

The Effects of Gender and Ethnicity on Students' Perceptions of Small-Group Work in Collegiate Mathematics Courses



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Motivation

- Small-group work prepares students for team work in future careers.
- Working with people of different genders and ethnicities is challenging.
- Mathematics courses are essential to success in all STEM fields.
- What roles do gender and ethnicity play in small-group work in mathematics courses?



Introduction

- Most available research is quantitative in nature.
- A qualitative survey assesses how and why small-group learning is beneficial for students' success in mathematics.
- Why do women and minorities benefit from small-group learning in their mathematics courses?
- 114 Likert scale surveys: To analyze students' perceptions of small-group learning in their math courses.



**STUDENT QUESTIONNAIRE :
PERCEPTIONS OF SMALL -GROUP WORK IN M A T H E M A T I C S C O U R S E S**

Math Instructor: _____

Math Course: 097 098 104 105 107 112 120 121 122 223

Gender: Male Female

Race/Ethnicity (please select all that apply):

- Black or African American White
 American Indian or Alaskan Native Asian
 Native Hawaiian or Other Pacific Islander Other (please specify): _____
 Hispanic or Latino _____

**Age Group
(please select one):**

- Under 18
 18 to 21
 22 to 25
 26 to 29
 Over 29

Please indicate your level of agreement to each of the following statements (circle only one for each):

SD = Strongly Disagree D = Disagree N = Neutral A = Agree SA = Strongly Agree

1. I have participated in group work in a college mathematics course before.	SD	D	N	A	SA
2. I only discuss a math problem with others once I fully understand it myself.	SD	D	N	A	SA
3. I enjoy working with other people on math problems.	SD	D	N	A	SA
4. I find that I understand a mathematical concept better once I have discussed it with other people.	SD	D	N	A	SA
5. I'm not confident enough with my math knowledge to discuss specific problems with others.	SD	D	N	A	SA
6. I would rather work in groups with people of my same gender.	SD	D	N	A	SA
7. I do not enjoy working on mathematics problems with others--math is a more solitary exercise.	SD	D	N	A	SA
8. I prefer working in groups that have both male and female members.	SD	D	N	A	SA
9. When I have no idea how to start a math problem, I find it useful to discuss possible approaches with others.	SD	D	N	A	SA
10. I feel that my ideas on how to solve a problem are valued by other group members.	SD	D	N	A	SA
11. I have never participated in group work in a college mathematics course before.	SD	D	N	A	SA
12. I find that each group member generally contributes equally to the work that needs to be done.	SD	D	N	A	SA
13. I often feel that my ideas on how to solve a problem are not valued by my group members.	SD	D	N	A	SA
14. When working in groups, I find that some people tend to do all the work while others do very little.	SD	D	N	A	SA

—PLEASE COMPLETE REVERSE SIDE—

Please provide a response to the following questions:

1. What things do you enjoy most about doing group work in this math course?

2. What things do you enjoy least about doing group work in this math course?

3. Please provide any additional information and/or comments you would like to share in the space below.

Figure 1

Methods

- Microsoft Excel
 - Student Biographical Data
 - Frequency Distributions for Survey Statements
 - Statement Modes (Highlighted in Color)
 - Transcription and Analysis of Open Response Questions
- MATLAB
 - Student's T-Test with P-Value of 0.05 to Yield a 95% Confidence Level
 - P_1 Compares All Students' Responses to Each of 8 Student Subgroups
 - P_2 Compares Non-Minority Males' Responses to Each of 8 Student Subgroups

STUDENT BIOGRAPHICAL DATA

	Male	Female	Survey Total
All Students	62 54.4%	52 45.6%	114 100.0%

	Male	Female	Survey Total
Non-Minority	52 58.4%	37 41.6%	89 78.1%
Minority	10 8.8%	15 13.2%	25 21.9%

Figure 2

Statement #1:
 I have participated in group work in a college mathematics course before.

Survey Statement #1	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
All Students (114 Total)	13 11.4%	23 20.2%	18 15.8%	34 29.8%	26 22.8%
Male Students (62 Total)	7 11.3%	8 12.9%	14 22.6%	18 29.0%	15 24.2%
Female Students (52 Total)	6 11.5%	15 28.8%	4 7.7%	16 30.8%	11 21.2%
All Non-Minority Students (89 Total)	12 13.5%	13 14.6%	13 14.6%	27 30.3%	24 27.0%
Male Non-Minority Students (52 Total)	7 13.5%	5 9.6%	10 19.2%	16 30.8%	14 26.9%
Female Non-Minority Students (37 Total)	5 13.5%	8 21.6%	3 8.1%	11 29.7%	10 27.0%
All Minority Students (25 Total)	1 4.0%	10 40.0%	5 20.0%	7 28.0%	2 8.0%
Male Minority Students (10 Total)	0 0.0%	3 30.0%	4 40.0%	2 20.0%	1 10.0%
Female Minority Students (15 Total)	1 6.7%	7 46.7%	1 6.7%	5 33.3%	1 6.7%

Table 1

Statement #11:
 (Counter Statement) I have never participated in group work in a college mathematics course before.

Yielded similar results with no significant differences.

Survey Statement #11 I have never participated in group work in a college mathematics course before.	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
All Students (114 Total)	35 30.7%	31 27.2%	13 11.4%	23 20.2%	12 10.5%
Male Students (62 Total)	21 33.9%	16 25.8%	10 16.1%	9 14.5%	6 9.7%
Female Students (52 Total)	14 26.9%	15 28.8%	3 5.8%	14 26.9%	6 11.5%
All Non-Minority Students (89 Total)	29 32.6%	27 30.3%	8 9.0%	16 18.0%	9 10.1%
Male Non-Minority Students (52 Total)	19 36.5%	15 28.8%	6 11.5%	7 13.5%	5 9.6%
Female Non-Minority Students (37 Total)	10 27.0%	12 32.4%	2 5.4%	9 24.3%	4 10.8%
All Minority Students (25 Total)	6 24.0%	4 16.0%	5 20.0%	7 28.0%	3 12.0%
Male Minority Students (10 Total)	2 20.0%	1 10.0%	4 40.0%	2 20.0%	1 10.0%
Female Minority Students (15 Total)	4 26.7%	3 20.0%	1 6.7%	5 33.3%	2 13.3%

Table 11

Statement #4:
 I find that I understand a mathematical concept better once I have discussed it with other people.

Survey Statement #4 I find that I understand a mathematical concept better once I have discussed it with other people.	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
All Students (114 Total)	3 2.6%	14 12.3%	27 23.7%	45 39.5%	25 21.9%
Male Students (62 Total)	2 3.2%	6 9.7%	12 19.4%	28 45.2%	14 22.6%
Female Students (52 Total)	1 1.9%	8 15.4%	15 28.8%	17 32.7%	11 21.2%
All Non-Minority Students (89 Total)	3 3.4%	11 12.4%	22 24.7%	33 37.1%	20 22.5%
Male Non-Minority Students (52 Total)	2 3.8%	6 11.5%	11 21.2%	21 40.4%	12 23.1%
Female Non-Minority Students (37 Total)	1 2.7%	5 13.5%	11 29.7%	12 32.4%	8 21.6%
All Minority Students (25 Total)	0 0.0%	3 12.0%	5 20.0%	12 48.0%	5 20.0%
Male Minority Students (10 Total)	0 0.0%	0 0.0%	1 10.0%	7 70.0%	2 20.0%
Female Minority Students (15 Total)	0 0.0%	3 20.0%	4 26.7%	5 33.3%	3 20.0%

Table 4

Statement #9:
 When I have no idea how to start a math problem, I find it useful to discuss possible approaches with others.

Survey Statement #9	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
When I have no idea how to start a math problem, I find it useful to discuss possible approaches with others.					
All Students (114 Total)	1 0.9%	12 10.5%	18 15.8%	51 44.7%	32 28.1%
Male Students (62 Total)	1 1.6%	6 9.7%	12 19.4%	25 40.3%	18 29.0%
Female Students (52 Total)	0 0.0%	6 11.5%	6 11.5%	26 50.0%	14 26.9%
All Non-Minority Students (89 Total)	1 1.1%	9 10.1%	13 14.6%	39 43.8%	27 30.3%
Male Non-Minority Students (52 Total)	1 1.9%	6 11.5%	10 19.2%	19 36.5%	16 30.8%
Female Non-Minority Students (37 Total)	0 0.0%	3 8.1%	3 8.1%	20 54.1%	11 29.7%
All Minority Students (25 Total)	0 0.0%	3 12.0%	5 20.0%	12 48.0%	5 20.0%
Male Minority Students (10 Total)	0 0.0%	0 0.0%	2 20.0%	6 60.0%	2 20.0%
Female Minority Students (15 Total)	0 0.0%	3 20.0%	3 20.0%	6 40.0%	3 20.0%

Table 9

Statement #7:
 I do not enjoy working on mathematics problems with others--math is a more solitary exercise.

Survey Statement #7	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
All Students (114 Total)	25 21.9%	38 33.3%	29 25.4%	19 16.7%	3 2.6%
Male Students (62 Total)	15 24.2%	21 33.9%	17 27.4%	8 12.9%	1 1.6%
Female Students (52 Total)	10 19.2%	17 32.7%	12 23.1%	11 21.2%	2 3.8%
All Non-Minority Students (89 Total)	21 23.6%	28 31.5%	23 25.8%	15 16.9%	2 2.2%
Male Non-Minority Students (52 Total)	12 23.1%	18 34.6%	13 25.0%	8 15.4%	1 1.9%
Female Non-Minority Students (37 Total)	9 24.3%	10 27.0%	10 27.0%	7 18.9%	1 2.7%
All Minority Students (25 Total)	4 16.0%	10 40.0%	6 24.0%	4 16.0%	1 4.0%
Male Minority Students (10 Total)	3 30.0%	3 30.0%	4 40.0%	0 0.0%	0 0.0%
Female Minority Students (15 Total)	1 6.7%	7 46.7%	2 13.3%	4 26.7%	1 6.7%

Table 7

Statement #5:
 I'm not confident enough with my math knowledge to discuss specific problems with others.

Survey Statement #5	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
I'm not confident enough with my math knowledge to discuss specific problems with others.					
All Students (114 Total)	25 21.9%	55 48.2%	17 14.9%	14 12.3%	3 2.6%
Male Students (62 Total)	15 24.2%	31 50.0%	7 11.3%	8 12.9%	1 1.6%
Female Students (52 Total)	10 19.2%	24 46.2%	10 19.2%	6 11.5%	2 3.8%
All Non-Minority Students (89 Total)	20 22.5%	46 51.7%	8 9.0%	12 13.5%	3 3.4%
Male Non-Minority Students (52 Total)	11 21.2%	29 55.8%	3 5.8%	8 15.4%	1 1.9%
Female Non-Minority Students (37 Total)	9 24.3%	17 45.9%	5 13.5%	4 10.8%	2 5.4%
All Minority Students (25 Total)	5 20.0%	9 36.0%	9 36.0%	2 8.0%	0 0.0%
Male Minority Students (10 Total)	4 40.0%	2 20.0%	4 40.0%	0 0.0%	0 0.0%
Female Minority Students (15 Total)	1 6.7%	7 46.7%	5 33.3%	2 13.3%	0 0.0%

Table 5

Statement #6:
 I would rather work in groups with people of my same gender.

Survey Statement #6	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
I would rather work in groups with people of my same gender.					
All Students (114 Total)	27 23.7%	41 36.0%	39 34.2%	5 4.4%	2 1.8%
Male Students (62 Total)	14 22.6%	23 37.1%	21 33.9%	2 3.2%	2 3.2%
Female Students (52 Total)	13 25.0%	18 34.6%	18 34.6%	3 5.8%	0 0.0%
All Non-Minority Students (89 Total)	21 23.6%	28 31.5%	35 39.3%	3 3.4%	2 2.2%
Male Non-Minority Students (52 Total)	11 21.2%	18 34.6%	20 38.5%	1 1.9%	2 3.8%
Female Non-Minority Students (37 Total)	10 27.0%	10 27.0%	15 40.5%	2 5.4%	0 0.0%
All Minority Students (25 Total)	6 24.0%	13 52.0%	4 16.0%	2 8.0%	0 0.0%
Male Minority Students (10 Total)	3 30.0%	5 50.0%	1 10.0%	1 10.0%	0 0.0%
Female Minority Students (15 Total)	3 20.0%	8 53.3%	3 20.0%	1 6.7%	0 0.0%

Table 6

Statement #8:

(Counter Statement)

I prefer working in groups that have both male and female members.

Yielded same results with no significant differences.

Survey Statement #8	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
I prefer working in groups that have both male and female members.					
All Students (114 Total)	1 0.9%	4 3.5%	48 42.1%	41 36.0%	20 17.5%
Male Students (62 Total)	1 1.6%	1 1.6%	23 37.1%	25 40.3%	12 19.4%
Female Students (52 Total)	0 0.0%	3 5.8%	25 48.1%	16 30.8%	8 15.4%
All Non-Minority Students (89 Total)	1 1.1%	3 3.4%	39 43.8%	31 34.8%	15 16.9%
Male Non-Minority Students (52 Total)	1 1.9%	1 1.9%	20 38.5%	20 38.5%	10 19.2%
Female Non-Minority Students (37 Total)	0 0.0%	2 5.4%	19 51.4%	11 29.7%	5 13.5%
All Minority Students (25 Total)	0 0.0%	1 4.0%	9 36.0%	10 40.0%	5 20.0%
Male Minority Students (10 Total)	0 0.0%	0 0.0%	3 30.0%	5 50.0%	2 20.0%
Female Minority Students (15 Total)	0 0.0%	1 6.7%	6 40.0%	5 33.3%	3 20.0%

Table 8

Statement #13:
 I often feel that my ideas on how to solve a problem are not valued by my group members.

Survey Statement #13	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
I often feel that my ideas on how to solve a problem are not valued by my group members.					
All Students (114 Total)	16 14.0%	55 48.2%	36 31.6%	7 6.1%	0 0.0%
Male Students (62 Total)	9 14.5%	29 46.8%	20 32.3%	4 6.5%	0 0.0%
Female Students (52 Total)	7 13.5%	26 50.0%	16 30.8%	3 5.8%	0 0.0%
All Non-Minority Students (89 Total)	14 15.7%	40 44.9%	29 32.6%	6 6.7%	0 0.0%
Male Non-Minority Students (52 Total)	8 15.4%	22 42.3%	18 34.6%	4 7.7%	0 0.0%
Female Non-Minority Students (37 Total)	6 16.2%	18 48.6%	11 29.7%	2 5.4%	0 0.0%
All Minority Students (25 Total)	2 8.0%	15 60.0%	7 28.0%	1 4.0%	0 0.0%
Male Minority Students (10 Total)	1 10.0%	7 70.0%	2 20.0%	0 0.0%	0 0.0%
Female Minority Students (15 Total)	1 6.7%	8 53.3%	5 33.3%	1 6.7%	0 0.0%

Table 13

Statement #10:
 I feel that my ideas on how to solve a problem are valued by other group members.

Survey Statement #10	Number & Percentage of Students' Responses by Group				
I feel that my ideas on how to solve a problem are valued by other group members.	SD	D	N	A	SA
All Students (114 Total)	2 1.8%	5 4.4%	34 29.8%	57 50.0%	16 14.0%
Male Students (62 Total)	0 0.0%	1 1.6%	15 24.2%	36 58.1%	10 16.1%
Female Students (52 Total) $p_2=0.010$	2 3.8%	4 7.7%	19 36.5%	21 40.4%	6 11.5%
All Non-Minority Students (89 Total)	2 2.2%	5 5.6%	24 27.0%	44 49.4%	14 15.7%
Male Non-Minority Students (52 Total)	0 0.0%	1 1.9%	12 23.1%	30 57.7%	9 17.3%
Female Non-Minority Students (37 Total) $p_2=0.012$	2 5.4%	4 10.8%	12 32.4%	14 37.8%	5 13.5%
All Minority Students (25 Total)	0 0.0%	0 0.0%	10 19.2%	13 25.0%	2 3.8%
Male Minority Students (10 Total)	0 0.0%	0 0.0%	3 8.1%	6 16.2%	1 2.7%
Female Minority Students (15 Total)	0 0.0%	0 0.0%	7 46.7%	7 46.7%	1 6.7%

Table 10

Statement #2:
 I only discuss a math problem with others once I fully understand it myself.

Survey Statement #2	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
I only discuss a math problem with others once I fully understand it myself.					
All Students (114 Total)	15 13.2%	48 42.1%	25 21.9%	22 19.3%	4 3.5%
Male Students (62 Total)	9 14.5%	28 45.2%	13 21.0%	10 16.1%	2 3.2%
Female Students (52 Total)	6 11.5%	20 38.5%	12 23.1%	12 23.1%	2 3.8%
All Non-Minority Students (89 Total)	15 16.9%	42 47.2%	15 16.9%	13 14.6%	4 4.5%
Male Non-Minority Students (52 Total)	9 17.3%	25 48.1%	9 17.3%	7 13.5%	2 3.8%
Female Non-Minority Students (37 Total)	6 16.2%	17 45.9%	6 16.2%	6 16.2%	2 5.4%
All Minority Students (25 Total) $p_1=0.017 / p_2=0.003$	0 0.0%	6 24.0%	10 40.0%	9 36.0%	0 0.0%
Male Minority Students (10 Total)	0 0.0%	3 30.0%	4 40.0%	3 30.0%	0 0.0%
Female Minority Students (15 Total) $p_1=0.030 / p_2=0.007$	0 0.0%	3 20.0%	6 40.0%	6 40.0%	0 0.0%

Table 2

Statement #3:
 I enjoy working
 with other people
 on math
 problems.

Survey Statement #3	Number & Percentage of Students' Responses by Group				
I enjoy working with other people on math problems.	SD	D	N	A	SA
All Students (114 Total)	5 4.4%	14 12.3%	25 21.9%	41 36.0%	29 25.4%
Male Students (62 Total)	1 1.6%	5 8.1%	14 22.6%	26 41.9%	16 25.8%
Female Students (52 Total)	4 7.7%	9 17.3%	11 21.2%	15 28.8%	13 25.0%
All Non-Minority Students (89 Total)	4 4.5%	8 9.0%	21 23.6%	31 34.8%	25 28.1%
Male Non-Minority Students (52 Total)	1 1.9%	5 9.6%	12 23.1%	20 38.5%	14 26.9%
Female Non-Minority Students (37 Total)	3 9.7%	3 9.7%	9 29.0%	11 35.5%	11 35.5%
All Minority Students (25 Total)	1 4.0%	6 24.0%	4 16.0%	10 40.0%	4 16.0%
Male Minority Students (10 Total)	0 0.0%	0 0.0%	2 20.0%	6 60.0%	2 20.0%
Female Minority Students (15 Total) $p_1=0.037 / p_2=0.015$	1 6.7%	6 40.0%	2 13.3%	4 26.7%	2 13.3%

Table 3

Statement #12:
 I find that each group member generally contributes equally to the work that needs to be done.

Survey Statement #12 I find that each group member generally contributes equally to the work that needs to be done.	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
All Students (114 Total)	18 15.8%	32 28.1%	34 29.8%	25 21.9%	5 4.4%
Male Students (62 Total)	11 17.7%	18 29.0%	17 27.4%	12 19.4%	4 6.5%
Female Students (52 Total)	7 13.5%	14 26.9%	17 32.7%	13 25.0%	1 1.9%
All Non-Minority Students (89 Total)	16 18.0%	31 34.8%	23 25.8%	18 20.2%	1 1.1%
Male Non-Minority Students (52 Total)	11 21.2%	18 34.6%	13 25.0%	9 17.3%	1 1.9%
Female Non-Minority Students (37 Total)	5 13.5%	13 35.1%	10 27.0%	9 24.3%	0 0.0%
All Minority Students (25 Total) $p_1=0.006 / p_2=0.001$	2 8.0%	1 4.0%	11 44.0%	7 28.0%	4 16.0%
Male Minority Students (10 Total) $p_1=0.001 / p_2=0.000$	0 0.0%	0 0.0%	4 40.0%	3 30.0%	3 30.0%
Female Minority Students (15 Total) $p_2=0.053$	2 13.3%	1 6.7%	7 46.7%	4 26.7%	1 6.7%

Table 12

Statement #14:
 When working in groups, I find that some people tend to do all the work while others do very little.

Survey Statement #14	Number & Percentage of Students' Responses by Group				
	SD	D	N	A	SA
When working in groups, I find that some people tend to do all the work while others do very little.					
All Students (114 Total)	1 0.9%	13 11.4%	39 34.2%	48 42.1%	13 11.4%
Male Students (62 Total)	1 1.6%	8 12.9%	21 33.9%	26 41.9%	6 9.7%
Female Students (52 Total)	0 0.0%	5 9.6%	18 34.6%	22 42.3%	7 13.5%
All Non-Minority Students (89 Total)	1 1.1%	10 11.2%	27 30.3%	40 44.9%	11 12.4%
Male Non-Minority Students (52 Total)	1 1.9%	5 9.6%	15 28.8%	25 48.1%	6 11.5%
Female Non-Minority Students (37 Total)	0 0.0%	5 13.5%	12 32.4%	15 40.5%	5 13.5%
All Minority Students (25 Total)	0 0.0%	3 12.0%	12 48.0%	8 32.0%	2 8.0%
Male Minority Students (10 Total) $p_1=0.013 / p_2=0.011$	0 0.0%	3 30.0%	6 60.0%	1 10.0%	0 0.0%
Female Minority Students (15 Total)	0 0.0%	0 0.0%	6 40.0%	7 46.7%	2 13.3%

Table 14

Open Response Questions

- Four groups of students that responded to these questions:
 - Minority Females
 - Minority Males
 - Non-Minority Females
 - Non-Minority Males
- Small-group work is beneficial to understanding mathematical concepts.
- Problems include:
 - Leader-slacker tensions
 - Working with others
 - Debating over correct answers
 - Group members getting left behind
 - Others slowing faster students down.



Conclusion

- Five statements yielded statistically different results:
 1. I feel that my ideas on how to solve a problem are valued by other group members.
 - Female students & Non-Minority Females: Neutral or Disagree
 2. I enjoy working with other people on math problems.
 - Female Minority students: Disagree
 3. I only discuss a math problem with others once I fully understand it myself.
 - Minority students & Female Minority: Agree
 4. I find that each group member generally contributes equally to the work that needs to be done.
 - Minority students & Male Minority students: Neutral or Agree
 5. When working in groups, I find that some people do all the work while others do very little.
 - Male Minority students: Neutral
- Ethnicity plays a larger role in response differences than gender does.