

Research on Mathematical Proof: A Review of RUME Conference Proceedings 2020-2022

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Mathematical proof is one of the major topics of research in the RUME community. In recent years, we have anecdotally noticed a trend in RUME that proof research is often conducted in laboratory settings rather than within authentic classrooms. Further, we, along with our collaborators, have special interest in researching proof as a collaborative activity (Bleiler-Baxter et al., 2021, 2023; Heath, 2022; Heath & Bleiler-Baxter, under review; Heath et al., 2022) because of our conviction that proof is a “communal, negotiated, and sense-making process” (Ko et al., 2016, p. 618). Yet, research on collaborative proving is still considered a new direction for proof research (Heath & Bleiler-Baxter, under review). In this project, we seek to review recent literature produced in the RUME conference proceedings to identify trends in up-and-coming research on proof and proving at the undergraduate level. We seek to answer the question: What kinds of research are being conducted on proof and proving in the RUME community?

Methods

In a methodical search of RUME conference proceedings (Karunakaran & Higgins, 2021, 2022; Karunakaran et al., 2020) during the period 2020-2022, we included contributed, preliminary, and theoretical reports containing the words “proof” or “proving” in their title. Two researchers developed and revised categories of interest for the reports, separately coded all reports according to these categories, and resolved any disagreements. The coding categories included: research conducted in real classrooms, survey research, interview research (non-task-based), task-based interview research, artifact analysis, assessment/inventory measures, text/document analysis, collaborative proof research, and early-career scholar first authorship.

Findings

A total of 30 reports qualified for inclusion in the review: 11 out of 148 reports (7.4%) in 2020, 4 out of 49 reports (8.1%) in 2021, and 15 out of 145 reports (10.3%) in 2022. Notable findings include the strong presence of interview research on proof (17/30 reports, 56.7%). Moreover, an overwhelming majority of interview-based research involved task-based interviews (13/17 reports, 76.5%). Our suspicions of a lack of research in authentic classroom contexts were confirmed, as only 6 reports (20%) used data collected from a real classroom. The number of reports concerning collaborative proving has slowly grown, with 2 reports in 2020, 3 reports in 2021, and 4 reports in 2022 concerning collaborative proving. Although this is still a minority of proof research at RUME in the last three years (9/30 reports, 30%), we noticed an overwhelming majority of RUME reports on collaborative proving had early-career first authorship (8/9 reports, 88.9%) compared to the presence of early-career scholarship in the reports included (22/30 reports, 73.3%). We will include a complete summary of the findings in our poster presentation, including trends in proof research in RUME over the past three years.

This review of literature can help the RUME community identify trends in proof research and identify ways in which the research base can grow. During the poster session, we will solicit feedback for how to continue this investigation and questions about trends in proof research the RUME community would like to see answered.

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Focus of Review

Mathematical proof is one of the major topics of research in the community of Research in Undergraduate Mathematics Education (RUME). We aimed to review literature produced in the RUME conference proceedings from the past three years to identify trends in up-and-coming research on proof and proving at the undergraduate level.

Research Question: What kinds of research are being conducted on proof and proving in the RUME community?

Method and Procedure

In a methodical search of RUME conference proceedings during the period 2020-2022, we included contributed, preliminary, and theoretical reports related to proof research containing the keywords “**proof**” or “**proving**” in their title. A total of 30 reports qualified for inclusion in the review: 11 out of 148 reports (7.4%) in 2020, 4 out of 49 reports (8.1%) in 2021*, and 15 out of 145 reports (10.3%) in 2022.

Two researchers developed and revised categories of interest for the proceedings papers and separately coded all reports according to these categories.

*There was no RUME Conference in 2021 due to COVID-19. In lieu of a face-to-face conference, the organization published a set of research reports open only to early-career scholars as lead authors.

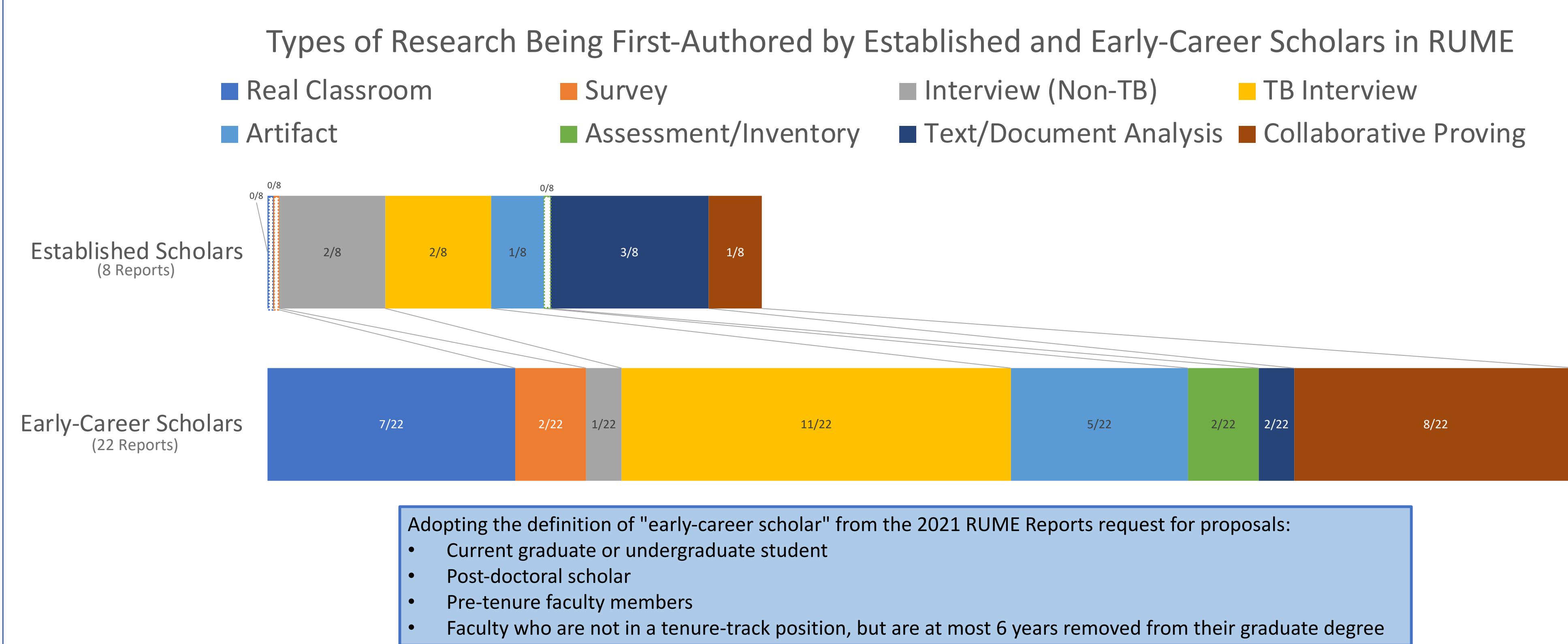
Authorship of RUME Proof Reports 2020-2022 (All Authors)



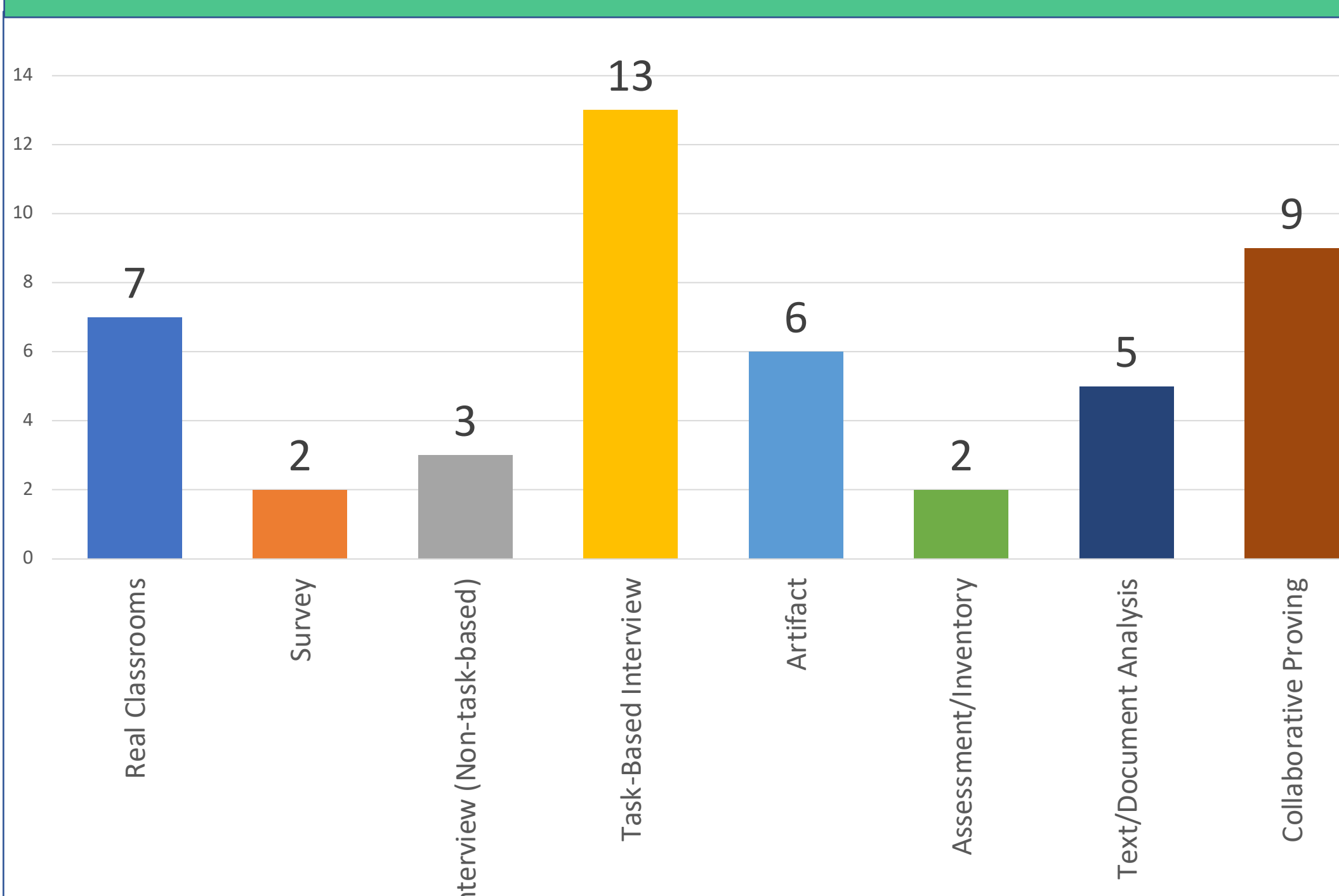
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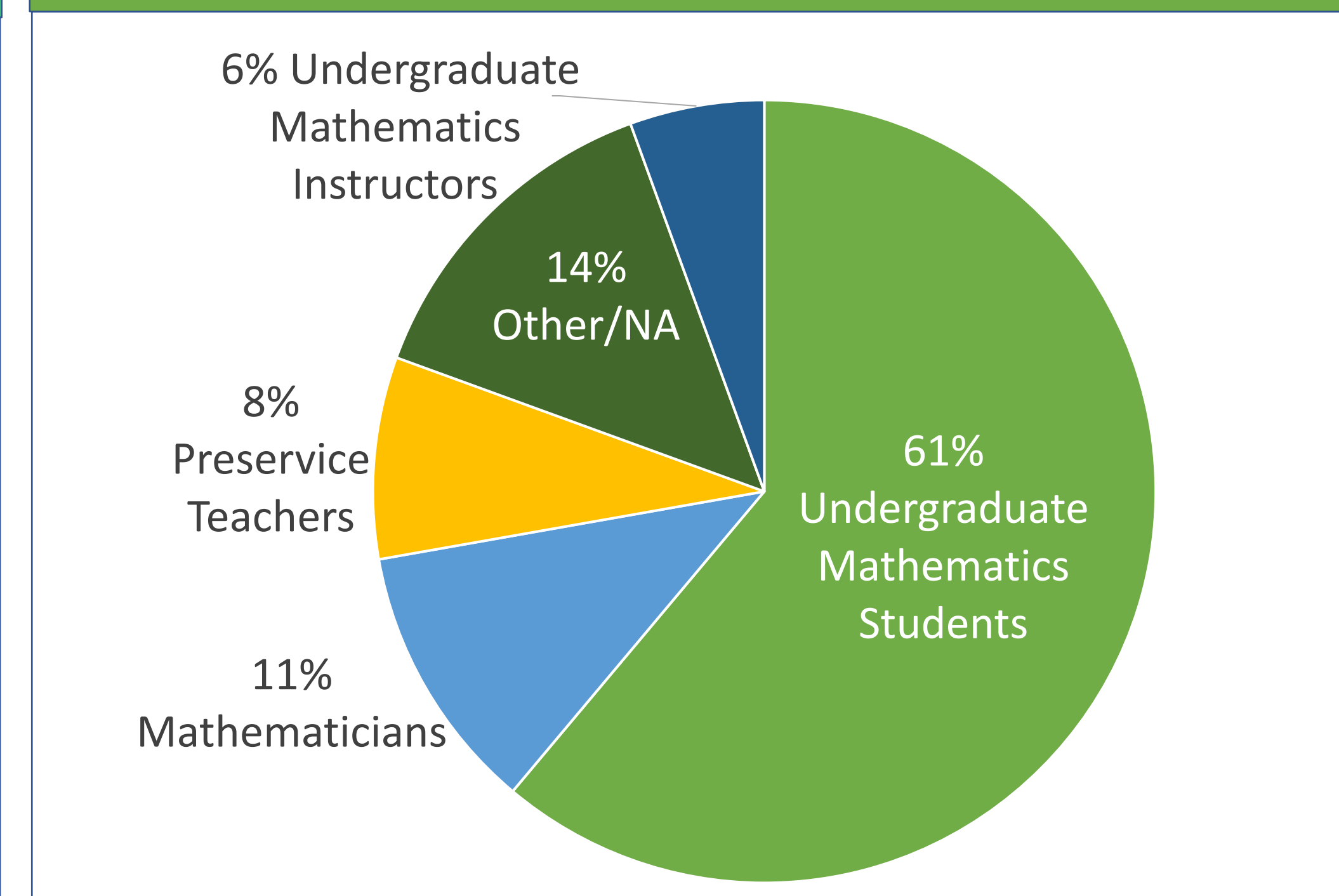
Trends Among Early-Career Scholars in Proof Research



Data in Current Proof Research



Populations of Interest



Code Definitions

Code	Description
Real Classroom Research	The study employed data collected from an instructional space, either physical or virtual, shared by instructor(s) and students, which mimics as closely as possible the naturalistic setting of their class meetings on any given day. This does not include classroom lessons of pre-service teachers delivering lessons as a course assignment.
Survey Research	The study employed data collected through a survey of opinions or experiences of participants.
Assessment/Inventory Measure(s) Research	The study employed data collected through an assessment or inventory, which assigned a score of some kind (e.g., pre-test/post-test, self-efficacy inventory).
Interview Research (Non-Task-Based)	The study employed data collected through a general interview not rooted in a think-aloud mathematical task.
Task-Based Interview Research	The study employed data collected through an interview rooted in having participants narrate their thoughts and actions while completing a mathematical task.
Artifact Analysis	The study employed data from classroom or course artifacts such as homework, classwork, or written reflections.
Text/Document Analysis	The study analyzed written resources (textbooks, exams, research publications, etc.) in order to answer a research question about the state of available resources.
Collaborative Proving Research	The study employed data from the context of collaborative proving (whether in a classroom or in an interview setting) or the study aimed to investigate collaborative proving as a primary goal. It is not enough for the course context to involve collaborative proving or collaboration without it being an element of the research.
Research Subject	A categorical variable describing the population of interest in the report. Pre-Service Teacher, In-Service Teacher, Undergraduate Mathematics Instructor, Mathematician, Multiple of these, or Other/NA.

Results

This review discovered three trends in undergraduate proof research in recent RUME conference proceedings:

01
The RUME Proceedings Reports concerning proof are dominated by early-career scholars, but there may be a new wave of interest in research on collaborative proving from and conducting research in real classrooms among early-career scholars in RUME.

02
Research was most often conducted in laboratory settings, with frequent use of task-based interviews

03
Research was most often focused on undergraduate math students.

Discussion

Why Conference Proceedings?

We chose to first look at the RUME conference proceedings because these best reflect the current research happening in undergraduate mathematics education research, as the process of publishing in a peer-reviewed journal may take an extended period of time and not best reflect current endeavors.

Future Directions

As we recognize some proof research may have been overlooked due to our search methods, we intend to expand this search in the future to more systematically identify research related to proof. This may occur either within the RUME proceedings by attending to the primary and secondary categories listed in accepted RUME submissions, or by expanding our keyword search in reputable research journals.

Questions

- When we expand the search to journal publications, what journals should we consider in order to get a broad representation of the field?
- What kinds of questions do you have about the proof research being conducted in RUME?

References, Contact, and Proceedings Paper

