Enhancing Engineering Course Evaluations: An Intercultural Competence Intervention and Assessment Program

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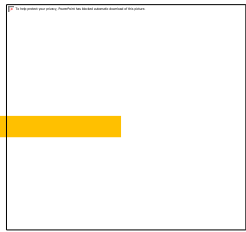
Sabine Smith & Shane Peterson



The Research Team

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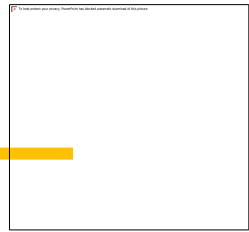
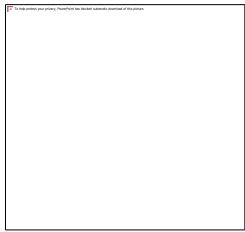


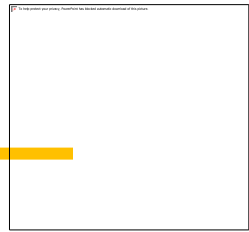
THANK YOU

Explorance for funding this study!



Introduction

- Over 7 years teaching ISYE courses with teamwork assignment “project”
- Personal observations
  - students prefer to create their own teams
  - 1-2 student groups complain about team dynamics/conflicts
  - assigned at end of semester
  - articulated in the end of semester student course evaluations
- IAB meetings: Lack of communication skills of graduates



Background

- Skills gap: “T-shaped” engineers
  - teamwork
  - intercultural competence
  - communication
- NSF 5-phase study (TUEE): Industry vs. Student Perceptions
- Accreditation (student outcomes)

ABET

Criteria for Accrediting Engineering Programs, 2016 – 2017

General Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

LR: Teamwork

- Communication as core TW skill (Kusano, Conger & Wright, 2016)
- Teamwork increasingly online and transnational: “globally dispersed teams” (Neeley, 2015)
- Students require structure, guidance & iterative feedback (Pfeifer & Stoddard, 2018)
- Faculty require “smart partnerships” (Paterson et al., 2016)

LR: UNESCO Story Circles

- Research compilation aligned with UN SDGs and subsequent methodology development: Intercultural Competencies: Conceptual and Operational Framework (UNESCO, 2013)
- Review of theory, practice, scholarship, methodology pilot-tested in five regions; reviewed and published as OER: Manual For Developing Cultural Competencies: Story Circles (Deardorff, 2020)
- Drawing on well-established practices to foster core competencies in IC development, promising for *many* contexts: (Diatta, 2020).

Objective

To enhance engineering students' IC and communication skills in a team setting via curricular changes to a semester-long, upper-level engineering course using multiple **novel** interventions:

I. Story Circles Method (2020) tailored to the engineering context
II. Practicing of IC guidelines via Preamble to team meetings: "Guiding Principles for Professional Leadership Skills in Engineering"
III. Iterative feedback: **critical** & technical

Method: Participants

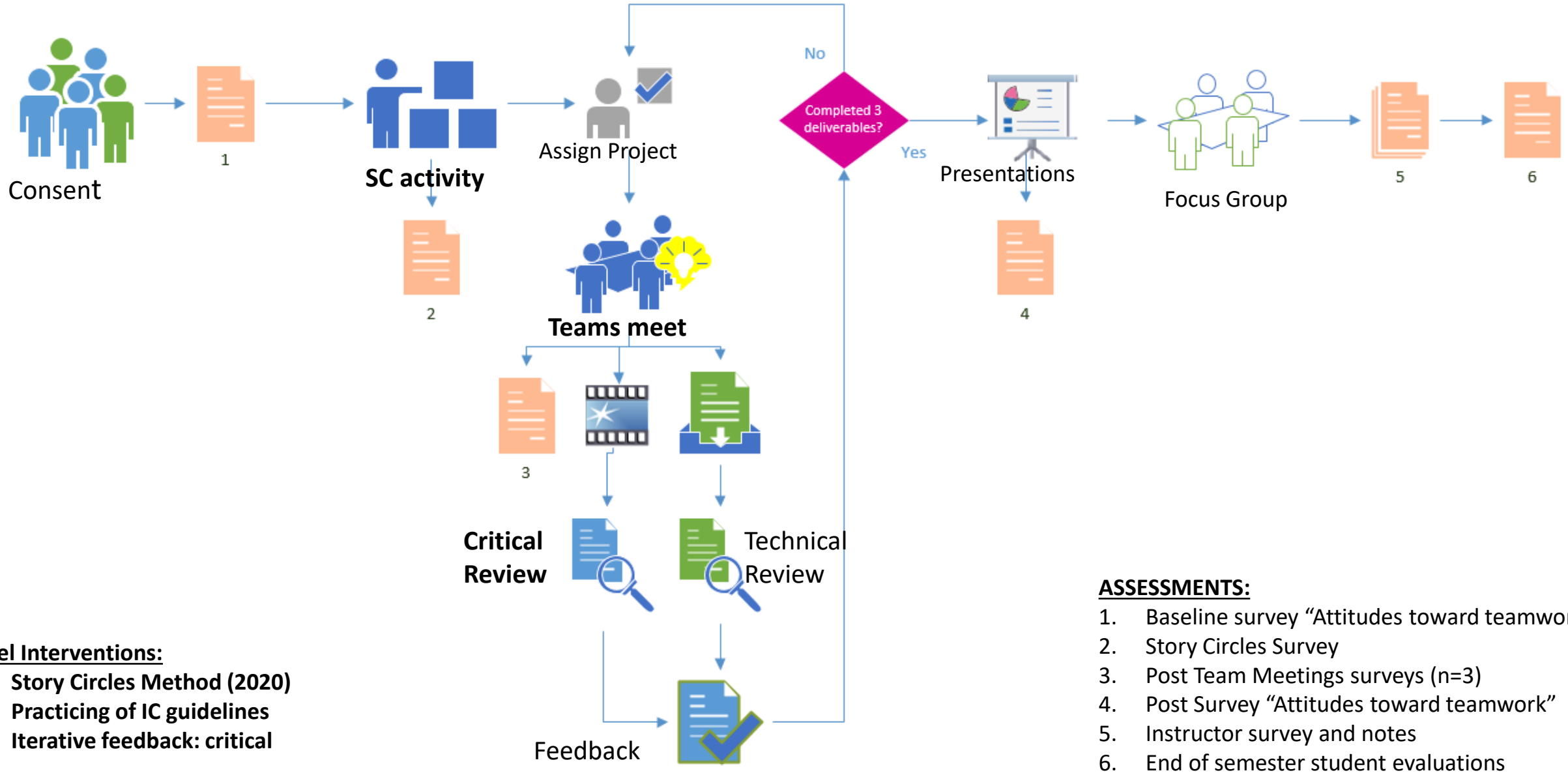
- 31 undergraduate engineering students enrolled in IYSE 3125: Statistical Quality Control in spring 2021 participated (1≥ survey)

- **Distribution of participants' number (percentage) by sex, rank, ethnicity, class modality, and cultural background.**

Sex	Men	Women		
	20 (65%)	11 (35%)		
Modality	In person	Online		
	9 (29%)	22 (71%)		
Rank*	Sophomore	Junior	Senior	
	1 (5%)	6 (30%)	13 (65%)	
Background*	US born	Foreign born		
	14 (70%)	6 (30%)		
Ethnicity*	White	African American	Latinx	Asian
	7 (35%)	5 (25%)	3 (15%)	5 (25%)

Note: asterisk information does not reflect data from all the participants (n=20)

Method: Process



Novel Interventions:

I. **Story Circles Method (2020)**
II. **Practicing of IC guidelines**
III. **Iterative feedback: critical**

ASSESSMENTS:

1. Baseline survey "Attitudes toward teamwork"
2. Story Circles Survey
3. Post Team Meetings surveys (n=3)
4. Post Survey "Attitudes toward teamwork"
5. Instructor survey and notes
6. End of semester student evaluations

Method: Story Circles Activity

- Introduction to Story Circles – why and how?
- Grounding Question
  - Think of someone who gets along well with others
- Small Groups with prompts:
  1. In one minute talk about your name
  2. In two minutes describe a time when you had a team assignment with partners who were different from you
  3. Flashbacks
- Discussion in small groups
- Debriefing in big group

Guiding Principles for Professional Leadership Skills in Engineering

*As part of your recording, please **read aloud** the following statement at the beginning of each team meeting, **taking turns** reading each part:*

To become a successful engineer, I must learn to **communicate effectively and respectfully** with teammates and clients. To develop these professional leadership skills:

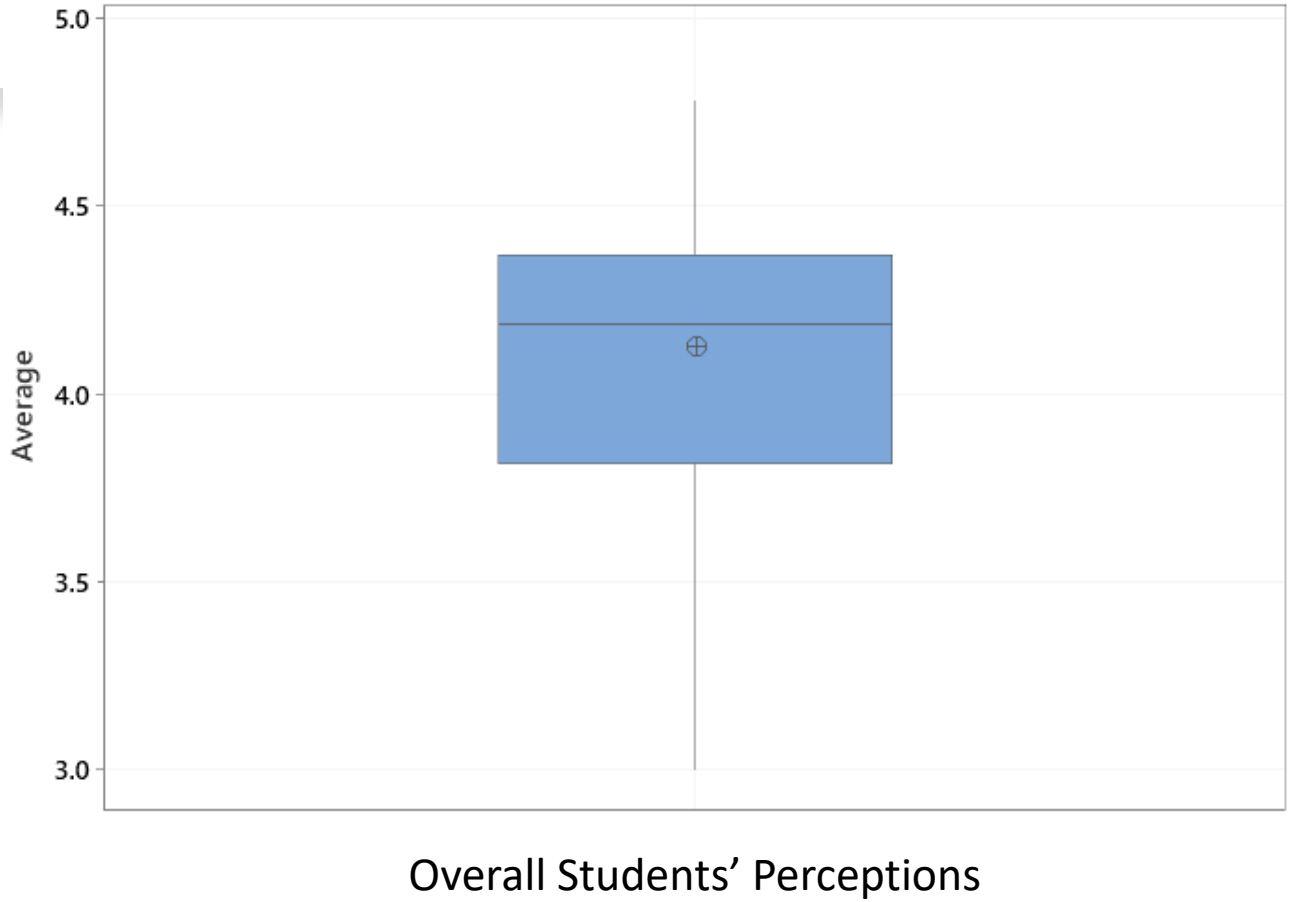
- I **listen carefully** and with an open mind to others' perspectives, even if they are different from my own or preferred views.
- I acknowledge **my own biases** and background and how they have shaped me. I also acknowledge that others may have been shaped by very different worldviews and experiences.
- I address problems, disagreements, and conflicts by analyzing the issue from my own perspective and **at least one additional and different viewpoint** before I formulate a response or determine my position.
- I **note my tone** (oral and written), facial expressions, and body language.

I strive to follow these four guidelines in both my **verbal and non-verbal communication**.

Results: Story Circles Evaluation

- 27 items
- Overall Cronbach's alpha: 0.88
- Response range: 1 (strongly disagree) to 5 (strongly agree)
- n=24
- Average = 4.075
- STD = 0.405

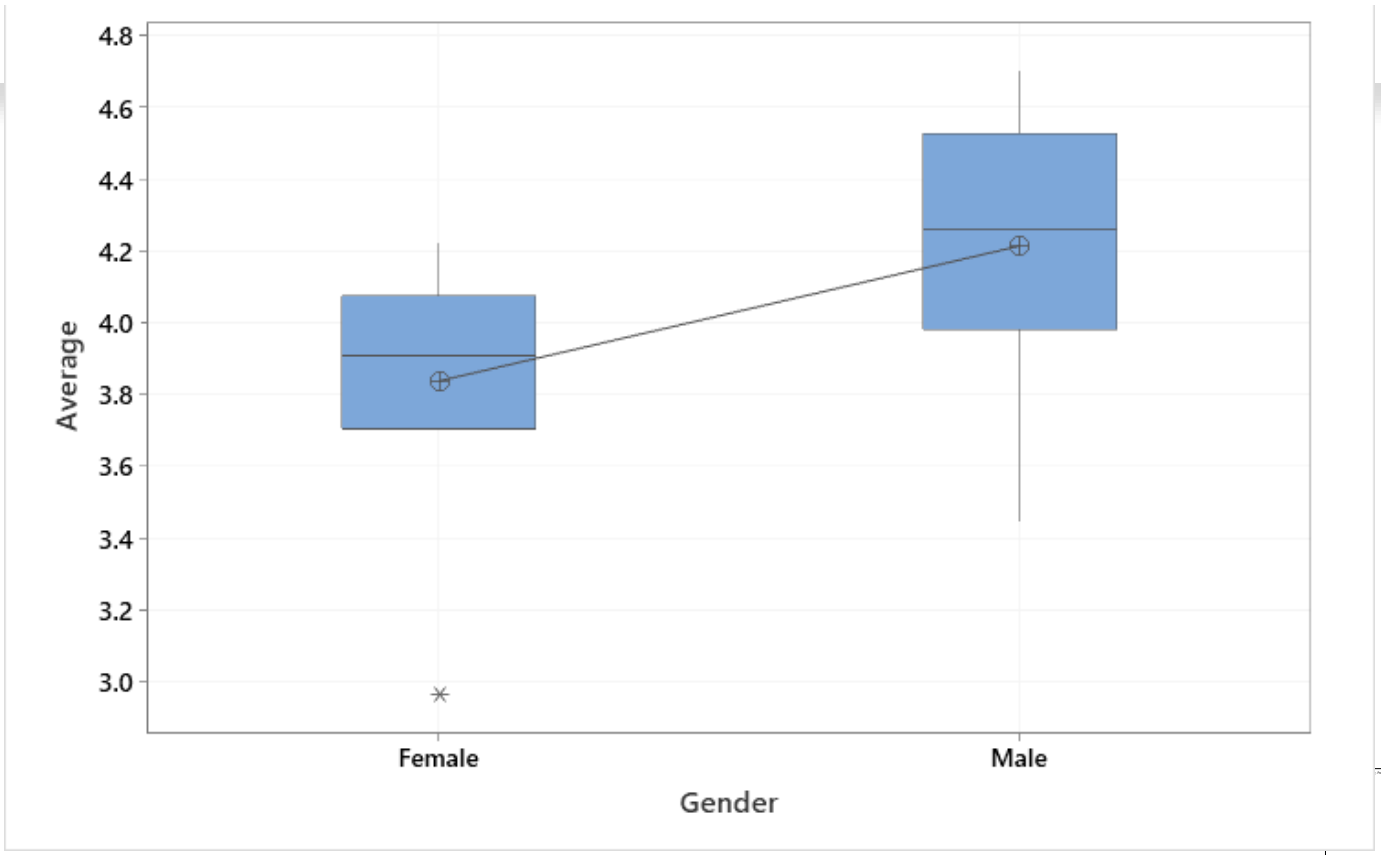
Overall



Results: Story Circles Evaluation

Gender	n	Mean	StDev
Female	10	3.837	0.355
Male	14	4.214	0.374

- p-value: 0.021



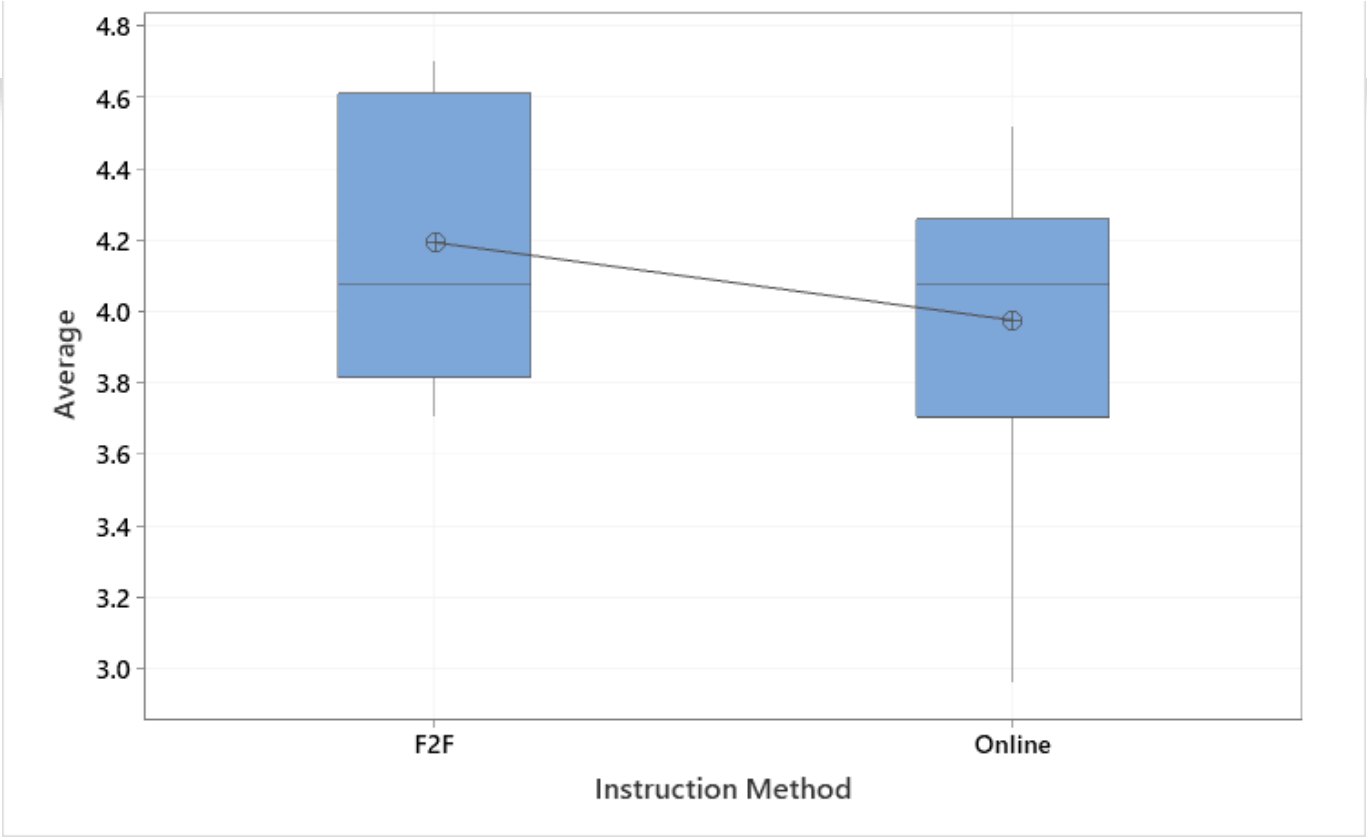
Overall Students' Perceptions by Gender

Results: Story Circles Evaluation

Instruction Mode

Method	n	Mean	StDev
F2F	9	4.194	0.388
Online	15	3.975	0.406

p-value: 0.207

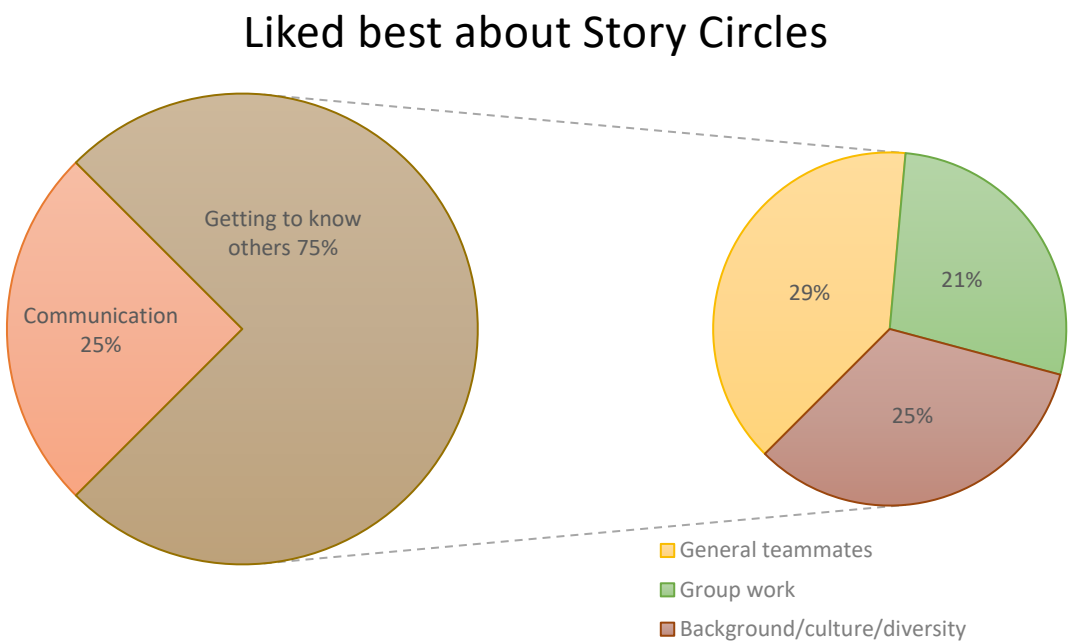


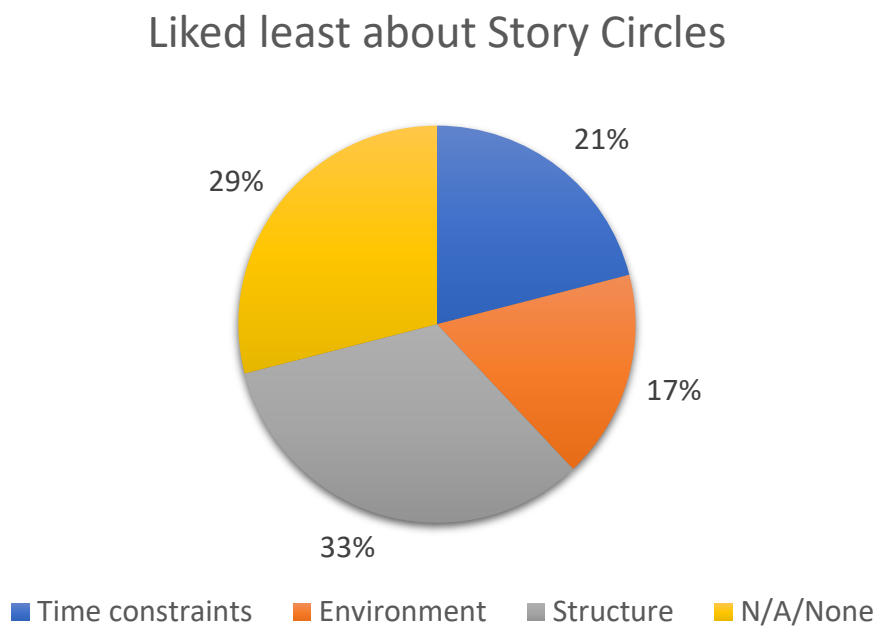
Overall Students' Perceptions by Instruction Mode

Results: Story Circles Evaluation: Qualitative Data

- There were more responses to “liked best” about SC than “liked least” (100% “liked best”, 60.4% liked least”).
- Content analyzed first by each team member individually, followed by team discussion to reach consensus.
- Two main themes emerged.

Results: Story Circles Evaluation: Qualitative Data



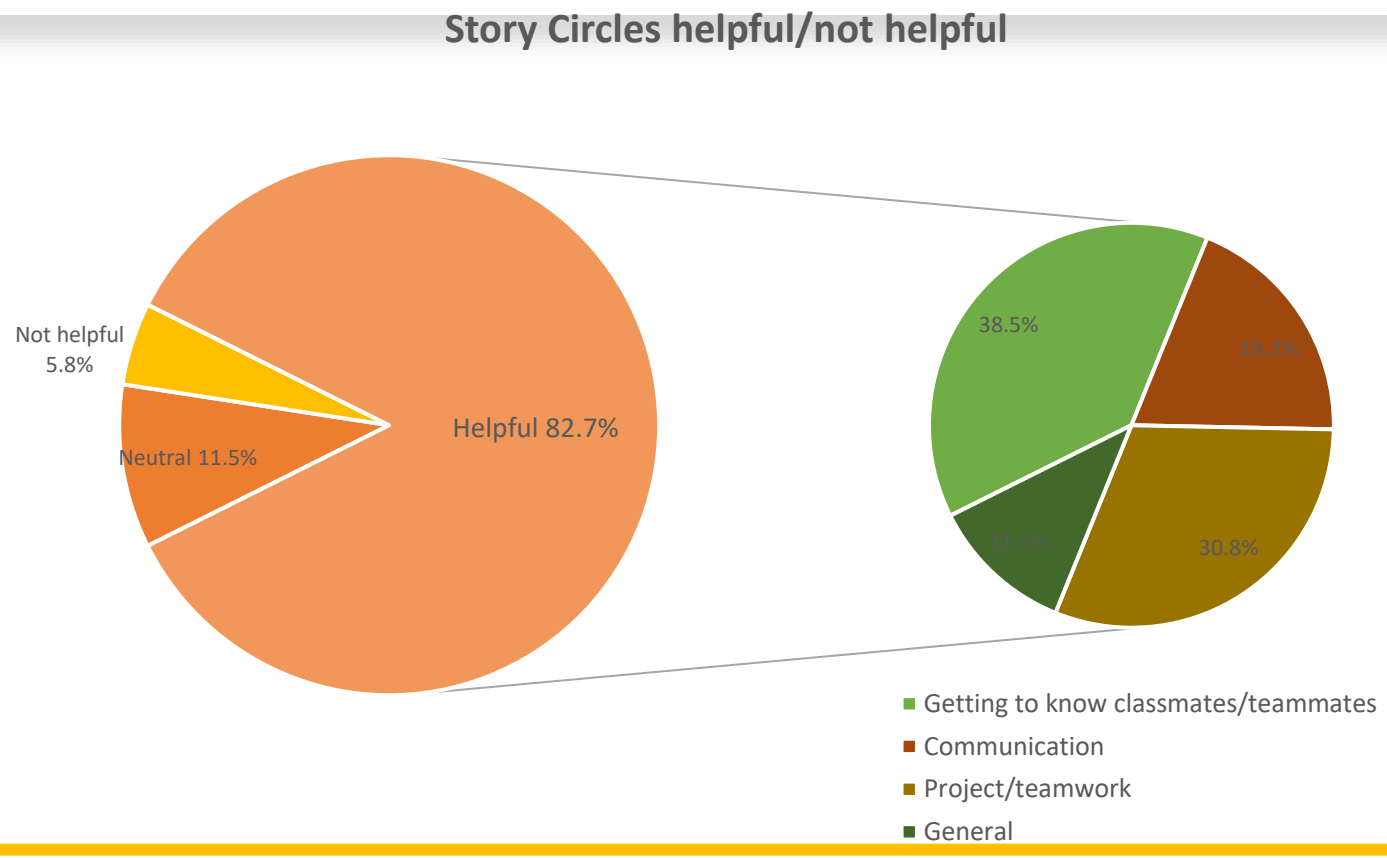


Results: Story Circles Post-Test Evaluation: Qualitative Data

"briefly describe the ways in which Story Circles was helpful/not helpful this semester."

- Administered 3 months after the activity; n=26.
- 82.7% described the Story Circles as helpful,
- 11.5% remained neutral, and
- 5.8% described it as not helpful.

Results: Story Circles Evaluation Qualitative (after 3 months)

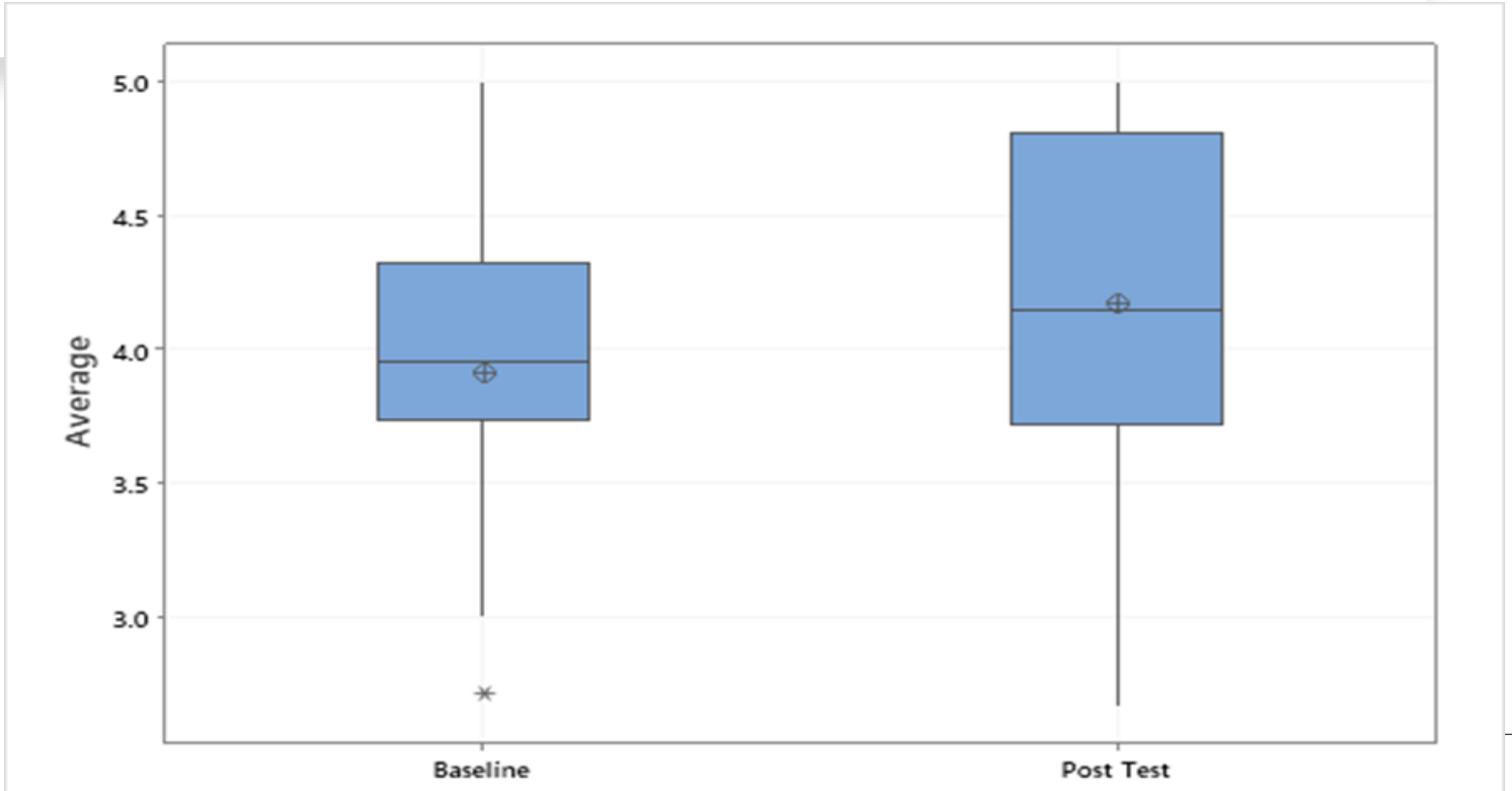


Results: Pre/Post Intervention Survey Teamwork

- 24 items
- Overall Cronbach's alpha
  - Preintervention: 0.94
  - Post intervention: 0.977
- Response range: 1 (strongly disagree) to 5 (strongly agree)
- Average
  - Pre: 3.91
  - Post: 4.18
- Paired t-test

P-value: 0.00

Overall



Overall Teamwork Perceptions

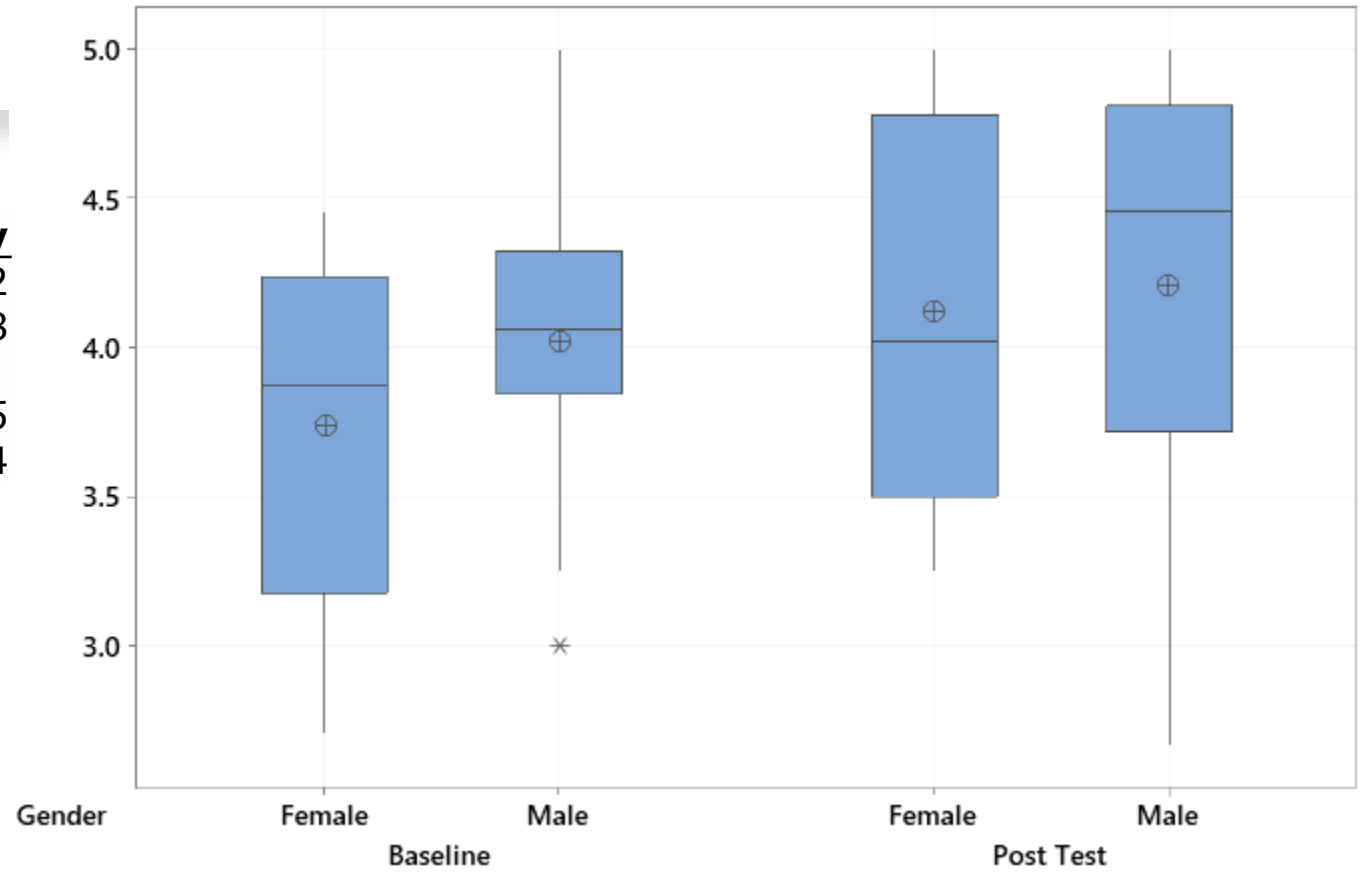
Results: Pre/Post Intervention Survey Teamwork

Variable	gender	N	Mean	StDev
Baseline	Female	8	3.604	0.622
	Male	12	4.094	0.578
Post Test	Female	8	4.292	0.625
	Male	12	4.406	0.674

Paired t-test

- P-value female: 0.238
- P-value male: 0.495

Gender



Overall Teamwork Perceptions by Gender

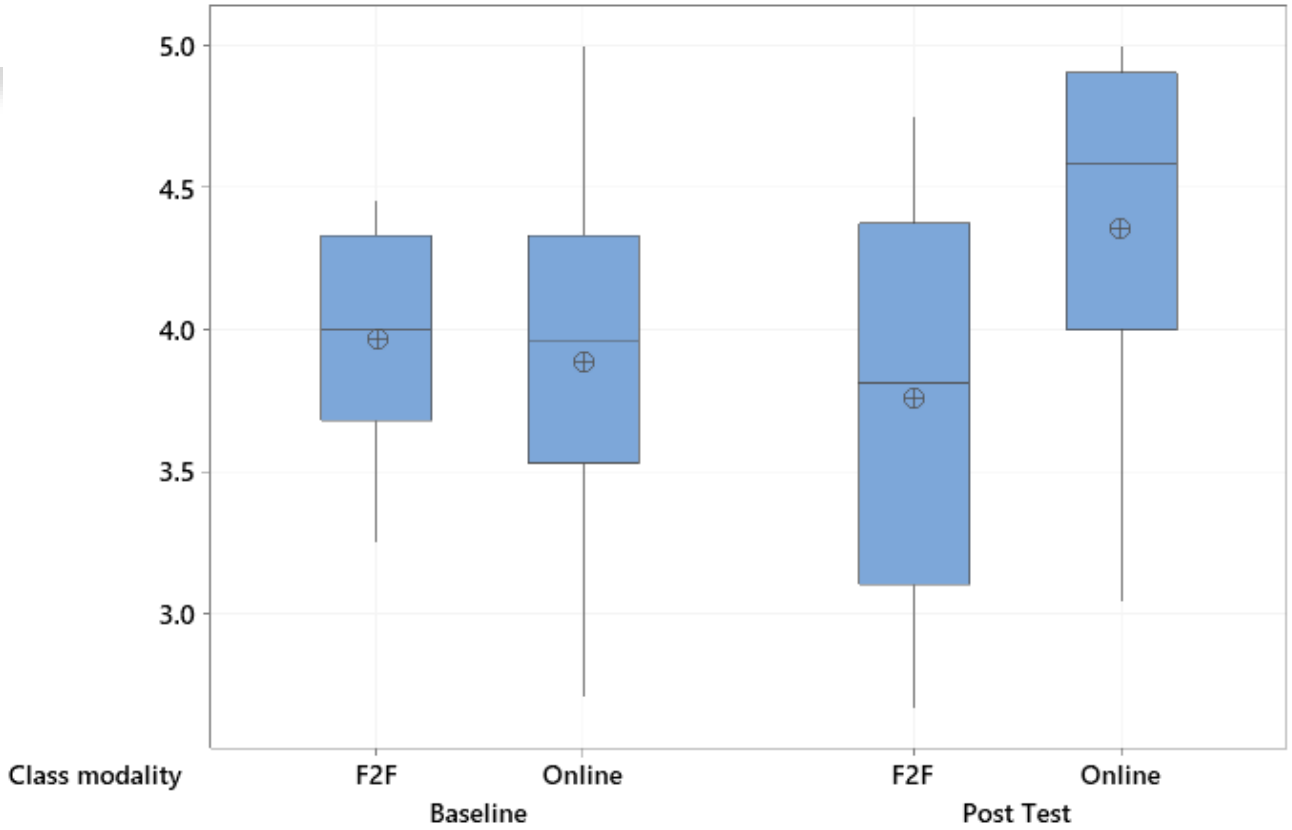
Results: Pre/Post Intervention Survey Teamwork

Variable	Class modality	N	Mean	StDev
Baseline	F2F	6	3.971	0.428
	Online	14	3.884	0.626
Post Test	F2F	6	3.757	0.742
	Online	14	4.357	0.631

Paired t-test

- **P-value online: 0.057**
- P-value F2F: 0.56

Instruction Mode



Overall Teamwork Perceptions by Instruction Mode

Results: Post-Intervention Team Meetings Qualitative (n=26)

1. 73.1% described the team meetings as helpful
2. 15.4% described them as not helpful
3. 11.5% remained neutral

Helpful-project efficiency & quality	*The team meetings being recorded and having values stated beforehand shortened meeting times a lot. With other projects I find we spend 2x the time doing the same amount of work or discussion.*
Helpful-communication practice	*It helped to communicate effectively and stay on track with the project. Working as a team effort is easier when everyone is willing to contribute ideas and open to different thoughts.*
Neutral	NA
Not helpful	*I felt like the meetings were not as direct as they should be. Discussion is important, but I felt like my team kept going in circles. The meetings would go very long, which in some situations is understandable. I felt like we were not as respectful of others' time outside of the project as we should have been.*

Results: Student Performance Project

SPRING 21	
Letter Grade	n (%)
A+	28 (90.3%)
A	3 (9.7%)
Average Score (STD)	99 (100) (2)

SPRING 19	
Letter Grade	n (%)
A+	15 (36.5%)
A-	10 (24.4%)
B+	10 (24.4%)
D	6 (14.6%)
Average Score (STD)	89.5 (100) (11.5)

Results: Student End of Semester Evaluations – Quantitative - Qualitative

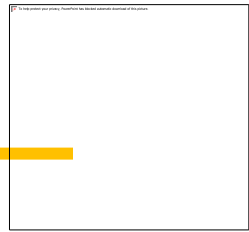
SPRING 21 F2F & virtual	
N=31; n=8 (25.8%)	Average 3.73 (+26%)

SPRING 19 F2F	
N=40; n=9 (22.5%)	Average 2.96

SPRING 21 F2F only	
N=10; n=2 (20%)	Average 3.85 (+30%)

"I liked the group project and code of ethics we read before each meeting."

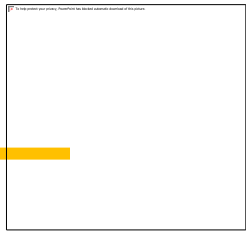
"The project was scheduled early in the semester for the sake of students."



Results: Instructor Observations

The instructor has had more positive experiences:

- Communication between instructor ⟷ students
- on how team members resolved concerns or conflicts.
- with team members' motivation to complete the project.
- With the quality and creativity of the work and presentations.



Conclusion

The multiple interventions suggest a positive effect on students' attitudes and performance with the project

- Engineering students evaluated Story Circles very positively
- Overall, students' perceptions on teamwork improved
- Team meetings were helpful to students to complete the project successfully
- The instructor had a more positive experience
- Our assessment tools filled a gap in the current institutional student end of semester evaluations

Limitations and Future Direction

- Small sample size
- Confounding variables “interventions”
- Continue this work to include multiple:
  - majors & course levels
  - research designs

Thank you!

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