THE EFFECT OF GROUP DIVERSITY ON TEAM AND STUDENT PERFORMANCE

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ABSTRACT

Group work and collaborative activities improve social skills, such as communication and leadership, which are sought after in the workplace. Our paper explores the effects of teamwork on student performance in an undergraduate applied statistics course. Particularly, we examine the compositional effects of a group on both team and individual student performance. We find that groups with more females generally perform better, while individual students benefit more from working with a racially-diverse group. In addition, assuming that peer evaluations can accurately measure social skills, we posit that students who are better team players receive higher course grades. Our findings support research on the complementarity between social and cognitive skills where more socially-skilled students benefit more under a collaborative environment.

Keywords: *Team-Based Learning, collaborative learning, diversity, applied business statistics, business statistics, higher education*

INTRODUCTION

Colleges and universities aim to increase the hiring rate of their students upon graduation through various strategies, such as increased academic rigor, career services, alumni networks, local business engagements, etc. While these methods are fruitful, employers are increasingly seeking out job candidates with better social and leadership skills (Borghans et al., 2014; Deming, 2017), as soft skills heavily influence success in the workplace (Heckman and Kautz, 2012). Firms are realizing increased productivity gains from fostering a collaborative work environment (Adhvaryu et al., 2023).

Studies on the readiness of new US workforce entrants show that employers value collaborative and leadership skills over basic knowledge skills (Casner-Lotto and Barrington, 2006; Cimatti 2016; McGunagle and Zizka, 2020), and that recent graduates present a notable lack of soft skills (Hart Research Associates, 2018). Previous research also reports the difficulty employers are facing when seeking college graduates that are proficient in both hard and soft skills (Karimi and Pina, 2021; Cimatti, 2016; Pritchard, 2013; White and Shakibnia, 2019; Hirudayaraj et al., 2021; Green et al., 2023).

To accommodate for the increase in demand for socially-skilled workers, universities actively engage their students through collaborative activities. Research shows that group work improves communication and team work skills for college students (Cho and Kweon, 2017; Elmore et

al., 2014). Further, the increasing complementarity between cognitive and social skills amplifies the positive effects of collaborative work (Weinberger, 2014).

Our paper examines how collaborative work influences student performance at the undergraduate level. Particularly, we study the impact of assigning a semester-long project on student grades. We further analyze the compositional effects of a group on team productivity and individual student performance.

Team-Based Learning (TBL) involves students working collaboratively within a small group, along with peer assessment to promote accountability (Peters et al., 2020; Davis and Mendoza, 2023). TBL has been described as a powerful tool for fostering both engagement and learning (Michaelsen et al., 2014). Many papers have documented the positive influence of TBL on student performance. Haidet et al. (2014) reviewed the educational literature associated with TBL and presented early evidence of positive educational outcomes in terms of knowledge acquisition, participation, engagements, and team performance. Additionally, Cagliesi and Ghanei (2022) find TBL to reduce the academic attainment gap between black, Asian, and minority ethnic (BAME) students and white students, as it enriches student learning experience, making it more enjoyable.

In our paper, we analyze student performance under a TBL framework. We focus on students who took the upper-level applied business statistics course and find small positive effects of collaborative work on their overall course grade. This paper adds to the research that shows the benefit of implementing TBL in math and statistics courses. Peters et al. (2020) found the effects of TBL in a Calculus I course to be generally positive, specifically observing exceptionally high class attendance and higher grades compared to sections that did not foster TBL; while, Campbell and Taylor (2020) observed better student performance among students who took introductory statistics with TBL.

Our paper further extends the literature by examining the effects of group composition and diversity on team and individual student performance. Research shows that diversity is necessary for creating an effective educational environment and enhances educational outcomes (Maruyama et al., 2000). More recent papers find that gender diversity influences team performance. Espey (2018) observes that team success is positively influenced by the percentages of females in the group; while, Hansen et al. (2015) finds that male-dominant groups tend to perform worse in group work.

In our paper, we find that gender diversity only affects team performance, while racial diversity in a group influences individual student performance. Particularly, we observe that having more females in a group has a positive impact on the group's project grade; however, we do not find any evidence of gender diversity in a group affecting individual student success. We also discover that, while racial diversity does not directly impact project grades, it does affect individual students' overall course grade. Specifically, we find that working with more Hispanic students in a group positively affects student course grades, while working with black or African-American students has a weakly negative influence on student grades.

Further, our paper finds that better team players and more socially-skilled students benefit more in a collaborative work environment, that is, assuming that peer evaluations accurately represent teamwork and social skills. Specifically, we find that students with better

peer evaluation scores earn higher overall course grades. This finding provides empirical support for the increasing complementarity between cognitive and social skills (Weinberger, 2014).

Our paper proceeds as follows. The next section details the institutional background surrounding the project and class structure. The succeeding section details the data used, followed by our empirical methodology and results.

BACKGROUND

Applied statistics is an upper-level course that is required of all undergraduate students majoring in the college of business at a regional comprehensive public university. The topics cover data collection, visualization, and analysis through the application of statistical theory such as multiple linear regression models.

Historically, students were only required to complete homework assignments and exams. However, beginning Fall 2021, the course has been administering a semester-long group project, in which students perform data analysis techniques, ranging from data visualization to regression analysis.

The main objective of the project is to promote team-based learning through simulating real-world data analysis by applying statistical theory with Microsoft Excel.[2] Students are tasked with cleaning, organizing, visualizing, and analyzing their dataset. As they complete their tasks, students utilize skills learned from the course, which include but are not limited to the use of Excel pivot tables, charts, formulas, and regression analysis.

Students are allowed to choose their own groups and research project that they were interested in. Each research project includes a research question that is associated with a publicly-available dataset. An example of a research project would be to use a sample from the 2019 American Housing Survey to address the research question: "What determines the market value of a home?" Allowing students to self-select their group and research project increases student engagement and motivation (Crossouard, 2012; Wurdinger et al., 2007). Those who do not select a group by the given deadline are randomly assigned into one. As part of the foundational practices essential for implementing TBL (Michaelsen et al., 2014), students are required to evaluate their group members to promote accountability and responsibility.

The project is completed in two main steps: 1. Data organization and visualization, and 2. Regression analysis. Each step is graded separately to provide detailed feedback throughout the semester and to foster student learning. Although graded separately, the project is still comprehensive in nature as success in Step 2 (regression analysis) can be achieved by having a good understanding of their data from Step 1 (data visualization).

The project grade also includes peer evaluations to emphasize accountability and responsibility. Each group member completes the peer evaluation form, which comprises of rating their peers through a series of evaluation criteria such as "contributed meaningfully to

[2] Most middle-skilled jobs require basic understanding of Microsoft Excel (Formby et al., 2017). For brevity, the paper will refer to Microsoft Excel as Excel.

group discussions," "prepared work in a quality and timely manner," and "did his/her fair share of work that was required." Each criterion is rated using a 10-point scale where 0 implies "strongly disagree" to 10 meaning "strongly agree." The average across the criteria is a group member's evaluation score for their peer. Once submitted, the instructor would determine a student's peer evaluation score by calculating the average evaluation score across his/her group members.

A student's overall project grade is determined by three factors: 1. Project step 1 - data organization and visualization, 2. Project step 2 - regression analysis, and 3. Peer evaluation score. Project step 1 is worth 35% of the project grade, while project step 2 and peer evaluations are weighted 50% and 15%, respectively.

DATA

The dataset primarily consists of student grades collected from electronic gradebooks in each section of the applied statistics course. It contains grades from 1,202 students across 32 sections taught by two instructors, spanning over a five-year period (Fall 2018 - Fall 2022). Table 1 summarizes our data for individual students. Since the group project was introduced in Fall 2021, only 429 students participated in the project, which results in 106 group observations. Table 2 displays the summary statistics for group observations. After receiving IRB exemption, demographic data was provided by the university and matched to the corresponding student through student ID numbers. Once merged, we de-identified the data for analysis.

An average student in our sample is 21 years old with a cumulative GPA of 2.88 and 14.04 attempted credit hours completed at the time of attending the applied statistic course. The average final grade was 78.02, which translates to a letter grade of C. Our sample comprises of 60% males (40% females), 60% whites, 20% Hispanics, and 12% black or African American. The remaining 8% is comprised of Asian, international, and multi-racial students. Race identifications were all self-reported.

The mean score for peer evaluations was 86.85 with a minimum of 0 and maximum of 102. Only 1 student attained a peer evaluation score of over 100 since their group members insisted on a higher than 100 grade due to the student's excellent performance in the group project. To note, there are 159 students who received full marks, or 100, for their peer evaluation. Further, students who did not submit a peer evaluation, regardless of the evaluations their peers submitted, received a score of 0 for peer evaluations.

Table 1
Student Summary Statistics

	Mean	Std. Dev.	Minimum	Maximum	Observations
Final Grade	78.02	15.71	2.33	103	1202
Peer Evaluation Score	86.85	24.87	0	102	429
Semester-Year	5.28	2.40	1.00	9.00	1202
Gender (Female = 1)	0.40	0.49	0.00	1.00	1202
Instructor (Instructor 1 = 1)	0.63	0.48	0.00	1.00	1202
Age	21.34	3.05	18	57	1202
Cumulative GPA	2.88	0.63	0.00	4.00	1202
Attempted Hours	14.04	2.27	3.00	21.00	1202
American Indian or Alaskan Native	0.01	0.08	0.00	1.00	1202
Asian	0.01	0.12	0.00	1.00	1202
Black or African American	0.12	0.33	0.00	1.00	1202
Hispanic	0.20	0.40	0.00	1.00	1202
International	0.02	0.13	0.00	1.00	1202
Two or More	0.04	0.20	0.00	1.00	1202
Unknown or Not Reported	0.00	0.07	0.00	1.00	1202
White	0.60	0.49	0.00	1.00	1202

Focusing on the summary statistics for the 106 groups in our sample, the average project grade was 79.29. We calculated the project grade discounting for the peer evaluation score to examine the effect of group dynamics on project score. Since project step 1 is weighed 35% of a student's overall project grade and project step 2 is worth 50%, we computed the project grade as $projectgrade = projectstep1 * 0.41 + projectstep2 * 0.58$. The average grade for project steps 1 and 2 were 82.80 and 78.18, respectively.

We focus on the following measures to analyze group dynamics: group size, count of female students, races, white students, black students, Hispanic students, Asian students, and international students. An average group is comprised of 4 members with about 2 females and 2 races represented. Groups generally had two to three white students, and one Hispanic student. The average cumulative GPA in a typical group was 2.91.

Since we allow for students to self-select their groups, we account for the number of students with the same major in a group. Considering that students who know each other are likely to be in the same group, we use this measure to control for self-selection. We find that an average group has 2 students who have the same major. There are 17 majors with the majority (93%) coming from the college of business, as expected since the applied statistics course is a required class to graduate. Out of the 17 majors, only 10 were from the college of business.

Table 2
Group Summary Statistics

	Mean	Std. Dev.	Minimum	Maximum	Observations
Project Grade (inc. Step 1 and Step 2 only)	79.29	13.87	28.85	99	106
Project Step 1 Grade	82.80	14.04	0	100	106
Project Step 2 Grade	78.18	17.80	0	100	106
Group Size	4.11	0.92	1	5	106
Count of Female Students	1.65	1.27	0	5	106
Count of Races	2.11	0.73	1	4	106
Count of White Students	2.48	1.30	0	5	106
Count of Black Students	0.48	0.85	0	5	106
Count of Hispanic Students	0.86	0.92	0	4	106
Count of Asian Students	0.07	0.25	0	1	106
Count of International Students	0.05	0.21	0	1	106
Count of Students with Same Major	1.94	0.81	1	4	106
Average Cumulative GPA	2.91	0.35	1.78	3.64	106
Average Attempted Hours	14.18	1.15	9.75	16.5	106
Average Age	21.44	1.74	19.4	30.5	106

When estimating the regression models, we control for the differences in instructor experience, ability, and course management by including a dummy variable equal to one for Instructor 1, and 0 otherwise (for Instructor 2). We also account for the semester and year by including the semester-year variable, which equals one for the first semester (Fall 2018) and increases by one for each succeeding semester. For example, if a student took a course from Spring 2019, the semester-year variable would equal 2. The semester-year variable captures the impact of COVID on teaching modalities, its subsequent effects, and any other variation across time.

EMPIRICAL METHODS & RESULTS

We estimate several linear regression models to examine the impact of group dynamics on the group project grade and individual students' course performance. We implement linear regression analysis because it allows us to measure and quantify the effect of group dynamics on student grades. Specifically, linear regression analysis can measure the strength of the relationship that multiple variables have with a given dependent variable. Regression analysis accounts for the differences in student background, instructors, and other variable components that could influence student grades which yields accurate measurements. In measuring group dynamics, we mainly focus on gender and racial diversity.

Impact of Group Dynamics on Project Grade

The impact of group dynamics on the project grade was examined through estimating the following regression model.

$$\text{Project Grade}_j = \alpha + \beta\,(\text{Group Dynamics Measure})_j + C_j + \varepsilon_j \quad (1)$$

Equation 1 evaluates how group *j*'s project grade was influenced by its group dynamics. The coefficient of interest, β, estimates the impact of group dynamics on project grade. We consider several measures for estimating group dynamics, which includes the count of female, white, black or African American, Hispanic, Asian, and international students, and the number of different races in a group. C_i reflects the controls added to the regression including group size, count of students with the same major, instructor, semester-year, group average age, average cumulative GPA, and group average attempted hours. Table 3 show the results from estimating Equation 1.

We find that gender diversity impacts project grades. Specifically, we found that having one more female in the group increases the project grade by 2.07 points, on average, as seen in Column I of Table 3. Our finding is consistent when accounting for racial diversity.

Based on our estimations, we observe that racial diversity does not affect a group's project grade. Even accounting for multiple races in a group does not impact project grades. However, we found that having an international student in the group significantly increases the project grade by 11.35 points.

Unsurprisingly, we note that groups with higher average cumulative GPAs tend to earn higher project grades by 10.72 points. Since cumulative GPAs can reflect student achievement, higher cumulative GPAs could indicate a student's academic achievement, including their commitment and dedication to learning.

Table 3
Project Grade Regressions

	I	II	III	IV	V	VI	VII
Count of Females	2.0700* (1.10)	2.0655* (1.10)	2.0605* (1.11)	2.1142* (1.10)	1.9900* (1.10)	2.0631* (1.10)	1.7215 (1.10)
Count of Races		-0.3278 (1.80)					
Count of White			-0.1061 (1.11)				
Count of Black				-1.2444 (1.48)			
Count of Hispanic					1.5136 (1.43)		
Count of Asian						0.8179 (5.11)	
Count of Int'l students							11.4792* (6.13)
Count of Same Major	-0.2303 (1.79)	-0.2876 (1.82)	-0.2205 (1.80)	-0.2509 (1.79)	-0.3358 (1.79)	-0.2441 (1.80)	0.2540 (1.78)
Group Size	2.4795 (1.69)	2.5623 (1.76)	2.5484 (1.85)	2.5664 (1.70)	2.1868 (1.71)	2.4615 (1.70)	2.4379 (1.67)
Instructor (Instructor 1=1)	-3.8765 (2.58)	-3.8719 (2.59)	-3.8871 (2.59)	-4.0146 (2.58)	-4.2033 (2.59)	-3.9109 (2.60)	-4.0739 (2.55)
Semester-Year	2.1354 (1.56)	2.1411 (1.57)	2.1352 (1.57)	1.9815 (1.57)	2.2080 (1.56)	2.1159 (1.57)	1.4443 (1.58)
Avg. Cum. GPA	10.7940*** (3.95)	10.7679*** (3.97)	10.8210*** (3.98)	10.7303*** (3.96)	11.3929*** (3.99)	10.7823*** (3.97)	11.4266*** (3.92)
Avg. Attempted Hours	1.4463 (1.21)	1.4737 (1.22)	1.4358 (1.22)	1.5179 (1.21)	1.4898 (1.21)	1.4273 (1.22)	1.3783 (1.19)
Avg. Age	0.4390 (0.82)	0.4222 (0.83)	0.4499 (0.83)	0.4185 (0.82)	0.5596 (0.83)	0.4346 (0.82)	0.5722 (0.81)
R^2	0.224	0.225	0.224	0.230	0.233	0.224	0.252
Observations	106	106	106	106	106	106	106

Note: The dependent variable across all specifications is the group project grade, which includes both Step 1 and Step 2 grades. Standard errors are reported in parentheses below the coefficients. * p<.10, ** p<.05, *** p<.01.

To further examine the impact of group dynamics, we analyze their effects on the grades from project steps 1 and 2, separately. Table 4 shows the regression results from using project step 1 grade instead of the total project grade as the dependent variable. We find that having more females in the group increases the grade for the first part of the project. Particularly, having one more female student increases the step 1 grade by 1.9 points. Analyzing the impact of racial diversity, we do not find any evidence of impacting grades at the first stage of the project.

We also observe that group size has a strong positive effect on project step 1 grades. We find that having one more student in the group increases the grade by 4.7 points, on average. We

surmise that our positive results reflect that our groups are restricted to five students, implying economies of scale. However, as theory suggests, having enormous groups of people should result in a decreasing trend in grades.

Table 4
Project Step 1 Grade Regressions

	I	II	III	IV	V	VI	VII
Count of Females	1.9048* (1.13)	1.9043* (1.13)	1.8668 (1.14)	1.9302* (1.13)	1.8373 (1.13)	1.9001* (1.13)	1.6242 (1.14)
Count of Races		-0.0379 (1.85)					
Count of White			-0.4250 (1.13)				
Count of Black				-0.7148 (1.53)			
Count of Hispanic					1.2763 (1.47)		
Count of Asian						0.5512 (5.24)	
Count of Int'l students							9.2418 (6.33)
Count of Same Major	-1.2039 (1.83)	-1.2105 (1.87)	-1.1644 (1.84)	-1.2157 (1.84)	-1.2928 (1.84)	-1.2132 (1.84)	-0.8140 (1.84)
Group Size	4.7231*** (1.73)	4.7326** (1.80)	4.9990*** (1.89)	4.7730*** (1.74)	4.4763** (1.76)	4.7109*** (1.75)	4.6895*** (1.72)
Instructor (Instructor 1 = 1)	-4.4835* (2.64)	-4.4830* (2.66)	-4.5259* (2.66)	-4.5629* (2.66)	-4.7590* (2.66)	-4.5067* (2.66)	-4.6425* (2.63)
Semester-Year	2.6556 (1.60)	2.6563 (1.61)	2.6550 (1.61)	2.5672 (1.62)	2.7169* (1.60)	2.6425 (1.61)	2.0992 (1.64)
Avg. Cum. GPA	5.6718 (4.05)	5.6688 (4.08)	5.7798 (4.08)	5.6352 (4.07)	6.1768 (4.10)	5.6639 (4.07)	6.1811 (4.04)
Avg. Attempted Hours	0.7011 (1.24)	0.7043 (1.25)	0.6589 (1.25)	0.7422 (1.25)	0.7378 (1.24)	0.6883 (1.25)	0.6463 (1.23)
R^2	0.204	0.204	0.205	0.206	0.210	0.204	0.221
Observations	106	106	106	106	106	106	106
Note: The dependent variable across all specifications is a group's grade on Step 1 of the project. Standard errors are reported in parentheses below the coefficients. * p<.10, ** p<.05, *** p<.01.							

Similarly, we estimate Equation 1 with project step 2 grades as the dependent variable. Table 5 displays our regression estimates. Surprisingly, we find no evidence of group dynamics influencing grades for the second stage of the project. However, we do observe that having a higher average cumulative GPA within the group, meaning that students with good past academic performance, tends to receive higher step 2 grades; while, the cumulative GPA had no influence when analyzing its impact on step 1 grades.

We deduce that group dynamics play an important role in the earlier stages of the project, while student achievement is more significant in the second stage of the project. We interpret that step 2 of the project tasks students to perform regression analysis, a more statistically-advanced technique to data visualization methods used in project step 1, implying that academic achievement can determine grades when using more advanced concepts over group dynamics.

Table 5
Project Step 2 Grades Regressions

	I	II	III	IV	V	VI	VII
Count of Females	2.2225 (1.46)	2.2152 (1.46)	2.2330 (1.47)	2.2808 (1.46)	2.1322 (1.46)	2.2139 (1.46)	1.8199 (1.46)
Count of Races		-0.5384 (2.39)					
Count of White			0.1176 (1.47)				
Count of Black				-1.6401 (1.97)			
Count of Hispanic					1.7074 (1.91)		
Count of Asian						1.0206 (6.77)	
Count of Int'l students							13.2588 (8.16)
Count of Same Major	0.4539 (2.37)	0.3599 (2.42)	0.4430 (2.39)	0.4269 (2.37)	0.3350 (2.38)	0.4367 (2.38)	1.0133 (2.38)
Group Size	0.9363 (2.24)	1.0724 (2.33)	0.8600 (2.45)	1.0508 (2.25)	0.6061 (2.27)	0.9138 (2.26)	0.8882 (2.22)
Instructor (Instructor 1=1)	-3.5143 (3.42)	-3.5066 (3.43)	-3.5025 (3.44)	-3.6963 (3.43)	-3.8828 (3.44)	-3.5571 (3.44)	-3.7423 (3.39)
Semester-Year	1.8045 (2.07)	1.8138 (2.08)	1.8046 (2.08)	1.6016 (2.09)	1.8864 (2.07)	1.7801 (2.09)	1.0062 (2.11)
Avg. Cum. GPA	14.6010*** (5.24)	14.5581*** (5.27)	14.5711*** (5.28)	14.5170*** (5.25)	15.2766*** (5.30)	14.5864*** (5.27)	15.3317*** (5.22)
Avg. Attempted Hours	1.9980 (1.60)	2.0431 (1.62)	2.0097 (1.62)	2.0924 (1.61)	2.0471 (1.60)	1.9743 (1.62)	1.9195 (1.59)
R^2	0.172	0.172	0.172	0.178	0.179	0.172	0.194
Observations	106	106	106	106	106	106	106
Note: The dependent variable across all specifications is a group's grade on Step 2 of the project. Standard errors are reported in parentheses below the coefficients. * p<.10, ** p<.05, *** p<.01.							

Impact of Group Dynamics on a Student's Overall Course Grade

We further examine the impact of group dynamics on individual student performance by estimating the following regression model.

$$\text{Course Grade}_i = \alpha + \beta_1 \text{Project}i + \beta_2 (\text{Group Dynamics Measure}i) + C_i + \varepsilon_i \quad (2)$$

Equation 2 estimates the effect of a group project and its dynamics on a student's overall course grade. Our main coefficient of interest is β_2 which measures the impact of group dynamics on student grades. Similar to our previous model, our group dynamics measures focus on gender and racial diversity.

Our model includes a dummy variable to indicate whether the student participated in the project (Project = 1), or not (Project = 0) since our sample includes semesters where the project was not assigned. Ci contains controls for race, gender, instructor, semester-year, age, cumulative GPA, and attempted hours. Table 6 displays the regression estimates for Equation 2.

We find that overall course grades are not strongly influenced by the project. However, we observe that having an international student in the group has a strong positive effect on student grades with 99% significance. Particularly, one more international student increases a student's course grade by 9.59 points, which is almost a letter grade.

We also find evidence that racial diversity in a group project influences a student's overall course grade. Specifically, we observe that including an additional Hispanic student in the group increases a student's grade by 1.86 points. While, having one more black or African-American student has a weakly negative impact on a student's grade, decreasing it by 1.49 points, on average.

We further note that students who self-report at American Indian or Alaskan native or Asian generally outperform other students by 10.03 points and 9.05 points, respectively. International students also receive higher grades, on average, by 5.16 points.

Our results do not indicate that gender diversity in a group project influences individual student grades. We also do not find evidence of grade disparity between female and male students.

Table 6
Course Grade Regressions

	I	II	III	IV	V	VI	VII	VIII
Project	1.0465 (3.99)	0.2583 (4.21)	1.0267 (4.00)	1.3969 (3.99)	1.8558 (4.00)	0.8535 (4.00)	0.4558 (3.99)	0.9465 (3.99)
Count of Females	0.5658 (0.55)	0.5690 (0.55)	0.5348 (0.55)	0.6181 (0.55)	0.5155 (0.55)	0.5882 (0.55)	0.3113 (0.55)	
Count of Races		0.5520 (0.93)						
Count of White			-0.3524 (0.58)					
Count of Black				-1.4869* (0.78)				
Count of Hispanic					1.8554** (0.74)			
Count of Asian						-2.1874 (2.59)		

Count of Int'l students							9.5907*** (3.26)	
Count of Same Major	0.8509 (0.87)	0.9455 (0.89)	0.8844 (0.88)	0.8353 (0.87)	0.7956 (0.87)	0.9011 (0.88)	1.2742 (0.88)	0.8032 (0.87)
Group Size	-0.1875 (0.98)	-0.3284 (1.01)	0.0221 (1.04)	-0.0846 (0.99)	-0.7391 (1.01)	-0.1474 (0.99)	-0.1966 (0.98)	0.0758 (0.95)
Instructor (Instructor 1=1)	3.9254*** (0.85)	3.9284*** (0.85)	3.9240*** (0.85)	3.8836*** (0.85)	3.8852*** (0.85)	3.9712*** (0.85)	3.8753*** (0.85)	3.9117*** (0.85)
Semester-Year	-0.5979** (0.29)	-0.5949** (0.29)	-0.5935** (0.29)	-0.6252** (0.29)	-0.5783** (0.29)	-0.5864** (0.29)	-0.6612** (0.29)	-0.5874** (0.29)
Cum. GPA	12.4291*** (0.63)	12.4225*** (0.63)	12.4216*** (0.63)	12.4796*** (0.63)	12.4794*** (0.63)	12.4334*** (0.63)	12.4951*** (0.63)	12.4585*** (0.63)
Attempted Hours	0.0155 (0.17)	0.0126 (0.17)	0.0136 (0.17)	0.0167 (0.17)	0.0127 (0.17)	0.0194 (0.17)	0.0160 (0.17)	0.0165 (0.17)
Female Student = 1	0.1288 (0.84)	0.1428 (0.84)	0.1131 (0.84)	0.1648 (0.84)	0.1278 (0.84)	0.1478 (0.84)	-0.1140 (0.84)	-0.1472 (0.80)
American Indian or Alaskan Native	10.0345** (5.04)	9.8419* (5.05)	10.2027** (5.05)	10.0322** (5.04)	9.8247* (5.03)	10.3432** (5.06)	8.6884* (5.05)	10.1062** (5.04)
Asian	9.0507*** (3.26)	8.8739*** (3.27)	9.3067*** (3.28)	8.8584*** (3.26)	9.2324*** (3.25)	7.6884** (3.64)	8.0218** (3.27)	9.1296*** (3.26)
Black or African American	-1.4928 (1.22)	-1.6291 (1.24)	-1.3462 (1.24)	-2.0860* (1.25)	-1.4908 (1.21)	-1.5402 (1.22)	-1.4106 (1.21)	-1.4681 (1.22)
Hispanic	1.2894 (1.00)	1.1890 (1.01)	1.4770 (1.05)	1.3367 (1.00)	2.3412** (1.08)	1.2619 (1.00)	1.0817 (1.00)	1.2860 (1.00)
International	5.1569* (3.02)	4.9647 (3.04)	5.3082* (3.03)	5.0919* (3.02)	4.6994 (3.02)	5.3331* (3.03)	12.5022*** (3.91)	5.2230* (3.02)
Two or More	-0.5258 (1.98)	-0.6725 (1.99)	-0.2969 (2.01)	-0.3707 (1.98)	-0.4884 (1.97)	-0.5713 (1.98)	-0.6357 (1.97)	-0.5507 (1.98)
Unknown or Not Reported	-0.7283 (5.47)	-0.8809 (5.48)	-0.4821 (5.49)	-0.8061 (5.47)	-0.8872 (5.46)	-0.7592 (5.47)	-0.7519 (5.46)	-0.8277 (5.47)
R^2	0.300	0.300	0.300	0.302	0.304	0.301	0.305	0.300
Observations	1202	1202	1202	1202	1202	1202	1202	1202

Note: The dependent variable across all specifications is the overall course grade of a student. Estimates are conditional on the student being subject to the project. Standard errors are reported in parentheses below the coefficients. * p<.10, ** p<.05, *** p<.01.

To account for student performance within the group, we consider their peer evaluation scores as research shows that peer assessments are valid and reliable tools in measuring student contribution (Yoon et al. 2018; Wahawisan et al. 2016). We estimate the following regression.

$$\text{Course Grade}_i = \alpha + \beta_1 \text{Peer Evaluation Score}_i + \beta_2 (\text{Group Dynamics Measure}i) + C_i + \varepsilon_i \quad (3)$$

We limit our sample to only contain those who participated in the project, and we use the same measures for Group Dynamics and controls as in Equation 2. Table 7 shows the regression estimates of Equation 3.

Accounting for the peer evaluation score and focusing only on those who participated on the project, our findings remain generally consistent. Particularly, we find that having an additional Hispanic student in the group raises a student's grade by 1.45 points, on average. Having one more international student in the group significantly increases a student's grade by 6.08 points. We find that once we consider peer evaluation scores, we do not find evidence of the negative impact of having black or African-American students in the group. We also still find no evidence of gender diversity influencing a student's overall grade.

We further find that students with better peer evaluation scores earn higher overall course grades. Specifically, a one-point increase in a student's peer evaluation score increases their overall course grade by 0.26 points. This finding coincides with previous research. In their meta-analysis, Li et al. (2019) synthesized results from 58 studies and found that students participating in peer assessments show increased performance. Other studies also conclude that peer evaluations promote engagement and participation (Alt and Raichel, 2020; Zhang, 2012).

Alt and Raichel (2020) imply that social interactions and peer assessments are positively correlated as it demonstrates the collaboration among students. Therefore, considering that peer evaluations can accurately represent student social and teamwork skills, we surmise from our findings that students who are better team players benefit more in a collaborative environment.

We also observe that Asian and international students generally outperform other students, on average, by 9.45 and 12.57 points, respectively. This is consistent when considering all students (those who have and have not participated in the project). When only focusing on the students who completed the project, we find that Hispanic students also earn a higher grade relative to an average white student by 2.27 points.

Table 7
Peer Evaluation Effect on Overall Grade

	I	II	III	IV	V	VI	VII	VIII
Peer Evaluation	0.2630*** (0.02)	0.2629*** (0.02)	0.2634*** (0.02)	0.2623*** (0.02)	0.2608*** (0.02)	0.2613*** (0.02)	0.2616*** (0.02)	0.2630*** (0.02)
Count of Females	0.0138 (0.48)	0.0202 (0.48)	-0.0274 (0.48)	0.0363 (0.48)	-0.0342 (0.48)	0.0272 (0.48)	-0.1096 (0.48)	
Count of Races		0.3844 (0.76)						
Count of White			-0.5476 (0.50)					
Count of Black				-0.5840 (0.71)				
Count of Hispanic					1.4469** (0.63)			
Count of Asian						-2.2113 (2.20)		

Count of Int'l students							6.0826** (2.90)	
Count of Same-Major	-0.0112 (0.67)	0.0482 (0.68)	0.0261 (0.67)	-0.0127 (0.67)	-0.0486 (0.67)	0.0449 (0.67)	0.2141 (0.68)	-0.0121 (0.67)
Group Size	0.7707 (0.78)	0.6727 (0.80)	1.1017 (0.84)	0.8185 (0.78)	0.4080 (0.79)	0.7996 (0.78)	0.7110 (0.77)	0.7767 (0.75)
Instructor (Instructor 1=1)	2.7506*** (1.03)	2.7456*** (1.03)	2.7175*** (1.03)	2.7192*** (1.03)	2.5830** (1.02)	2.8431*** (1.03)	2.7796*** (1.02)	2.7508*** (1.03)
Semester-Year	0.8181 (0.61)	0.8313 (0.61)	0.8520 (0.61)	0.7844 (0.61)	0.9584 (0.61)	0.8407 (0.61)	0.5950 (0.62)	0.8191 (0.61)
Cum. GPA	8.0199*** (0.77)	8.0067*** (0.77)	7.9943*** (0.77)	8.0494*** (0.77)	8.1438*** (0.77)	8.0987*** (0.77)	8.0403*** (0.77)	8.0222*** (0.77)
Attempted Hours	0.1312 (0.22)	0.1284 (0.22)	0.1299 (0.22)	0.1258 (0.22)	0.1299 (0.22)	0.1465 (0.22)	0.1332 (0.22)	0.1312 (0.22)
Female Student = 1	0.9703 (1.04)	0.9940 (1.04)	0.9857 (1.04)	0.9734 (1.04)	1.0240 (1.03)	0.9516 (1.04)	0.9418 (1.03)	0.9761 (1.02)
American Indian or Alaskan Native	4.1940 (10.14)	3.3929 (10.27)	3.1296 (10.19)	4.0838 (10.14)	3.4092 (10.09)	6.3393 (10.36)	-1.1972 (10.42)	4.2002 (10.13)
Asian	9.4454** (3.89)	9.1247** (3.94)	9.5736** (3.89)	9.2939** (3.89)	9.7675** (3.87)	9.3091** (3.89)	7.8568** (3.94)	9.4477** (3.88)
Black or African American	-2.0587 (1.56)	-2.3270 (1.65)	-2.4132 (1.60)	-1.6505 (1.64)	-2.0391 (1.55)	-2.2038 (1.57)	-1.9879 (1.56)	-2.0579 (1.56)
Hispanic	2.2680* (1.24)	2.0813 (1.29)	2.1286* (1.24)	2.3177* (1.24)	2.0478* (1.23)	2.2088* (1.24)	1.8778 (1.25)	2.2679* (1.24)
International	12.5706*** (4.59)	12.0564** (4.71)	11.9539** (4.63)	12.4463*** (4.60)	11.2811** (4.60)	13.3173*** (4.65)	13.0572*** (4.58)	12.5752*** (4.58)
Two or More	-2.1816 (2.60)	-2.4815 (2.67)	-2.1894 (2.60)	-2.0074 (2.61)	-2.0743 (2.59)	-2.3192 (2.60)	-2.3527 (2.59)	-2.1797 (2.59)
Unknown or Not Reported	4.5019 (7.18)	4.2342 (7.21)	4.6587 (7.18)	4.4323 (7.19)	4.2284 (7.15)	4.3498 (7.18)	4.8028 (7.15)	4.4951 (7.17)
R^2	0.522	0.522	0.524	0.523	0.528	0.523	0.527	0.522
Observations	429	429	429	429	429	429	429	429

Note: The dependent variable across all specifications is the overall course grade of a student. Sample only focuses on students who participated in the project. Standard errors are reported in parentheses below the coefficients. * p<.10, ** p<.05, *** p<.01.

CONCLUSION

This paper has shown the effects of gender and racial diversity on team performance and individual student course grades in an undergraduate applied statistics course. Groups that have more females generally perform better, while individual students benefit more from working with a racially-diverse group.

Considering that peer evaluations accurately measure social skills, we posit that students who are better team players receive higher course grades. This observation supports research on

the complementarity between social and cognitive skills, where more socially-skilled students learn more under a collaborative work environment.

Our findings suggest that instructors should consider the benefits of implementing a Team-Based Learning framework into their classes as it positively influences both team and student performance. However, when doing so, instructors should be mindful of the potential group dynamics. Specifically, our observations imply that encouraging group diversity fosters student learning, therefore, instructors could improve collaborative learning by being mindful of student group compositions. We also believe that providing students with opportunities to develop their social skills could enhance learning due to the complementarity between social and cognitive skills.

Overall, our paper contributes to the literature by examining the effects of Team-Based Learning in an applied business statistics course. Our findings provide further support for its effectiveness, extending the literature on how group composition can affect both team and student performance.

We acknowledge that our findings are limited to the data gathered from a single regional public university. Research using a broader set of data collected from multiple universities could yield more accurate student representation and results. We also encourage future research to include a survey of students to further elaborate on group dynamics, such as the implications of varying socio-economic background on teamwork.

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