman on the team does improve the experience of group work for female engineering students.

Table 8
Percent becoming more favorable toward group work from fall to spring by gender composition of clinic team
(Women only)

	Only woman in Clinic team	Had another woman in Clinic team
Group study is better than studying alone	25%	35%
I prefer to study alone	25%	35%
I don't enjoy assigned groups in class	25%	25%
Working in assigned teams helps me understand class material	0%	20%
(n)	(8)	(20)

Relationships between Attitudes toward Group Work and Other Aspects of the Engineering Culture

In addition to teaching students teambuilding skills they will need professionally, one of the pedagogical assumptions about group work is that its cooperative nature will foster a sense of community and integration, rather than competitiveness, isolation and alienation.

In this section we consider the relationship between attitudes toward group work and perceptions of peer culture, an important facet of the informal student climate. The perception of peer culture are asked in the spring semester, toward the end of the student's first year. The measures of attitudes toward group work are from each of the first three semesters.

The correlations between the first-year fall score on the group work factor and evaluations of students in the spring suggest that predispositions to group work help students get along better with their peers. Indeed, several correlations suggest this link (Table 9). Students who entered Rowan with a more favorable predisposition to group work were more likely to find students supportive, listening when the student was in trouble, respecting them, and caring about them as an individual. They also were more likely to perceive a sense of community among students in the Engineering College, that students were proud to be engineering students, and were highly regarded by non-engineers at Rowan.

They were also more likely to find Rowan students competitive, which brings up an interesting twist in this teamwork tale. Rowan teams compete against each other in many ways, they have an incentive to excel as a team. The individual competitiveness characteristic of traditional engineering programs apparently has been transferred to a team level rather than eliminated.

The correlations between the spring attitudes toward group work and evaluations of students in the spring can be seen more as mutually reinforcing. That is, students who favor group work are more likely to evaluate their peers highly, as well as students who evaluate their peer relations highly being more likely to enjoy group work. Nearly every evaluation of students is significantly related to being favorable to group work in the spring, with especially high correlations between attitudes toward group work and students having a sense of community in the Engineering College.

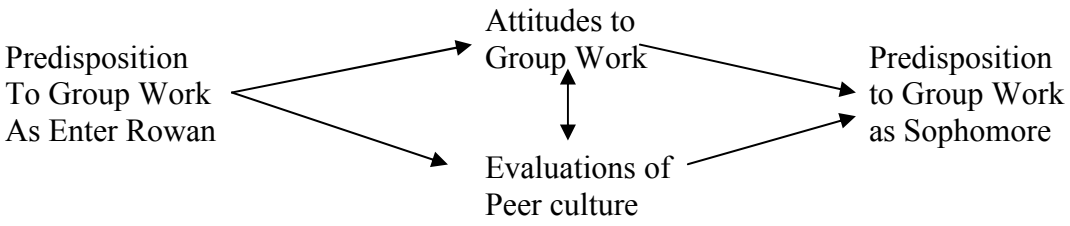
Table 9
Pearson correlations between group work factor in three semesters and evaluation of students

Students are:	First-year Fall	First-year Spring	Sophomore Fall
Approachable	.110	.072	.129*
Competitive	.158*	.124*	.065
Supportive	.225*	.154*	.234*
Friendly	.100	.124*	.126
Helpful	.117	.188*	.179*
(work harder)	.017	.150*	.020
Proud	.136*	.199*	.171*
Sense of community	.214*	.252*	.253*
(highly regarded)	.216*	.215*	.225*
(mix well)	.149*	.143*	.032
Listen	.200*	.127*	.072
Respectful	.153*	.122*	.095
Caring	.180*	.134*	.039
I have a lot in common with other students in my dept	.023	.147*	.048
(n)	(251)	(317)	(231)

*Pearson correlation significant at $p<.05$.

The correlations between the Sophomore attitudes toward group work and evaluations of students in the previous spring allow us to consider whether those who evaluate their peer relations more highly have a more favorable attitude to group work for the future? The data suggest that students who find their peers supportive, helpful and approachable are more likely to look forward to future group work, as are those who feel a sense of community and pride among engineering students.

In summary, predispositions to group work appear to be related to a stronger sense of community and pride as an engineering student, and to many favorable evaluations of students' relationships with peers; positive experiences with group work appear to reinforce these important aspects of the engineering student culture; and favorable evaluations of peer culture appear to predispose the student favorably to future teamwork (something like the diagram below).



Attitudes to group work and persistence in engineering

In a program where teamwork is embedded in the core engineering course, a positive predisposition to group work may facilitate retention and commitment. We looked at the relationship between attitudes to group work and measures of commitment to the engineering program in the freshman year, as well as actual persistence in the major.

When we consider the role that predispositions to group work play in commitment to engineering, we find that students who are more favorable to group work as they enter the program are less likely to consider dropping out from the major, transferring to another college's engineering program, or more generally dropping out from college (Table 10). The mean scores on the group work factor are higher for students who say they are unlikely or very unlikely to consider changing majors, transferring to another college's engineering program, or dropping out of college than for those who are considering any of these actions. A similar relationship between group work attitudes and intentions to persist in the major or in college are found at the end of the second semester, although differences between students with different intentions about persisting are smaller. At the beginning of the sophomore semester there is hardly any difference in attitudes toward group work between those who are considering leaving the program and those who are more firmly committed to it. So the relationship between commitment to the program and attitudes toward group work seems to weaken as students stay in the program, and presumably other factors become more important (see, for example, the analysis of retention in the program in Hartman & Hartman, 2006).[17]

Among students who took our survey in their first semester, we could also compare those students who stayed in engineering to those who dropped the program before their sophomore year (as explained above). The mean score on the group work factor for students who stayed in engineering was .004 (n=291), compared to -.026 for those who dropped (n=46). This difference was not statistically significant. Among students who took our survey in the spring semester, the mean score on the group work factor for students who stayed in engineering was .029 (n=284) compared to -.252 for those who dropped (n=33). Although a larger difference, it still was not statistically significant. It suggests that attitudes to group work may be related to reasons for dropping, but these results are not conclusive. Among these same students who subsequently dropped, 90% of them said their opinions about teams/groups had not changed or had improved as a result of engineering clinic. However, those who dropped did report lower engineering grades than students who stayed in engineering (statistically significant at $p<.05$), which suggests that it is not attitudes to group work but academic success that is a better predictor of persistence in the engineering major.

Table 10

Mean scores on group work factors by probability of changing majors, transferring to another college, or dropping out of college, for three semesters

	First-year Fall	First-year Spring	Sophomore Fall
Probability of changing major			
Unlikely	.052	-.124	.002
Possible	-.320*	-.166	-.011
Probability of transferring to another college			
Unlikely	.048	.077	.008
Possible	-.203**	-.171**	-.019
Probability of dropping out of college			
Unlikely	.016	.007	-.002
Possible	-.063	.041	.014

*T-test between "unlikely" and "possible" group statistically significant at $p<.05$.
** T-test between "unlikely" and "possible" group statistically significant at $p<.10$.

Discussion

We began the paper with several questions in mind. First we wanted to see whether women indeed favor group learning more than men do. The answers to this question is significant, because if women do prefer group work more than men do, undergraduate programs which include extensive group work will be more comfortable for women – perhaps even more comfortable than for men – which will give them and others who prefer group work an advantage in contemporary programs which incorporate this principle. It is therefore important to assess how the males react to these programs as well, since the labor market demand for engineers requires not that women replace men in the labor market but that women join the existing supply of male engineers. If group work is a necessary part of the engineering curriculum, then it must be delivered satisfactorily to all concerned. On the other hand, if women's experience in group learning is less positive, their support for this type of learning and later, this type of working, may actually decline as they experience it.

As they enter the Rowan engineering program, women are somewhat more favorably predisposed to group study and learning, reinforcing expectations to that effect. The year of teamwork in engineering clinic evens out most of these gender differences, as overall women become somewhat less enthusiastic about group work than they were at the beginning of the year. This also reinforces findings in other engineering studies that suggest that the experience of women in groups may be more negative than for males. However, males and females are quite similar in terms of how many become more positive or how many become more negative on individual indicators, and women more than men seem to increase their opinion that teams help them understand the class material better. This also reinforces previous findings that suggest that women are more likely than men to look to groups from points of weakness, i.e., to help them understand material better.

Favorable predispositions to group work that students bring with them to Rowan are positively related to their evaluating their clinic experience highly and to their perception that the group

work in engineering clinic made them even more favorable to group work. A positive experience in clinic in turn reinforces a positive predisposition to group work, which carries over at least to the beginning of the sophomore year. Controlling for gender adds little to our understanding of the relationship between attitudes toward group work and the evaluation of the engineering clinic experience, which suggests that this interrelationship is true for both males and females.

Favorable predispositions to group work are also related to more positive evaluations of peer relations and a sense of community among engineering students. This perception of positive peer culture in turn reinforces a favorable predisposition to group work at the beginning of the sophomore year.

While attitudes toward group work seem to be integral to a positive experience in the engineering program, students who leave the program do not appear to do so because they do not like group work. Much more related to leaving the program appear to be students' grades, which are not related to their attitudes toward group work.

Attitudes toward group work undergo considerable fluctuation from the first semester to the second. One reason for this fluctuation among the female students is the gender composition of their teams. Women who shared the teamwork experience with at least one other female over the course of the first year, were more likely to become more positive in their attitudes toward group work. This reinforces anecdotal evidence about the importance of taking into consideration the gender composition of teams when females are a minority in the student population.

Future research will analyze how students' attitudes toward group work evolve over the rest of their experience in the undergraduate engineering program, and whether there are other aspects of the group work experience which contribute to more positive or more negative changes in these attitudes. Of interest for future study would be how the undergraduate experiences in group work carry over to teaming skills in the workplace.

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End Notes

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