Ben McCarty

University of Memphis
Department of Mathematical Sciences
Dunn Hall
Memphis, TN 38152

Email: ben.mccarty@memphis.edu
Homepage: msci.memphis.edu/faculty/bmmccrt1.html

Education

Ph.D. Mathematics, Advisor: Scott Baldridge, Louisiana State University, August 2012

M.S. Mathematics, Louisiana State University, December 2007.

B.S. Mathematics (Summa Cum Laude), University of Texas at Tyler, May 2005.

Interests

Geometric and Algebraic Topology, Topological Graph Theory, Mathematics Education

Experience

Associate Professor, University of Memphis, 2018-present.

Assistant Professor, University of Memphis, 2012-2018.

Publications

S. Baldridge and B. McCarty, New relations for the Penrose polynomial, arXiv:2606.06643v1, submitted to *Journal of Combinatorial Theory, Series B*.

S. Baldridge, L.H. Kauffman, B. McCarty, A counterexample for the polar conjecture of Spencer-Brown, submitted to *Journal of Graph Theory*.

S. Baldridge, B. McCarty, A new way to prove configuration reducibility using gauge theory, arXiv:2412.18558, submitted to *Advances in Mathematics*.

S. Baldridge, L. Kauffman and B. McCarty. A state sum for the total face color polynomial, *Journal of Graph Theory*, Vol. 109, Issue 4, 2025, pp. 481-491, arXiv:2308.02732.

S. Baldridge and B. McCarty, Quantum state systems that count perfect matchings, arXiv:2401.07939, submitted to *Transactions of the London Mathematical Society*.

S. Baldridge and B. McCarty, A topological quantum field theory approach to graph coloring, arXiv:2303.12010, submitted *Journal of Topology*.

S. Baldridge, L. H. Kauffman, B. McCarty, Unoriented Khovanov Homology, *New York Journal of Mathematics*. 28 (2022) 367-401, arXiv:2001.04512.

S. Baldridge, B. McCarty and D. Vela-Vick, Lifting Lagrangian immersions in $\mathbb{C}P^{n-1}$ to Lagrangian cones in $\mathbb{C}^n$, *The Open Book Series*,Vol. 5 (2022), No. 1, 43–79, arXiv:1708.09048.

S. Baldridge, A. Lowrance and B. McCarty, The 2-factor polynomial detects even perfect matchings, *The Electronic Journal of Combinatorics*, Vol. 27 Issue 2 (2020) arXiv:1812.10346.

S. Baldridge, B. McCarty, "On the rotation class of knotted Legendrian tori in $\mathbb{R}^5$," *Topology and its Applications*, Volume 209, August 2016, 91-114, arXiv:1405.2358.

B. McCarty, "An infinite family of Legendrian torus knots distinguished by cube number," *Topology and its Applications*, Volume 159, Issue 1, (2012), 162-174, arXiv:1012.4482.

B. McCarty, "Cube number can detect chirality and Legendrian type of knots," *Journal of Knot Theory and its Ramifications*, Vol. 21, Issue 03, (2012), arXiv:1006.4852.

S. Baldridge, B. McCarty, "Small Examples of Cube Diagrams of Knots," *Topology Proceedings*, Vol. 36 (2010), 213-228, arXiv:0907.5401.

C. Mann, B. McCarty, J. McLoud-Mann, R. Ranalli, and N. Smith, "Minimal Knotting Numbers," *Journal of Knot Theory and its Ramifications*, Vol. 18 (2008), No. 8, 1159-1173.

C. Mann, B. McCarty, J. McLoud-Mann, R. Ranalli, and N. Smith, "Metrics in Three-Dimensional Lattices," *Journal for Geometry and Graphics*, Vol 12 (2008), No. 2, 133-140.

Non-Refereed Publications

B. McCarty, S. Baldridge. Cube Diagram Table of Knots of 7 Crossings or Less. Formerly hosted on Google Code. Available on request.

S. Baldridge, B. McCarty, R. Ramos "Fluency without equivocation,"

http://tinyurl.com/z3ku5oj.

S. Baldridge, B. McCarty, "A quick comparison of a state assessment and Eureka Math,"

http://tinyurl.com/h4qyu72.

A critique of the Partnership for 21st Century Skills Math Map, for Common Core, Inc.

https://tinyurl.com/mm8s38r2

Other Professional Experience

2015-2024	Mathematics Subject Matter Expert for Eureka Math, Great Minds.
2012-2015	Lead Mathematician and Writer, NYSED Common Core Curriculum Development.
2011-2014	K-6 Mathematics Lead, The Illustrative Mathematics Project.
Summer 2011	LSU Math Circle.
2008-2011	Singapore Math Project Professional Development Workshop, Baker Heights Elem.
Summer 2008	REU Graduate Assistant, Louisiana State University
Summer 2007	REU Graduate Assistant, Louisiana State University
Fall 2006	R2R Tutoring Lab Manager
Spring 2006	R2R Tutoring Lab Manager
2005-2012	Graduate Assistant, Louisiana State University.

EngageNY/Eureka Math Curriculum

I served as the Lead Mathematician for a national PK-5 mathematics curriculum based upon the Common Core State Standards that is still one of the most widely used in the US today. According to a report by the RAND Corporation in 2016, it was in use by 57% of elementary teachers in the US. The curriculum, titled A Story of Units, is the first component of a complete PK-12 curriculum designed to meet the Common Core State Standards and includes teacher lesson plans, student textbooks, homework sets, and student assessments. The curriculum was initially created for New York and is freely available to download at engageNY.org; the national version of the curriculum is called Eureka Math, and is available at GreatMinds.org. The following is a list of the first editions of textbooks that resulted from this work. The majority of the curriculum development took place from 2012 to 2015, and I continued in an advisory capacity until 2024.

The lead writers consisted of Scott Baldridge, Robin Ramos, and myself. Books were published for pre-Kindergarten through fifth grade. The following presents a summary of each book that was published.

Pre-Kindergarten

Curricular Modules available at: https://www.engageny.org/content/prekindergarten-mathematics.

Kindergarten

Module 1: Numbers to 10.

Module 2: Two-Dimensional and Three-Dimensional Shapes.

Module 3: Comparison of Length, Weight, Capacity, and Numbers to 10.

Module 4: Number Pairs, Addition and Subtraction to 10.

Module 5: Numbers 10-20 and Counting to 100.

Module 6: Analyzing, Comparing and Composing Shapes.

First Grade

Module 1: Sums and Differences to 10.

Module 2: Introduction to Place Value Through Addition and Subtraction Within 20.

Module 3: Ordering and Comparing Length Measurements as Numbers.

Module 4: Place Value, Comparison, Addition and Subtraction to 40.

Module 5: Identifying, Composing, and Partitioning Shapes.

Module 6: Place Value, Comparison, Addition and Subtraction to 100.

Second Grade

Module 1: Sums and Differences to 20.

Module 2: Addition and Subtraction of Length Units.

Module 3: Place Value, Counting, and Comparison of Numbers to 1,000.

Module 4: Addition and Subtraction Within 200 with Word Problems to 100.

Module 5: Addition and Subtraction Within 1,000 with Word Problems to 100.

Module 6: Foundations of Multiplication and Division.

Module 7: Problem Solving with Length, Money and Data.

Module 8: Time, Shapes, and Fractions as Equal Parts of Shapes.

Third Grade

Module 1: Properties of Multiplication and Division and Solving Problems with Units of 2-5 and 10.

Module 2: Place Value and Problem Solving with Units of Measure.

Module 3: Multiplication and Division with Units of 0,1,6-9 and Multiples of 10.

Module 4: Multiplication and Area.

Module 5: Fractions as Numbers of the Number Line.

Module 6: Collecting and Displaying Data.

Module 7: Geometry and Measurement Word Problems.

Fourth Grade

Module 1: Place Value, Rounding and Algorithms for Addition and Subtraction.

Module 2: Unit Conversions and Problem Solving with Metric Measurement.

Module 3: Multi-Digit Multiplication and Division.

Module 4: Angle Measure and Plane Figures.

Module 5: Fraction Equivalence, Ordering, and Operations.

Module 6: Decimal Fractions.

Module 7: Exploring Multiplication.

Fifth Grade

Module 1: Place Value and Decimal Fractions.

Module 2: Multi-Digit Whole Number and Decimal Fraction Operations.

Module 3: Addition and Subtraction of Fractions.

Module 4: Multiplication and Division of Fractions and Decimal Fractions.

Module 5: Addition and Multiplication with Volume and Area.

Module 6: Problem Solving with the Coordinate Plane.

In addition to the above, I served as a math editor on:

A Story of Functions: Geometry, Module 2: Similarity, Proof, and Trigonometry.

Other Creative Works

B. McCarty, S. Baldridge. Cube Diagram Table of Knots of 7 Crossings or Less. http://alturl.com/ify2d.

Grants

Served as Co-PI on the project, Promoting Success in Undergraduate mathematics through Graduate Teacher Training, July 2018-June 2022. The project was funded by the NSF in the amount of $892,649.

A. Windsor (PI), B. McCarty (Co-PI). Preparing Mathematical Minds, Tipton County Schools, September 2014-February 2015. Funded by the Tennessee Department of Education's Mathematics and Science Partnership Grant Program, in the amount of $26,850. We delivered professional development to teachers in grades 3, 4, 7 & 8.

B. McCarty (PI), A. Windsor (Co-PI), C. Anderson (Co-PI). Mathematics and Science Partnership, Shelby County Schools, May 2014-July 2015. The project was funded by the Tennessee Department of Education's Mathematics and Science Partnership Grant Program, via Shelby County Schools, and our portion of the grant totaled $109,127. We delivered professional development to teachers in Grades K-5 designed to prepare them for implementation of the Tennessee Academic Standards.

B. McCarty (PI), A. Windsor (Co-PI). 5th Grade Mathematics Professional Development, Tipton County Schools, Oct. 2013-March 2014. Funded by Tipton County Schools in the amount of $7,987. We delivered professional development to 5th grade teachers in Tipton County.

I worked with DeAnna Owens and Nicole Thompson on a proposal titled "Making Math Matter with Middle School Mathematics Teachers, Leaders, and Peers." The proposal was for an Improving Teacher Quality Grant, in partnership with Shelby County and Jackson-Madison County Schools. We applied for $74,993 to conduct teacher training. However, this project was not funded.

Along with several members of the department, I worked on an NSF proposal titled "Improving Undergraduate STEM Education: (NSF) PD 14-75132." This project was not funded.

Invited Lectures

What does the Penrose polynomial actually count? Moscow Knots and Representation Theory Seminar, December 2024.

A new approach to the four color theorem, LSU Physics and Representation Theory Seminar, March 2024.

A TQFT approach to graph coloring, Lou Kauffman's Quantum Topology Seminar, September 2023.

n-Color Vertex Homology, V. Manturov's Knots and Representation Theory Seminar, August 2023.

A TQFT approach to graph coloring, V. Manturov's Knots and Representation Theory Seminar, June 2023.

A TQFT Approach to Graph Coloring: Examples, April 2023, AMS Sectional Meeting in Cincinnati, Ohio

Unoriented Khovanov Homology, CKVK Seminar for The Ohio State University, Nov 2021, `https://www.youtube.com/watch?v=8_pE5hHTzmc`.

September 2017 *Coherence in modeling*, Fortify Conference, Nashville, TN.

November 2015 *Bridging the gap between elementary and middle school mathematics*, NCTM Regional Meeting, Nashville, TN.

May 2014 *Closing Math Content Gaps*, INVEST Teacher Prep Conference, Nashville (co-presented with Alistair Windsor).

January 2014 *A Story of...*, AMS/MAA Joint Meetings, Baltimore.

July 2013 *A System of Algorithms in A Story of Units*, Network Team Institute, Albany.

January 2013 *Quality Problems Through Collaboration*, AMS/MAA Joint Meetings, San Diego.

October 2012 *New Standards–New Opportunities for Collaboration*, Haddockfest, University of Memphis.

January 2012 *On the rotation class of knotted Legendrian tori in* $\mathbb{R}^5$, AMS/MAA Joint Meetings, Boston.

December 2011 *On the rotation class of knotted Legendrian tori in* $\mathbb{R}^5$, Virtual Seminar, LSU.

September 2011 *Baker Project Panel Discussion*, LA Gear Up Fall Conference, Baton Rouge.

July 2011 *My Undergraduate Research Experience*, University of Texas at Tyler REU

March 2011 *Hypercube diagrams knotted tori*, Spring Topology and Dynamics Conference, University of Texas at Tyler.

March 2011 *Hypercube diagrams of knotted tori*, AMS Southeast Sectional Meeting, Georgia Southern University.

January 2011 *Cube number can detect chirality and Legendrian knot type*, AMS/MAA Joint Meetings, New Orleans.

November 2010 *An infinite family of Legendrian torus knots distinguished by cube number*, Indiana University.

October 2010 *Cube number can detect chirality and Legendrian knot type*, Faculty Seminar, University of Texas at Tyler.

October 2010 *Introduction to Legendrian Knots*, Junior Topology Seminar, Louisiana State University.

August 2010 *Cube Diagrams for Knots*, GEAUX (a math graduate student orientation), Louisiana State University.

June 2010 *The Singapore Math Project in the Baker School System*, Mathematical Sciences Research Institute.

May 2010 *On the cube number of a knot*, New Jersey AMS Sectional Meeting, presented by Scott Baldridge.

April 2010 *On the cube number of a knot*, Spring Topology and Dynamics Conference, Mississippi State University.

October 2009 *An introduction to combinatorial knot floer homology*, Junior Topology Seminar, Louisiana State University.

August 2009 *Knots: Grids and Cubes*, GEAUX (a math graduate student orientation), Louisiana State University.

Spring 2009 *Legendrian knots and an application to arc index*, Junior Topology Seminar, Louisiana State University.

Spring 2005 *Minimal Lattice Knots*, MAA Texas Sectional Meeting.

Fall 2004 *Minimal Lattice Knots*, LSAMP Presentation.

Service

2023-present	College of Arts and Sciences UG Curriculum Committee Rep
2020-present	Undergraduate Coordinator
2020-present	Cantor Sect Faculty Advisor
2013-present	Undergraduate curriculum and instruction committee, Univ. of Memphis.
2013-present	Undergraduate recruitment and outreach committee, Univ. of Memphis.
2017-present	Oversee MS for Teachers program, Univ. of Memphis.
2017	Instructor Hiring Committee, Univ. of Memphis.
2016-present	Created/Oversee New Certificate Program in the Teaching of Mathematics, Univ. of Memphis.
2015-present	GA Teacher Training Committee, Univ. of Memphis.
2014	Instructor Hiring Committee, Univ. of Memphis.
2014	Served on an NSF Review panel.
2013-2016	Elementary Mathematics for Teachers, Course Coordinator Univ. of Memphis.
2013-present	Undergraduate Curriculum/Instruction, Univ. of Memphis.
2013-present	Undergraduate Recruitment/Outreach Committee, Univ. of Memphis.
2012-present	Math/STEM Education & Math Bootcamp Committee, Univ. of Memphis.
2013	Research Capacity Assessment People Study Team, Univ. of Memphis.
2012-2013	Cantor Sect, Univ. of Memphis.

Other Advising

PhD, Aaron Mathis (advisor), expected 2026, University of Memphis.

PhD, Runze Wang (committee member) 2026, University of Memphis.

PhD, Rasika Mahawattege (committee member) 2022, University of Memphis.

PhD, Stephen Guffey (committee member) 2021, University of Memphis.

MS, Shauna Baker (committee chair), 2021, University of Memphis.

MS, Charlotte Baucke (committee chair), 2020, University of Memphis.

MS, Dustin Perry (committee chair), 2020, University of Memphis.

PhD, Holly Renaud (committee member), 2019, University of Memphis.

MS, Ashley Coates (committee chair), 2018, University of Memphis.

MS, Karl Kreitlein (committee chair), 2018, University of Memphis.

MS, Molly Prewitt (committee chair), 2017, University of Memphis.

PhD, Aaron Taylor (committee member), 2016, University of Memphis.

MS, Cassandra Williams (committee member), 2014, University of Memphis.

MS, Jeff Lewis (committee member), 2014, University of Memphis.

Certificate in the Teaching of Mathematics: Mike Showers, Cale Johnson, Marsha Kuykendall.

Teaching Experience

MATH 7411 Point Set Topology, University of Memphis.

MATH 7385 Concepts of Calculus 3, University of Memphis.

MATH 7384 Concepts of Calculus 2, University of Memphis.

MATH 7383 Concepts of Calculus 1, University of Memphis.

MATH 7282 Algebra for Teachers, University of Memphis.

MATH 7281 Linear Algebra for Teachers, University of Memphis.

MATH 7024 Calculus for Teachers, University of Memphis.

MATH 4411/6411 Topology, University of Memphis.

MATH 4080, Math for Secondary Teachers, University of Memphis.

MATH 3410/3411 Honors Seminar, University of Memphis.

MATH 3402 Honors Mathematics 4, University of Memphis.

MATH 2421 Honors Calculus 2, University of Memphis.

MATH 1910 Calculus 1, University of Memphis.

MATH 1710 College Algebra, University of Memphis.

MATH 1481 Elementary Math for Teachers 2, University of Memphis.

MATH 1480 Elementary Math for Teachers 1, University of Memphis.

MATH 1202 Elementary Geometry for Teachers Instructor, Louisiana State University.

MATH 1201 Elementary Mathematics for Teachers Instructor, Louisiana State University.

Singapore Math Project, Graduate Assistant 3^{rd} grade - Bakerfield Elem.

Singapore Math Project, Graduate Assistant 2^{nd} grade - Bakerfield Elem.

The Nature of Mathematics Instructor, Louisiana State University.

Singapore Math Project, Graduate Assistant 1^{st} grade - Baker Heights Elem.

Calculus 2 Instructor, Louisiana State University.

Calculus 1 Instructor, Louisiana State University.

College Algebra R2R Teacher, Louisiana State University.

College Algebra R2R Tutor, Louisiana State University.