

The Teaching Practices of Calculus Recitation Leaders

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INTRODUCTION

Calculus recitation sections, typically led by a graduate teaching assistant (TA), are often an integral part of the undergraduate calculus experience in the United States, especially at large research universities (Bressoud, Mesa, & Rasmussen, 2015). For instance, the MAA National Survey on College Calculus found that one third of all calculus students in the US reported attending a recitation. When the data was restricted to just PhD granting universities, 49% of students reported that their calculus I course utilized a lecture/recitation format. At the same time, the data shows that only 15% of universities that offered recitation sections integrated some form of active learning into the recitation component (Apakarian et al., 2018). Not all universities that offer recitation sections have developed standardized materials for the recitation nor do they support TAs in developing appropriate evidence-based teaching practices. As a consequence, TAs are often responsible for developing their own approach to leading a calculus recitation.

- Past studies have shown that TAs and students in STEM may prefer teacher-centered classrooms which focus on procedural content (Speer, Gutmann, & Murphy, 2005; Felder & Brett, 1996; Smith & Cardaciotto, 2011).
- However, as more evidence-based practices are adopted in STEM (Rasmussen et al., 2019), students and TAs may have more positive perceptions on student-centered instruction and teaching that focuses on concepts (Patrick, Howell, & Wischusen, 2018).
- It is unclear what teaching practices are being used by TAs in the recitations and whether these practices are effective in supporting students in calculus.
- Also, it is unclear whether departments are providing calculus students with a consistent experience across different recitation sections.

RESEARCH QUESTIONS

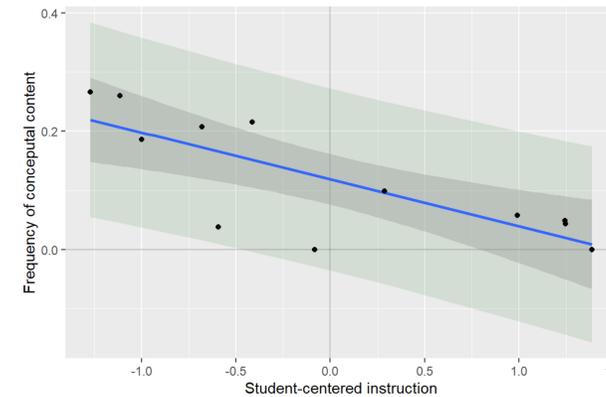
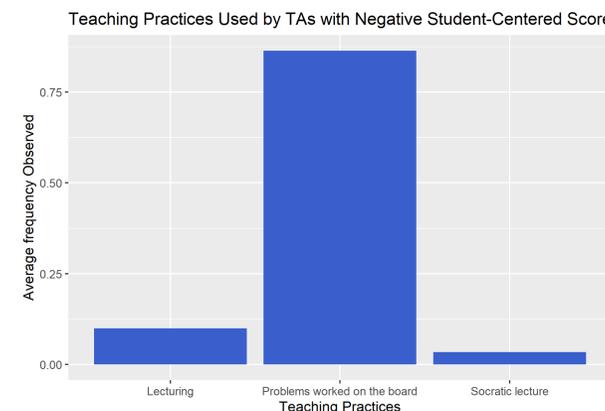
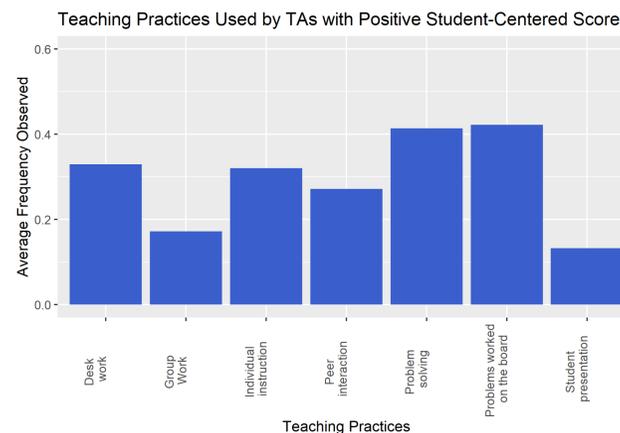
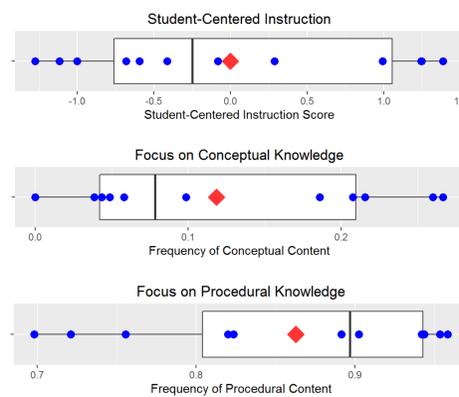
1. What teaching practices did TAs use in the calculus recitations they instructed?
2. How do these different practices impact student attitudes towards the recitation, student engagement in the recitation, and students' perceived success in their calculus course?

METHODS

- **Context:** This study took place at a large university in the southwest.
- **Participants:** Twelve teaching assistants (TAs) leading either a calculus I, calculus II, or calculus III recitation participated in the study.
- **Measures:** All TAs were observed twice during the semester using the Teaching Dimensions Observation Protocol (TDOP). Their students (n=388) were surveyed at the end of the semester using the Student Evaluation of Recitation Teaching Practices Survey (SERTPS). This survey measured students' attitude toward the recitation, their engagement in the recitation, and had students predict their final calculus course grade.
- **Data-analysis:** Factor analysis was used to create a factor variable representing student-centered instruction, where a positive score represents a positive correlation with student-centered instruction and a negative score represents a negative correlation. Linear regression was used to describe the relationship between different teaching practices and their correlation with student course attitude and student engagement. Ordinal regression was used to determine the relationship between different teaching methods and students' likelihood of predicting their final course grade of being an A, B, C or lower than a C.

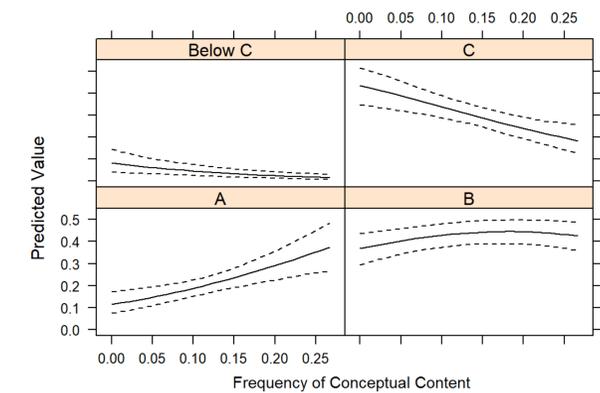
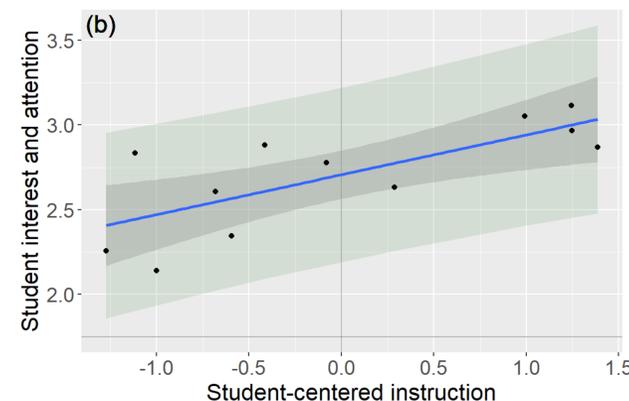
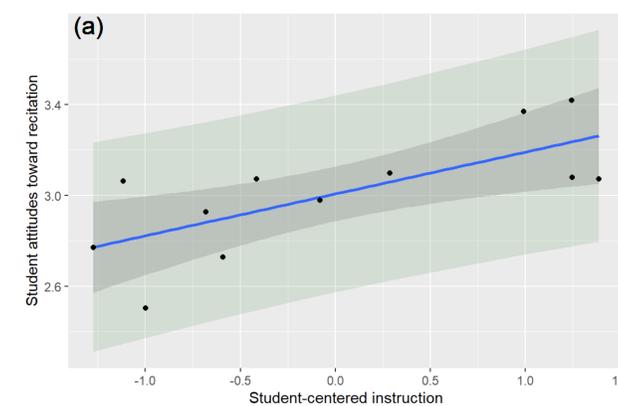
RESULTS: TA Teaching Practices

- Five out of the twelve TAs received a positive score for student-centered instruction.
 - Students in these sections were observed working on problems individually twice as frequently as they were observed working in groups with peers.
- Seven out of the twelve TAs received a negative score for student-centered instruction.
- In both groups, the TA working problems on the board was the most frequently observed teaching practice.
- Out of all TA observations, the procedural content code was observed at least 68% of the time (the average frequency was 86%).
- There was a negative correlation ($\beta = -0.08, p = 0.0027, R^2 = 0.61$) between student-centered instruction and conceptual content, meaning TAs who used student-centered instruction were more likely to focus on procedures.



RESULTS: Impact on Students

- There was a positive correlation between student-centered instruction and student attitudes towards the recitation ($\beta = 0.18, p = 0.008, R^2 = 0.52$).
- The frequency with which TAs included conceptual content was not correlated with student attitudes towards the recitation ($\beta = -0.8, p = 0.34, R^2 = 0.46$).
- Student-centered instruction was positively correlated with student engagement in the course ($\beta = 0.24, p = 0.0056, R^2 = 0.55$).
- The frequency with which TAs included conceptual content was not correlated with student attitudes towards the recitation ($\beta = -0.94, p = 0.006, R^2 = 0.55$).
- The ordinal regression model inferred that students were almost twice as likely to predict their final course grade to be a B or higher when TAs included more conceptual content ($p = 0.00001, 95\% CI(1.96, 5.77)$).



CONCLUSIONS

- TAs used a variety of both research-based and traditional teaching methods; however, the content focus was primarily procedural.
- TAs that did use a more student-centered approach to the recitation focused primarily on having students work problems individually at their desk. Group work was not a salient part of their teaching practices. On average, students were not frequently observed interacting with their peers during the recitation.
- The teaching methods used in the recitation did impact students' attitudes towards the recitation, their engagement in the recitation, and the final course grade that they predicted.
- One implication from this study is the need to provide TAs with teacher training that specifically supports them in leading a recitation section.
- Training should focus on providing TAs with tools for implementing group work effectively and using conceptually rich materials.

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