

# The Relationships Between Modality, Peer Instruction Discussion, and Class Sentiment in Hybrid Courses

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## ABSTRACT

Although hybrid courses have become increasingly common in higher education, it remains uncertain whether a student's experience of a course is consistent between in-person and online modalities. To investigate this, we analyzed student modality and discussion data from the Spring 2023 offering of an elective data science course where students are allowed to attend each lecture in person or synchronously online.

Our analysis revealed that there were, counter-intuitively, no statistically significant effects between students' modality mixes alone and their feelings of community and learning in the course. Rather, discussing peer instruction questions with others, particularly while attending class in person, was positively related with stronger feelings of community. However, we did not find a statistically significant relationship between students' discussions and perceptions of whether their modality mix supported their learning.

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## 1 INTRODUCTION

Hybrid courses where students can self-select their modality provide flexibility in how students attend class but present unique challenges [1, 3] due to the simultaneous presence of both in-person and online instruction. It is unclear whether in-person and online modalities are equally as effective in facilitating student engagement in courses where *students can alternate modalities between each lecture* [2]. We thus sought to understand a student's experience in hybrid courses with this level of flexibility.

Our data is from the Spring 2023 offering of a data science elective at a medium-sized, research-oriented private university. The course

followed a hybrid format, allowing students to attend each lecture in person or synchronously online.

Our data includes a mid-semester survey and peer instructions (in-class questions) [4]. The mid-semester survey asked students to estimate their modality mix (of in-person and online attendance) and evaluate whether their modality mix supports “[their] feeling of community in the course” and “[their] learning” using a 5-point Likert scale ranging from *strongly agree* to *strongly disagree*. Due to how few students chose some options, we bucketed the options into three categories: *Agree*, *Neutral*, and *Disagree*. All lectures used peer instruction sets (PIs) that were accessible across both in-person and online modalities. The PI data relevant to our research included students' self-estimated modality and whether they engaged in peer discussion between the two rounds of each PI.

Our research question is: *What is the relationship between students' modality and/or peer discussions v.s. their feelings of community and learning?*

## 2 METHODS

### 2.1 Data Collection

Students (N=159) filled out the mid-semester survey during weeks 7-8 of the 15-week course. They were asked to self-estimate their modality mix and answer two Likert scale questions.

**Table 1: Summary of PI data. Not all PIs had 2 rounds.**

Total lectures	# lectures with PIs	# lectures with PIs and modality data	Total PIs	# PIs with 2 rnds	# PIs with 2 rnds and modality data
20	20	19	49	45	42

Table 1 summarizes our PI data. Students were asked to self-estimate their modality for each lecture and, for PIs with a second round, indicate whether they discussed the PI between rounds.

### 2.2 Metrics

**2.2.1 Modality.** In studying students' modality mixes, we define a student's *in-person/Classroom*<sup>1</sup> *Modality Fraction* (CMF) as follows:

$$\text{CMF} := \frac{\# \text{ lectures attended in classroom}}{\# \text{ lectures attended in classroom or online}}$$

<sup>1</sup>To reduce confusion, in-person is here on referred to as in-classroom.

Question Response group	My ... modality supports my <b>feeling of community</b>									My ... modality supports my <b>learning</b>								
	Agree			Neutral			Disagree			Agree			Neutral			Disagree		
Metrics	N	Mean	Med.	N	Mean	Med.	N	Mean	Med.	N	Mean	Med.	N	Mean	Med.	N	Mean	Med.
CMF (PI)	96	0.56	0.58	44	0.53	0.56	19	0.43	0.33	124	0.54	0.54	23	0.57	0.73	12	0.49	0.48
CMF (survey)	96	0.60	0.70	44	0.60	0.68	19	0.41	0.23	124	0.58	0.65	23	0.63	0.84	12	0.43	0.27
DF	96	0.75	0.81	44	0.70	0.83	19	0.59	0.64	124	0.71	0.78	23	0.76	0.84	12	0.66	0.64
CDF	93	0.86	0.95	41	0.82	0.93	18	0.71	0.83	120	0.84	0.94	20	0.85	0.91	12	0.72	0.82
ODF	85	0.59	0.65	41	0.48	0.40	19	0.45	0.50	112	0.54	0.59	21	0.54	0.62	12	0.55	0.56

**Table 2: Summary statistics of modality/discussion metrics for all categories of student responses to two questions in the mid-semester survey. Not all students have a CDF or ODF depending on their modality mixes.**

Metrics	Modality Related	Discussion Related	Community			Learning K-W Test $p$
			K-W Test $p$	Post-hoc Cliff's $\delta$	Post-hoc $p$	
CMF (PI)	Yes	-	0.21	-	-	0.72
CMF (survey)	Yes	-	0.18	-	-	0.40
DF	-	Yes	<b>0.033</b>	0.383	<b>0.030</b>	0.48
CDF	Yes	Yes	<b>0.032</b>	0.386	<b>0.027</b>	0.095
ODF	Yes	Yes	0.15	-	-	1.00

**Table 3: Summary of results on relationships between modality-/discussion-related metrics and students' perceptions of how their modality mixes supported their learning/feeling of community. We only report post-hoc results (after Bonferroni corrections) between the Agree and Disagree groups if the Kruskal-Wallis test revealed a significant effect. We found no post-hoc significant effects involving the Neutral group across all tests.**

This allows us to compare survey and PI data using a single number for a student's modality mix (as the online complement = 1–CMF).

We assessed the accuracy of students' self-reported modality mix by comparing their CMF from the survey to the PI data up to the survey's due date. Overall, we found that students were fairly accurate in estimating their modality mixes (median absolute difference in CMF = 0.09). However, more students over-estimated the number of lectures they attended in person (67.09%) than over-estimated the number attended online (26.25%).

**2.2.2 Discussion.** We created the *Discussion Fraction* (DF), *In Classroom Discussion Fraction* (CDF), and *Online Discussion Fraction* (ODF) metrics to measure the frequency of student discussions between rounds of PI with respect to their modality:

$$DF := \frac{\# \text{ PIs discussed}}{\# \text{ PIs with 2 rounds}}, \quad CDF := \frac{\# \text{ PIs discussed in classroom}}{\# \text{ PIs with 2 rounds attended in classroom}},$$

$$ODF := \frac{\# \text{ PIs discussed online}}{\# \text{ PIs with 2 rounds attended online}}.$$

Note that CDF and ODF are *not* complements and do *not* sum to 1.

### 3 RESULTS

We investigated how students' behavior (modality and discussing with peers) could have influenced their feeling of community and learning as measured by the Likert questions. As shown in Table 2, students who agreed more with the statement that their modality mix supported their feeling of community generally had higher mean and median values *across all metrics*, implying they *attended more lectures in the classroom, discussed more with their peers, or both*. However, students who responded to be *Neutral* about their modality mix supporting their learning had higher means and medians in most metrics than students who agreed that it did.

To quantify these effects, we conducted Kruskal-Wallis tests for each metric on the three groups (Agree, Neutral, and Disagree) of survey responses. Our null hypothesis was that the metric's underlying distributions are identical across groups. We summarized the results in Table 3.

Counterintuitively, although the two survey questions emphasized *only students' modality mixes*, we found no statistically significant effects for any metric that uses only students' modality. Instead, we found significant effects between students' feelings of community and both the DF (which *only* measured discussion) and CDF (which measured both discussion and modality). For both metrics, post-hoc Dunn's tests revealed a significant, medium-sized effect between the Agree and Disagree groups.

In all, our analyses found substantial evidence that suggests students' *discussions with peers*, particularly while in person, are related to their feeling of community, while revealing that *perceived modality* is intertwined with peer discussion.

### 4 LIMITATIONS AND FUTURE WORK

A limitation to our results is self-selection bias. Students were allowed to choose their modalities for each lecture, and the sample sizes of each (modality, discussion) combination varied. Additionally, our analyses relied on students' self-estimated modality and discussion data, which may be inaccurate. However, students knew their responses to all questions are ungraded, so we do not expect any inaccuracies to be intentional. Finally, our analysis is based on data from a single semester, as prior semesters lacked comprehensive discussion data. Future research will seek to validate these results with additional data.

### ACKNOWLEDGMENTS

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