Relations between Teacher Practices, Classroom Climate, and Students' STEM Competency

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BACKGROUND

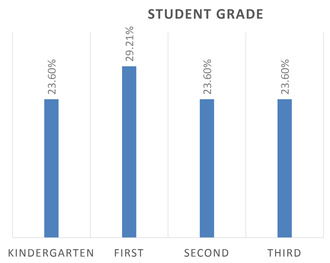
- Increasing concern for low percentage of adults earning degrees and pursuing careers in engineering and Science Technology Engineering Math (STEM)-related fields (NAE, 2011; NSB, 2012; NSF, 2015)
- Due to the lack of participation in engineering U.S. citizens, especially **women** and **ethnic minorities**, the sustainability of our technology-based U.S. society is endangered (NSF, 2010; PCAST, 2010)
- Early experiences affect later skill development and motivation to learn (Heckman, 2006)
- Understanding effects of early beliefs and experiences can aid in decreasing disparities (Heckman, 2006)
- Several studies report competency-beliefs for STEM domains decline across the elementary school years (e.g., Fredricks & Eccles, 2002)
- Ecological frameworks (Bronfenbrenner & Morris, 2006) provide potential ways to understand and change the developmental trajectories of **competency-beliefs**
- **Classroom context**, including **teacher practices** and supportive **climate**, may play an important role

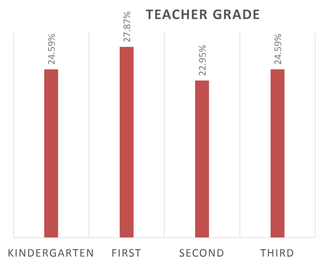
QUESTIONS & HYPOTHESES

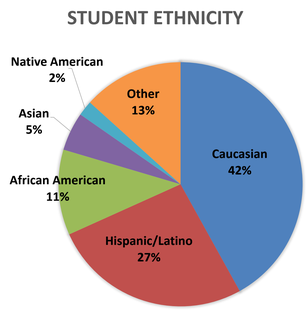
1. What teacher practices are related to classroom climate?
   - Positive growth mindset practices encourage a positive classroom climate
   - Gender stereotyped practices lead to a negative classroom climate
2. What aspects of classroom climate are related to student competency?
   - Classroom climates regarding positive peer relations, high respect for others, and a low negative overall environment foster higher math and activity/skill competency

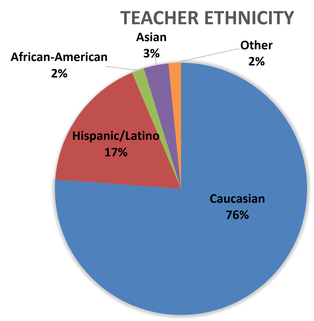
PARTICIPANTS

- Grades K-3 from Southwestern schools
- Teachers (*N* = 61, 93.4% female)
- Students (*N* = 606, 54.4% female)









MEASURES

Teacher Reports

- Classroom Practices (PRA)
  - 4 Growth Mindset (PRA-GRO): e.g., "Encourage students to ask the teacher why the class is learning a topic." [Dweck, 2015; Mindset Works]
  - 5 Gender Stereotyped (PRA-GEN): e.g., "Create girl and boy teams for friendly competitions." [Gaertner & Miller, 2010, unpublished]
  - Likert-scale 0 - 4 ("Never," "Rarely," "Sometimes," "Often," and "All of the time")
- Classroom Climate (CLI) [Lickona & Davidson, 2003]
  - 9 Peer (CLI-PEER): e.g., "Students work well together."
  - 4 Negative Environment (CLI-NEGENV): e.g., "Students show poor sportsmanship."
  - 4 Respect (CLI-RESP): e.g., "Students behave respectfully toward all school staff (including secretaries, custodians, and aides)."
  - Likert-scale 0 - 4 ("Almost never," "Sometimes," "As often as not," "Frequently," and "Almost always")

Student Report

- Competence (COM) [Eccles & Wigfield, 2002]
  - 1 Math (COM-MATH): e.g., "How good are you at math?"
  - 10 Engineering Activities and Skills: (COM-A/S) e.g., "How good are you at trying out your ideas?"
  - Likert-scale 0 - 3 ("Not at all good," "A little good," "Sort of good," and "Very good")

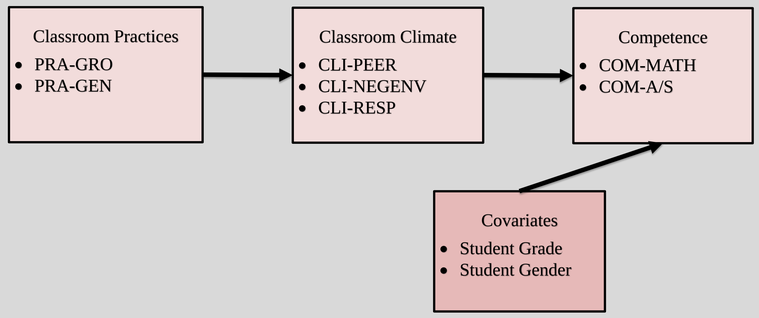


Figure 1. **Conceptual model of** relations between classroom practices, climate, and competence.

RESULTS

- Teachers' growth mindset practices were positively related to peer classroom climate. On average, for every one unit increase in reports of teachers using growth mindset practices, there was a 0.43 unit increase in positive peer climates.
- Teachers' growth mindset practices were positively related to respectful classroom climate. For every one unit increase in growth mindset practices, on average there was a 0.45 unit increase in a respectful climate.
- Teachers' respectful classroom climate was positively related to students' competence in engineering activities/skills. For every one unit increase in teacher reports of a respectful classroom climate, on average there was a 0.14 unit increase in students' engineering activity and skills competence.
- There were gender differences in students' math and engineering competency beliefs. Boys' competency beliefs, on average, were 0.15 units higher in Math than girls. On the other hand, boys' overall engineering activity and skill competency beliefs were 0.09 units lower than girls.

Table 1. *Significant effects from the predicted model.*

Variables	β	SE	t-value	p-value	95% CI
CLI-PEER on PRA-GRO	.43	.14	3.15	.0026	[.16, .71]
CLI-RESP on PRA-GRO	.45	.14	3.12	.0028	[.16, .74]
COM-MATH on Gender (boys = 1)	.15	.04	2.03	.0428	[.00, .30]
COM-A/S on CLI-RESP	.14	.06	2.56	.0108	[.05, .29]
COM-A/S on Gender (boys = 1)	-.09	.04	-2.10	.04	[-.18, -.01]

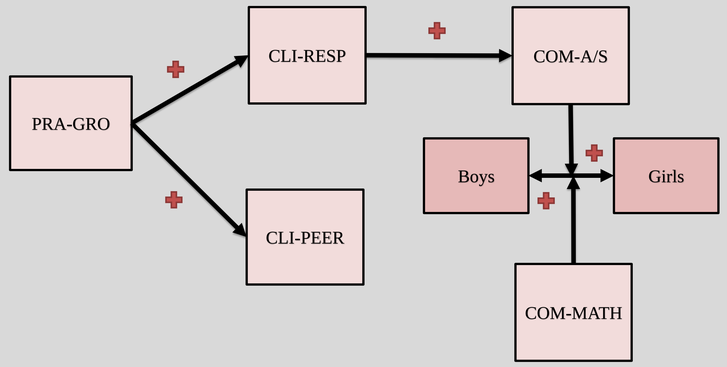


Figure 2. **Confirmed** relation between classroom practices, climate, and competence, with moderated effects between genders for COM-A/S and COM-MATH.

DISCUSSION

- Practices that encourage growth mindset within the classroom foster an environment where students are respectful and considerate of their peers, authorities, and environment.
- Classrooms where respectful environments are observed relate to higher rates of engineering activity and skill competency beliefs, suggesting that further research should consider how student interactions in the classroom affect learning outcomes related to STEM fields.
- Results suggested for math competency beliefs there were gender differences; however, previous research suggests other factors may also need to be accounted for, such as self-efficacy, anxiety, SES, and racial differences (Cheema & Galluzzo, 2013).
- Results suggested that girls had higher overall engineering activity and skill competency beliefs than boys, indicating a need for further consideration into the factors supporting this finding.

Limitations and Future Directions

- Difference in nested factors between measures (practices and climate not nested – teacher-level only, while competencies was nested – students nested within teachers) restricted different types of analyses
- This study is cross-sectional in nature – thus, we could not test causal associations. Future work should examine these relations longitudinally to determine if ultimately teachers' classroom practices relate to changes in classroom climate, and, in turn, to changes in students' competencies.
- Future work should also consider other explanations for relations between classroom practices, climate, and competence relations, such as demographic differences, anxiety, teacher influence, etc.

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Acknowledgements: Funding - National Science Foundation, 1561424, Equity in Engineering: Understanding and Promoting All Elementary School Children's Knowledge of and Motivation to Engage in Engineering, C. Miller (P.I.), L. Wheeler (Co-P.I.), M. Reisslein (Co-P.I.).