14th Annual Meeting of the Indiana Mathematics Education Research Symposium (IMERS)

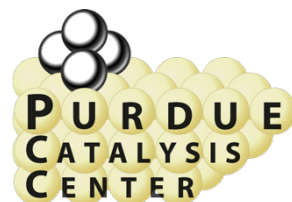## April 4th, 2025

Indianapolis, IN

Conference Program

&

Abstract Book

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CATALYST is an interdisciplinary research-oriented center that is jointly sponsored by the College of Education and the College of Science at Purdue University. education.purdue.edu/catalyst/

14th Indiana Mathematics Education Research Symposium
Friday, April 4, 2025

	Morning Sessions		
Time	**Session Type**	**Session Title and Presenters**	**Rooms and Moderators**
8:00a – 9:00a	Registration	**Breakfast and Registration**	President's Room
9:00a – 9:30a	Opening Session	**Welcome and Opening Remarks** Selim Yavuz (Indiana University – Bloomington)	INIP 231
9:30a – 10:15a	Equity Panel	**Fostering Inclusion – Integrating Equity in Mathematics Education** *Panelists*: Juan Manuel T. Gerardo (University of Cincinnati), Jill A. Newton (Purdue University), Andrew Gatza (Ball State University), and Sarah Lubienski (Indiana University - Bloomington)	INIP 231 Erik Jacobson

	Session Block #1		
Time	**Session Type**	**Session Title and Presenters**	**Room and Moderators**
10:15a – 10:25a	Coffee Break	---	President's Room
10:25a – 11:05a	Completed Study	**Redesigning Content and Pedagogy Courses for Elementary Teachers: Centering Student Thinking and School Partnerships** Andrew M. Gatza (Ball State University), Jonathan D. Watkins (Ball State University), Jerry A. Woodward (Ball State University), Jenna Menke (Ball State University), Kristi Martin (Ball State University), LeAnn Neel-Romine (Ball State University)	INIP 231 Mihyun Jeon
	Work In Progress	**Amplifying the Voices of Mother Educators in K-12 Public Schools** Kelsey Tiller (IU Indianapolis) **Diverse Perspectives on Student Achievement: Exploring Teachers' Attributional Beliefs in Mathematics Education** S. Yavuz (IU Bloomington), A. Arora (IU Indianapolis), J. Franklin (IU Indianapolis), S. Peirce (Georgia State University), A. Gustaveson (University of North Carolina), C. Willey (IU Indianapolis)	INIP 236 Bernard Smith
	Work In Progress	**Human vs. Automated Feedback: A Self-Study on Teachers' Questioning Techniques** Ladan Shojaei (Indiana University – Bloomington) **Does Students' Understanding of Partial Derivatives Evolve When Learning Related Topics?** Alexandra Cuadra (Purdue University)	INIP 232 Matthew Hardee

Session Block #1 (continued)			
Time	**Session Type**	**Session Title and Presenters**	**Room and Moderators**
10:25a – 11:05a	Work Under Design	**Bridging the Gap: Addressing AI Challenges in Educational Contexts with a Multi-Disciplinary Approach** Mert Onur Cakiroglu (Indiana University - Bloomington), Selim Yavuz (Indiana University - Bloomington), Huseyin Amac (Indiana University - Bloomington) **Investigating Stem Achievement and Teachers' Beliefs About Multilingual Learners in Science Education** Krystal Brand (Indiana University - Indianapolis)	INIP 222 Signe Kastberg
	Work Under Design	**Give Less Corrective Feedback, Ask Questions, and Listen More** Ryan Schaben (Indiana University – Bloomington)	INIP 216 Hyunjeong Lee

Mid-Day Sessions			
Time	**Session Type**	**Session Title**	**Rooms and Moderators**
11:05a – 11:15a	Coffee Break	---	President's Room
11:15a – 12:00p	Keynote Speaker	**Research to Practice: Exploring Math with Technology** Dr. Jennifer Lovett (Middle Tennessee State University)	INIP 231 Enrique Galindo
12:00p – 1:00p	Lunch	(There is a meeting for faculty at 12:30pm. See below.)	President's Room
12:30p – 1:00p	Network Activity (Faculty)	Networking Activity for HAMTE Faculty	INIP 231
1:00p – 1:45p	Panel	**Sharing Insights – Disseminating Research in Mathematics Education** *Panelists*: Evthokia Stephanie Saclarides (University of Cincinnati), Rachael H. Kenney (Purdue University), Jean S. Lee (University of Indianapolis), and Erik Tillema (Indiana University Bloomington)	INIP 231 Amy Hackenberg

Session Block #2			
Time	**Session Type**	**Session Title and Presenters**	**Room and Moderators**
1:45p – 2:00p	Coffee Break	---	President's Room
2:00p – 2:40p	Completed Study	**Planning to Attend to Student Thinking in Instruction: Examining Elementary Pre-Service Teachers' Lesson Plans** Erik Tillema (Indiana University – Bloomington)	INIP 231 Jeffery Franklin

Time	Session Type	Session Title and Presenters	Room and Moderators
Session Block #2 (continued)			
2:00p – 2:40p	Work In Progress	**Elementary Preservice Teachers' Mathematical Knowledge for Teaching Fractions** Hyunjeong Lee (Indiana University – Bloomington) **Preservice Secondary Teachers' Learning to Position Their Students as Problem-Posers in Algebra** Comfort Aje (Purdue University), Alexandra Cuadra (Purdue University), Rachael Kenney (Purdue University)	INIP 236 Ghan Shyam Joshi
	Work In Progress	**Feedback to Change: Using Expert Reviews to Develop Surveys on Mathematics Teacher Beliefs** Bernard Smith (Indiana University), Elizabeth Roan (Indiana University), Selim Yavuz (Indiana University) **Reimagining Math Classrooms: Integrating SEL, TIPs, Care Practices, and Rehumanizing Pedagogies** Asenath Odondi (Purdue University)	INIP 232 Matthew Hardee
	Work Under Design	**Integrating Generative AI in Designing Mathematics Lesson Plans: Applying UTAUT3 Model to Generation Z Teachers** Atefeh Ataran (Clemson University), Ladan Shojaei (Indiana University – Bloomington) **Secondary Mathematics Teachers' Perceptions and Motivation to Implement Mathematics-Focused Integrated Stem** Hanan Alyami (Purdue University in Fort Wayne), Hyun Jin Cho (Purdue University in Fort Wayne)	INIP 222 Guili Zhang
	Work Under Design	**Exploring Pre-Service Elementary Teachers' Construction of Fraction Schemes** Jonathan Valero (Indiana University – Bloomington) **Enhancing Student Engagement Through Local Data Inquiry** Abigail Erskine (Purdue University)	INIP 216 Ryan Schaben

| Time	Session Type	Session Title and Presenters	Room and Moderators
Session Block #3			
2:40p – 2:50p	Coffee Break	---	President's Room
2:50p – 3:30p	Completed Study	**Spooks, Saviors & Saltwater: Counternarratives of Black Male Math Teachers** Evan M. Taylor (Indiana University – Indianapolis)	INIP 231 Matthew Hardee
	Work In Progress	**Unpacking the Use of a Math Literacy Activity for Formative Assessment in Calculus** Alexandra Cuadra (Purdue University), Rachael H. Kenney (Purdue University) **Analysis of Problem-Solving in Mathematics Textbooks: A Study of Indonesia and the United States** Said Fachry Assagaf (Indiana University – Bloomington)	INIP 236 Doris Fulwider

		Session Block #3 (continued)	
Time	**Session Type**	**Session Title and Presenters**	**Room and Moderators**
2:50p – 3:30p	Work In Progress	**Coordinating the Five Practices and Generalization Frameworks** Mihyun Jeon (Indiana University), Erik Tillema (Indiana University), Jonathan Rojas Valero (Indiana University) **Connecting Socio-Ecological and Mathematical Modeling: Promoting Sustainability in Mathematics Education** Dayat Hidayat (Purdue University)	INIP 232 Bernard Smith
	Work Under Design	**Future Teachers' Preparedness: Examining Inclusive Education Perceptions at Kilis 7 Aralik University, Türkiye** Zeynel Amac (Kilis 7 Aralik University, Türkiye) **Bridging Curricula Across Five Countries: Fraction Learning Opportunities in Indonesia, Korea, Taiwan, Türkiye, and the United States** Hyunjeong Lee (Indiana University – Bloomington), Iwan Sianturi (Indiana University – Bloomington), Selim Yavuz (Indiana University – Bloomington)	INIP 222 Abigail Erskine

		Session Block #4	
Time	**Session Type**	**Session Title and Presenters**	**Room and Moderators**
3:30p – 3:40p	Coffee Break	---	President's Room
3:40p – 4:20p	Completed Study	**A Grounded Theory Approach to Profiling Student Competencies in ChatGPT-Based Teaching and Learning Environments** Ahmad Keykha (Sharif University), Fateme Jafari (The University of Tehran), Ladan Shojaei (Indiana University)	INIP 231 Comfort Aje
	Completed Study	**Preparing Preservice Teachers to Align Standards, Goals, and Desmos Tasks** Jenna Menke (Ball State University), Elyssa Stoddard (SUNY – Oneonta)	INIP 236 Ryan Schaben
	Work In Progress	**A Three-Tier Analysis of Pre-Service Teachers' Misconceptions about Statistics** Ayten Öykü Yaşar (Haci Bektas Veli Nevsehir University), Selim Yavuz (Indiana University – Bloomington), Deniz Kaya (Haci Bektas Veli Nevsehir University) **Insights from Impact and Experience: Reporting on Four Years of Summer Courses** Selim Yavuz (Indiana Univarsity – Bloomington)	INIP 232 Akaash Arora
	Work In Progress	**Preservice Mathematics Teachers' Perceptions of AI's Role in Motivating Students in Learning Linear Equations** Humphrey Chinenye Ochulor (Purdue University) **The Hermeneutic Calculator** Theodore M. Savich (Indiana University – Bloomington)	INIP 222 Matthew Hardee

Closing Sessions			
Time	**Session Type**	**Session Title and Presenters**	**Rooms and Moderators**
4:30p – 5:00p	Closing	**Closing Reception: Remarks, Feedback, and Reception** Selim Yavuz (Indiana University – Bloomington)	President's Room
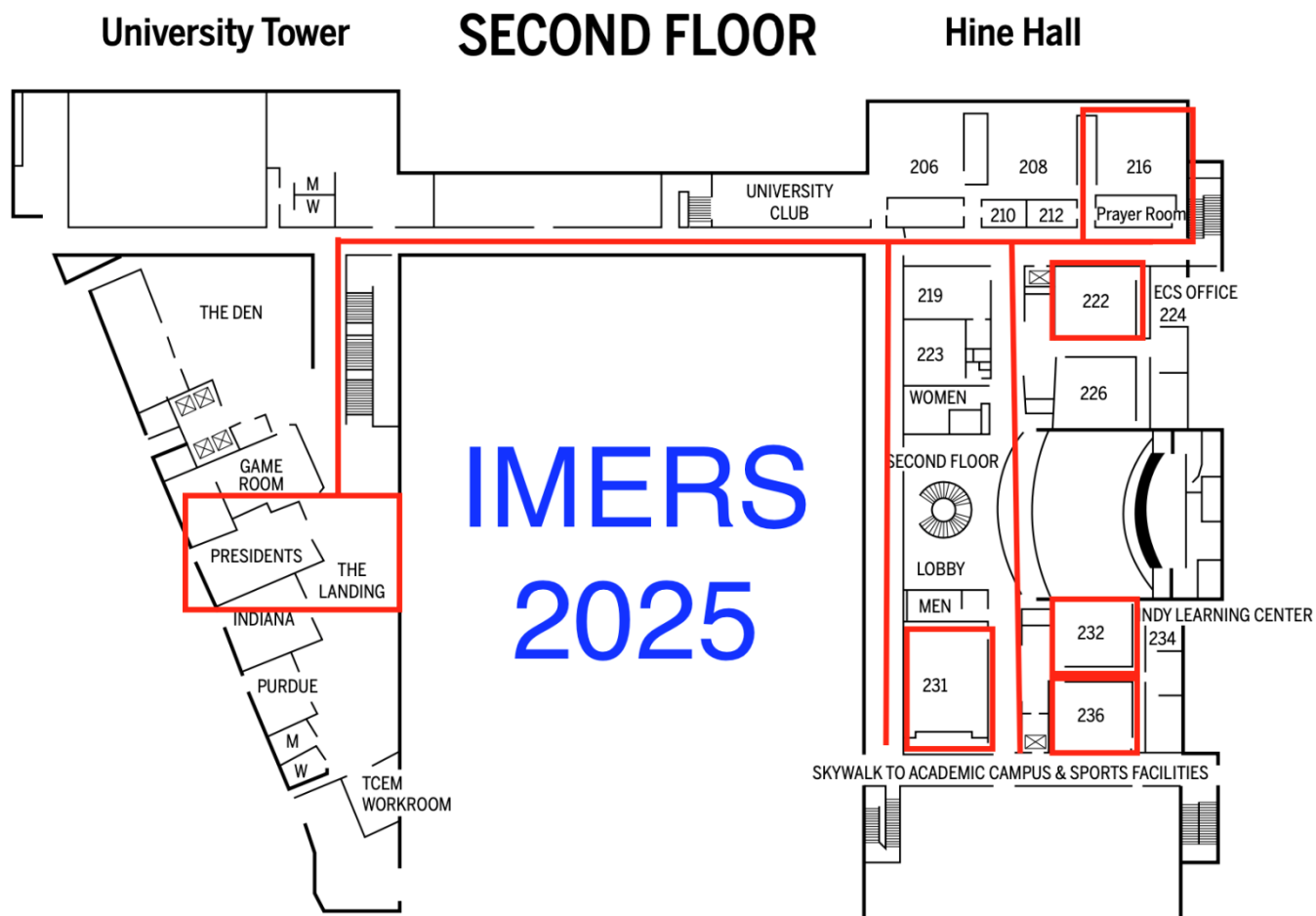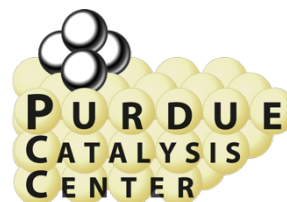
*This is the **alphabetical order** based on **the first author's first name.***

[*Work-under-Design*]
ENHANCING STUDENT ENGAGEMENT THROUGH LOCAL DATA INQUIRY

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Student engagement is a critical component of effective Science, Technology, Engineering, and Mathematics (STEM) education, particularly in mathematics and data analysis. Traditional instruction in statistics often isolates concepts such as mean, median, range, and standard deviation from real-world applications, leading to low student motivation and disengagement (Garfield & Ben-Zvi, 2008). Research suggests that collaborative learning environments, where students work together to solve authentic problems, significantly improve engagement and conceptual understanding of statistical reasoning (Franklin & Kader, 2006; Yeen-Ju & Mai, 2016). For this study under design, an inquiry-based lesson was designed using publicly available deer mortality data from Tippecanoe County. The lesson aims to engage students in a collaborative exploration of real-world data, where they will analyze deer-vehicle collision trends and population control efforts through a team-based approach. Students will have career roles such as insurance analysts and biologists and work in groups to interpret data and formulate data-driven recommendations. The purpose of this study is to explore the role of collaboration in promoting student engagement in statistical learning. The following research question guides the instructional design: How does collaborative learning impact student engagement in statistical data inquiry?

Keywords: Student engagement, collaborative learning, statistical analysis, data-driven mathematics, real-world applications

[*Completed Study*]
A GROUNDED THEORY APPROACH TO PROFILING STUDENT COMPETENCIES IN CHATGPT-BASED TEACHING AND LEARNING ENVIRONMENTS

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Abstract
Objective: Integrating ChatGPT technology has become essential to modern educational frameworks. Higher education institutions worldwide have adopted various strategies and policies to promote or limit its use. However, managing technological advancements within certain boundaries is increasingly challenging due to the ongoing evolution and innovations that significantly influence the future of education. ChatGPT presents both advantages and challenges for students, depending on their engagement and ability to utilize the technology. Consequently, this research aims to explore and identify the skills students need to use ChatGPT effectively.
Methodology: Due to the limited prior research in this area, we utilized the systematic grounded theory approach developed by Strauss and Corbin (1990). We interviewed 18 international students at the University of Tehran using purposive sampling and a random selection strategy.

Findings: The research results, based on grounded theory, encompass a wide range of topics, including factors that cause changes—such as technological progress, biological shifts, and transformations in the higher education system; variables that intervene and influence the situation, including political and economic factors; contextual factors that illustrate how societal and academic cultures have evolved over time; actions and strategies aimed at enhancing human capital, establishing legal frameworks, creating incentive and regulatory systems, targeting policymaking, and improving infrastructure; as well as developmental outcomes that include enhanced academic and research performance at universities and personal growth. A paradigmatic model was also developed, and the participants' stories were detailed.

This research explores new frontiers by evaluating students' abilities to use ChatGPT in higher education. The researchers provided valuable insights that can help students employ ChatGPT more effectively in their academic pursuits. These findings also encourage the seamless integration of AI technologies into higher education systems.

Keywords: Learning Environments, ChatGPT-Based Teaching, Grounded Theory, Student Competencies, ChatGPT in Teaching, ChatGPT in Learning

[*Work-in-Progress*]

DOES STUDENTS' UNDERSTANDING OF PARTIAL DERIVATIVES EVOLVE WHEN LEARNING RELATED TOPICS?

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Mathematical literacy is a critical component of teaching mathematics as its own language. In this proposal, I share the use of writing to learn mathematics (WTLM) activities to help college students communicate their mathematical thinking and understanding. I conducted an embedded single-case study with two sections of undergraduate students enrolled in a Calculus II course focused on integral and multivariable calculus topics. Three WTLM activities were integrated into the course to provide opportunities for students to explain their symbolic, procedural, and conceptual understandings of partial derivatives and related topics. I share the framework and tools developed for this study and the data analysis plan and preliminary analysis steps.

Keywords: Math literacy, partial derivatives, concept definition, concept image

[*Work-in-Progress*]

UNPACKING THE USE OF A MATH LITERACY ACTIVITY FOR FORMATIVE ASSESSMENT IN CALCULUS

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A mathematical literacy is a critical component of teaching mathematics as its own language. In this study, we incorporated two writing to learn mathematics (WTLM) activities as formative assessment tools in a second-semester college calculus course. Our goals were (a) to examine how WTLM broadens students' opportunities to communicate their mathematical thinking and understanding and (b) to explore WTLM activities as formative assessment tools that influence instructor decision-making. We conducted this work with 84 undergraduate students enrolled in a hybrid calculus course taught by the first author. The course focuses on integral and

multivariable calculus; we focused our WTLM activities specifically on students' understanding of partial derivatives. Analysis is currently ongoing, and we share preliminary findings here.

Keywords: Math literacy, partial derivatives, formative assessment

[*Completed Study*]
REDESIGNING CONTENT AND PEDAGOGY COURSES FOR ELEMENTARY TEACHERS: CENTERING STUDENT THINKING AND SCHOOL PARTNERSHIPS

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This session describes the collaborative work of faculty at one institution to redesign the mathematics content and pedagogy courses for elementary education majors—a four-course sequence with three content courses and one methods course. This redesign was in support of efforts to recruit and retain a diverse pipeline of educators as well as efforts to cultivate bidirectional partnerships with local elementary schools. In light of more recent teacher preparation guidance from the Indiana Department of Education on the number and types of courses that should be included in teacher preparation programs, we see this presentation as particularly timely.

Keywords: Elementary, content, methods, partnerships

[*Work-under-Design*]
INTEGRATING GENERATIVE AI IN DESIGNING MATHEMATICS LESSON PLANS: APPLYING UTAUT3 MODEL TO GENERATION Z TEACHERS

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REIMAGINING MATH CLASSROOMS: INTEGRATING SEL, TIPS, CARE PRACTICES, AND REHUMANIZING PEDAGOGIES

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Traditional mathematics education has often prioritized cognitive skills while neglecting the emotional, social, and cultural dimensions of learning. This study investigates how integrating Social Emotional Learning (SEL), Trauma-Informed Practices (TIPs), Care Practices, and Rehumanizing Pedagogies can transform secondary mathematics classrooms into inclusive and supportive spaces. These frameworks collectively address affective dimensions of learning by fostering equity, positive mathematical identities, and emotional well-being. Using a qualitative research approach, this study synthesizes findings from literature reviews, thematic analysis, and document analysis of secondary mathematics methods courses. The research identifies overlapping classroom practices across these frameworks, such as collaborative problem-solving, culturally responsive teaching, safe learning environments, and growth mindset development. Preliminary findings suggest that these practices promote student engagement, resilience, and equity while addressing challenges like math anxiety and systemic inequities. This research aims to equip pre-service teachers with actionable strategies to create emotionally supportive classrooms that academically and socially empower students. This study contributes to the broader conversation on fostering inclusive learning environments that prepare students as confident problem-solvers for the future by reimagining math classrooms through affective pedagogies.

A THREE-TIER ANALYSIS OF PRE-SERVICE TEACHERS' MISCONCEPTIONS ABOUT STATISTICS

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This study investigates preservice teachers' misconceptions and skill deficiencies in statistics using a three-tier diagnostic approach with a certainty response index to identify positive and negative skill deficiencies and detect knowledge gaps. A literature review established the theoretical framework. The study was conducted with 48 preservice teachers enrolled in an elementary mathematics education program in Turkey during the 2024-2025 academic year, fall semester. The Statistical Reasoning Assessment served as the data collection tool. Findings indicate that the three-tier assessment effectively measures statistical thinking levels, revealing that preservice teachers struggle particularly with solution generation and explanation.

FEEDBACK TO CHANGE: USING EXPERT REVIEWS TO DEVELOP SURVEYS ON MATHEMATICS TEACHER BELIEFS

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In this research, we review analysis of a survey instrument designed to measure K-8 mathematics teachers' beliefs around mathematical success and struggle in students. We chose experts in various identity fields as well as equity in mathematics education to provide feedback on the design of the survey instrument. These experts provided individual feedback around the survey and participated in focus groups to address changes to better focus the survey. The preliminary findings center around issues in addressing systemic factors in survey items and balancing survey items that discuss deficit stereotypes with the need to avoid perpetuating stereotypes among teachers.

Keywords: Focus groups, instrument validity, mathematics teacher beliefs

PRESERVICE SECONDARY TEACHERS' LEARNING TO POSITION THEIR STUDENTS AS PROBLEM-POSERS IN ALGEBRA

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This study was an initial investigation into how we can help secondary preservice teachers understand problem-posing and how to position their students as problem-posers in the classroom. We collected data from a set of activities and via focus group discussions conducted in a teaching seminar. Preliminary findings reveal preservice teachers' initial view of problem-posing from teacher-centered and later recognized its shift to student-centered in fostering student engagement, curiosity, and conceptual understanding. Challenges include aligning open-ended questions with lesson objectives, contextualizing problems for meaningful application, and feeling confident that students can problem-pose in meaningful ways. The study emphasizes the importance of helping preservice teachers recognize problem-posing as a practice that can deepen mathematical understanding and promote student ownership of learning.

Keywords: Problem-posing, preservice secondary teachers, algebra

CONNECTING SOCIO-ECOLOGICAL AND MATHEMATICAL MODELING: PROMOTING SUSTAINABILITY IN MATHEMATICS EDUCATION

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There is a growing need for mathematics education to expand its scope by addressing social and environmental issues such as climate change, pollution, water and food insecurity, biodiversity loss, social injustice and inequalities. Socio-ecological perspective and mathematical modeling are widely recognized as transformative approaches for responding to these challenges and promoting sustainability in mathematics education. This study highlights the connection between socio-ecological perspective and mathematical modeling, as well as their potential for fostering sustainability in mathematics education. Our theoretical findings are grounded in a mathematical modeling project using a mudflow disaster context that occurred in a specific region of East Java, Indonesia. The findings suggest that integrating socio-ecological perspectives and mathematical modeling can serve as meaningful approaches to teaching and learning mathematics while also promoting sustainability and responsible citizenship within mathematics education.

Keywords: Socio-ecological, mathematical modeling, sustainability in mathematics education

PLANNING TO ATTEND TO STUDENT THINKING IN INSTRUCTION: EXAMINING ELEMENTARY PRE-SERVICE TEACHERS' LESSON PLANS

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Mathematics educators have made long-standing recommendations to attend to students' mathematical thinking during mathematics instruction. For many teachers, one of the most difficult components of attending to student thinking is the process of making sense of, and responding to it, in real time. This difficulty is heightened for pre-service teachers who often do not have significant experiences interpreting and responding to students' mathematical thinking. One way to address this teacher difficulty is to help teachers prepare ahead of time for student thinking so that attention to student thinking is part of the planning process. I use this session to examine two pre-service elementary teachers (PSTs) lesson plans to illustrate how I have integrated attention to student thinking into PSTs' lesson planning in their elementary methods and field experience course work.

Keywords: Elementary pre-service teachers, planning to attend to student thinking

[*Completed Study*]
SPOOKS, SAVIORS & SALTWATER: COUNTER-NARRATIVES OF BLACK MALE MATH TEACHERS

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Bennett (2020) questioned what we can learn from Black men in American literature beyond narratives of pain. This phenomenological study examines the lived experiences of four Black male math educators in large U.S. urban areas, using Critical Race Theory (CRT) to explore how education policies affect their professional identities. Responding to Joseph et al.'s (2021) call to document Black teachers' mathematical experiences, the study presents interview data as a stage play with instructive vignettes, centering Black male educators' perspectives. These vignettes serve as counter-narratives, highlighting their relationships with mathematics, responses to anti-Blackness in assessments, and professional identity development. Insights from this study inform policymakers and researchers on crafting supportive policies that nurture identity development for Black men in teaching.

Keywords: Black, male, teacher, politics, intersectionality

[*Work-under-Design*]
SECONDARY MATHEMATICS TEACHERS' PERCEPTIONS AND MOTIVATION TO IMPLEMENT MATHEMATICS-FOCUSED INTEGRATED STEM

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[*Work-in-Progress*]
PRESERVICE MATHEMATICS TEACHERS' PERCEPTIONS OF AI'S ROLE IN MOTIVATING STUDENTS IN LEARNING LINEAR EQUATIONS

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This study explores preservice mathematics teachers' perceptions of the role Artificial Intelligence (AI) plays in motivating middle school students to learn linear equations. Focusing on three key dimensions of motivation-affective, cognitive, and socio-cultural, the research aims to understand how AI-driven tools can enhance student engagement in mathematics. Through semi-structured interviews with preservice teachers, the study will investigate their views on AI's potential to reduce math anxiety, support problem-solving, and foster collaborative learning. Findings will provide insights into how future educators might integrate AI into instructional practices to improve motivation and achievement in middle school algebra.

Keywords: Artificial intelligence, preservice mathematics teachers, middle school, linear equations

ELEMENTARY PRESERVICE TEACHERS' MATHAMTEICAL KNOWLEDGE FOR TEACHING FRACTIONS

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This study examines how elementary Pre-Service Teachers' (PSTs) capacity for units coordination is related to how they construct fraction schemes and create mathematical meanings for teaching fractions with two research questions focusing on PSTs' first order knowledge (their construction of fraction schemes and stages of units coordination) and their second order knowledge (their understanding on students' fractions knowledge). To respond them, I plan to initiate the data collection by administering a written task using an instrument by Norton et al (2015) to eight elementary PSTs, aiming to select four (out of the 8) candidates for the subsequent 12-episode teaching experiment and post-test. Among 12 episodes, the initial four will concentrate on their first-order knowledge, engaging participants in fraction-related problems. The latter eight episodes will center on the PSTs' second-order knowledge, involving their interpretation of elementary students' problem-solving videos (4 episodes) as well as real interaction with elementary students (4 episodes) on fractions.

Keywords: Keywords: Mathematical Knowledge for Teaching, Pre-Service Teacher Education, Algebraic Thinking.

BRIDGING CURRICULA ACROSS FIVE COUNTRIES: FRACTION LEARNING OPPORTUNITIES IN INDONESIA, KOREA, TAIWAN, TÜRKIYE, AND THE UNITED STATES

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PREPARING PRESERVICE TEACHERS TO ALIGN STANDARDS, GOALS, AND DESMOS TASKS

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Mathematics teachers need to be prepared to interpret state standards, write learning goals that align with those standards and then find activities that align with those learning goals. This is a lot for beginning teachers to coordinate. Adding mathematical action technology to those activities adds an addition layer as beginning teachers must consider if the technology enhances the task. In this session, I will describe a module that mathematics teacher educations can engage PSTs in to help PSTs learn how to unpack the standards, construct meaningful goals, and create a task using mathematical action technology that aligns with those goals. I will share successes and shortcoming and discuss revisions to the module to address those shortcomings.

Keywords: Mathematical action technology, secondary preservice teachers, desmos

[*Keynote speaker*]
RESEARCH TO PRACTICE: EXPLORING MATH WITH TECHNOLOGY

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In this talk, I discuss the importance of teaching and learning mathematics with technology, including how I think about affecting change across K–16 education. Specifically, I will share studies that I have conducted using a specific technology task and the various ways it was studied and disseminated to inform research, teaching, and teacher education. In discussing these studies, I highlight strategies for writing to different audiences that I hope you can apply to your own work.

[*Work-under-Design*]
EXPLORING PRE-SERVICE ELEMENTARY TEACHERS' CONSTRUCTION OF FRACTION SCHEMES

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This work-under-design is a continuation of a pilot research project I conducted with two pre-service elementary teachers during Spring 2022 in a Midwestern intensive research university. Originally, the project was a 10-episode teaching experiment (Steffe & Thompson, 2000) and aimed to explore cognitive structures associated with fraction knowledge in PSTs. The preliminary findings of that researcher suggested that there are PSTs who have not constructed some of the fraction knowledge they will need to teach to their future students. For instance, I found that one of the PSTs, Annie, had not constructed the Reversible Partitive Fraction Scheme (Steffe & Olive, 2010), RPFS, which is a scheme necessary to solve problems such as findings a whole bar given three-fifths of that bar. Researchers have documented what percentage of PSTs have (not) constructed schemes and operations at the pre-service teacher education level (e.g., Lovin et al., 2018), which elucidates the challenge of teacher education programs in supporting PSTs in their mathematical learning. However, evidence for the nuances and complexities associated with the construction of fraction schemes in PSTs is limited. Therefore, I aim to develop a research project to qualitatively contribute to the characterizations on how PSTs build their fraction knowledge. The following research question will guide the study: *What are some characterizations of PSTs' schemes associated with fraction knowledge?*

Keywords: Learning Theory, Preservice Teacher Education, and Rational Numbers.

[*Work-in-Progress*]

AMPLIFYING THE VOICES OF MOTHER EDUCATORS IN K-12 PUBLIC SCHOOLS A QUALITATIVE RESEARCH PROJECT

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Women are at the core of two incredibly important caretaking roles: mothering and teaching. The historical feminization of the field of education alongside the steadfast patriarchal American society in which we live creates a gendered identity unique to mother educators. The purpose of this qualitative study is to explore identity in relation to the duality of these service-oriented roles as a form of social activism. I plan to utilize O'Reilly's (2016) Matricentric Feminism framework to create a narrative inquiry that examines intersectional perspectives of educators who identify as doing the work of mothering. These important firsthand accounts will shed light on what it means to hold these caretaking roles in America today.

[*Work-under-Design*]

INVESTIGATING STEM ACHIEVEMENT AND TEACHERS' BELIEFS ABOUT MULTILINGUAL LEARNERS IN SCIENCE EDUCATION

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[*Work-in-Progress*]

HUMAN VS. AUTOMATED FEEDBACK: A SELF-STUDY ON TEACHERS' QUESTIONING TECHNIQUES

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Abstract is not available.

BRIDGING THE GAP: ADDRESSING AI CHALLENGES IN EDUCATIONAL CONTEXTS WITH A MULTI-DISCIPLINARY APPROACH

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Artificial Intelligence (AI) is becoming a powerful tool in education, yet current AI models often fail to fully meet the needs of educators and researchers (Luckin and Holmes, 2016; Zawacki-Richter et al., 2019). This study will conduct by a team of educators and computer scientists, aims to identify key limitations in AI tools used for teaching, research, and data security. Specifically, we examine challenges in literature review automation, data privacy, and AI-assisted assessment tools (Chen et al., 2020). Our goal is to explore potential improvements to existing AI models and propose customized AI solutions for educational settings. The presentation will provide an overview of AI's current capabilities and limitations, followed by an interactive discussion to gather insights from mathematics education researchers on their experiences with AI.

COORDINATING THE FIVE PRACTICES AND GENERALIZATION FRAMEWORKS

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In the presentation, we present methodological insights from a multi-year classroom-based design study investigating how three experienced in-service mathematics teachers (ISTs) adapted and adopted the Five Practices (5Ps) instructional framework (Smith et al., 2020) to support student generalization in their classroom instruction. This report focuses on qualitative data analysis, particularly the coding process for coordinating two frameworks, the 5Ps framework and Ellis et al.'s (2022) generalization framework. Through iterative coding and refinement, we developed an emergent framework that captures differences in the way teachers used particular of the 5 Practices (e.g., selecting) to support different generalization goals (e.g., identifying regularities). We share our research team's experience in coding video data, refining definitions through collaborative discussions, and resolving boundary cases. We discuss our current analytic phase, offering insights into the challenges and affordances of qualitative coding in mathematics education research. We also present initial observations about relationships between the 5Ps and generalization frameworks.

Keywords: Qualitative coding, five practices framework, generalization

GIVE LESS CORRECTIVE FEEDBACK, ASK QUESTIONS, AND LISTEN MORE

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In US mathematics, the status quo for mathematical learning is the teacher is the expert, while the student is the novice in mathematics education. This is supported by how feedback is given in mathematics classrooms. Teachers will correct students' incorrect answers during group, discourse, and tests. Teachers also write comments, sometimes lengthy, on assignments, tests, and report cards. Feedback is viewed as vital to growth and development of children including in mathematics (Metcalfe, 2017). This feedback, though sounds normal may create unintended consequences. When a teacher corrects students, it may lead to frustration or anxiety from the students when grappling to understand mathematics. This frustration compiles and eventually, the assumed helpful feedback from the teacher gets lost in clouds of doubt, frustration, disinterest. The feedback is now limited in its scope of helping students as intended. What is the purpose of feedback? In the US, feedback is meant to steer students away from making mistakes (Stevenson & Stigler, 1992) which sounds like a solid practice; however, I argue that this error-avoidant approach limits how people are able to understand mathematics. Error-learning is vital to learning, but in mathematics it is largely avoided. In fact, when observing mathematics practices, teachers mostly lecture and correct students, but rarely are students given enough time to make mistakes and have time to recognize and work through mistakes. Instead of the teacher being the primary source of feedback, students need to be giving most of the feedback to their peers on problems. Teachers need to speak less and listen more. Speaking less allows students to engage in discourse and become more involved in their learning. Teachers speaking less, allows students to test possible ways of solving problems. Speaking less will allow students to compare ideas and challenge their own solutions. Teachers listening more, gives teachers more feedback about what students truly understand because according to von Glasersfled (1995), teachers can never fully know what each students is thinking. The listening role enables teachers to ask better thought-provoking questions to stimulate deeper learning or keep students in flow (Csikszentmihalyi et al., 2018) before frustration starts to set in. Doing so, allows students to receive corrective feedback that does not come from an authority figure. Questioning also allows students to work with preconceptions and mistakes in mathematical learning. Teachers are given more time to assess students learning because they are explaining/correcting less.

ANALYSIS OF PROBLEM-SOLVING IN MATHEMATICS TEXTBOOKS: A STUDY OF INDONESIA AND THE UNITED STATES

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Problem-solving is one of the main skills in many curriculums across countries. Textbooks play a fundamental and central role in implementing problem-solving skills in mathematics classrooms. They serve as curriculum guides that support teachers in promoting problem-solving skills through tasks, exercises, activities, and problems. This study aims to describe how mathematics textbooks develop problem-solving skills through their tasks. This study compares two mathematics textbooks for 8-graders from two countries with different curriculum types: Indonesia, as a centralized education, and the United States, as a decentralized education. I observed problems from three main topics in mathematics: Algebra, Geometry, and Statistics. There are three research questions applied in this study: (1) To what extent do textbooks in Indonesia and the United States present different types of problems?, (2) To what extent do mathematics textbooks in Indonesia and the United States demonstrate task-relatedness?, (3) How do mathematics textbooks in Indonesia and the United States structure their problems? As a result, both textbooks effectively support problem-solving through various problem types, task-relatedness, and well-structured problems. These elements help students develop and apply their problem-solving skills throughout the lessons. However, the two textbooks use problems differently based on the goals of their curricula. These differences reflect the educational priorities of each curriculum. Both approaches are effective in their contexts and highlight different ways to teach problem-solving.

Keywords: Problem solving, textbooks, mathematics, Indonesia, the United States.

INSIGHTS FROM IMPACT AND EXPERIENCE: REPORTING ON FOUR YEARS OF FSM SUMMER COURSES

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This study highlights insights from the Foundations in Science and Mathematics (FSM) Summer Program at Indiana University—an outreach initiative that has provided middle and high school students with summer science and mathematics courses for over 15 years. FSM's mission is to increase student interest, confidence, and preparedness in STEM fields through engaging, accessible learning experiences. Drawing on my involvement with FSM over the past five years—first as an instructor and, for the last three years, as program administrator—I share both teaching and leadership perspectives. The presentation reports on four years of program data, including course offerings, enrollment trends, instructional formats, and participant feedback. It also previews upcoming plans and reflects on lessons learned in program coordination and outreach. In addition to reporting on program outcomes and administrative practices, this session invites feedback and suggestions for future development. The presentation will also explore how FSM's model can inform other outreach and research-based STEM education initiatives.

DIVERSE PERSPECTIVES ON STUDENT ACHIEVEMENT: EXPLORING TEACHERS' ATTRIBUTIONAL BELIEFS IN MATHEMATICS EDUCATION

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Teachers' beliefs about why students struggle in mathematics have profound implications for the instruction they provide (Jackson et al., 2007; CITE [Horn meritocracy paper]). This study investigates the attributional beliefs of 34 teachers—13 preservice and 21 in-service—and extends prior work by exploring teachers' reasons for student success as well as struggle in mathematics. Using semi-structured, hour-long interviews, we examined the attributions teachers made when asked, "Why do some students succeed in mathematics while others struggle?" Responses were analyzed using a mixed-methods approach, categorizing attributions with four constructs: Genetic, Personal, Social, and Educational (Jacobson et al., 2022). Our findings indicate that teachers often refer to factors across multiple constructs, revealing nuanced beliefs that resist simplistic categorization. For instance, while teachers referenced genetic factors like natural ability, they also considered personal and societal influences such as motivation and family support. Educational factors, such as pedagogy and teacher bias, were more frequently highlighted by preservice teachers than in-service teachers. This study's results emphasize the complexity of teachers' beliefs and suggest that, while certain categories of attributional beliefs (e.g., Genetic) often reflect deficit perspectives and others do not (e.g., Educational), this is not always the case. These insights contribute to a deeper understanding of how teachers understand the factors that shape students' mathematical achievement, and we discuss the implications of this study for teacher education and professional development.

THE HERMENEUTIC CALCULATOR

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I present the next iteration of the Hermeneutic Calculator (Savich, 2022) as a bridge between mathematics, meta-mathematics, and mathematics education that extends formal pragmatics into those distinct fields. Why? Modeling student thinking with formal languages allows formal proofs related to the essential unlimitedness of mathematics to enter political and curricular debates about the necessary freedom of human subjects. Lest we descend to mathematical incoherence, these necessary freedoms inform our collective obligation to treat people as free. Because of the highly abstract nature of the project, I will include examples from children's literature and a four-function calculator that participants can access here:
https://tiosavich.github.io/UMEDCTA/Calculator/index.html
Keywords: Senses of number, numerals, pronouns, mathematics education, elementary teachers

[*Work-under-Design*]
FUTURE TEACHERS' PREPAREDNESS: EXAMINING INCLUSIVE EDUCATION PERCEPTIONS AT KILIS 7 ARALIK UNIVERSITY, TÜRKIYE

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Türkiye hosts over 3.6 million Syrian refugees, with Kilis experiencing one of the highest refugee-to-local population ratios. This demographic shift poses significant challenges to the education system, particularly in implementing inclusive education. Inclusive education aims to provide equal learning opportunities for all students, including refugees, but its success depends on teachers' preparedness and willingness to address diverse needs. This study investigates the perceptions of pre-service teachers at Kilis 7 Aralık University regarding inclusive education and their preparedness to teach refugee students. Utilizing a qualitative phenomenological approach, data will be collected through semi-structured interviews, focus group discussions, and curriculum analysis. Thematic analysis will be employed to identify key themes. Findings are expected to highlight gaps in teacher training programs, particularly in culturally responsive pedagogy and trauma-informed teaching. This study aims to inform improvements in teacher education, ensuring better preparedness for inclusive classrooms in refugee-affected regions like Kilis.