

Exploring Group Dynamics in a Group-Structured Computing Undergraduate Research Experience

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2023-11-24

Background & Motivation

Undergraduate Research Experiences (URE) have been found to be beneficial in

- ▶ increasing major retention ([Bowling et al. 2004](#))
- ▶ the likelihood of graduate study ([Lopatto 2004](#))

Collaboration in computing also has benefits in

- ▶ increasing confidence in programming skills ([Bowman et al. 2019](#))
- ▶ increasing feelings of belonging ([Stout, Tamer, and Alvarado 2018](#))

How about collaboration in URE?

- ▶ Benefits and drawbacks of working in a group in the context of URE in computing.
- ▶ Concrete suggestions for how to make these experiences successful.

ERSP: Early Research Scholars Program @ UCSD

A group-based research program for second year students in computer science and engineering majors¹

- ▶ Groups of 2~4 CSE students working on an academic-year-long research project provided by faculty mentors.
- ▶ Groups are decided based on common interest and availability to meet weekly with a mentor.



¹<https://ersp.eng.ucsd.edu>

The Study

Research Questions

- ▶ **RQ1:** How does working in a research group in this context affect students sense of belonging and support in computing?
- ▶ **RQ2:** What are the successes and struggles of working in groups of 2 to 4 in a computing URE?
- ▶ **RQ3:** Do these experiences vary based on demographic factors and group composition?

Data Collection

115 students from 3 cohorts of ERSP participants

- ▶ UC San Diego (2019-2020), UC San Diego (2020-2021), UC Santa Barbara (2019-2020)

Survey-based approach with **Likert-style questions** and **open-ended** prompts

- ▶ The same survey questions distributed at the beginning of ERSP (three months into the program), and at the end of ERSP (few weeks before the end of the program)

Sample questions (Likert-style)

- ▶ "Overall, how well does your group function?"
- ▶ "To what extent do you feel that group members are contributing equally to the success of the project?"
- ▶ "Does your team help or hinder your feelings of being supported?"
- ▶ "Does your team help or hinder your feeling of belonging in computing?"

Data Analysis Methods

Qualitative thematic analysis on the open-ended responses

- ▶ Two coders (the first two authors)
- ▶ Multiple codes were applied to a student's entire response to a single question on one survey.
- ▶ Cycles of independent coding and discussion until an inter-rater reliability of 0.8 on a new set of data prior to discussion.
- ▶ The coders then each independently coded half of the remaining responses.

After coding was completed

- ▶ Codes were grouped into higher-level themes.
- ▶ Excerpts were extracted and re-examined to better understand students' reasoning behind using these codes.

Demographics

	UCSD 2020-2021	UCSD 2019-2020	UCSB 2019-2020	Total
Women	28	25	9	62
Men	21	25	7	53
Transfer	18	14	0	32
Non-transfer	31	36	16	83
Asian Amer.	24	27	-	51
Black	2	3	-	5
Hispanic/Latinx	14	6	-	20
White	2	5	-	7
Foreign Nat.	5	7	-	12
Other/Unknown	2	2	-	4
BLN	-	-	2	2
Non-BLN	-	-	14	14
Total	49	50	16	115

Quantitative Analysis: Group Function

Table 2: Responses to the survey question “Overall, how well does your group function?” at the two points in time.

Answer options	Beginning of ERSP	End of ERSP
Extremely Well	44.0% (37/84)	33.3% (28/84)
Pretty Well	45.2% (38/84)	60.7% (51/84)
Just OK	9.5% (8/84)	4.8% (4/84)
Not Well	1.2% (1/84)	1.2% (1/84)

89.2% of students said their group functioned well in the beginning, and 94.0% said well in the end.

Ratings between the two surveys were very stable.

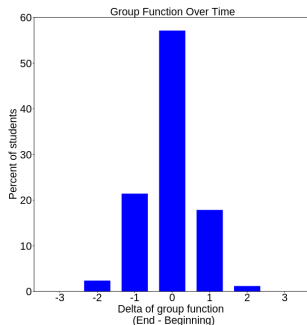
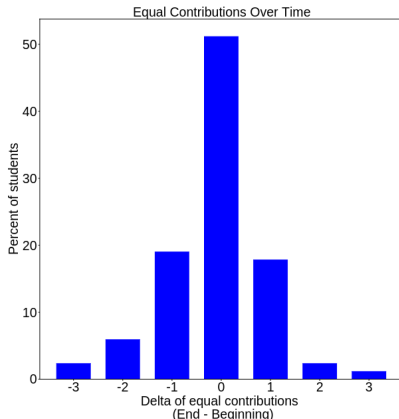


Figure 1: Histogram of the changes in individual students' responses to the question “How well does your group function?” between the two surveys. Positive numbers indicate an increase in perception of how well the group functions.

Quantitative Analysis: Equal Contributions

Table 5: Responses to the question “To what extent do you feel that group members are contributing equally to the success of the project?” at the two points in time.

Answer options	Beginning of ERSP	End of ERSP
5	23.8% (20/84)	22.6% (19/84)
4	52.4% (44/84)	47.6% (40/84)
3	17.9% (15/84)	19% (16/84)
2	6% (5/84)	10.7% (9/84)
1	0% (0/84)	0% (0/84)



- Answer options range from 1 (very unequal) to 5 (very equal)

Sense of Belonging (Quantitative)

Table 3: Responses to the question “Does your team help or hinder your feeling of belonging in computing?” at the two points in time.

Answer options	Beginning of ERSP	End of ERSP
They very much make me feel like I belong in computing	56% (47/84)	54.8% (46/84)
They somewhat make me feel like I belong in computing	23.8% (20/84)	23.8% (20/84)
They don't affect my feelings of belonging in computing	20.2% (17/84)	19.0% (16/84)
They somewhat make me feel that I DON'T belong in computing	0% (0/84)	2.4% (2/84)
They very much make me feel that I DON'T belong in computing	0% (0/84)	0% (0/84)

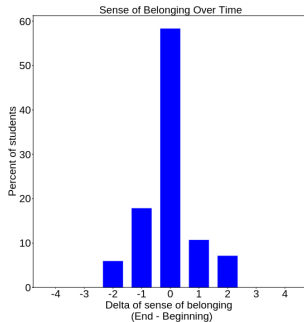


Figure 2: Histogram of the changes in individual students' responses to the question “Does your team help or hinder your feeling of belonging in computing?” between the two surveys. Positive numbers indicate a more positive perception of belonging at the end of the program.

Sense of Belonging (Qualitative)

"In what ways does your team help or hinder your feeling of belonging in computing?"

Two common sentiments:

- ▶ Being heard by their group
- ▶ Relative knowledge gap compared to others

Being heard by their group

- ▶ 45/106 responses discussed about psychological comfort and inclusion in their group.
- ▶ 15/45 students reported that their team had "no negative judgements."

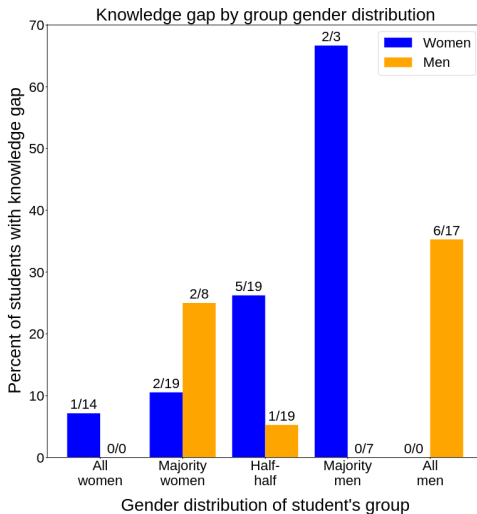
Sense of Belonging: Knowledge Gap

Students who felt a knowledge gap expressed negative (3 students), neutral (9 students), mixed (5 students), or even positive emotions (3 students).

- ▶ *There are very large knowledge gaps between me and members of my team so I feel like an annoyance and I feel out of place when most things are being discussed.*
- ▶ *My teammate is definitely a much better programmer than I am. This doesn't affect me because I'm still learning and forming good coding skills in the process.*
- ▶ *I guess you could say [my team] helps [my feelings of belonging in computing] as I aspire to do as well as they do and so it makes me want to work harder and be better.*

Knowledge Gap vs Gender Distribution in Groups

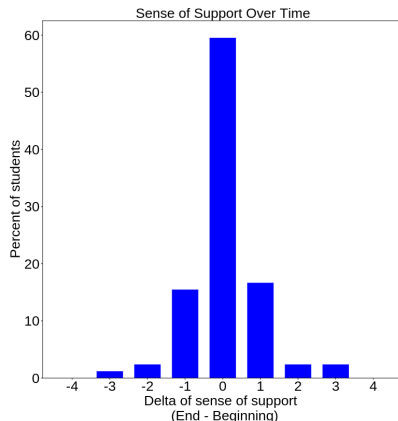
19 students reported instances of knowledge gap, 10 were women and 9 were men.



Sense of Support (Quantitative)

Table 4: Responses to the question “Does your team help or hinder your feelings of being supported?” at the two points in time.

Answer options	Beginning of ERSP	End of ERSP
They make me feel very supported	64.3% (54/84)	65.5% (55/84)
They make me feel somewhat supported	27.4% (23/84)	28.6% (24/84)
They don't affect my feelings of being supported	6% (5/84)	4.8% (4/84)
They make me feel somewhat unsupported	2.4% (2/84)	1.2% (1/84)
They make me feel very unsupported	0% (0/84)	0% (0/84)



Sense of Support (Qualitative)

"In what ways does your team help or hinder your feeling of belonging in computing?"

Two central themes:

- ▶ Common interests/struggles/feelings
- ▶ Sense of community

Common interests/struggles/feelings: 32 students reported bonding over common feelings and struggles related to CS

- ▶ *We just talk about how sometimes we are so lost in some of our classes and I guess it is reassuring that others are going through the same thing.*

Sense of Support: Community

Both shared-identity and diverse-identity groups can bring feelings of support and belonging.

- ▶ *I think that since we are an all-girls group, I felt very open about my feelings and the troubles I have in computing. Seeing reassurance from them really helped with my feeling of belonging.*
- ▶ *My team helps me feel like I belong in computing because we all come from diverse backgrounds and we are being given the opportunity to work on exciting research in machine learning together.*

Logistics

"What suggestions do you have, if any, on what would have made your team function better?"

Logistical themes

- ▶ Separating work into individual tasks
- ▶ Coordinating meetings
- ▶ Effective communications

Logistics: Division of Labor

32 students discussed how groups divided their work. 16 indicated an effective division of labor and 16 indicated an ineffective division of labor.

- ▶ *My group in general tries to be considerate about individuals schedules and abilities. We split tasks based on interest and skill, and understand that members may be able to do less when they have more tests or assignments.*
- ▶ *I think one suggestion would be a set time for getting group work done. At this point it has become 4 individual projects and it would be nice to be able to do this together!*

Logistics: Scheduling of Meetings

15 students mentioned scheduling and attendance as factors that affected how their group supports them. 5 discussed about difficulties in scheduling/attending meetings and 10 were able to regularly attend meetings.

- ▶ *Two members on my team say they are too busy to meet some days, a couple times they have not responded to my messages and left me hanging on a few meetings that they said they would come to....I really enjoyed working with them and I thought that these were all small issues that we could resolve internally.*
- ▶ *My team consistently meets on Fridays at 5pm. We update each other on what we are doing and try our best to give help.*

Logistics: Communication

21 students mentioned their team had good communication; 4 mentioned poor communication amongst group members.

- ▶ *There have been instances of protracted radio silence, so to speak, and consecutive absences from meetings. I understand that people may be experiencing issues outside of [ERSP], and I would rather not comment on their behavior.*

Discussion: Research Questions

RQ1: How does working in a research group in this context affect students sense of belonging and support in computing?

- ▶ Provided support through bonding over common feelings, shared identity, and recognizing diversity.
- ▶ Less support when teammates miss meetings and have difficulties with scheduling.
- ▶ Common for students to compare themselves to others.

RQ2: What are the successes and struggles of working in small groups in a computing URE?

- ▶ Division of labor and equal contributions
- ▶ Regular meetings

RQ3: Do these experiences vary based on demographic factors and group composition?

- ▶ Some do, especially for students who identify as women.

Conclusion

- ▶ Understand how undergraduates experience working with a group in a computing research experience.
- ▶ Encourage others to adopt a group-based approach to their UREs.

Suggestions

- ▶ Group composition is important.
- ▶ Help students manage their feelings when they compare themselves with others.
- ▶ Ensure students work together.
- ▶ Make meetings a priority.

Threats to Validity

1. Authors: two undergraduate students and the director of ERSP at UCSD. All identify as women.
 - ▶ Can better contextualize the students responses.
 - ▶ Susceptible to confirmation bias.
2. USCD and UCSB's CS department: more than 20% women, predominantly Asian.
3. Codes might not be general enough that others would not be able to learn and apply our codes.
4. It is possible that different trends would have stood out to different researchers.
5. Data comes from student self-reports.
 - ▶ Difficult to know why students did or did not mention something as important.
6. COVID happened at end of 2019-2020 cohorts and throughout 2020-2021 cohorts .
 - ▶ Nothing notable in the responses that suggests there are any COVID-specific benefits or challenges for any of the cohorts.

Thank you!