MAKING MATHEMATICS MEANINGFUL

How learning about local injustices develops undergraduate students' criticality, identities, intellect, skill, and emotion

AUTHORS

Emanuel Boutros, Mechanical Engineering
Nicole L. Fonger, Mathematics, Mathematics Education
Qiong (Mars) Wu, Accounting, Economics, Business Analytics
Hanyi Xu, Advertising

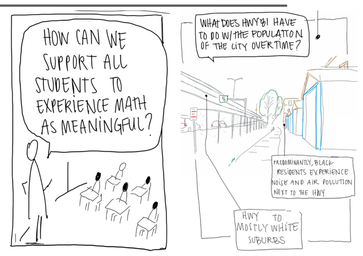
SOURCE Symposium August 2023

REACH OUT

Nicole L. Fonger, PhD
nfonger@syr.edu
Principal Investigator
Meaningful Math Research Group
Syracuse University

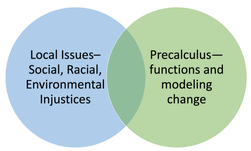
ABSTRACT

Current math instruction often "ignores" critical literacy. Relating topics to where students live and current social justice issues, may empower them to become more informed and empathetic members of their communities.



OBJECTIVES

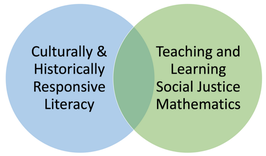
- How can mathematical concepts be linked to real-life experiences, helping students to recognize the practical value of mathematics beyond the classroom?
- Examine local injustices through a mathematical lens by combining the fundamentals of precalculus like functions and change modeling to:
  - Create contexts that resonate with students' backgrounds and identities
  - Facilitate critical thinking and dialogue about systemic inequalities and societal challenges while making math relatable and applicable to their lives



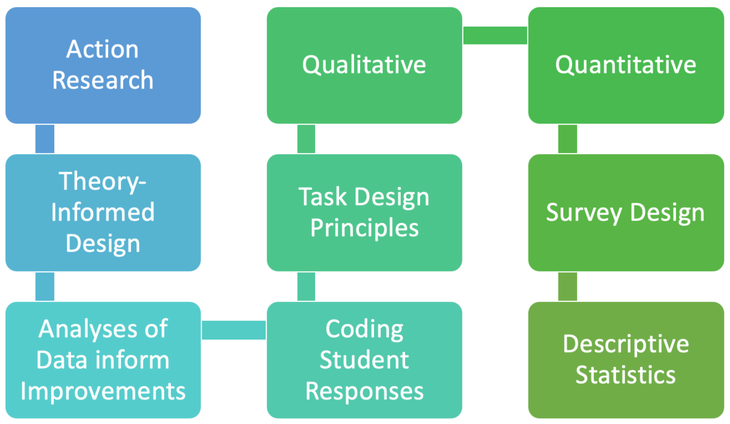
BACKGROUND THEORY

Muhammad (2018) argues that mathematics education should focus on identity and criticality in addition to skill and intellect (knowledge).

In practice, we combine culturally and historically responsive teaching and teaching mathematics for social justice.

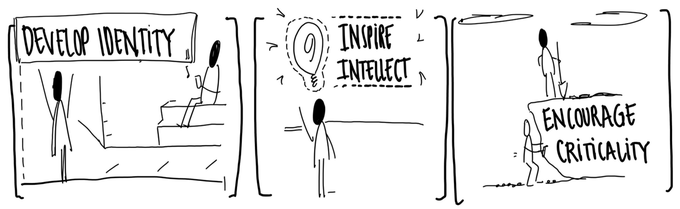


METHODS



RESULTS

QUALITATIVE ANALYSES OF TASKS



QUANTITATIVE ANALYSES OF SURVEYS

POST LAB SURVEY, RESULTS, AND FINDINGS

We asked 57 students to rate their level of agreement or disagreement with the following statements on a scale of 1 to 5

- model local data: $\bar{x}$ = 4.62069
- appreciate math connection: $\bar{x}$ = 4.637931
- inspire righteous indignation: $\bar{x}$ = 3.706897
- linear equation, predictions: $\bar{x}$ = 4.172414
- city planning predictions: $\bar{x}$ = 4.413793

Scan the QR code to see the full survey and results

This suggests that students found these tasks meaningful in improving their mathematical literacy.

We also done the correlation test. Here we found three strong correlations (Cor > 0.69)

- Cor(Q2, Q7) = 0.722555

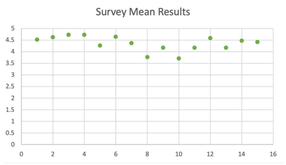
This might indicate that the Lab successfully linked hands-on tasks (like data modeling) to broader skills.

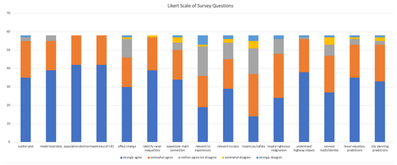
- Cor(Q11, Q12) = 0.710057

It appears the Lab effectively tied these socio-political issues together in students' perceptions.

- Cor(Q14, Q15) = 0.866167

This is a good demonstration of students integrating mathematical knowledge with real-world applications.





IMPORTANCE OF FINDINGS

Undergraduate students found their experience with social justice mathematics tasks meaningful and supportive of their learning, critical thinking, and understanding of societal issues

LESSONS LEARNED AS RESEARCHERS

- Team work and collaboration
- Process and problems faced during qualitative coding
- Social science research is connected to community-engagement

IDENTITY Students describe something about themselves or others in the social context of the lesson (Muhammad, 2020). Students may express a broad range of identities including race, family, religion, community, or geographic location.

Task: What stood out to you as important in the I-81 video?

> I didn't realize the health problems that come with being under a highway, and how much a highway can disconnect people from society. (C1_Lab81_Sp23_Slide 02, Pos. 1)

INTELLECT Students apply their knowledge about mathematics to predict, explain, or otherwise express understanding of a social issue or policy.

Task: List three ideas, events, or dates that seem important

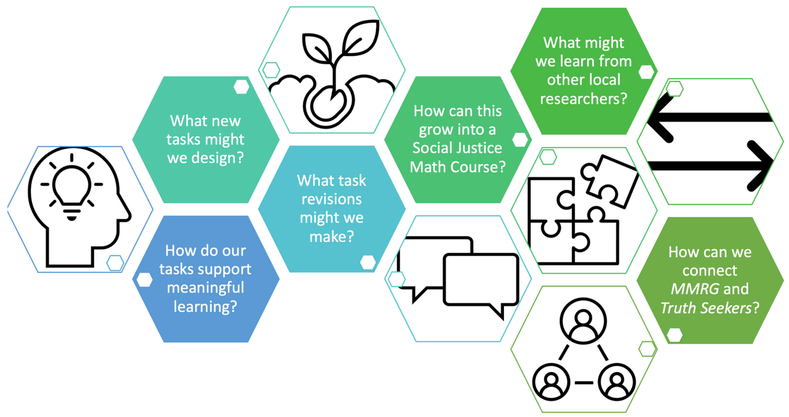
> The construction of I-81 tore down 90% of the 15th Ward, which housed eight of every nine black resident in Syracuse. The construction displaced 1,300 - 2,200 families and relocated 75% of Syracuses black population of other areas White residents living on the south and east side of Syracuse also sold their homes (C1_Lab81_Sp23_Slide 03, Pos. 1)

CRITICALITY Students express awareness of a specific or general injustice and/or power structures that shape communities and consider addressing injustices.

Task: What stood out to you as important in the I-81 video?

> It is in a predominantly black neighborhood. People were kicked out from their homes in order for the highway to be built. People don't have a voice to what is going on. The people who live there, their health is being affected negatively. (C1_Lab81_Sp23_Slide 02, Pos. 1)

NEXT STEPS & RESEARCH AGENDA



RELATED LITERATURE

Please scan the QR Code for a complete reference list.

ACKNOWLEDGEMENTS

This work represents a collaborative effort of the Meaningful Mathematics Research Group at Syracuse University led by Associate Professor Nicole L. Fonger. Team members during Summer 2023 include (alphabetical order by last name): Emanuel Boutros, Stephen Caviness, Nicole Fonger, Sankalp Gautam, Winnie Naggar, Karley Voyias, Qiong (Mars) Wu, Hanyi Xu. Our work is informed by collaborations with the Antiracist Algebra Project and Engaged Communities Team including: Lauren Ashby, Ken Keech, Jonnell Robinson, Betty Routhouska. We are grateful to the SOURCE for student funding, the Mathematics Department for resource support, and the Engaged Humanities Network for grant funding.