



Bringing Math to Life with Social Justice

Mathematical Modeling with Teachers

Diana Cheng, Professor, Mathematics Department
Graduate Program Director in Mathematics Education
John Gonzalez, US Dept of Defense

MATH 525: Problem Solving for Teachers (SP22)

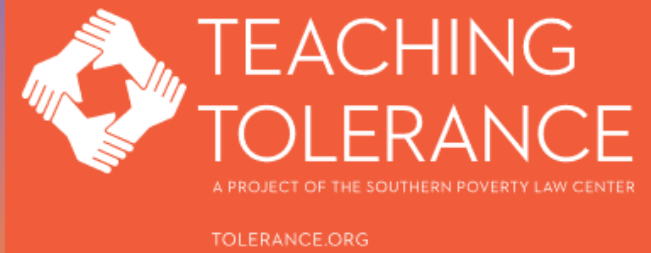
Abstract

We describes a graduate course in which in-service teachers solved and developed mathematical modeling problems through the lens of social justice mathematics lessons (SJML's) tailored towards the middle and high school levels.

- We mentored teachers first to practice solving SJML's, then use micro-teaching with their peers to create or extend SJML's to meet the needs of their student populations, and then to reflect upon their implementations to build a sustainable way to continue using SJML's in their instructional practices.
- The results of a pre- and post- survey indicated favorable shifts in teachers' beliefs about their teaching for the purposes of empowering students to consider social justice.

From the lens of a facilitator of the professional learning experience, we discuss the sustainability of this approach to helping mathematics teachers teach SJMLs.

Teaching Tolerance: Social Justice Standards



Identity

Diversity

Justice

Action

Why social justice in math?

SJML's can be beneficial for students in the following ways:

- **Build an informed society**
- **Connect mathematics with students' cultural and community histories**
- **Empower students to confront and solve real-world challenges they face**
- **Help students learn to value mathematics as a tool for social change**

(p.23, Berry et al, 2020)

Modeling cycle for SJML's: Student Actions (Jung & Brand, 2021)

Interpreting

- Interpreting the problem and underlying social justice issue

Proposing

- Proposing approaches to addressing the social justice problem

Mathematizing

- Mathematizing the situation and working mathematically

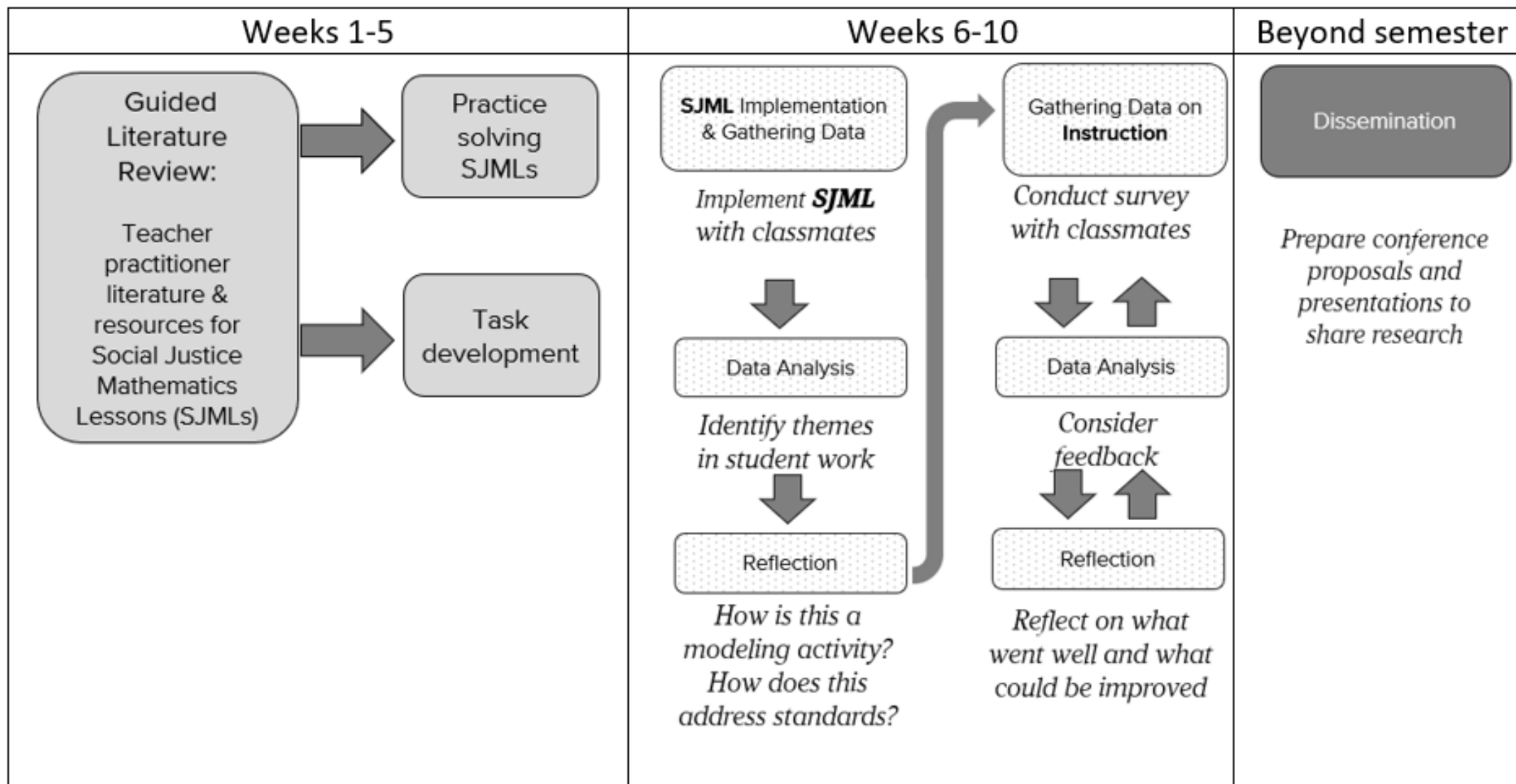
Validating

- Validating the solution against contextual constraints

Applying

- Applying the solution to a social justice context

Course timeline



Description of participants

- 10 graduate students, all in-service full-time teachers, employed within the same public school district
 - 1 student completed only pre-survey
- The course included 3 graduate credits offered over a ten-week semester session from January through mid-March, 2022. Each week of the course included 2 hours of synchronous instruction and 4 hours of asynchronous instruction.

Example of a social justice mathematics lesson

Math, Maps, and Misrepresentation
 BY ERIC (RICO) GUTSTEIN
 (pages 189-194)



Justice 13	JU.9-12.13	I can explain the short and long-term impact of biased words and behaviors and unjust practices, laws and institutions that limit the rights and freedoms of people based on their identity groups.
------------	------------	---

CCSS.MATH.CONTENT.7.G.B.6
 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Geometric Measurement and Dimension

- Explain volume formulas and use them to solve problems
- Visualize relationships between two-dimensional and three-dimensional objects

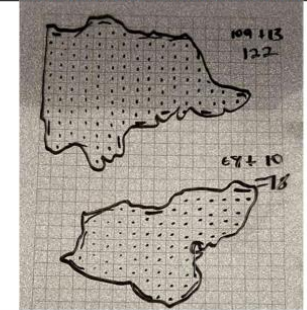
Modeling with Geometry

- Apply geometric concepts in modeling situations

Activity 1: Representing 3 dimensional Earth with 2 dimensions



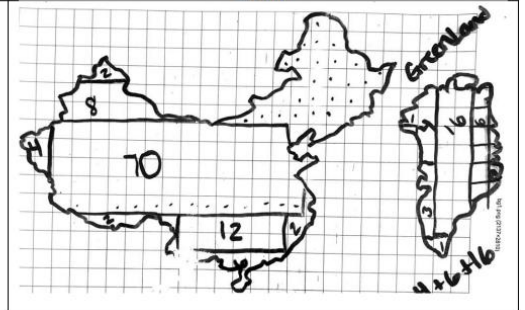
Student Work on Mercator Projection (Activity 2), showing that Greenland's area seems larger than China's area



Activity 2: Estimating land mass areas



Student Work on TrueSize Projection (Activity 2), showing that China's area is larger than Greenland's area



Reflection Q's: Had you ever been taught in school how distorted the Mercator map made the landmass sizes?
 ~ Why do you think the Mercator map is used so much in schools?
 ~ The teacher in the book used this lesson as a social justice lesson. How could you connect this lesson to social justice with your students?

Learning to Teach for Social Justice-Beliefs (LTSJ-B) Survey (Enterline et al., 2008)

- Includes 12 Likert-scale items, each on a scale of 1 (strongly disagree) to 5 (strongly agree). Maximum score per participant is 60, representing what the survey authors consider high in believing they can teach grade school students about social justice (not math specific).

Subdivided into two types by the authors of the survey:

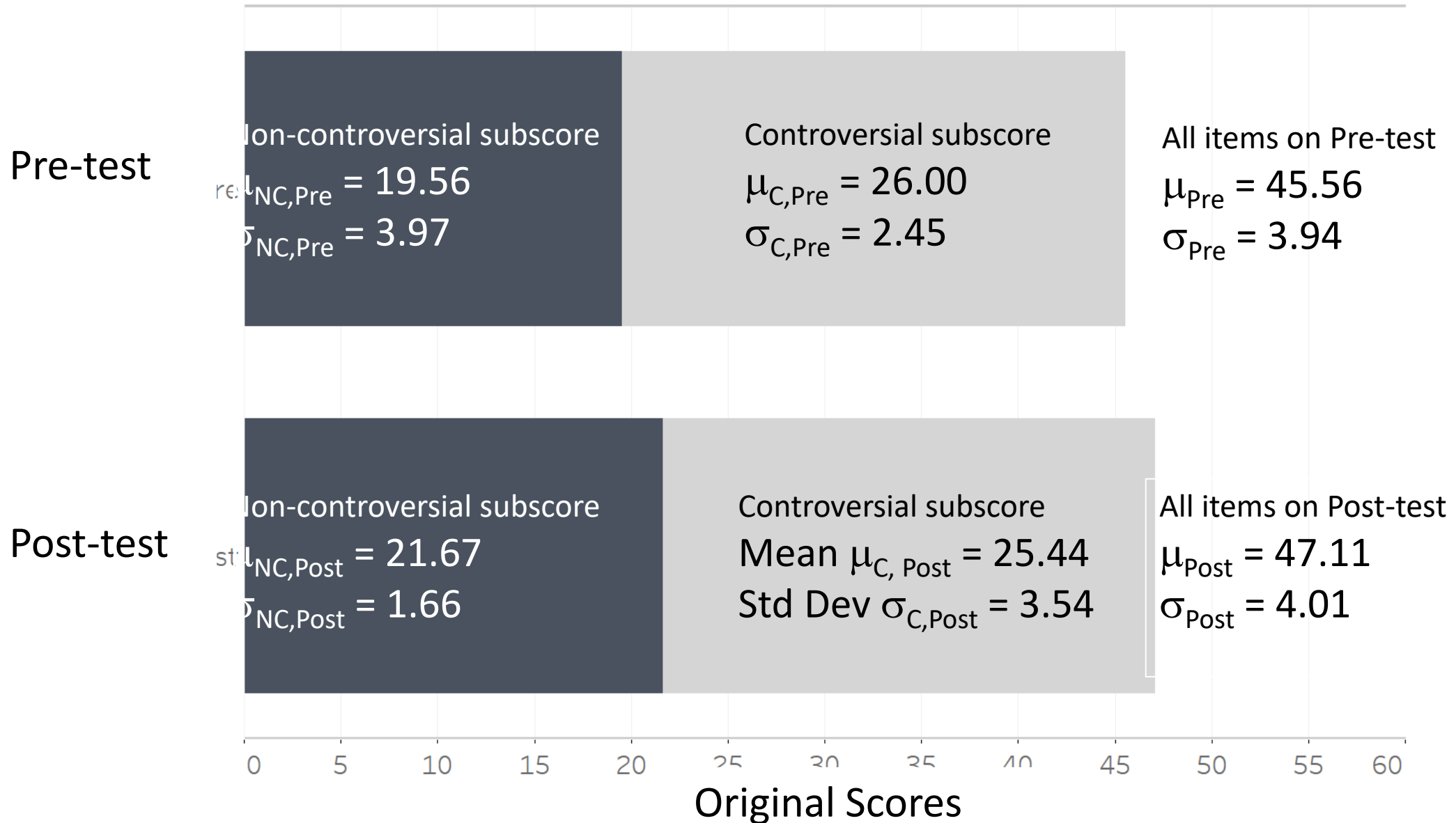
* “Non-controversial” items - easier to endorse by beginning teachers

- Includes five of the items Q1, 2, 4, 7, 8 (maximum score 25)
- Example: “An important part of learning to be a teacher is examining one’s own attitudes and beliefs about race, class, gender, disabilities, and sexual orientation (pg. 275).”

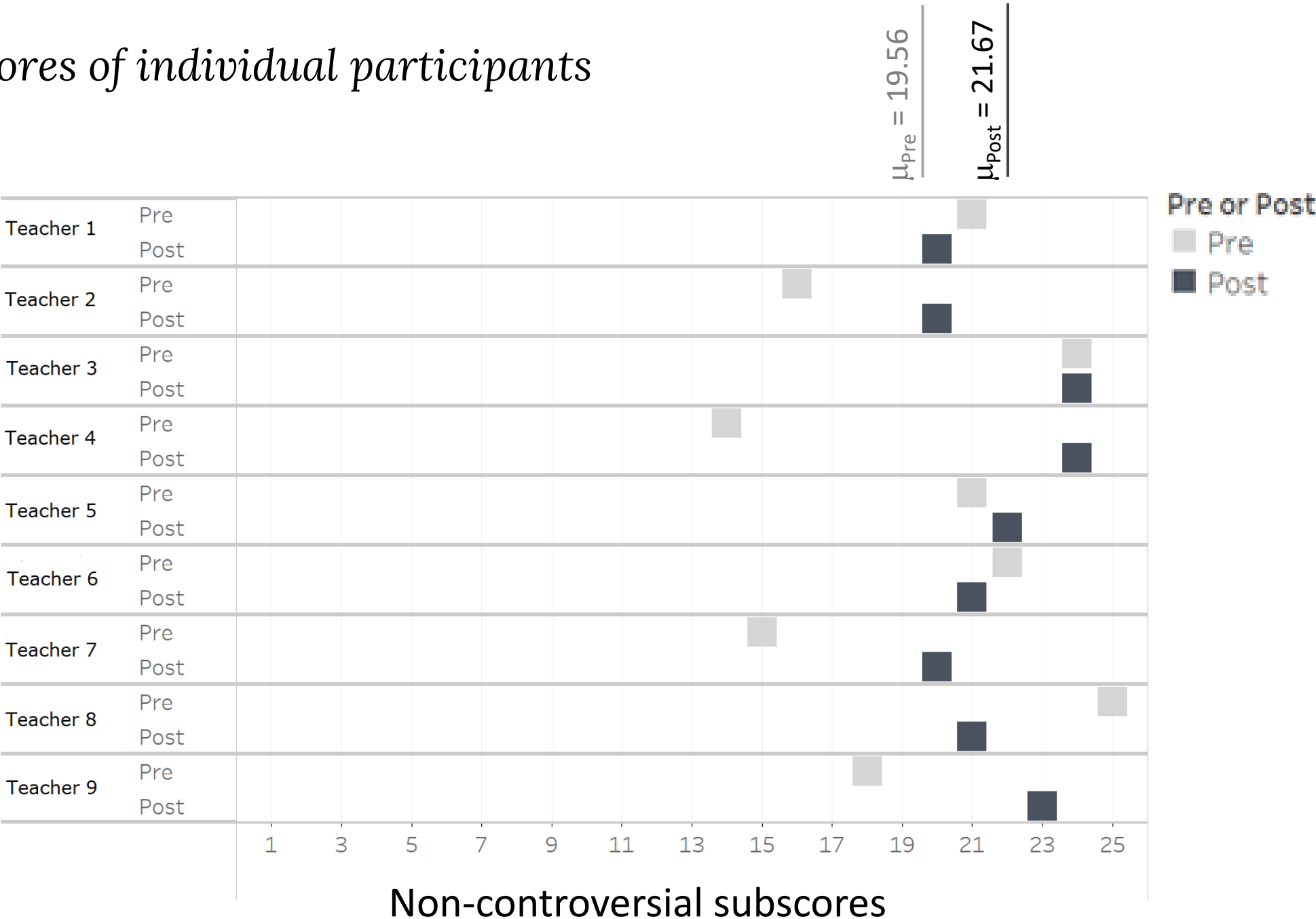
* “Controversial items” - more difficult to endorse. These items were written in a way that requires reverse-scoring to be implemented by those who analyze the responses.

- Includes seven of the items Q3, 5, 6, 8, 10, 11, 12 (maximum score 35)
- Example: “Economically disadvantaged students have more to gain in schools because they bring less into the classroom (pg. 275).”

Learning to Teach for Social Justice – Beliefs scores of participants



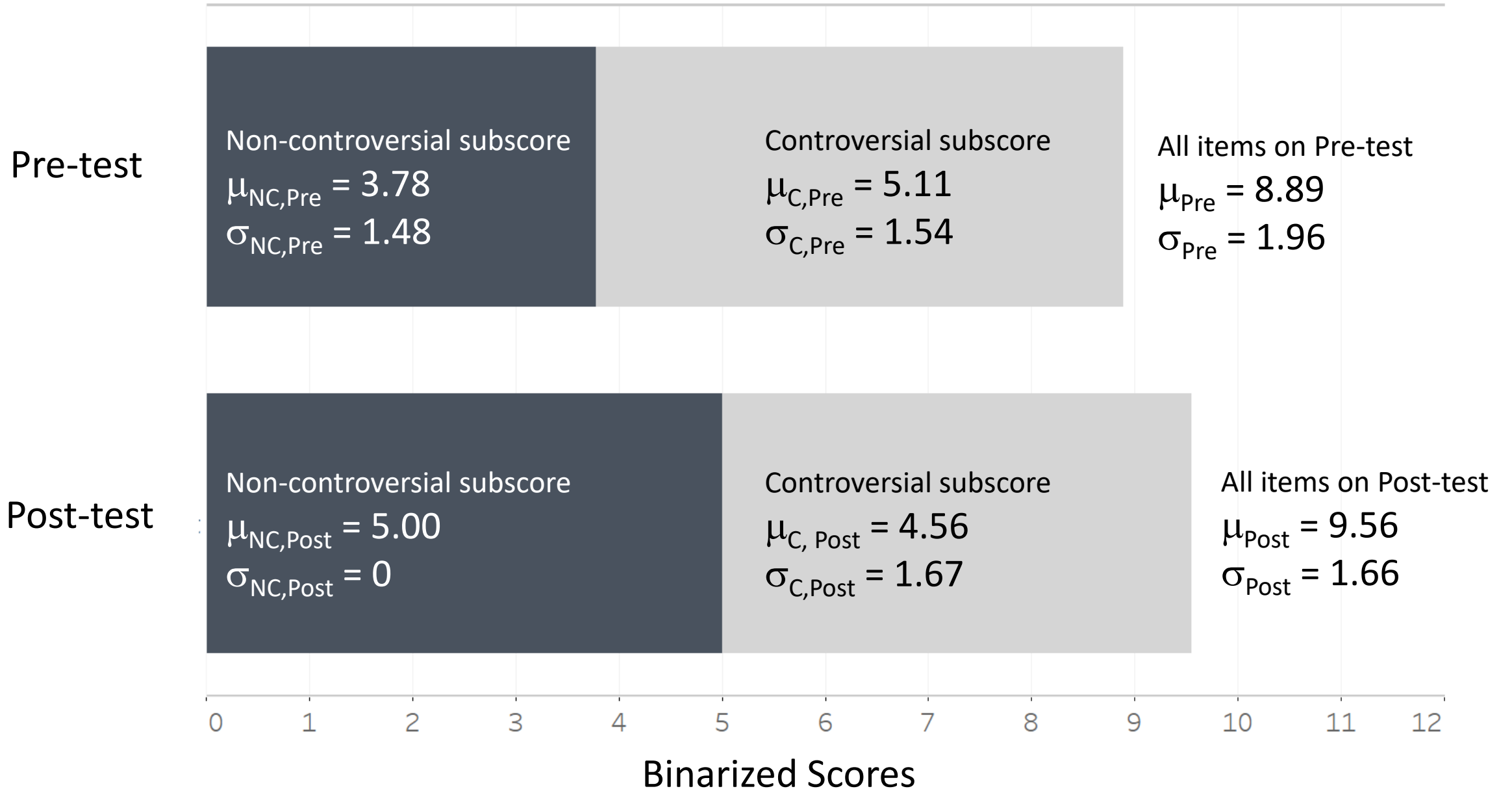
LTSJ-B scores of individual participants



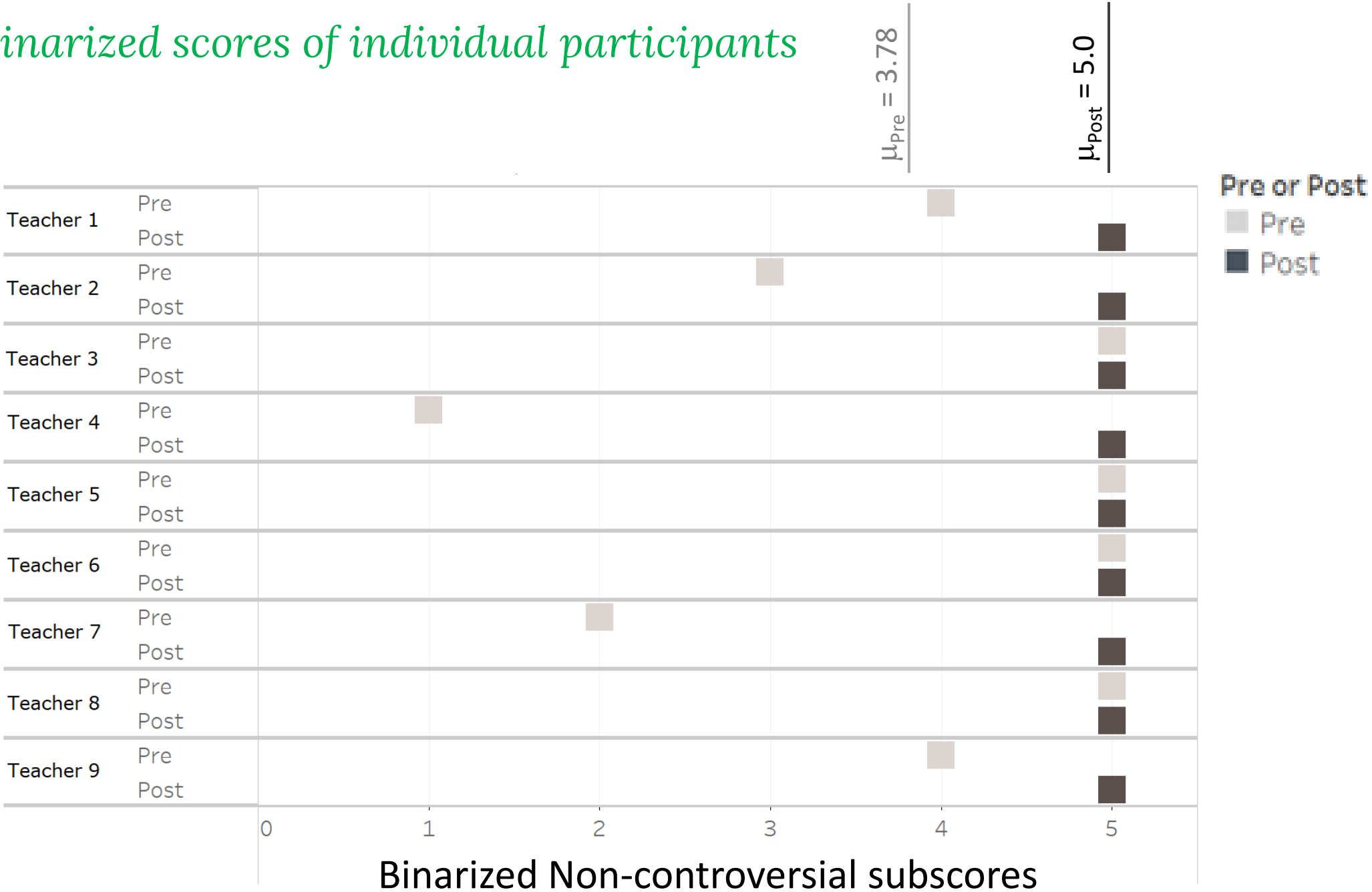
Binary scoring

- Since participants' responses of 1, 2, and 3 indicate not-endorse, and 4 & 5 indicate endorsing, we also assigned a score using a binary fashion, with "0" for 1,2,3 and "1" for 4,5.

LTSJ-B Binarized scores of participants



LTSJ-B Binarized scores of individual participants



Student perspectives

- “Every teacher should have training to be able to speak with their students about social justice issues.”
- “One of the most valuable things about this course was the chance to talk about our experiences and hopes in melding social justice into the math content area. It’s not an easy thing to make teachers feel comfortable talking about those concepts, but this course was an excellent experience.”
- “For teachers not used to teaching social justice concepts, it might be easy to explore less ‘hot’ issues like race and socioeconomic issues at first, and ease into the idea with things like environmental action.”

Disseminations

Engaging with Social Justice Mathematics Modeling Lessons

6–8 Session

Baltimore Convention Center, 341–342

Social justice mathematics modeling lessons (SJMMLs) can empower students to act as agents of change in their communities. Come and experience two SJMMLs: predicting the treatment of LGBTQ+ students in schools and placing a grocery store in a healthy food priority area. Participants will analyze the lessons and sample student work.

Mark Heath, Baltimore County Public Schools, Cockeysville, Maryland

William Lynch, Parkville, Maryland

Jodie Wohlfort, Perry hall, Maryland

Jean Ciscell, Towson University, Middle River, Maryland

Kimberly Corum, Towson University, Maryland



Regional Conference
& Exposition

BALTIMORE

NOVEMBER 30–DECEMBER 2, 2022



Math4SocialJustice

Online Professional Learning Workshop for Secondary Math Teachers

What?

The Math4SocialJustice (Math4SJ) professional learning workshop prepares participating teachers to engage their students in social justice issues through four student-centered lessons that focus on topics including politics, identity, and community. Over the course of five sessions, participants will engage in these lessons as learners, share ideas with colleagues, and reflect on their own learning. Participants will leave the workshop with increased confidence in incorporating social justice issues into their classroom curriculum.

Who?

This workshop is open to 6th – 9th grade math teachers in Maryland. Participants are expected to attend all workshop sessions (detailed below). Participants who successfully complete the workshop will earn a \$150 stipend.

October – November 2022

Staff: Kara Berger, Mary K. Stapleton

Graduate Students: Sarah Mamaril, Lynn Nichols, Rachael (Talbert) Miles, Ann Keen, Jodie (Wohlfort) Harris, William Brooks Lynch, Mark Heath

Undergraduate Student serving as breakout group facilitator: Jean Ciscell

Faculty: Sandy Spitzer, Kristin Frank, Kim Corum, Diana Cheng

Funded by the Fisher Endowment Fund

Acknowledgements



National Science Foundation
WHERE DISCOVERIES BEGIN

This project is based upon work supported by the National Science Foundation under Grant No. 2243461. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Science Foundation.

Publication: Cheng, D. & Gonzalez, J. (2023). Teaching to Make Math Resonate: Including Social Justice in a Graduate Course for Teachers. In J. Briganti, J. Sible & A. M. Brown (Eds.), *Fostering Communities of Transformation in STEM Higher Education: A Multi-Institutional Collection of DEI Initiatives*. Virginia Tech Publishing.

<https://pressbooks.lib.vt.edu/fosteringcommunities/chapter/teachingtomakemathresonate/>

