

Mike Ion

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Education

2017–Present **Ph.D.**, *Mathematics Education*, University of Michigan.
(ABD) Advisor: Pat Herbst

Dissertation Title: Understanding Conceptions of the Derivative at Scale: A Machine Learning Approach

2013-2015 **M.S.**, *Mathematics*, Cal Poly.

Advisor: Ben Richert

2009-2013 **B.S.**, *Mathematics*, Cal Poly.

Research Interests

I am interested in understanding mathematics teachers' and students' knowledge through their use of language in mathematics settings. Methodologically, this involves using machine learning/natural language processing to train models to analyze their dialogue. I aspire to specialize as a methodologist working on interdisciplinary projects.

Research Experience

Feb. 2021 - **Editorial Assistant - Journal for Research in Mathematics Education (JRME)**,
Present NCTM, Ann Arbor, MI.

My primary role as editorial assistant for JRME is to check the statistical methods or advanced math (both text and tables/figures) of the manuscripts in review for typos and errors as well as read through the text to make sure that the grammar and style are clearly communicating what the statistics show.

Sept. 2017 - **Graduate Student Research Associate - Geometry, Reasoning, and Instructional Practices (GRIP) Lab**, University of Michigan, Supervisor: Pat Herbst.

I primarily serve as a research assistant working on an NSF Grant studying the undergraduate geometry course (NSF Award Number: 1725837). Some responsibilities include:

- Conducting item-response theory (IRT) analysis of results from mathematical knowledge for teaching (MKT) assessments, and distribute reports to 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.
- Writing conference papers and presenting research at national conferences.

Apr. 2020 - **Graduate Student Research Associate - College and Beyond II Project (Mellon Grant)**, University of Michigan, Supervisor: Anne Gere.

I am responsible for running statistical analyses and providing insight to a research team studying the effects of a liberal arts education on life outcomes. Some responsibilities include:

- 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.

- May 2019 - **Graduate Student Research Apprentice - Wolverine Pathways Curriculum Development Project**, University of Michigan, Supervisor: Maisie Gholson.
Dec. 2019
Responsibilities included:
- Working on a team to develop social-justice oriented curriculum materials for a summer mathematics program.
 - Facilitating a professional development workshop for Wolverine Pathways teachers.
 - Advising team members on survey methodologies.

Publications

Journal Publications

- 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>.
Gere, A, Godfrey, J., Griffin, M., **Ion, M.**, Limlamai, N., Moos, A., Van Zanen, K.
- In review (accepted with revisions) **Teaching Geometry for Secondary Teachers: What are the Tensions Instructors Need to Manage?**, *International Journal for Research in Undergraduate Mathematics Education*.
Herbst, P., Brown, A. **Ion, M.**, Margolis, C.
- In review **Measuring Tacit Mathematics Teaching Knowledge: A Natural Language Processing Approach**, *Journal of the Learning Sciences*.
Ion, M., Herbst, P.
- In progress **Importance of Writing Coursework and Writing in Undergraduate Education: Learning at Scale using Machine Learning**, *Educational Effectiveness and Policy Analysis*.
Paulsen, A., **Ion, M.**, Godfrey, J.

Peer-Reviewed Conference Proceedings

- Feb. 2023 **Learning from Lesson Study in the College Geometry Classroom**, 25th Annual Conference on Research in Undergraduate Mathematics Education.
Boyce, S., An, T., Pyzdrowski, L., Oppong-Wadie, K., **Ion, M.**, St. Goar, J.
- 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.
Hetrick, C., Herbst, P., **Ion, M.**, Brown, A.
- 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
- Feb. 2022 **Conceptions of the Derivative: A Natural Language Processing Approach**, Research in Undergraduate Mathematics Education Conference. Boston, MA..
Ion, M., Herbst, P.
- Nov. 2020 **Understanding instructional capacity for high school geometry as a systemic problem through stakeholder interviews**, *Psychology of Mathematics Education*, North America. Mexico..
Margolis, C., **Ion, M.**, Herbst, P., Milewski, A., Shultz, M.

- 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.
Bardelli, E., **Ion, M**, Ko, I., Herbst, P.
- 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.
Ion, M., Herbst, P., Margolis, C., Milewski, A., Ko, I.
- Apr. 2019 **Tensions in Teaching Mathematics to Future Teachers: Understanding the Practice of Undergraduate Mathematics Instructors**, American Education Research Association Conference. Toronto, Canada.
Milewski, A., **Ion, M.**, Herbst, P., Shultz, M., Ko, I., 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.
Herbst, P., Milewski, A., **Ion, M.**, Bleecker, H.
- [Conference presentations](#)
- 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.
Paulson, A., Bardelli, E., Godfrey, J., **Ion, M**, Frisby, M.
- Apr. 2022 **Learning and Participating in Scholarship of Teaching and Learning through a Faculty Online Learning Community**, American Education Research Association. San Diego, CA.
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.
- Jan. 2020 **State of Undergraduate Geometry Courses for Secondary Teachers: Curriculum, Instructional Practices, and Student Achievement**, Joint Mathematics Meeting. Denver, CO.
Herbst, P., Stevens, I., Milewski, A., **Ion, M.**, Ko, I.
- Mar. 2019 **Sources of Justification for College Geometry Instructional Actions**, Graduate Student Community Organization Graduate Student Conference. Ann Arbor, MI.
Ion, M., Margolis, C.
- 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., **Ion, M.**, Bleecker, H.
- Jan. 2019 **What do we know about courses in Geometry for Secondary Teachers?**, Joint Mathematics Meetings, Baltimore, Maryland.
Milewski, A., Herbst, P., Margolis, C., **Ion, M**, Ko, I., Akbuga, E.
- 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.
Ion, M., Bardelli, E., Herbst, P.
Awarded 'Most Likely Scientific Impact'
- Mar. 2018 **Characterizing University Geometry Courses: An Interview-Based Approach**, Graduate Student Community Organization Graduate Student Conference Ann Arbor, MI.
Ion, M.

Non-peer-reviewed articles, blog posts, proceedings, and white papers

- Nov. 2021 **A Contribution to Stewarding the SLOs: Developing SLO Assessment Items and Examining Item Responses.**, GeT: The News!,3(1).<https://www.gripumich.org/v3-i1-f2021/#a-contribution-to-stewarding-the-slos-developing-slo-assessment-items-and-examining-item-responses>.
Ion, M., Herbst, P.
- 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). <https://www.gripumich.org/v3-i1-f2021/#a-deeper-dive-into-an-slo-item>.
Herbst, P., **Ion, M.**
- May 2021 **Best-Laid Co-Plans for a Lesson on Creating a Mathematical Definition.**, AMS Blogs: On Teaching and Learning Mathematics. <https://blogs.ams.org/matheducation/2021/05/06/best-laid-co-plans-for-a-lesson-on-creating-a-mathematical-definition/>.
Boyce, S., **Ion, M.**, Lai, Y., McLeod, K., Pyzdrowski, L., Sears, R., St. Goar, J.
- ## Invited Talks
- Mar. 2021 **Measuring Liberal Education: A Report from the College and Beyond II Study at the University of Michigan**, College and Beyond II: Liberal Arts and Life Colloquium Series, Ann Arbor, MI..
Courant, P., Flaster, A., Koester, B., Paulson, N., Gere, A., Godfrey, J., **Ion, M.**, Limlamai, N., Moos, A. Van Zanen, K.
- Sept. 2020 **Reporting on the MKT-G Results from the GeT Students**, GeT Seminar, Ann Arbor, MI..
Ion, M., Ko, I.
- Nov. 2019 **What Do We Mean by Equity: A Topic Modeling Approach**, Education in Mathematics, Science, and Technology Research Interdisciplinary Workshop. Ann Arbor, MI.
Ion, M., Robinson, D.

Teaching Experience

- May 2023 **Teaching Assistant.**
CoRise - R for Data Science
This is a part-time position for a two-week massive online synchronous data science course for professionals. Responsibilities include:
- Running office hours
 - Leading project walkthroughs,
 - Creating mini-walkthrough videos,
 - Asynchronously replying to questions about the material in Slack.
 - Additionally, I was hired as a consultant to do quality assurance for the course. In this role, I go through weekly projects and course materials, and check for coherence, difficulty, and relevance to industry.
- Sept. 2018 - Present **Graduate Student Instructor.**
University of Michigan. Ann Arbor, MI.
I serve as a teaching assistant for the graduate-level Introduction to Quantitative Methods course (EDUC 793) provided in the School of Education. Responsibilities include:
- Delivering weekly lab instruction to 20 students on supplementing their statistics learning through the use of Stata software.
 - Attending lecture and providing instructional support to students.
 - Grading homework, exams, and final papers.

- Jul. 2019 & **Instructor for John Hopkins University CTY Summer Program.**
 Jul. 2018 Hong Kong University. Hong Kong, S.A.R. & Seattle University. Seattle, WA.
 Primary instructor for course titled *Paradoxes and Infinities* during the summers of 2018 and 2019.
 These courses had around 20 students from around the world. Responsibilities included:
- Developing curriculum for 100+ contact hours in the classroom.
 - Writing written evaluations for all students
 - Supervising the work of a teaching assistant.
- Jan. 2017 - **Lecturer - Mathematics Department.**
 Jul. 2017 Cal Poly. San Luis Obispo, CA.
 Served as instructor of record for the following courses:
- Precalculus (Math 118)
 - Trigonometry (Math 119)
 - Calculus for Business and Economics (Math 221)
 - Calculus for the Life Sciences (Math 161)
- Sept. 2013 - **Graduate Teaching Associate (Instructor of Record).**
 Jun. 2015 Cal Poly. San Luis Obispo, CA.
 Served as instructor of record for the following courses:
- Precalculus (Math 116, Math 118)
 - Calculus for Business and Economics (Math 221)
- Sept. 2011 - **Calculus Workshop Facilitator.**
 Jun. 2013 Cal Poly. San Luis Obispo, CA.
 Workshop coordinator for Calculus I, II, and III courses. Responsibilities included:
- Attending the content course
 - Preparing worksheets, mock quizzes and exams, and games
 - One-on-one meetings with students
 - Meeting weekly with course instructor and Math Program Staff
 - Running a workshop with 10-25 students, assisting and guiding them through the content.
- Jun. 2011 - **Residential Counselor/Teaching Assistant for EPGY Summer Institutes.**
 Aug. 2012 Stanford University. Palo Alto, CA.
 A full-time residential position during the summers of 2011 and 2012. I provided educational support for mathematics courses for gifted middle school students.

Awards

- May 2022 **Rackham Debt Management Award**, (\$15000).
 University of Michigan
- Oct. 2021 **Harold and Vivian Shapiro/John Malik/Jean Forrest Award**, (\$2000).
 University of Michigan
- Mar. 2021 **Jones-Payne-Coxford Award**, (One semester + healthcare).
 University of Michigan
- Sept. 2017-
 Present **School of Education Scholar Award**, (Full tuition + healthcare).
 University of Michigan
- Apr. 2021 **Educational Studies Summer Grant**, (\$2500).
 University of Michigan
- Apr. 2019 **Educational Studies Summer Grant**, (\$5000).
 University of Michigan
- Oct. 2018 **Most Likely Scientific Impact**, (\$100).
 University of Michigan Data Science Symposium
- Jun. 2015 **Outstanding Teaching Associate Award**, (\$500).
 Cal Poly Mathematics Dept.

- Jun. 2014 **Marie Porter Lehman Math Educator Scholarship**, (\$1500).
Cal Poly Mathematics Dept.
- Jun. 2013 **Bryant Russell Memorial Award**, (\$1500).
Cal Poly Mathematics Dept.
- June 2012 **Volmar A. and Viola I. Folsom Scholarship**, (\$800).
Cal Poly Mathematics Dept.
- June 2011 **Ralph M. Warten Memorial Scholarship**, (\$1200).
Cal Poly Mathematics Dept.
- June 2010 **George H. McMeen Scholarships**, (\$1000).
Cal Poly Mathematics Dept.

Professional Development

- Feb. 2023 **Natural Language Processing Course**, *Corise*.
Four week course (with certification) where I got to work alongside peers working in the industry to learn the core NLP building blocks powering search engines like Google or voice assistants like Siri or Amazon Alexa. Projects included developing an understanding of core NLP components — word vectors, intent classification, entity recognition and many more using transformer architectures like BERT and GPT — as well as building apps that use embedding-based retrieval and smart-compose.
- Feb. 2021 **Cutting-Edge Quantitative and Computational Methods for STEM Education Research**, *AERA-ICPSR*.
One day workshop led by leading scholars to discuss advanced analytic techniques in causal inference.
- Nov. 2019 **Deep Learning Workshop**, *led by Google*.
- Jun. 2018 **Introduction to Deep Neural Networks with Keras/Tensorflow Workshop**, *led by Greg Teichert*.
- May. 2018 **Big Data Camp**, *led by Interdisciplinary Committee on Organizational Studies at University of Michigan*.
Worked with a team of grad students on a big data project looking at success rates of NSF grants based on language use. Code can be found at: <https://github.com/mikeion/NSF-Awards-Project>
- Mar. 2018 **An Introduction to Machine Learning for Social Scientists Workshop**, *led by Jake Hofman from Microsoft Research*.

Skills

- Programming Languages Python, R, Stata, M-Plus, SQL, C++
- Other Technical Skills Git, DVC, Databases (SQL), Data Annotation (LabelStudio/Dagshub), SSH management,
- ML/NLP Specific Skills Libraries/Frameworks (Pytorch, Lightning, Langchain Agents, Vector Embedding Databases (e.g., FAISS, QDrant, Pinecone)). Architectures: Transformers, LSTMs, RNNs, Naive Bayes, Logistic Regression Models, SVMs
- Spoken Languages English, Spanish (intermediate), Farsi (beginner), Setswana (beginner)
- Specialties Natural Language Processing, Machine Learning, Large Language Models, Deep Learning, Mathematics Education, Mathematics, Statistics, TPsychometrics, Structural Equation Modeling, Teaching, Technical Writing

(Recent) Relevant Coursework

- University of Michigan Natural Language Processing: Algorithms and People (SI 630); Systemic Functional Linguistics (EDUC 737); Introduction to Quantitative Methods (EDUC 793); Quantitative Methods for Non-Experimental Research (EDUC 795); Psychometrics (EDUC 707); Structural Equation Modeling (EDUC 803)
- Datacamp.com Introduction to Python; Intermediate Python; Python Data Science Toolbox (Part 1 and Part 2); Supervised Learning with Sklearn; Introduction to Importing Data with Python; Intermediate Importing Data with Python; Introduction to Natural Language Processing in Python
- fast.ai Introduction to Machine Learning for Coders; A Code-First Introduction to Natural Language Processing

Service

- Jun. 2015 - **Peace Corps Volunteer, Botswana.**
- 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)
- Dec. 2014 **Alternatives to Violence Project, California Men's Colony.**
- Served as a volunteer for a two-day workshop aimed at providing inmates advice on understanding why conflict happens and strategies for communicating in difficult situations.