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The Impact of Prior Math Experience on College Students' Math Beliefs and Anxiety



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Overview



- 1) Background
- 2) Research Question
- 3) Literature Review
- 4) Methodology
- 5) Preliminary Results

Question



Thinking back to high school, what percentage of students do you think enjoyed mathematics?

Background



- Students do not seem to enjoy mathematics

I want to understand why students perceive math in a certain way

- This knowledge can give rise to effective strategies for learning mathematics

Background



- Two broad categories of interest
 - Students' perception of mathematics
 - Influencing factors

Perceptions of Math



Mathematical Beliefs

- Formal/Static Beliefs
 - 1) Learning Math collection of rules/formulas
 - 2) Teaching Math show the "best" approach to solve problems
- Constructivist/Dynamic Beliefs
 - 1) Learning Math creative process
 - 2) Teaching Math multiple approaches to problemsolving
- ☐ Info from Geisler & Rolka, 2020 | Ly & Brew, 2010

Perceptions of Math



Mathematical Anxiety

- Tension, apprehension, or fear when working with mathematics problems
- Basic arithmetic or Calculus / Trigonometry

☐ Info from Ashcraft, 2002

Influencing Factors



Mathematical Creativity in the Classroom

- Six conditions
 - 1. Teaching Style flexible, student-centered approach
 - 2. Innovative Teaching Practices innovative teaching methods
 - 3. Classroom Climate general "warmth" of the classroom
 - 4. Asking Questions ask students extraordinary questions
 - 5. Overcoming Barriers remove obstructions to teaching
 - 6. Confidence increase student confidence
- ☐ Info from Kandemir et al., 2019

Influencing Factors



High School Mathematics Courses

Number of mathematics courses taken

Algebra I/II/III, Geometry, Statistics, Calculus, etc.

☐ Info from U.S. Department of Education

Research Question



How can institutions and educators minimize math anxiety and foster more dynamic mathematical beliefs in the classroom?



Impact of Mathematical Anxiety (MA)

- Negative correlation to math achievement (Caviola et al., 2021; Schmitz et al., 2023)
- Less engagement and exam preparation (Geary et al., 2021; Jenifer et al., 2023)
- STEM avoidance (Daker et al., 2021)

Overcoming MA

- Teacher attitudes about mathematics (Lin et al., 2016)
- Growth mindset (Stohlmann & Yang, 2024)

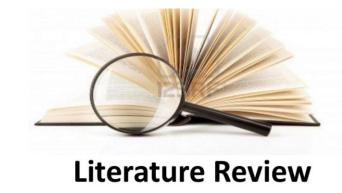




Impact of Mathematical Beliefs (MB)

- Static Beliefs Memorization > Understanding
- Dynamic Beliefs Growth mindset
 - Students are willing to learn mathematics

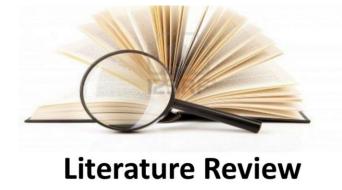
☐ Info from Geisler & Rolka, 2020





Fostering Creativity in the Classroom

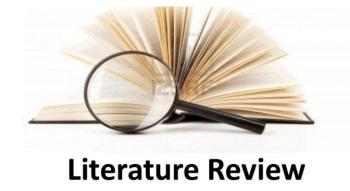
- Connect mathematics to student interests (Henriksen & Mehta, 2016)
- Divergent Thinking & Problem Posing (Fetterly, 2020)
 - Brainstorming several approaches / solutions to a problem
 - Generation of new problems / re-forming old problems





Mathematics Background

- More HS math courses lead to higher STEM enrollment (Wang, 2013)
- Calculus credit is the largest factor (Chang et al., 2023)



Unanswered Question



- Substantial literature around math anxiety
- Seldom literature around mathematical beliefs and creativity
- This study will both reinforce existing knowledge and identify how math educators can influence the classroom environment to foster more dynamic beliefs and lower anxiety



Research Design



Mixed Methods Design

Variables:

- HS math courses
- Creativity and efficacy of HS math teachers
- Current mathematical beliefs
 - Learning math
 - Teaching math
- Current mathematical anxiety



Sample



Participants

- Quantitative Literacy and Business Mathematics students
- Mathematics Education students
 - Two undergraduate courses, one graduate course

Procedure

- Survey all participants
- Conduct focus group interviews with math education students



Instruments



- High School math courses from U.S. Department of Education
- Creative Teaching of Mathematics Courses Scale (20 items) (Kandemir et al., 2019)
 - "The teacher enabled the students to solve problems through collaborating with each other"
- Revised Mathematical Beliefs Survey (16 items)
 (Ly & Brew, 2010)
 - "Mathematics requires independent and original thinking"
- Abbreviated Mathematics Anxiety Scale (10 items)
 (Hopko et al., 2003)
 - "Taking an examination in a math course"

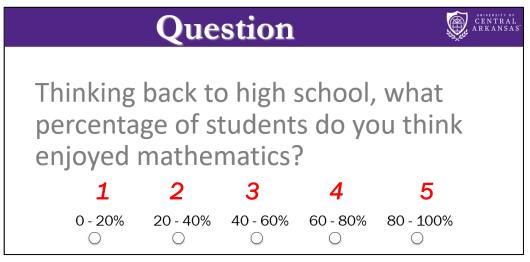
Quantifying Survey Data



Survey items use Likert scale

- Teacher Creativity:
 - Higher score = higher creativity
- Math Beliefs:
 - Higher score = more dynamic beliefs
 - Negatively oriented questions use flipped scores
- Math Anxiety
 - Higher score = higher anxiety

Recall:





Quantifying Survey Data



Total score for Teacher Creativity, Beliefs, Anxiety

$$\sum Q_{score}$$



Focus Groups



Focus groups will involve explanatory questions to expand upon math education students' experiences

- Examples
 - What factors have contributed to your confidence in mathematics?
 - How do students learn mathematics?
 - What does "good" teaching look like?

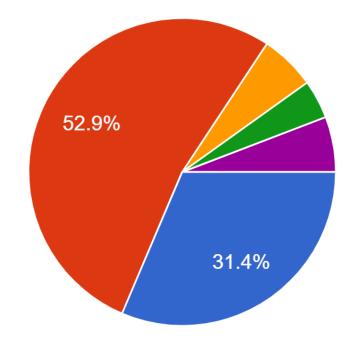


Prelim. Results (Sample)



170 participants

- 145 students in non-Math oriented courses
- 25 students in Math Education courses
 - 9 graduate students



- MATH 1360 QUANTITATIVE LITERACY
- MATH 1395 BUSINESS MATHEMATICS
- MATH 3370 MATHEMATICS IN THE SECONDARY SCHOOLS
- MATH 4314 APPLICATIONS OF MIDDLE LEVEL MATHEMATICS
- MATH 5300 PROFESSIONALIZED SUBJECT MATTER

Prelim. Results



Currently...

 We have results concerning differences in Teacher Creativity, Beliefs, and Anxiety (CAB) scores between non-math and math education students

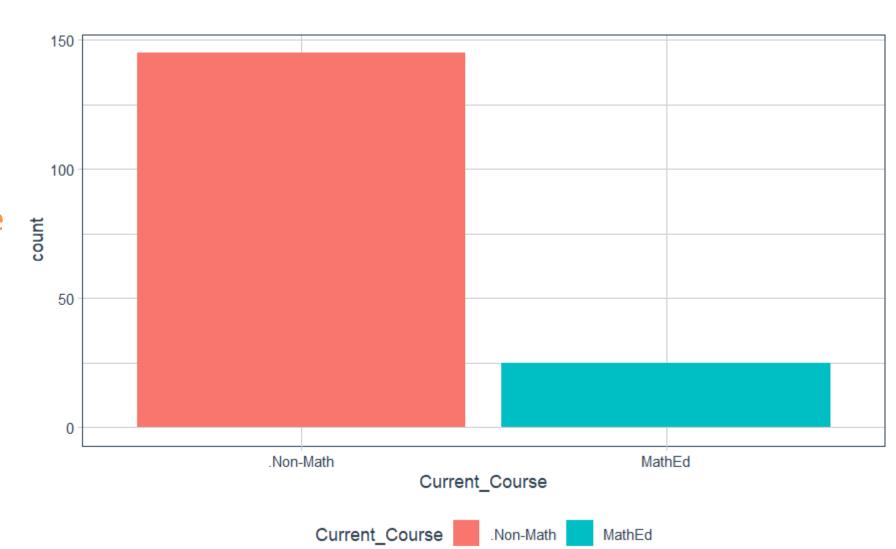
In the works...

- Remaining analysis of all quantitative survey data
- Focus group data collection and analysis



Students in...

- Non-Math Course(n = 145)
- Math Ed. Course (n = 25)

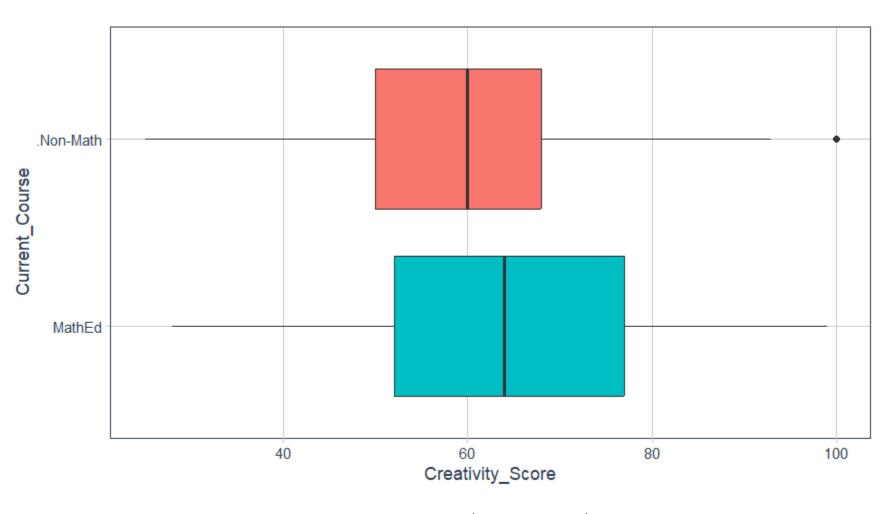




Creativity Scores:

 $-\mu = 59.71$

 $-\mu = 63.76$

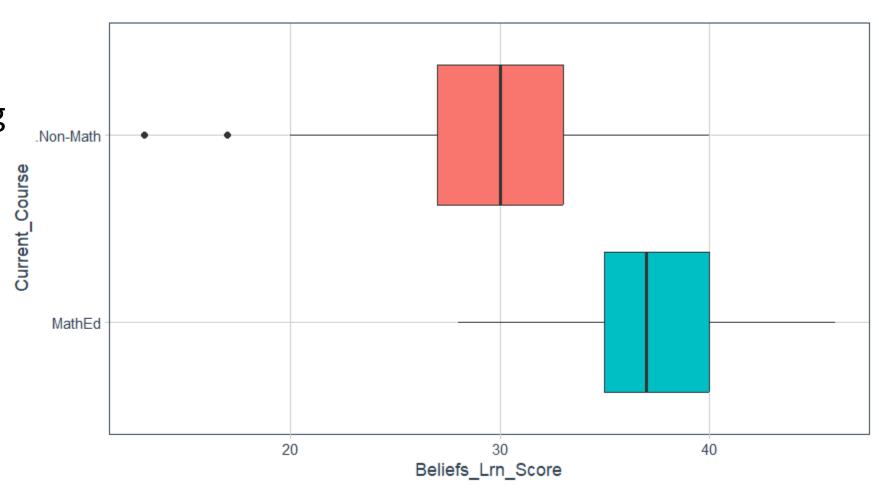




Beliefs about Learning Mathematics Scores:

 $-\mu = 30.34$

 $-\mu = 36.84$

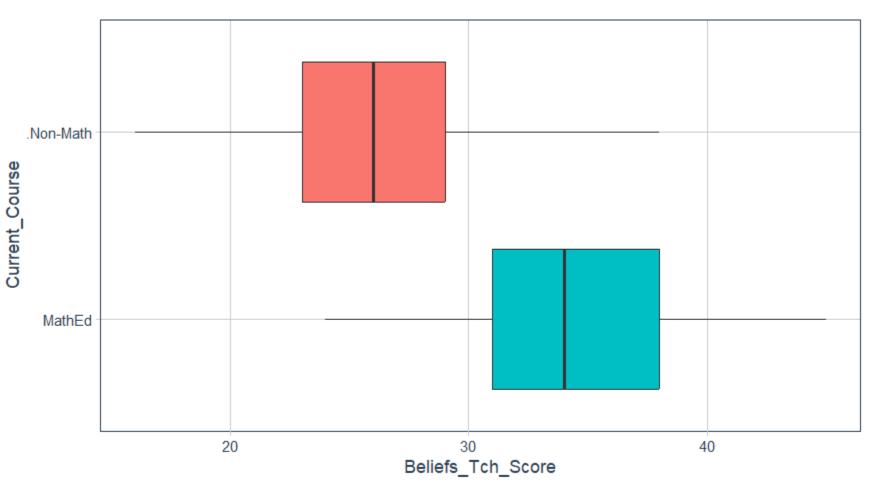




Beliefs about Teaching Mathematics Scores:

 $- \mu = 26.19$

 $-\mu = 34.28$



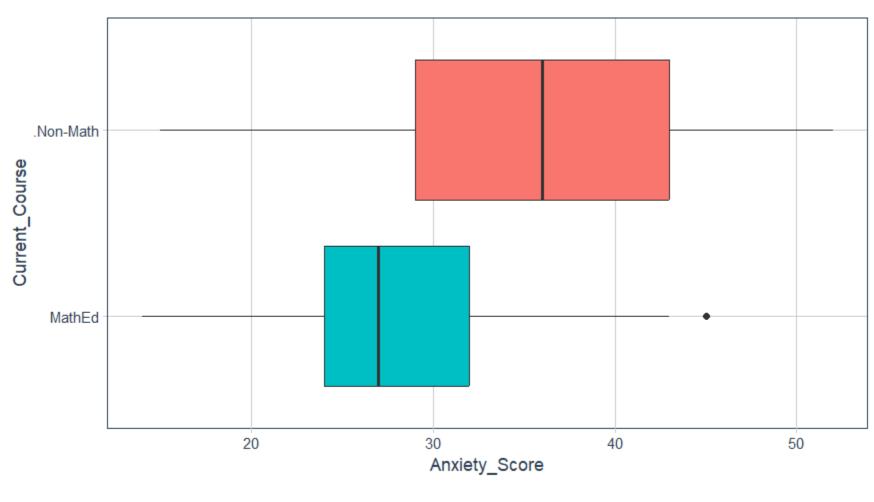
Current_Course = .Non-Math = MathEd



Anxiety Scores:

 $-\mu = 35.43$

 $-\mu = 28.44$



Current_Course in .Non-Math in MathEd

Hypothesis Test



M = math ed students NM = non-math-oriented students $\vec{\mu}$ = mean vector of CAB scores

$$H_0$$
: $\vec{\mu}_M = \vec{\mu}_{NM}$

$$H_A$$
: $\vec{\mu}_M \neq \vec{\mu}_{NM}$

Note:

- CAB Scores for M and NM follow multivariate normality
- Heterogeneous covariance matrices (p-value = 0.008)

Hypothesis Test



Results:

Test stat: 134.63

Numerator df: 4

Denominator df: 29.7103964080814

P-value: 1.507e-10

 Reject H₀ and conclude a difference in CAB scores between math education and non-math-oriented students

Discussion



Implications

- Foster a mathematics classroom environment where:
 - Both students and teachers express positive, dynamic attitudes about math
 - Students feel less anxious about math

 Identify factors at the institutional and educator level that can influence beliefs and anxiety

Discussion



Limitations

$$\lim_{x\to 0} \frac{\sin(x)}{x}$$

Discussion



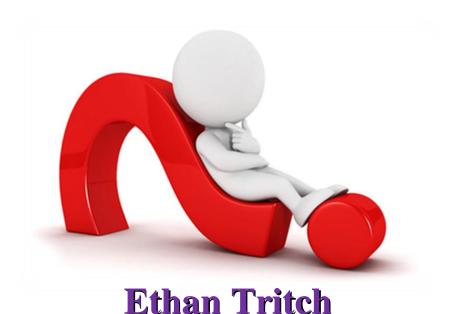
Limitations

- Cross-sectional study on past influences
- Time limitations

Future Work

- Track cohorts across several years as a longitudinal study
- More research could be done on how math educators can implement creative teaching practices

Questions?



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