

SARAH D. CASTLE

EDUCATION

- Ph.D.** *Michigan State University, Mathematics Education* June 2023
Dissertation: *Exploring the Effects of Computing Enacted Through Coding on Students' Mathematical Creativity and Understanding*
Committee: Dr. Shiv Smith Karunakaran (chair), Dr. Danny Caballero, Dr. Jennifer Green, Dr. Vince Melfi, & Dr. Devin Silvia
- M.S.** *Michigan State University, Mathematics* December 2022
- B.S.** *Whitworth University, Engineering Physics* May 2016
- B.A.** *Whitworth University, Mathematics* May 2016
Minor in French, Summa Cum Lade

PUBLICATIONS

Castle, S. D., (Accepted, In Press). Embracing Mathematical Conjecture Through Coding and Computational Thinking, *Submitted to 54th ACM Technical Symposium on Computer Science Education*.

Levin, M., Smith III, J. P., Karunakaran, S. S., Hwang, J., **Castle, S. D.**, Kuchle, V., Elmore, B., Lu, Y., Abreu, S. (Accepted, In Press) Re-conceptualizing the Construct of Mathematical Autonomy: From Individual Trait to Quality of Action in Context. To appear in Cook, S., Katz, B., & Moore-Russo, D. (Eds.). In *Proceedings of the 26th Annual Conference on Research in Undergraduate Mathematics Education* Omaha, NE

Castle, S. D. (2023) Exploring How Computation Can Foster Mathematical Creativity in Linear Algebra Modules. In Cook, S., Katz, B., & Moore-Russo, D. (Eds.). In *Proceedings of the 25th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 582-590) Omaha, NE

Castle, S. D. (2023). Leveraging Computational Science Students' Coding Strengths for Mathematics Learning. In *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1* (pp. 263-269).
<https://doi.org/10.1145/3545945.3569861>

Castle, S. D. (2022). If Creativity Return Computing: Exploring the Impact of Computing on Students' Mathematical Creativity in Linear Algebra. In *Proceedings of the 2022 ACM Conference on International Computing Education Research-Volume 2* (pp. 24-25).

Pearson, M. I., **Castle, S. D.**, Matz, R. L., Koester, B. P., & Byrd, W. C. (2022). Integrating Critical Approaches into Quantitative STEM Equity Work. *CBE—Life Sciences Education*, 21(1)

Hwang, J., **Castle, S. D.**, & Karunakaran, S. S. (2022). One is the Loneliest Number: Groupwork within Linguistically Diverse Classrooms. *PRIMUS*, 1-13.

Castle, S. D., Smith III, J. P., Levin, M., Hwang, J., Karunakaran, S. S., Küchle, V., & Elmore, R. (2022). Shifts in External Authority and Resources for Sense-making in the Transition to Proof-Intensive Mathematics: The Case of Amelia. In Karunakaran, S. S., & Higgins, A. (Eds.). *Proceedings of the 24th Annual Conference on Research in Undergraduate Mathematics Education*. (pp.100-107) Boston, MA.

Castle, S. D., Byrd, W. C., Koester, B. P., Boenem, E., Caporale, N., Cwik, S., Denaro, K., Denaro, D., Fiorini, S., Matz, R., Mead, C., Whitcomb, K., Singh, C., Levesque-Bristol, C., & McKay, T. (2021) Equity in the STEM Landscape: A Multi-Institutional Approach to Mapping Systemic Advantages Within STEM Courses, *2021 American Education Research Association Annual Meeting Proceedings*. <https://doi.org/10.3102/1689325>

Castle, S. D., (2021) Connecting Computation: Mediating Mathematical Knowledge Through Computational Modules, In Karunakaran, S. S., & Higgins, A. (Eds.). *2021 Research in Undergraduate Mathematics Education Reports*. (pp.30-38).

Levin, M., Smith III, J. P., Karunakaran, S. S., Küchle, V., **Castle, S. D.**, Hwang, J., Elmore, B., Bae, Y. (2020). Math and Moral Reasoning in the Age of the Internet: Undergraduate Students' Perspectives on the Line Between Acceptable Use of Resources and Cheating, In Karunakaran, S. S., Reed, Z. & Higgins, A. (Eds.). *Proceedings of the 23rd Annual Conference on Research in Undergraduate Mathematics Education*. (pp.366-373) Boston, MA.

Smith III, J. P., Küchle, V., **Castle, S. D.**, Karunakaran, S. S., Bae, Y., Hwang, J., Levin, M., Elmore, B. (2020). Dimensions of Variation in Group Work within the "Same" Multi-Section Undergraduate Course. In Karunakaran, S. S., Reed, Z. & Higgins, A. (Eds.). In *Proceedings of the 23rd Annual Conference on Research in Undergraduate Mathematics Education*. (pp.606-613) Boston, MA.

Levin, M., Smith, J. P., Karunakaran, S., Küchle, V. A., & **Castle, S. D.** (2020). Conceptualizing STEM Majors' Developing Agency and Autonomy in Undergraduate Mathematics. In Gresalfi, M. and Horn, I. S. (Eds.), *The Interdisciplinarity of the Learning Sciences*, 14th International Conference of the Learning Sciences (ICLS) 2020, Volume 2 (pp. 887-888). Nashville, Tennessee: International Society of the Learning Sciences.

Sankaran, K., French, A., **Gady, S.**, Wisniewski, T., & Woodkey, M. (2014). Evaluation of Electric Propulsion Systems for Asteroid and Comet Sample-Return

Missions. In *50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference* (p. 3720).
<https://doi.org/10.2514/6.2014-3720>.

Other Manuscripts

Gady, S., & Munson, T. (2017). Stochastic Cogeneration System Design Applied to University Campus. Argonne National Laboratory MCS Internal Report.

Manuscripts in Progress

Castle, S. D., Pearson, M. I., Byrd, W. C., Koester, B. P., Boenem, E., Caporale, N., Cwik, S., Denaro, K., Denaro, D., Fiorini, S., Matz, R., Mead, C., Sweeder, R., Singh, C., Levesque-Bristol, C., & McKay, T. (2023, Resubmitted after Revise and Resubmit) Foregrounding Systems and Structures of Inequity: A Multi-Institutional Analysis Examining Systemic Advantage Manifestation Within Introductory STEM Courses. *Submitted to The International Journal for STEM Education*

Castle, S. D., (In Preparation) The Case for Computing: How Computation has the Potential to Reinvigorate Mathematical Creativity. *Submitting to FLM*

Castle, S. D., (In Preparation) Creation and Computation: A Series of Linear Algebra Jupyter Notebooks Designed to Promote Mathematical Creativity. *Submitting to The Journal of Open-Source Education*

PRESENTATIONS

Refereed Conference Presentations

**Denotes presenter*

Castle, S. D.* (2023, April 27-29) *Constructing Creativity: Exploring the effects of computing enacted through coding on students' mathematical understanding, mathematical creativity, and relationship to mathematics* [Poster Presentation]. Symposium on Coding, Computational Modelling, & Equity in Mathematics Education: St. Catharines, Ontario, CA

Castle, S. D.* (2023, March 15-18). *Leveraging Computational Science Students' Coding Strengths for Mathematics Learning* [Paper Presentation]. 54th ACM Technical Symposium on Computer Science Education: Toronto, Ontario, CA

Castle, S. D.* (2023, February 23-25) *Exploring How Computation Can Foster Mathematical Creativity in Linear Algebra Modules* [Paper Presentation]. 25th Annual Conference on Research in Undergraduate Mathematics Education: Omaha, NE

Hwang, J.*, **Castle, S. D.**, Karunakaran, S. S. (2023, January 4-7) *Two students' groupwork experiences in a linguistically diverse classroom* [Abstract Presentation], 2023 Joint Mathematics Meetings: Boston, MA.

Castle, S. D.* (2022, August 7-10). *If Creativity Return Computing: Exploring the Impact of Computing on Students' Mathematical Creativity in Linear Algebra* [Abstract Presentation]. 2022 ACM Conference on International Computing Education Research, Lugano, Switzerland.

Sweeder, R.*, **Castle, S. D.**, Koester, B. P., Byrd, W. C.; Pearson, M.; Boenem, E., Caporale, N., Cwik, S., Denaro, K., Fiorini, S., Levesque-Bristol, C.; Matz, R., Mead, C., Brownell, S., Molinaro, M., Singh, C., McKay, T. (2022, March 20-24) *Exposing inequity: A multi-institutional analysis of systematic advantages in introductory STEM courses* [Abstract Presentation]. ACS (American Chemical Society) Spring 2022 National Meeting, San Diego, CA.

Castle, S. D.*, Smith III, J. P., Levin, M., Hwang, J., Karunakaran, S. S., Kuchle, V., & Elmore, R. (2022, February 24-26). *Shifts in External Authority and Resources for Sense-making in the Transition to Proof-Intensive Mathematics: The Case of Amelia* [Paper Presentation]. 24th Annual Conference on Research in Undergraduate Mathematics Education, Boston, MA

Castle, S. D.*, Byrd, W. C., Koester, B. P., Boenem, E., Caporale, N., Cwik, S., Denaro, K., Denaro, D., Fiorini, S., Matz, R., Mead, C., Whitcomb, K., Singh, C., Levesque-Bristol, C., & McKay, T. (2021, April 8-12) *Equity in the STEM Landscape: A Multi-Institutional Approach to Mapping Systemic Advantages Within STEM Courses* [Paper Presentation], 2021 American Education Research Association Annual Meeting

Levin, M.*, Smith III, J. P., Karunakaran, S. S., Kuchle, V., **Castle, S. D.**, (2021). *Conceptualizing Agency and Autonomy in Tertiary Mathematics* [Abstract Presentation], In 14th International Congress on Mathematical Education Conference Proceedings.

Caporale, N.*, **Castle, S. D.***, Denaro, K. (2020, November) *Developing Multi-institutional Collaborations in Student Analytics* [Poster Presentation], AAC&U Transforming STEM Higher Education, Virtual.

Levin, M., Smith III, J. P., Karunakaran, S. S., Kuchle, V., **Castle, S. D.***, Hwang, J., Elmore, B., Bae, Y. (2020). *Math and Moral Reasoning in the Age of the Internet: Undergraduate Students' Perspectives on the Line Between Acceptable Use of Resources and Cheating* [Paper Presentation], 23rd Annual Conference on Research in Undergraduate Mathematics Education, Boston, MA.

Smith III, J. P.*, Kuchle, V., **Castle, S. D.**, Karunakaran, S. S., Bae, Y., Hwang, J., Levin, M., Elmore, B. (2020). *Dimensions of Variation in Group Work within the*

“Same” Multi-Section Undergraduate Course [Paper Presentation]. 23rd Annual Conference on Research in Undergraduate Mathematics Education, Boston, MA.

Levin, M.*, Smith III, J. P., Karunakaran, S. S., Küchle, V. A., & **Castle, S. D.** (2020, June 19-23). *Conceptualizing STEM Majors’ Developing Agency and Autonomy in Undergraduate Mathematics* [Paper Presentation], 14th International Conference of the Learning Sciences (ICLS).

Gady, S.* (2019, February 28 - March 2). *Integrating Integration: Deepening Mathematical Understanding Through Computation* [Abstract Presentation], 22nd Annual Conference on Research in Undergraduate Mathematics Education, Oklahoma City, OK.

Gady, S.*, Kubota, S., & Johnson, I. (2015, November 16-20). *Comparison of a 3-D GPU-Assisted Maxwell Code for Synthetic Diagnostics on ITER* [Poster Presentation], 57th Annual Meeting of the APS Division of Plasma Physics, Savannah, GA.

Sankaran, K. *, French, A., **Gady, S.**, Wisniewski, T., & Woodkey, M. (2014, July 28-30). *Evaluation of Electric Propulsion Systems for Asteroid and Comet Sample-Return Missions* [Paper Presentation]. 50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Cleveland, OH.

French, A. *, **Gady, S.***, & Sehgal, A.* (2014, May 1-3). *Evaluation of Electric Propulsion Systems for Asteroid Sample-Return Missions* [Poster Presentation], Annual Meeting of the Northwest Section of the APS, Seattle, WA.

Refereed Conference Presentations Under Review

Castle, S. D., (Submitted). *Coding for Conjecturing: How Machine-Based Coding Can Support Mathematical Practice and Computational Thinking* [Poster Presentation], In 15th International Congress on Mathematical Education Conference Proceedings.

Other Presentations

Castle, S. D.* (2023, May 12-13) *Constructing Creativity: Exploring the effects of computing enacted through coding on students’ mathematical understanding, mathematical creativity, and relationship to mathematics* [Poster Presentation]. Symposium – Culturally Relevant Integration of CS and Mathematics: Kennesaw, GA

Castle, S. D.* (2022, June) Exploring the Impact of Computing on Students’ Mathematical Creativity, University of Oslo Physics Education Research Summer Institute, Oslo, Norway

Castle, S. D.* (2021, November) Systemic Advantages Within Introductory STEM Courses, University of Pittsburgh dB-SERC Colloquium, Pittsburgh, PA.

Matz, R.*, Fiorini, S.*, Caporale, N.*, **Castle, S. D.***, Fisher, C.* (2021, May) Analytics to support student success in STEM: *Stories from the Sloan Equity and Inclusion in STEM Introductory Courses (SEISMIC) Measurement Working Group* [Panel Presentation], Indiana University Learning Analytics Summit, Bloomington, IN.

Gady, S.* (2014, September). Modeling Astronaut Central Nervous System Cerebral Fluid Response to Microgravity and Its Effects on Astronaut Vision, Spokane Mathematics Colloquium, Spokane, WA.

MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Education Research Association (AERA)

Div J - Postsecondary Education

Research in Mathematics Education

Technology as an Agent of Change in Teaching and Learning

Association for Computing Machinery (ACM)

Special Interest Group Computer Science Education

Computer Science Teachers Association (CSTA)

Mathematical Association of America (MAA)

SIGMAA on Research on Undergraduate Mathematics Education

Society for Industrial and Applied Mathematics (SIAM)

SIAG on Applied Mathematics Education

SIAG on Computational Science and Engineering

TEACHING EXPERIENCE

Summary: At the undergraduate level, I have teaching experience as (1) an instructor of record with full responsibility for teaching the class, grading, writing assessments and assignments, developing interactive computational exercises, etc. (2) private and volunteer tutor (middle school to post-secondary), and (3) teaching assistant for the instructor of record where I graded materials, lead recitations, and held office hours.

University of Idaho

2023-Current

Instructor of Record, *Curriculum & Instruction Department*

Secondary Mathematics Methods (EDCI 434), Secondary Mathematics Practicum (EDCI 454), Geometric Reasoning (EDCI 411)

Instructor of Record, *Mathematics & Statistical Science Department*

Proof & Viable Argumentation (MTHE 410)

Michigan State University

2020-2022

Instructor of Record, *Mathematics Department*

Taught Elementary Mathematics for Teachers I (MTH 201), Calculus I (MTH 132),
Survey of Calculus II (MTH 126)

Developed interactive materials and curriculum to engage students in mathematical
exploration and foster mathematical creativity within the classroom

Mead School District

2016

Instructor, *Summer STEM Academy*

Developed week-long, hands-on STEM modules and curriculum for 5th-7th grade
students and was lead instructor on a high-altitude balloon launch for testing of near
space phenomena and co-instructor and developer for coding and gaming module

Whitworth University

2012-2016

S.I. Instructor, *Engineering and Physics Department*

Led weekly supplemental instructions session to reinforce physics concepts by
developing assignments and resources and held weekly office hours to assist students
with homework, and ran review sessions prior to tests

Grader and Teaching Assistant, *Mathematics and Computer Science Department*

Teaching assistant for Calculus II, Calculus for Sciences, Discrete Mathematics, and
Mathematical Statistics I and II

PROFESSIONAL SERVICE

PiMUC 2024 Organizer, 2023-2024

Serving as Local Institution Host with Dr. Amy Yielding

SEISMIC Collaboration Council Member, 2022 – Present

Measurement Working Group Representative

SEISMIC Collaboration Taskforce Member, 2021

Conducted structural work for the SEISMIC collaboration to examine existing collaboration
structures in order to redress harm and focus on promoting diversity and inclusion

MSU PRIME Colloquium Committee Member, 2019 – 2021

UNIVERSITY SERVICE

Secondary Education Program Committee, 2023 – Current

Secondary Mathematics Representative

Teacher Education Coordinating Committee, 2023 – Current

Mathematics Education Representative

Math for Elementary Teachers Course Supervisory Committee, 2023 – Current

Master of Arts in Teaching (M.A.T) Committee and Lead Advisor, 2023 – Current

College of Science Student Research Exposition Judge, 2023 – Current
Graduate Division Judge

REVIEWING SERVICE

MAA SIGMA on RUME, 2018 - Current

ACM SIGSCE, 2022 - Current

International Journal for STEM Education, 2023 - Current

OTHER SERVICE

Graduate Women in Science (GWIS) Mentor
Michigan State University, 2022 – 2023

PRIME Graduate Student Organization Officer
Michigan State University, 2019 – 2021

Graduate Student Representative
Princeton University, 2017-2018

Science Outreach Volunteer
Princeton University, 2016-2018

Math is Cool Organizer and Volunteer
Spokane WA, 2012-2016

National Science Bowl Proctor
Spokane WA, 2015-2016, 2021

Physics Outreach Volunteer
Whitworth University, Spokane WA, 2013-2016

HONORS AND AWARDS

College of Natural Science Dissertation Continuation Fellowship (\$7500) 2022

Dr. Marilyn Zweng Endowed Graduate Student Award in Mathematics Education (\$3250) 2022

SEISMIC Measurement Fellowship (\$5000) 2021

Michigan State University Distinguished Fellowship (\$60,000)	2018
Michigan State University College of Natural Science Recruiting Fellowship	2018
Department of Energy Computational Science Graduate Fellowship (\$161,000)	2016
Princeton University Gordon Y.S. Wu Fellowship (\$23,000)	2016
Whitworth University Mathematics and Computer Science Research Award (\$300)	2016
American Physical Society Division of Plasma Physics Student Participation and Travel Grant (\$800)	2015

**All award values given do not include tuition costs*

RESEARCH EXPERIENCE

Summary: My primary research interest is focused on the integration of mathematics and computation at the undergraduate level while maintaining an eye towards equity. My dissertation research has focused on how computation can serve as a pedagogical tool to promote mathematical creativity within the context of linear algebra. My additional research centered on student experiences in the transition to proof within undergraduate mathematics has leveraged the concepts of agency and autonomy which are reflected in my current conception of computation for mathematical creativity. Further, my own experiences in research combining computation, mathematics, and engineering highlight a unique scholarly positioning to be able to speak to the application and benefit of computation in a mathematics program.

SEISMIC Collaboration Research Member 2020 - Present
 Developed code and theoretical frameworks to analyze institutional data regarding student experiences and systemic inequities that manifest in introductory STEM courses, specifically with an eye towards intersectionality

Transition to Proof Research Assistant, Michigan State University 2018 - 2023
 As part of an NSF funded grant documented student experiences within an introduction to proof course through classroom observations, surveys, interviews, and task-based interviews in order to develop frameworks for student's mathematical agency and autonomy development

CERL Research Member, Michigan State University 2018, 2021-Present
 Analyzed relationship between computational thinking and mathematical thinking within the context of integration through task-based interviews with students who had completed an introduction to modeling course

Research Intern, Argonne National Laboratory 2017

Developed mixed integer linear program with uncertainty for optimization of cogeneration, performed extensive data processing and formatting with raw data and clustered the data using various k-clustering methods

Research Intern, Princeton Plasma Physics Laboratory 2015
Aided in development of 3-D GPU-assisted Maxwell code for reflectometry synthetic diagnostics on ITER by performing domain decomposition to allow for analysis of an ITER-sized plasma

NASA Space Academy Intern, NASA Glenn Research Center 2014
Developed an integrated model of the cardiovascular and central nervous systems for use in analysis of microgravity induced fluid redistribution through a computational simulation of model within MATLAB and performed validation and verification tests in order to ensure accuracy

Research Intern, Whitworth University 2013
Advanced computational simulation of plasma propulsion systems for interplanetary spacecraft and improved previous code to allow for simulation of mission to any near-earth object and implemented engine shutoff during mission simulation