Michael (Mike) Ion

Contact Information

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Education

University of Michigan

Ph.D. in Mathematics Education, May 2024
Advisor: Deborah Ball, Commitee: (Cognate) David Jurgens, Christopher Quintana, Ying Xu

California Polytechnic State University

M.S. in Mathematics, June 2015
B.S. in Mathematics, June 2013

Research Interests

- Applications of Data Science and Machine Learning in Educational Contexts
- Quantitative Survey Methodologies for Educational Assessment
- Large Language Models as a Tool for Educational Research
- STEM Education Research

Research Experience

University of Michigan

Postdoctoral Research Fellow

School of Information, University of Michigan (hybrid) — May 2024-Present
Supervisor: Prof. Kevyn Collins-Thompson
I serve as a senior member of the Collins-Thompson lab, focusing on developing and disseminating creative, high-impact research contributions at the intersection of AI and education. My responsibilities include:

- Conducting theoretical modeling, experimental design and implementation, and data analysis in AI and education research.
- Publishing scholarly papers and presenting research at national and international conferences and meetings.
- Writing grant proposals, either leading them or making significant contributions.
- Mentoring undergraduate and graduate students working in the lab.
- Developing research in areas such as teaching models for conversational AI, AI-based simulated student models, AI-assisted optimal practice scheduling, and AI-assisted methods for analyzing learning interaction data.
- Creating new datasets and tasks, including gold-standard benchmarks.

Research Assistant

Grasping Rationality and Instructional Practices (GRIP) Lab — Sept. 2017-May 2023
Supervisors: Pat Herbst and Amanda Brown (Milewski)

I served as the lead graduate student researcher for the Geometry for Teachers (GeT) Support Project, a $2.3 million NSF IUSE Grant (#1725837). My responsibilities included:

- ❑ Conducting item-response theory (IRT) analysis of results from mathematical knowledge for teaching (MKT) assessments taken by university students, and distributing reports to their instructors.
- ❑ Coding qualitative data (e.g., interview data, survey responses) manually and with machine learning models.
- ❑ Organizing working groups for an online professional development network of university geometry instructors from across the US.
- ❑ Developing and analyzing psychometric survey instruments to be taken to assess and understand the nature of the university geometry course.
- ❑ Writing conference papers and presenting research at national conferences.

College and Beyond II Project (Mellon Grant) — Apr. 2020-Jun 2022
Supervisor: Anne Gere

I ran statistical analyses and provided insight to a research team studying the effects of a liberal arts education on life outcomes. Additionally, our team reported our findings at two conferences and published one journal article from our work. My responsibilities included:

- ❑ Working on a team to analyze results from a pilot survey to determine next steps forward.
- ❑ Providing readability statistics on a set of essay responses.
- ❑ Connecting responses on a pilot survey using structural equation modeling.

Wolverine Pathways Curriculum Development Project — May 2019-Dec 2019
Supervisor: Maisie Gholson

I developed social-justice oriented mathematics curriculum materials for a summer bridge program. I helped facilitate a professional development workshop for the teachers of the summer program and advised team members on quantitative survey methodologies.

Journal for Research in Mathematics Education (JRME)

Editorial Assistant

National Council of Teachers of Mathematics (NCTM) — Jan 2022-Mar 2023
As an Editorial Assistant on the Editorial Board of JRME, my primary responsibility was to review manuscripts being considered for publication. My focus was on ensuring the accuracy and validity of statistical methods and advanced mathematics used in the text and accompanying figures/tables. I meticulously checked for typos and errors while also reviewing the grammar and writing style to guarantee clear and effective communication of the findings and statistics presented in the manuscript.

California Polytechnic State University

Research Experience for Undergraduates (REU)

Research Topic: Stanley's Conjecture, Cover Depth, and Simplicial Complexes — Jun 2013-Sept 2013
Research Advisor: Ben Richert

Publications

Peer-Reviewed Journal Articles

- ❑ **Ion, M.**, Herbst, P. (In review). Measuring Tacit Mathematics Teaching Knowledge: A Natural Language Processing Approach. *Journal of the Learning Sciences.*
- ❑ Paulsen, A., Godfrey, J., **Ion, M.**, (In review). Writing Across the Curriculum: a Text as Data Approach. *Educational Effectiveness and Policy Analysis.*
- ❑ Short, C., **Ion, M.** (In progress). Generative Artificial Intelligence for Theory Building. *Academy of Management Review.*
- ❑ Herbst, P., Brown, A.M., **Ion, M.**, Margolis, C. (2023). Teaching Geometry for Secondary Teachers: What are the Tensions Instructors Need to Manage? *International Journal of Research in Undergraduate Mathematics Education.* (2023). `https://doi-org.proxy.lib.umich.edu/10.1007/s40753-023-00216-0`
- ❑ Gere, A., Godfrey, J., Griffin, M., **Ion, M.**, Limlamai, N., Moos, A., Van Zanen, K. (2023). Alumni Perspectives on General Education: How Writing Can Increase What We Know. *Journal of General Education, 70*(1-2), 149-175. `https://doi.org/10.5325/jgeneeduc.70.1-2.0149`

Peer-Reviewed Conference Proceedings

- ❑ **Ion, M.**, Herbst, P., Ko, I., Hetrick, C. (Oct. 2023). Surveying Instructors of Geometry for Teachers Courses: An Illustration of Balanced Incomplete Block Design. *Psychology of Mathematics Education, North America Annual Conference.* Reno, NV.
- ❑ Brown, A., Herbst, P., **Ion, M.** (Oct. 2023). How Instructors of Undergraduate Mathematics Courses Manage Tensions Related to Teaching Courses for Teachers. *Psychology of Mathematics Education, North America Annual Conference.* Reno, NV.

- ❑ Boyce, S., An, T., Pyzdrowski, L., Oppong-Wadie, K., **Ion, M.**, St. Goar, J. (Feb. 2023). Learning from Lesson Study in the College Geometry Classroom. *25th Annual Conference on Research in Undergraduate Mathematics Education.* Omaha, NE.
- ❑ Hetrick, C., Herbst, P., **Ion, M.**, Brown, A. (Feb. 2023). Building Instructional Capacity Across Difference: Analyzing Transdisciplinary Discourse in a Faculty Learning Community focused on Geometry for Teachers Courses. *25th Annual Conference on Research in Undergraduate Mathematics Education.* Omaha, NE.
- ❑ **Ion, M.** (Jul. 2022). Studying Conceptions of the Derivative at Scale: A Machine Learning Approach. *45th Conference of the International Group for the Psychology of Mathematics Education.* Alicante, Spain.
- ❑ **Ion, M.**, Herbst, P. (Feb. 2022). Conceptions of the Derivative: A Natural Language Processing Approach. *Research in Undergraduate Mathematics Education Conference.* Boston, MA.
- ❑ Margolis, C., **Ion, M.**, Herbst, P., Milewski, A., Shultz, M. (Nov. 2020). Understanding instructional capacity for high school geometry as a systemic problem through stakeholder interviews. *Psychology of Mathematics Education, North America.* Mexico.
- ❑ Bardelli, E., **Ion, M.**, Ko, I., Herbst, P. (Apr. 2020). Who Benefits from Mathematics Courses for Teachers? An Analysis of MKT-G Growth During Geometry for Teachers Courses. *American Education Research Association.* San Francisco, CA.
- ❑ **Ion, M.**, Herbst, P., Margolis, C., Milewski, A., Ko, I. (Nov. 2019). Developing Practical Measures To Support the Improvement of Geometry for Teachers Courses. *Psychology of Mathematics Education, North America Annual Conference.* St. Louis, MO.
- ❑ Milewski, A., **Ion, M.**, Herbst, P., Shultz, M., Ko, I., Bleecker, H. (Apr. 2019). Tensions in Teaching Mathematics to Future Teachers: Understanding the Practice of Undergraduate Mathematics Instructors. *American Education Research Association Conference.* Toronto, Canada.
- ❑ Herbst, P., Milewski, A., **Ion, M.**, Bleecker, H. (Oct. 2018). What Influences Do Instructors of the Geometry for Teachers Course Need to Contend With? *Psychology of Mathematics Education, North America.* Greenville, SC.

Non-peer-reviewed articles and blog posts

- ❑ **Ion, M.**, Herbst, P. (Nov. 2021). A Contribution to Stewarding the SLOs: Developing SLO Assessment Items and Examining Item Responses. *GeT: The News!, 3*(1).
- ❑ Herbst, P., **Ion, M.** (Nov. 2021). A Deeper Dive into an SLO Item: Examining Students' Ways of Reasoning about Relationships between Euclidean and Non-Euclidean Geometries. *GeT: The News!, 3*(1).
- ❑ Boyce, S., **Ion, M.**, Lai, Y., McLeod, K., Pyzdrowski, L., Sears, R., St. Goar, J. (May 2021). Best-Laid Co-Plans for a Lesson on Creating a Mathematical Definition. *AMS Blogs: On Teaching and Learning Mathematics.*

Presentations

Conference Talks

- Paulsen, A., Godfrey, J., **Ion, M.**. (Mar. 2023). Writing Across the Curriculum: a Case Study in Text as Data Methods for Postsecondary Education Policy Research. Denver, CO.
- Godfrey, J., Paulson, A., **Ion, M**. (2023). What Are the Common Contexts for College Writing? *Conference on College Composition and Communication Annual Convention.* Chicago, IL.
- Paulsen, A., **Ion, M.**, Godfrey, J. (Dec. 2022). Writing Across the Curriculum: a Text as Data Approach. *Causal Inference in Education Research Seminar (CIERS).* Ann Arbor, MI.
- Paulson, A., Bardelli, E., Godfrey, J., **Ion, M.**, Frisby, M. (Apr. 2022). Who Follows Placement Recommendations? Differential Effects of Non-binding Placement Recommendations on Students' Course-taking Decisions. *American Education Research Association.* San Diego, CA.
- Herbst, P., Stevens, I., Milewski, A., **Ion, M.**, Ko, I. (Jan. 2020). State of Undergraduate Geometry Courses for Secondary Teachers: Curriculum, Instructional Practices, and Student Achievement. *Joint Mathematics Meeting.* Denver, CO.
- Milewski, A., Herbst, P., **Ion, M.**, Bleecker, H. (Feb. 2019). Preparing Teachers for Secondary Geometry: Understanding the Tensions in Teaching Undergraduate Mathematics Courses for Future Teachers. *Association of Mathematics Teacher Educators Annual Conference.* Orlando, FL.
- Milewski, A., Herbst, P., Margolis, C., **Ion, M.**, Ko, I., Akbuga, E. (Jan. 2019). What do we know about courses in Geometry for Secondary Teachers? *Joint Mathematics Meetings.* Baltimore, Maryland.

Roundtable Discussions

- Berzina Pitcher, I., **Ion, M.**, An, T., Brown, A., Buchbinder, O., Herbst, P., Hetrick, C., Miller, N., Prasad, P., Pyzdrowski, L., St. Goar, J., Sears, R., Szydlik, S., Oshkosh, Vestal, S. (Apr. 2022). Learning and Participating in Scholarship of Teaching and Learning through a Faculty Online Learning Community. *American Education Research Association.* San Diego, CA.
- **Ion, M.**, Margolis, C. (Mar. 2019). Sources of Justification for College Geometry Instructional Actions. *Graduate Student Community Organization Graduate Student Conference.* Ann Arbor, MI.
- **Ion, M.** (Mar. 2018). Characterizing University Geometry Courses: An Interview-Based Approach. *Graduate Student Community Organization Graduate Student Conference.* Ann Arbor, MI.

Posters

- Boyce, B., **Ion, M.** (Oct. 2023). Geometry Students' Ways of Thinking About Adinkra Symbols. *Psychology of Mathematics Education, North America Annual Conference.* Reno, NV.
- Danai, A., Quimper Osores, A., **Ion, M.**, Herbst, P. (Apr. 2023). Analysis of Citation Networks of Submitted Manuscripts in Mathematics Education. *Undergraduate Research Opportunity Program (UROP) Symposium.* Ann Arbor, MI. *'Blue Ribbon Outstanding*

Presenter Award'

- ❑ Beckemeyer, R., Brown, A., **Ion, M.**, Spiteri, A., Herbst, P. (Apr. 2022). How Experience and Knowledge Affect the Breaching Patterns of Secondary Mathematics Teachers. *Undergraduate Research Opportunity Program (UROP) Symposium.* Ann Arbor, MI. *'Blue Ribbon Outstanding Presenter Award'.*
- ❑ **Ion, M.**, Bardelli, E., Herbst, P. (Oct. 2018). Learning About the Norms of Teaching Practice: How Can Machine Learning Help Analyze Teachers' Reactions to Scenarios? *Michigan Institute for Data Science Annual Symposium.* Ann Arbor, MI. *Awarded 'Most Likely Scientific Impact'.*

Honors and Awards

University of Michigan

Undergraduate Research Opportunity Program (UROP) Mentor Nominee	Feb. 2023
School of Education Travel Grant, School of Education (Pay for travel to international conference)	May 2022
Harold and Vivian Shapiro/John Malik/Jean Forrest Award ($2000)	Oct. 2021
Jones-Payne-Coxford Award for my scholarly paper, "Measuring Tacit Mathematics Teaching Knowledge: A Natural Language Processing Approach" (One semester of full funding + healthcare)	Mar. 2021
School of Education Scholar Award (Full funding + healthcare for at least four years of study)	Sept. 2017-Present
Most Likely Transformative Science Impact Award for my presentation on "Learning About the Norms of Teaching Practice: How Can Machine Learning Help Analyze Teachers' Reactions to Scenarios" ($100)	Oct. 2018

California Polytechnic State University

Outstanding Teaching Associate Award, ($500)	Jun. 2015
Marie Porter Lehman Math Educator Scholarship ($1500)	Jun. 2014
Bryant Russell Memorial Award ($1500)	Jun. 2013
Volmar A. and Viola I. Folsom Scholarship ($800)	Jun. 2012
Ralph M. Warten Memorial Scholarship ($1200)	Jun. 2011
George H. McMeen Scholarships ($1000)	Jun. 2010

Grants and Fellowships

Candidacy Tuition Fellowship, University of Michigan (One semester of full funding + healthcare)	August 2023
ES Mini Grant, School of Education, University of Michigan ($1100)	May 2023
Rackham Debt Management Award, University of Michigan ($15000)	May 2022
Educational Studies Summer Grant, University of Michigan ($2500)	Apr. 2021
Educational Studies Summer Grant, University of Michigan ($5000)	Apr. 2019
Graduate Student Researcher, GeT Support Grant (NSF IUSE Grant #1725837), University of Michigan ($2.3 million). P.I.s: Pat Herbst and Amanda Brown.	Sept. 2017-May 2023

Teaching Experience

Uplimit (formerly Corise)

Teaching Assistant (TA) and Quality Assurance (QA)

Fine-tuning Large Language Models (QA)	Fall 2023
Prompt Design and Building AI Products (QA and TA)	Summer 2023
Building AI Products with OpenAI (QA and TA)	Summer 2023
R for Data Science (QA and TA)	Summer 2023
Python for Data Science (QA)	Summer 2023

Uplimit is an online education platform that offers courses in data science, machine learning, and artificial intelligence.
These courses hundreds to thousands of students from all around the world, enrolling upwards of thousands of students.
My responsibilities include:

- ❑ Running office hours
- ❑ Leading project walkthroughs
- ❑ Replying to student questions about the material in Slack and reviewing and debugging code
- ❑ A month out from the course starting, I am hired as a quality assurance of the course materials, which includes reviewing and debugging code, weekly meetings with the instructors and Uplimit course management staff, ensuring the course materials are up-to-date, and providing feedback to the course instructors

University of Michigan, Ann Arbor, MI

Graduate Student Instructor

Introduction to Quantitative Methods (EDUC 793)	Sept. 2018- Dec. 2022

- ❑ Delivering weekly lab instruction on Stata software.
- ❑ Attending lectures and providing instructional support.
- ❑ One-on-one office hours with students.
- ❑ Exam-preparation sessions and creating review materials for the students.
- ❑ Grading assignments and exams.

John Hopkins University, Hong Kong & Seattle

Instructor

Paradoxes and Infinities	Jul. 2018 & 2019

- ❑ Curriculum development for "Paradoxes and Infinities".
- ❑ 100+ contact hours across 3 weeks, each course had 20 students ages 12-15 from around the world.
- ❑ Writing evaluations for students.
- ❑ Supervising a teaching assistant.

Cal Poly, San Luis Obispo, CA

Lecturer

Calculus for Life Sciences (Math 161)	Summer 2017
Precalculus (Math 118), Calculus for Life Sciences (Math 161)	Spring 2017
Precalculus (Math 118), Trigonometry (Math 119)	Winter 2017

Graduate Teaching Associate, instructor of record

Calculus for Business and Economics (Math 221)	Spring 2015
Precalculus (Math 118), Calculus for Life Sciences (Math 161)	Winter 2015
Precalculus (Math 118)	Fall 2014
Calculus for Business and Economics (Math 221)	Spring 2014
Precalculus (Math 118)	Winter 2014
Precalculus (Math 116)	Fall 2013

Calculus Workshop Facilitator

Calc I, II, III — Sept. 2011-Jun. 2013
Responsibilities included:

- ❑ Attending the content course.
- ❑ Preparing worksheets, quizzes, and games.
- ❑ One-on-one student meetings.
- ❑ Weekly meetings with course instructor and Math Program Staff.
- ❑ Conducting workshops assisting students with content.

Stanford University, Palo Alto, CA

Residential Counselor/Teaching Assistant

Stanford Pre-Collegiate Studies Program — Jun. 2011 - Aug. 2012

- ❑ Provided educational support for gifted middle school students in mathematics courses.
- ❑ Collected specific instances of good work by individual students to help write evaluations

Mentorship

Graduate Students

Soobin Jeon	2022-2023
Anna Paulson	2019-2023
Jason Godfrey	2018-2023
Davinia Rodriguez-Wilhelm	2018-2020
Matt Park	2019-2021
Scott Bridges	2019-2020

Undergraduate Students

Andre Quimper Osores	2022-2023
Amirali Danai	2022-2023
Noah Boudrie	2022-2023
Robert Beckemeyer	2021-2022
Andrew Spiteri	2021-2022
Alan Zhang	2020-2021
Michael Green	2020-2021

Professional Memberships & Affiliations

- ❑ American Educational Research Association (AERA)
- ❑ Association of Mathematics Teacher Educators (AMTE)
- ❑ Graduate Employees' Organization (GEO)
- ❑ National Council of Teachers of Mathematics (NCTM)

Professional Training

Natural Language Processing Course, Corise - Comprehensive four-week certification covering the core NLP components such as word vectors, intent classification, and entity recognition using transformer architectures like BERT and GPT.	Feb. 2023
Statistics and Machine Learning Reading Group - Weekly collaboration focused on applying quantitative research methodologies to social science datasets. Textbooks covered spanned various topics from structural equation modeling to statistical and deep learning.	Sept. 2018-Jun. 2022
AERA-ICPSR Workshop - One-day session discussing advanced analytic techniques in causal inference.	Feb. 2021
Deep Learning Workshop - Facilitated by Google.	Nov. 2019
Introduction to Deep Neural Networks with Keras/Tensorflow Workshop - By Greg Teichert.	Jun. 2018
Big Data Camp - Interdisciplinary team project on NSF grants' success rates based on language use led by the University of Michigan's Interdisciplinary Committee on Organizational Studies. Code available at: https://github.com/mikeion/NSF-Awards-Project.	May. 2018
Machine Learning for Social Scientists Workshop - By Jake Hofman from Microsoft Research.	Mar. 2018

Service

United States Peace Corps

Volunteer in Hukuntsi, Botswana

Life Skills and Middle School Mathematics Teaching — Jun. 2015-May 2016

- ❑ Served as a mentor for an HIV-awareness youth group and a chess club.
- ❑ Acted as a health promoter while training young people to serve as peer educators, enabling them to provide HIV/AIDS education and awareness to other youth and adults in their communities.
- ❑ Inside and outside the classroom work developing a math curriculum at a low-income junior secondary school.
- ❑ Advanced-Mid proficiency on the Language Proficiency Interview in the local language (Setswana)

California Men's Colony, San Luis Obispo, CA

Alternatives to Violence Project, Volunteer

Served as a volunteer for a two-day workshop aimed at providing inmates advice on non-violent conflict resolution and strategies for communicating in difficult situations. — December 2014

Technical Skills

Programming Languages

- ❑ Python

- ❑ R
- ❑ Stata
- ❑ SQL
- ❑ LaTeX
- ❑ M-Plus

Statistical Models

- ❑ Linear and Logistic Regression
- ❑ Multi-level Models
- ❑ Psychometric Models
- ❑ Structural Equation Models
- ❑ Bayesian Methods

Machine Learning and Natural Language Processing (ML/NLP)

- ❑ Frameworks and Libraries: PyTorch, Transformers, HuggingFace, NLTK, Spacy, Scikit-Learn, Pandas, Numpy, Matplotlib, Seaborn, Plotly, Streamlit, Tensorflow, Keras, Docker
- ❑ Machine Learning Models: Linear/logistic regression, decision trees, random forests, SVMs, neural networks, CNNs, RNNs, LSTMs, Transformers
- ❑ Large Language Models (LLMs) and Embeddings: Open-source frameworks/models like Langchain/Langsmith, HuggingFace, LilacML, Streamlit, Gradio, and Closed-source tools (e.g., OpenAI's GPT models). Vector Embeddings tools (e.g., DeepLake, Pinecone, ChromaDB, Faiss, Redis, Qdrant).

Additional Programming/Software Knowledge

- ❑ Git/GitHub
- ❑ C++
- ❑ Mathematica
- ❑ Go
- ❑ Javascript