

Valuing Teams: What Influences Student Attitudes?

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Abstract

The ability to work with others is a skill highly valued by employers. Students often work in groups for class projects, but extensive teamwork is usually limited. This research explores student attitudes toward working with peers through a “Value of Teams” survey administered in three introductory and two intermediate level economics courses between fall 2007 and spring 2009. The extent to which a semester in an intensive team-based learning environment changes student attitudes about working with peers and whether or not attitude changes persist beyond that semester are both assessed. In addition, the degree to which student attitudes vary in relation to demographic characteristics and academic ability is estimated using ordered probit models. Prior experience with teamwork in an academic setting significantly influences initial attitudes, but attitudes do not generally vary significantly across students based on gender, age, or class levels. While a negative correlation exists between grade point average and student attitudes toward teamwork, attitudes improved over the course of the semester for nearly every demographic group, some more than others.

Introduction

The ability to work with others and communication skills are two of the traits employers most desire in prospective employees, a fact that has changed very little over time (Lizenberg and Schneider, 1987). The National Association of Colleges and Employers annual survey of employers consistently finds “teamwork skills” and the ability to work with others among the top five qualities employers want in employees. Good teamwork requires effective communication, regular interaction, mutual respect, and trust. Teams are more than just groups working together. Teams are comprised of a small number of people with complementary skills who work cooperatively to achieve a common goal and hold themselves mutually accountable.

Perhaps the most common experience students have working with others in an academic setting is in group projects or group activities. Such experiences are not always viewed positively by students. Impediments to effective teamwork range from free-riding to overly dominant personalities to group apathy and generally poor leadership. Many of these problems arise as a result of either one-time use of groups or constantly changing groups for daily

cooperative activities; both of these limit the opportunity to build trust and synergy. Team-based learning attempts to address these impediments to effective group interaction by keeping students in the same group throughout the semester and utilizing collaborative activities daily in class. In such a context, “teams” are distinct from and more effective than “groups.” But it is only after some period of time, as students begin to trust each other and develop a commitment to the group that the group becomes a team (Michaelson, 2002). Just as in a work environment where a team cannot be built by having a retreat for a couple of days each year, student teams are not built by doing a group project each semester. Team building is something that must be done on a regular basis.

Numerous researchers of cooperative learning have found both cognitive and social and emotional gains from group learning (Barkley, et al., 2005; Natası and Clements, 1991; Millis and Cottell, 1998). Working in small groups improves higher level critical thinking skills and improves students' motivation and attitudes toward the subject matter (Johnson et al., 1991). Cooperative learning enhances communication skills (Johnson and Johnson 1987; Sharan and Sharan, 1992) and results in greater achievement (Johnson, et al., 1990; Slavin 1987; Holtfreter, et al., 1997). While research on group learning in higher education is not as extensive as in K-12 education, learning gains have been found at all levels. In a study of managerial finance students, Wilson (2005) found significant improvements in decision-making from use of team-based exercises in senior and graduate level courses. In a meta-analysis of undergraduate science, mathematics, engineering, and technology (SMET) research, Springer, Stanne, and Donovan (1999) found significant favorable impacts on academic achievement, attitudes toward learning, and persistence in SMET courses and programs from cooperative small group learning.

The cooperative/collaborative learning literature focuses on how to structure successful collaborative learning environments and their impact on learning and student satisfaction with their learning, but few researchers have analyzed student attitudes toward small group learning itself. Glass and Putnam (1989) and Holtfreter and Holtfreter (2002) determined that students prefer cooperative learning to the more traditional lecture/discussion format, but did not measure changes in attitude over time. Using a variety of measures, Levine et al. (2004) found that

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student attitudes about working in teams increased following their experiences with team learning in a clinical psychiatry course. Parmelee et al. (2009) compared changes in medical student attitudes toward team based learning during the first two years of medical school, finding an improvement in overall satisfaction with the team experience. None of these studies, however, analyze what influences students attitudes toward working with others prior to beginning a cooperative learning experience. Attitudes are most often formed on the basis of experiences, both positive and negative, but differences in personalities, learning styles, and backgrounds of students will all play a role. Once formed, attitudes shape a person's actions, and affect their subsequent experiences, producing a continuous feedback between attitude and behavior. Having some recognition of this diversity of factors influencing attitudes toward group interactions may help instructors design more effective collaborative learning environments.

Three aspects of students' attitudes toward teamwork are assessed here. First, whether or not student attitudes about working with others change after a semester of working in a team-based learning (TBL) class is measured by comparing responses to a "Value of Teams" survey from the beginning of the semester and end of the semester. Next, the enduring impact of a TBL experience on attitudes is measured by surveying students in an upper division class for which a significant proportion had a lower division TBL courses as a prerequisite. Finally, the extent to which student attitudes toward teamwork are affected by age, grade level, gender, and prior experience working in groups is estimated.

Methods

In all of the courses analyzed, students worked in the same team of five to seven students throughout the semester, with daily interaction involving both graded and un-graded activities. Team-based learning is learner-centered but uses a very structured individual and group accountability process. At the start of each unit, readiness assessment tests encourage student preparation, while group assessments and activities hold individuals accountable to peers. Individual homework assignments and end of unit tests ensure students cannot free-ride on efforts of teammates. In the courses

analyzed here, teams are formed to take greatest advantage of student diversity, accounting for differences in grade point average, major, and class level. Geographic and gender diversity are also considered in team formation. For more information about TBL, see Michaelsen et al., (2002).

All courses analyzed were taught by the same instructor. At the beginning of the fall 2007 and 2008 semesters, a survey was administered to 142 students in three introductory level agricultural economics courses. Seven of the students failed to complete the second page of the survey so were not included in the analysis. This survey is a modified version of an instrument developed at Baylor College of Medicine (Levine et al., 2004) and includes twelve statements about working with peers both in the classroom and in a career as shown in Table 1. Students were asked to indicate the extent to which they agreed with each statement on a scale of 1 to 5, with 1 being "strongly disagree," 2 being "disagree," 3 being "neither agree nor disagree," 4 being "agree," and 5 being "strongly agree."

Students were also asked whether or not they had previous experience with "team based learning" and if so, to rate the quality of the experience on a scale of 1 to 7 where 1 was "horrible" and 7 was "excellent." Students were not provided with any details about the implementation of TBL in the course they were just starting, nor were any details about their prior experience collected other than their subjective assessment of its quality. This subjective assessment, that is, students' feelings about their prior experiences, as opposed to any details about their experience, is what is expected to influence their attitude about working with peers in the classroom and work settings. Students were also asked how familiar they were with the instructor's teaching methods on a scale of 1 to 7, where 1 was "not at all familiar" and 7

Table 1. Value of Teams Survey Statements^a

1. The ability to collaborate with my peers will be necessary if I am to be successful as a student.
2. It is a waste of time to work in groups.
3. I have a positive attitude about working with my peers.
4. The ability to work with my peers is a valuable skill.
5. In my career, I can be as successful working alone as working with others.
6. Collaborating with my peers will help me be a better student.
7. Collaborating with my peers will help me in my career.
8. Solving problems in a group is an effective way to practice what I have learned.
9. Solving problems in a group is an effective way to learn.
10. Working in teams in class is productive and efficient.
11. Group decisions are often better than individual decisions.
12. Solving problems in groups leads to better decisions than solving problems alone.

^a These statements were adapted from an instrument developed at Baylor College of Medicine (Levine et al., 2004).

was “very familiar.” Demographic information collected includes age, gender, and class level, while academic information includes grade point average, major, and whether or not the student had a scholarship that required maintaining a B (or better) grade point average.

This same survey was also administered to 54 students in two intermediate level natural resource economics courses in which just over 60% of the students had a previous TBL experience from the same instructor in one of the introductory level agricultural economics courses, although not necessarily during the immediately preceding semester. Finally, during the last class session of the semester, students in all of these classes were asked to respond to the same survey statements about working with peers that they completed at the beginning of the semester.

Data

Demographic information is summarized in Table 2, disaggregated by course section. About one-third of APEC 202 Introduction to Agricultural Economics students were freshman, one-third were sophomores, and the remainder upper classmen. Of the forty students in APEC 202, one quarter were animal science or pre-veterinary science majors, 17.5% were food science majors, 10% were agricultural economics majors, and no other major had more than three students. Averaging across the two sections, APEC 257 Natural Resources, Environment, and Economics students were primarily sophomores (33%) and juniors (42%) majoring in wildlife and fisheries biology (29%), environment and natural resources (36%), or parks and protected areas management (21%). APEC 202 had a much greater proportion of female students at 67% to only 33% male, while in APEC 257 those proportions were reversed, with 67% male students and only 33% female between the two classes. APEC 202 also had a higher percentage of students on academic scholarships than APEC 257 (54% versus 37%) yet average GPA among the non-freshmen was not significantly different across the three classes. This difference in scholarships is likely due to the higher percentage of freshman in APEC 202, many of whom lose their state grade-based scholarships during their first year of college.

Like APEC 257, a significant proportion of CRD 357 Natural Resource Economics students are sophomores (26%) and juniors (49%) although 25% are seniors. Many of these students take APEC 257

during the fall semester of their sophomore year and CRD 357 during the following spring semester. Compared to the other two classes, CRD 357 has more gender balance with 58% males and 42% females and somewhat higher average grades at 3.15.

High percentages of students indicated having prior “team based learning” experience in all of the classes with only 13 out of 189 rating their experience negatively (less than 4 on a scale from 1 to 7). Another 25 gave their experience a neutral rating, while the majority rated their experience relatively good, with about 9% rating it a 7, 29% rating it a 6, and 40% rating it a 5. A much higher percentage of students in CRD 357 were familiar with the instructor's teaching style from having taken either APEC 202 or APEC 257 from her. Those students in APEC 202 and APEC 257 who indicated familiarity with the instructor's teaching style had likely taken an introductory University Success Skills course from her.

Table 2. Summary Demographic Information by Class^a

	APEC 202 F07 (n=40)	APEC 257 F07 (n=44)	APEC 257 F08 (n=51)	CRD 357 S08 (n=27)	CRD 357 S09 (n=27)
Age (years)	19	21	20	21	21
Male	33%	61%	72%	56%	60%
Female	67%	39%	28%	44%	40%
Freshman	34%	2%	12%	0%	0%
Sophomore	37%	32%	33%	48%	5%
Junior	23%	49%	37%	37%	61%
Senior	6%	17%	18%	15%	35%
GPA (4.0 scale)	2.93	3.00	3.04	3.08	3.22
Scholarship ^b	54%	34%	40%	52%	56%
Prior TBL experience	80%	77%	92%	100%	80%
Neutral/bad prior TBL	21%	29%	30%	7%	25%
Familiar with instructor's style	10%	14%	10%	74%	47%

^a APEC 202 is “Introduction to Agricultural Economics,” APEC 257 is “Natural Resources, Environment, and Economics,” and CRD 357 is “Natural Resource Economics”

^b Scholarship indicates if the student has a scholarship requiring maintenance of a B (or better) average.

Results and Discussion

Analysis of Attitudes over Time

The average responses by class at both the beginning and the end of the semester are summarized in Table 3a for the 200 level courses and Table 3b for CRD 357. These tables also indicate whether or not there was a statistically significant improvement in attitudes as measured by the response to each of the survey statements using a one-tailed t-test. A one-tailed test was used rather than a two-tailed test because attitudes were anticipated to improve between the beginning to the end of the semester.

The results suggest that for the 200 level students, attitudes toward working with others changed significantly over the course of the semester. At the end of the semester, these students were less likely to agree that working in groups is a waste of time and more likely to agree that working in teams in class is productive and efficient. They were also more positive about the quality of group versus individual decisions. Students in two out of three of the classes were more likely to agree that solving problems in groups is both an effective way to learn and an effective way to practice what has been learned. Fall

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2007 APEC 257 students were more likely to agree that working with peers is a valuable skill and these students had a more positive attitude about working with peers in general by the end of the semester. Fall 2008 APEC 257 students were more likely to agree that collaborating with peers would help them become better students. Few of the responses by CRD 357 changed significantly, but the students' attitudes started at a higher level relative to the other classes, with not much room for change in survey responses ranked on a scale of 1 to 5. Yet, responses in the spring 2008 class were significantly more positive regarding the quality of group decisions at the end of the semester and both CRD 357 classes were more positive in response to the statement, "Solving problems in groups leads to better decisions than solving problems alone."

In order to compare the enduring effect of TBL experiences on attitudes and team interactions, average responses of CRD students who had previously taken a TBL course with the instructor are compared to the average responses of the students in the introductory level APEC courses. Although survey responses were anonymous, students' indication of being very familiar with the instructor allowed these students to be separated from those who had not previously had a course from the instructor. Cross checking course rosters confirmed that 60% of the CRD students had taken either APEC 202 or APEC 257 taught using TBL, but only about a third of those had taken it during the previous semester. All but one student had taken the introductory level course within the previous three years. These CRD students' responses at the start of the semester are compared to APEC students' responses at both the start and the end of the semester. Results are shown in Table 4.

Significant differences exist between the starting attitudes of the two groups of students, with statistically significant responses

to 9 out of 12 questions, suggesting that the CRD students enter the class with a more positive attitude about working in teams and with peers. Comparison of the end-of-semester 200 level APEC student responses to the beginning-of-semester 300 level CRD student responses indicates almost no differences, suggesting that the changes in attitudes achieved over the course of the first semester of TBL carry over to subsequent courses. The only response that was significantly different was for the statement, "Group decisions are often better than individual decisions" and it was only significant at the 10% level. However, this gap was closed by the end of the semester.

Statement	APEC 202 F07			APEC 257 F07			APEC 257 F08		
	Start	End	t-statistic for difference	Start	End	t-statistic for difference	Start	End	t-statistic for difference
1	4.35	4.49	0.97	3.94	4.42	3.16**	4.12	4.33	1.56*
2	2.23	1.73	-2.62**	2.18	1.91	-1.85**	2.27	2.07	-1.35*
3	4.35	4.24	-0.74	4.00	4.22	1.70**	3.94	4.07	0.92
4	4.50	4.57	0.53	4.39	4.67	2.47**	4.39	4.53	1.18
5	2.80	2.86	0.24	3.08	3.09	0.04	3.12	2.96	-0.78
6	4.13	4.24	0.93	3.96	4.13	1.16	3.92	4.18	1.89**
7	4.28	4.41	0.95	4.18	4.27	0.72	4.27	4.32	0.43
8	4.20	4.41	1.56*	4.14	4.20	0.44	3.96	4.32	2.53**
9	4.05	4.27	1.45*	3.92	4.13	1.21	3.92	4.14	1.50**
10	3.70	4.03	1.76**	3.57	3.91	1.95**	3.27	3.95	3.81**
11	3.60	3.97	1.73**	3.69	4.11	2.58**	3.59	4.28	4.42**
12	3.68	4.03	1.90**	3.73	4.07	2.20**	3.69	4.23	3.54**
N =	40	37		44	41		51	57	

Note: * and ** indicate statistically significant at the 10% level and 5% level for a one-tailed test.

Statement	CRD 357 S08			CRD 357 S09		
	Start	End	t-statistic for difference	Start	End	t-statistic for difference
1	4.22	4.28	0.40	4.19	4.26	0.41
2	1.96	1.88	-0.39	2.08	2.19	0.52
3	4.15	4.36	1.17	4.04	3.93	-0.55
4	4.48	4.64	1.14	4.37	4.41	0.23
5	3.15	3.20	0.17	3.07	3.22	0.51
6	4.19	4.28	0.50	3.81	4.04	0.97
7	4.37	4.48	0.68	4.19	4.26	0.39
8	4.30	4.24	-0.29	4.22	4.00	-1.14
9	4.26	4.36	0.62	3.96	3.89	-0.35
10	4.00	4.12	0.55	3.74	3.52	-0.91
11	4.00	4.28	1.38*	3.96	4.15	0.86
12	4.07	4.40	1.78**	3.78	4.15	1.85**
N =	27	24		27	27	

Note: * and ** indicate statistically significant at the 10% level and 5% level for a one-tailed test.

Statement	200 Level APEC Courses		CRD 357	t-statistic for CRD v APEC at the start	t-statistic for CRD v APEC at the end
	Start	End			
1	4.12	4.40	4.34	1.86**	-0.50
2	2.23	1.93	1.97	-1.48*	0.22
3	4.08	4.17	4.14	0.46	-0.21
4	4.42	4.58	4.59	1.56*	0.33
5	3.01	2.98	3.00	-0.06	0.10
6	3.99	4.18	4.10	0.80	-0.56
7	4.24	4.32	4.34	1.38*	0.71
8	4.09	4.30	4.34	1.98**	0.34
9	3.96	4.17	4.21	1.77**	0.24
10	3.50	3.96	4.03	3.45***	0.50
11	3.63	4.14	3.93	1.85**	-1.29*
12	3.70	4.12	4.03	2.36***	-0.62

Note: *, **, and *** indicate statistically significant at the 10%, 5%, and 1% level respectively for a one-tailed test.

Demographic Analysis of Attitudes

To determine the role demographics, academic ability, and prior TBL experiences play in influencing student attitudes toward working with peers, ordered probit models are estimated for each of the survey statements. For this study, choices range from 1 to 5 in response to each of the survey statements, with a higher number indicating a higher degree of agreement with the statement. The cumulative model has the form

$$\Pr(Y \leq 1 | x) = F(x'\beta)$$

$$\Pr(Y \leq i | x) = F(\alpha_i + x'\beta), 2 \leq i \leq 5$$

where β is a vector of parameter estimates, F is the cumulative distribution function, x is the vector of explanatory variables including an overall intercept term, and $\alpha_2, \dots, \alpha_5$ are intercept shift parameters.

Probit models were estimated for both beginning-of-semester responses and end-of-semester responses. Explanatory variables for student responses include demographic variables, academic ability, and prior experience working with peers. Demographic variables included in the survey are age, class level, and gender. Age and class level are highly correlated, so only age is included in the regression. Age also likely better reflects students' experiences that might influence receptivity to TBL than class level, but results were not significantly different when class level was used instead of age. Indicators of academic ability include grade point average and whether or not the student had an academic-based scholarship. However, grade point averages do not exist for entering freshman and 85% of the twenty freshmen in the courses had scholarships. Thus, a dummy variable was created to indicate whether or not each student was a freshman and grade point average was used to indicate academic ability for all non-freshmen. The scholarship variable was also tested as a proxy for academic achievement; however results were not significantly different when scholarship was used instead of GPA. Thus Y is estimated as: $Y = f(\text{age, gender, freshman, gpa})$ where age ranges from 17 to 54 years old, gender equals 1 if the student is male and 0 if female, freshman equals 1 if the student is a first semester freshman and 0 if not, GPA is grade point average for students who are not first semester freshmen and ranges from 1.69 to 4.0 on a four point scale.

One of the objectives of this analysis is to determine if a semester of exposure to TBL changes attitudes toward working with peers; therefore, one set of regressions was run using survey statement responses from just APEC 202 and APEC 257 students, for both the beginning of the semester and the end of the semester. For comparison, the 357 classes are pooled with the 200 level class data. One set of regressions was run using just age, gender, a freshman dummy, and cumulative grade point average as explanatory variables. A second set of regressions was run for the start of the semester

responses adding two additional explanatory variables. The first is a dummy variable that takes a value of 1 if the student had prior TBL experience that was not positive (rated 4 or less on the 7 point scale). The second is a dummy variable that indicates whether or not the student was familiar with the instructor's teaching style at the start of the semester (rated 5 or higher on a 7 point scale). This variable is used to determine if students' prior experience with the instructor's use of TBL biased their attitudes relative to their peers.

Most of the coefficient estimates are not statistically significant. Expanding the data set from just the 200 level students to also include the 357 students increased the statistical significance of the coefficients on the variable related to prior TBL experience and the variable related to familiarity with the instructor's teaching style. Given that 60% of the students in CRD 357 but only 12% of the 200 level students were familiar with the instructor, and nearly all of the 357 students had some sort of TBL experience, it is not surprising that the significance of these variables increased. Other than that though, the statistical significance of only one other variable in only one equation changed after adding the 357 data, changing from significant at the 10% level to not significant. Adding the two variables related to prior experience did not change the sign or statistical significance of any of the other variables. Interestingly, there were no significant differences in age, gender, GPA, or the percent who were freshman between those with good and those with less than good prior TBL experience. There were also no significant differences in gender or grade point average between those students who were familiar with the instructor's teaching style coming into the class and those who were not.

Given the volume of regressions, only the estimates using all of the data and all of the variables for the beginning of the semester are shown here, in Table 5. (Seventy-two regressions were run. First, regressions were estimated using only 200 level data then using both 200 and 300 level data for beginning of semester responses. This was repeated for each of the twelve survey questions and repeated for each question with the two additional variables related to prior TBL experience. Finally, this was repeated for each question for the end of semester responses with only the 200 level data and again with all the data.) Other results are available upon request. In general, there appear to be few differences related to age or gender in terms of attitudes toward working with others at the beginning of the semester. Age alone was not statistically significant for any of the statements. On the other hand, freshman were less likely to agree that it is a waste of time to work in groups, yet also less likely to agree that group decisions are often better than individual decisions. Males were less positive than females in response to two statements: "The ability to work with my peers is a

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valuable skill,” and “Solving problems in a group is an effective way to practice what I have learned.” In contrast, grade point average was statistically significantly correlated with less positive student responses to four out of twelve of the survey statements (statements 3, 8, 10, and 12).

Having had a less than positive prior group or team learning experience significantly and negatively impacted students' attitudes about working with others, with this variable statistically significant for every statement except, “The ability to work with my peers is a valuable skill” and “In my career, I can

be as successful working alone as working with others.” Finally, familiarity with the instructor's teaching style before starting the class improved students' attitudes about working with others, with significantly more positive responses to ten of the twelve statements.

End-of-semester regression results suggest even more difference in attitudes related to both demographics and academic ability. Age was statistically significant for three statements, gender for two, and GPA was statistically significant for nine out of twelve statements. Closer inspection of the responses, however, reveals that the attitudes of students across nearly all of these categories became more positive. So while differences may exist at the end of the semester among students of different ages, between males and females, or among students based on grade point average, attitudes improved over the semester for nearly all of these groups. Unfortunately, since survey responses were anonymous and not individually coded, beginning of semester and end of semester responses could not be paired, so it is not possible to determine the significance of these changes using regression analysis. Instead, categorical response averages are reported for each question at the beginning and end of the semester and statistically significant improvements are noted. Indication is also made for statements for which there was a statistically significant coefficient estimate in the probit regression for the category

Table 5. Beginning of Semester Ordered Probit Coefficient Estimates

Statement	Intercept	Age	Freshman	Gender: Male=1	GPA	Not Good Prior TBL	Familiar
1	2.39*** (3.48)	-0.03 (-0.99)	0.38 (0.84)	-0.12 (-0.69)	-0.05 (-0.42)	-0.40* (-1.89)	0.07* (1.84)
2	1.00 (1.52)	0.004 (0.17)	-0.76* (-1.70)	-0.05 (-0.30)	0.05 (0.43)	0.51** (2.51)	-0.10** (-2.49)
3	4.00*** (5.19)	-0.01 (-0.42)	-0.51 (-1.08)	-0.40** (-2.17)	-0.39*** (-3.05)	-0.87*** (-3.99)	0.07* (1.73)
4	3.12*** (4.26)	0.04 (-1.59)	0.10 (0.20)	-0.30 (-1.55)	-0.08 (-0.62)	-0.20 (-0.89)	0.07 (1.63)
5	1.38** (2.18)	0.01 (0.59)	-0.35 (-0.83)	-0.06 (-0.37)	0.06 (0.57)	-0.26 (-1.35)	-0.08** (-2.21)
6	2.78*** (3.99)	-0.03 (-1.20)	0.02 (0.04)	-0.02 (-0.14)	-0.16 (-1.29)	-0.45** (-2.18)	0.11*** (2.81)
7	3.02*** (3.76)	-0.03 (-1.20)	0.36 (0.76)	0.06 (0.32)	0.07 (0.57)	-0.50** (-2.28)	0.07* (1.67)
8	3.50*** (4.65)	-0.30 (-1.14)	-0.32 (-0.67)	-0.34* (-1.83)	-0.28** (-2.20)	-0.50** (-2.27)	0.15*** (3.55)
9	2.98*** (3.94)	-0.01 (-0.49)	0.34 (0.75)	-0.07 (-0.40)	-0.04 (-0.35)	-0.59*** (-2.81)	0.10*** (2.63)
10	2.07*** (3.09)	-0.02 (-0.59)	-0.06 (-0.14)	0.01 (0.08)	-0.22* (-1.86)	-1.11*** (-5.20)	0.14*** (8.01)
11	3.23*** (4.36)	-0.01 (-0.31)	-1.00** (-2.27)	0.12 (0.72)	-0.14 (-1.20)	-0.47** (-2.31)	0.04 (1.11)
12	2.07*** (3.00)	0.01 (0.34)	-0.72 (-1.61)	0.15 (0.86)	-0.21* (-1.75)	-0.55*** (-2.67)	0.08** (2.14)

Note: *, **, and *** indicate statistically significant at the 10%, 5%, and 1% level respectively for a two-tailed test.

Table 6. Changes in Attitude by Gender

Statement	Male Students			Female Students		
	Start	End	t-statistic for difference	Start	End	t-statistic for difference
1 ^a	4.08	4.28	2.07**	4.23	4.49	2.62***
2 ^a	2.21	2.02	-1.81**	2.14	1.85	-2.19**
3	3.99	4.18	2.23**	4.21	4.11	-0.84
4	4.37	4.54	2.24**	4.53	4.61	0.99
5	3.02	3.07	0.35	2.99	2.96	0.15
6	3.97	4.23	4.06***	4.05	4.07	0.44
7	4.26	4.37	1.33*	4.27	4.31	0.38
8	4.03	4.22	1.88**	4.25	4.29	0.44
9	3.93	4.12	1.70**	4.04	4.20	1.46*
10	3.56	3.94	3.16***	3.60	3.87	1.82**
11	3.79	4.24	4.06***	3.60	4.05	3.22***
12	3.82	4.17	3.34***	3.68	4.16	3.81***
N =	101	109		81	75	

^a Gender coefficient statistically significant at the end of the semester: negative and significant at 10% for statement 1 and positive and significant at 10% for statement 2.
*, **, and *** indicate statistically significant at the 10%, 5%, and 1% level respectively for a one-tailed test.

Table 7. Changes in Attitude: Freshmen Versus Non-Freshmen

Statement	Freshmen			Non-Freshmen		
	Start	End	t-statistic for difference	Start	End	t-statistic for difference
1	4.43	4.75	2.17**	4.11	4.32	2.80***
2	1.74	1.60	-0.87	2.24	1.99	-2.77***
3	4.39	4.40	-0.04	4.04	4.12	1.02
4	4.61	4.80	1.22	4.42	4.54	2.08**
5	2.61	2.95	1.03	3.06	3.04	-0.21
6	4.22	4.40	1.17	3.97	4.13	1.99**
7	4.30	4.50	1.17	4.26	4.32	0.98
8	4.35	4.40	0.27	4.09	4.23	1.75**
9	4.17	4.50	1.96**	3.95	4.11	1.84**
10	3.83	4.30	2.26**	3.55	3.87	3.19***
11 ^a	3.26	4.00	4.36***	3.77	4.18	3.51***
12	3.57	4.20	4.34***	3.79	4.16	2.88***
N =	23	20		159	164	

^a Fresh coefficient negative and statistically significant at the end of the semester at 1% for statement 11.
*, **, and *** indicate statistically significant at the 10%, 5%, and 1% level respectively for a one-tailed test.

represented in the table. Table 6 shows the results broken down by males versus females. Table 7 shows freshmen versus other students. Table 8 shows responses by age. Table 9 shows responses by grade point average. Note that the starting and ending number of students in each category is not necessarily the same due to adds and drops occurring during the semester resulting in about a seven percent difference between the students answering the survey questions at the beginning of the semester and those responding at the end.

Regression results indicate male students were significantly less likely than female students to agree that they have a positive attitude about working with peers and that solving problems in a group is an effective way to practice what they have learned, yet the attitude of male students became significantly more positive over the course of the semester for all statements except, "In my career, I can be as successful working alone as working with others." While female students started out more positive than male students about working with peers in general, they also became significantly more positive by the end of the semester in response to half of the statements.

While freshmen tended to enter the semester quite positive about working with peers, they nonetheless became even more positive in response to five out of twelve of the statements. Similarly, responses of non-freshmen became more positive in response to nine out of twelve statements. Interestingly, their response to the statement, "I have a positive attitude about working with peers" did not change significantly. The other two responses that did not change were the two related to the importance of collaborating with others in their career. The regression analysis indicated that at the end of the semester, freshmen were less likely than non-freshmen to agree that group decisions are often better than individual decisions, yet their mean response to this question increased from 3.26 to 4.0 out of 5.

While age was estimated to be significant and negative in the end-of-semester regression for statements 1, 3, and 5, every age category response improved significantly over the semester in response to statement 1, about the importance of collaborating

with peers for success as a student, with all ending at 4.13 or higher out of 5. The response to statements 3 ("I have a positive attitude about working with my peers") and 4 ("The ability to work with my peers is a valuable skill") also became more positive for every age group over the semester, although not always statistically significantly. Older students were also more likely to agree that they can be as successful in their careers working alone as working with others, with a statistically significant increase in the response for the oldest age group (over 22 years old). In spite of these differences among age groups, all groups tended to respond more positively about working with others at the end of the semester compared to the beginning of the semester, especially the youngest two groups (those under 20). All age groups became significantly more positive about the quality of group decisions and all but the oldest group of students became significantly more positive about the decisions arising from group problem solving, and all ended with responses above 4 out of 5. Four out of five groups were significantly more likely to agree that working in teams in class is productive and efficient and three out of five were significantly more likely to agree that solving problems in a group is an effective way to learn, although responses were more positive for both of these questions for all age groups. Interestingly, the oldest age group started out least likely to agree that collaborating with peers would help them become better students, but ended up second most likely to agree to that statement.

The end-of-semester regression results indicated the higher a student's grade point average, the less positive he/she was likely to be about peer collaborations. However, breaking grades into four categories, 4.0 to 3.5, 3.49 to 3.0, 2.99 to 2.5, and below 2.5 indicates some interesting variation across the grade scale. Those in the highest grade category were more positive by the end of the semester, but not significantly so except in response to the statement that solving problems in groups leads to better decisions than solving problems alone. Students in the next highest grade category, what might be thought of as high-B students, became more positive in response to every statement, significantly so in response to seven

Statement	17 to 18 Year Olds			19 Year Olds			20 Year Olds			21 to 22 Year Olds			Over 22 Years Old		
	Start	End	t-stat for difference	Start	End	t-stat for difference	Start	End	t-stat for difference	Start	End	t-stat for difference	Start	End	t-stat for difference
1 ^a	4.37	4.73	2.05**	4.21	4.63	3.03***	4.18	4.40	1.69**	4.14	4.17	0.25	3.59	4.13	1.71**
2	1.89	1.60	-1.68**	2.16	1.84	-1.71**	2.16	1.82	-1.96**	2.24	2.20	-0.30	2.53	1.94	-2.18**
3 ^a	4.33	4.40	0.30	4.13	4.24	0.63	4.12	4.28	1.18	3.96	3.97	0.08	3.88	4.06	0.67
4	4.63	4.73	0.58	4.55	4.68	1.06	4.50	4.70	1.98**	4.28	4.40	1.22	4.18	4.44	1.18
5 ^a	2.74	2.93	0.50	2.92	2.76	-0.57	3.26	3.00	-1.18	2.92	3.06	0.69	3.12	3.69	1.51*
6	4.22	4.33	0.70	4.11	4.34	1.62	4.02	4.16	0.98	3.96	4.00	0.33	3.53	4.25	2.15**
7	4.37	4.47	0.59	4.39	4.45	0.42	4.30	4.36	0.52	4.12	4.23	0.99	4.12	4.38	1.04
8	4.33	4.47	0.68	4.08	4.32	1.39*	4.16	4.20	0.28	4.10	4.22	1.02	3.88	4.19	0.94
9	4.04	4.47	2.46***	4.03	4.26	1.36*	4.02	4.10	0.49	3.92	4.11	1.35*	3.82	3.94	0.37
10	3.78	4.33	2.41***	3.58	4.08	2.46***	3.58	3.88	1.59**	3.56	3.75	1.22	3.35	3.88	1.52*
11	3.33	3.93	2.76***	3.95	4.39	2.50***	3.74	4.06	1.67**	3.72	4.14	3.04***	3.65	4.25	1.78**
12	3.56	4.13	2.33***	3.92	4.39	2.97***	3.76	4.16	2.48***	3.74	4.06	2.36***	3.76	4.06	0.90
N =	27	15		38	38		50	50		50	65		17	15	

^a Age coefficient statistically significant for end of semester: negative and significant at 1% for statement 1, negative and significant at 10% for statement 3, and positive and significant at 1% for statement 5.
*, **, and *** indicate statistically significant at the 10%, 5%, and 1% level respectively for a one-tailed test.

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out of the twelve statements. Those in the next category, low-B students, were more positive to begin the semester than the high-B students and became significantly more positive by the end of the semester in response to nine out of twelve statements. Finally, students in the lowest grade category started the semester more positive about peer collaboration than most of the other students, but their attitude did not change significantly over the course of the semester.

Table 9. Changes in Attitude by Grade Point Average

Statement ^a	3.5 to 4.0			3.0 to 3.49			2.5 to 2.99			Below 2.5		
	Star t	End	t-stat for differenc e	Star t	End	t-stat for difference	Star t	End	t-stat for difference	Star t	End	t-stat for differenc e
1	4.13	4.25	0.75	4.02	4.24	1.28	4.08	4.42	2.69***	4.43	4.47	0.26
2	2.26	2.27	0.05	2.38	1.88	-2.93***	2.12	1.89	-1.60*	2.05	1.89	-0.63
3	3.95	3.82	0.74	3.89	4.19	1.99**	4.14	4.29	1.48*	4.33	4.16	-0.81
4	4.55	4.50	0.44	4.24	4.55	2.53***	4.45	4.58	1.25	4.48	4.47	-0.01
5	3.05	2.89	-0.64	2.93	3.07	0.57	3.31	3.16	-0.67	2.76	3.11	1.06
6	3.92	3.98	0.32	3.93	4.14	1.42*	3.98	4.24	1.83**	4.24	4.16	-0.38
7	4.34	4.30	-0.34	4.18	4.24	0.43	4.27	4.42	1.39*	4.33	4.37	0.17
8	4.00	4.05	0.25	4.07	4.24	1.22	4.14	4.36	1.81**	4.24	4.16	-0.32
9	3.84	3.93	0.46	3.89	4.10	1.13	4.06	4.22	1.22	4.24	4.21	-0.13
10	3.26	3.43	0.76	3.53	3.95	2.23**	3.75	4.15	2.68***	3.76	3.89	0.44
11	3.66	3.89	1.13	3.67	4.19	3.09***	3.80	4.31	3.06***	4.14	4.42	1.18
12	3.66	3.95	1.60*	3.71	4.19	3.19***	3.80	4.20	2.70***	4.10	4.37	1.05
N =	38	44		45	42		51	55		21	19	

^a GPA coefficient is statistically significant and positive for statement 2 and statistically significant and negative at end of semester for all other statements except 4, 5, and 7.
*, **, and *** indicate statistically significant at the 10%, 5%, and 1% level respectively for a one-tailed test.

Discussion

The results of this study indicate that student attitudes toward teamwork are not fixed, but rather can improve significantly over the course of just one semester with these positive attitudes possibly lasting for even longer. In initiating a team-based or collaborative learning environment, it is important to be aware of possible differences in acceptance of TBL across demographic groups. Freshmen in this study tended to enter the semester with a more positive attitude about peer collaboration than older students. These students were all entering their first semester of college and perhaps the prospect of sharing the learning experience with others was less daunting than bearing the full burden by oneself. It is also possible that the idea of getting to know other people through interactive class activities was a welcome concept for these students who were in a new environment, many with few or no friends around. This is not just a phenomenon of excited young freshmen with a positive attitude, though. The older the student was entering the class the less positive he/she was about peer collaboration on average. This attitude difference appears to grow gradually over time, perhaps due to a variety of

negative or less than positive experiences in working with and interacting with peers in a variety of settings. On a positive note, students are not steadfast in their opinions, with all age groups showing significant changes over the semester.

Creating teams with a mix of students with different academic abilities based on grade point average can help balance teams in terms of likelihood of success on graded activities, but is also likely to produce a mix of attitudes about peer collaboration in general within each group. While these attitudes change over the semester for many students, it is not very surprising that there is little change in attitude among the top students academically. Students with a grade point average over 3.5 are those students who are likely to succeed in the classroom regardless of the environment or instruction. They are not likely to see collaboration as important to their success when they have a history of succeeding whether or not they collaborate. They likely make good decisions and successfully solve problems on their own, so would not be expected to agree that group processes would be better. In contrast, the lowest grade students

started out relatively positive about peer collaboration and also did not change their attitude significantly. Interestingly, the mean responses of these students as a group actually became less positive for five of the statements, although not significantly so. Personal observation and experience suggest that students in this group tend to miss more classes and come to class less prepared, missing out on much of the value of team interactions. TBL appears to have had the greatest impact on attitudes among students in the mid-grade ranges, from 2.5 to 3.49. While there is, of course, a mix of effort among this large group of students, these are students who are not necessarily successful in all their classes, as often getting a mix of A's, B's, and C's as getting straight B's. Very few of the students in the study are majoring in economics, so the courses analyzed here are not the first choice of subject for most of these students, yet are required for about 85% of them. For these students to start with reasonably positive attitudes toward peer collaboration and become significantly more positive by the end of the semester in a course outside their discipline implies that a semester of TBL as implemented in these courses is a positive and attitude influencing experience.

Summary

The ability to work in a team is a highly valued skill which academics can cultivate in students through team-based and collaborative learning. Collaborative learning has also been found to produce significantly greater academic achievement and improved attitudes toward the learning of the material. However, many group activities do not allow time to build team dynamics and trust, and many group projects result in significant free riding and consequent excessive burden on the few students willing to do more of the work. Such experiences are likely to negatively influence student attitudes about working with others and may negatively affect subsequent group interactions. Gains accruing from collaborative learning found by previous researchers are associated with learning structures that promote interaction and encourage both individual and group achievement in pursuit of group goals (Barkley et al., 2005). In analyzing student attitudes in five courses using such a learning structure, this study finds that attitudes can improve over a semester of TBL and that these improvements last beyond the end of the semester. Instructors interested in implementing effective team or collaborative learning into the classroom should take care to learn best management practices in the implementation of such activities to minimize opportunity for free-riding and maximize the opportunity for true collaborative and student-centered learning.

Awareness of demographic differences in acceptance of peer collaboration can also help faculty more carefully design experiences to enhance outcomes. For example, most effective teams will have members with complementary skills but effectiveness may also be enhanced by having a mix of age, grade level, and gender as well. In building teamwork over time, positive attitudes on the part of certain members may help offset initial negative or less positive attitudes on the part of others. Improved student attitudes toward working with peers carries over to subsequent classes, creating positive externalities for the rising number of instructors also implementing collaborative learning in their classrooms.

Finally, this research also suggests that a positive learning experience can enhance attitudes toward working with others, possibly making students more employable upon graduation, having had experience working in teams and having a positive attitude about the experience. Employers consistently rank communication skills and the ability to work with others as highly valued employee skills, and TBL enhances both of these abilities in students, but requiring extensive interpersonal communication and problem solving in class, coordination on short written assignments, and consensus building. Faculty interested in teaching and learning strategies that enhance professional competencies of interper-

sonal skills, communication, and teamwork along with improving academic achievement should explore team-based and other collaborative learning methods.

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