

# JOHN R. THOMPSON

Department of Physics and Astronomy  
University of Maine  
5709 Bennett Hall  
Orono, ME 04469-5709

Phone: (207) 581-1030  
FAX: (207) 581-3410  
Email: thompsonj@maine.edu

---

Physics Education Research – research on the learning and teaching of physics, as well as the associated mathematics – including research-based curriculum development.

Supervised/co-supervised 4 Ph.D., 2 M.S. in Physics, 11 M.S. in Teaching, 1 Honors Thesis, and 2 Senior Project students to completion; mentored 4 postdoctoral research associates.

## PROFESSIONAL EXPERIENCE

<b>Professor of Physics</b>	September 2016 to present
<b>Cooperating Professor of STEM Education</b>	
<b>Member, Maine Center for Research in STEM Education</b>	
<i>University of Maine, Orono, ME</i>	
Associate Professor of Physics	September 2008 to August 2016
Cooperating Associate Professor of STEM Education	
Member, Maine Center for Research in STEM Education	
<i>University of Maine, Orono, ME</i>	
Visiting Professor, Fulbright Scholar	September 2008 to July 2009
Physics Education Research Group, School of Physics	
<i>Dublin Institute of Technology, Dublin, Ireland</i>	
Assistant Professor of Physics	September 2002 to August 2008
Cooperating Assistant Professor of Education	
Member, Center for Science and Mathematics Education Research	
<i>University of Maine, Orono, ME</i>	
Assistant Professor of Physics,	August 2000 to August 2002
<i>Grand Valley State University, Allendale, MI</i>	
Research Associate, Physics Education Group	September 1997 to July 2000
Department of Physics, <i>University of Washington, Seattle, WA</i>	

## EDUCATION

<i>Brown University, Providence, RI</i>	Ph.D., Physics, May 1998
	Sc.M., Physics, May 1992
<i>Rensselaer Polytechnic Institute, Troy, NY</i>	B.S., Physics, May 1990

## SELECT RECENT PUBLICATIONS

### Peer-reviewed journal articles

- R.R. Bajracharya and J.R. Thompson, “Analytical derivation: An epistemic game for solving mathematically based physics problems,” *Physical Review Physics Education Research* **12**, 010124 (2016).
- T.I. Smith, D.B. Mountcastle, and J.R. Thompson, “Student understanding of the Boltzmann factor,” *Physical Review ST – Phys. Educ. Res.* **11**, 020123 (2015).
- T.I. Smith, W.M. Christensen, D.B. Mountcastle, and J.R. Thompson, “Identifying student difficulties with heat engines, entropy, and the Carnot cycle,” *Phys. Rev. ST Phys. Educ. Res.* **11**, 020116 (2015).
- T. I. Smith, J. R. Thompson and D. B. Mountcastle, “Student understanding of Taylor series expansions in statistical mechanics,” *Phys. Rev. ST Phys. Educ. Res.* **9**, 020110 (2013).
- W. M. Christensen and J. R. Thompson, “Investigating graphical representations of slope and derivative without a physics context,” *Phys. Rev. ST Phys. Educ. Res.* **8**, 023101 (2012).
- J. R. Thompson, W. M. Christensen, and M. C. Wittmann, “Preparing future teachers to anticipate student difficulties in physics in a graduate-level course in physics, pedagogy, and education research,” *Phys. Rev. ST*

*Phys. Educ. Res.* **7**, 010108 (2011); reprinted in *Teacher Education in Physics: Research, Curriculum, and Practice*, D.E. Meltzer and P.S. Shaffer, Eds., pp. 91-102 (American Physical Society, 2011). **This book was distributed to every physics department chair in the United States.**

M.J. O'Brien and J.R. Thompson, "Effectiveness of ninth-grade physics in Maine: Conceptual understanding," *The Physics Teacher* **47**(4), 234-239 (2009).

M.C. Wittmann and J.R. Thompson, "Integrated approaches in physics education: A graduate level course in physics, pedagogy, and education research," *American Journal of Physics* **76**(7), 677-683 (2008).

R.P. Springuel, J.R. Thompson, and M.C. Wittmann, "Applying clustering to statistical analysis of student reasoning about two-dimensional kinematics," *Phys. Rev. ST Phys. Educ. Res.* **3**, 020107 (2007). <http://prst-per.aps.org/abstract/PRSTPER/v3/i2/e020107>

#### **Peer-reviewed conference proceedings**

B. P. Schermerhorn and J. R. Thompson, "Physics students' construction and use of differential elements in an unconventional coordinate system," in *Proceedings of the 19th Annual Conference on Research in Undergraduate Mathematics Education* (Mathematical Association of America, 2016).

V. L. Sealey and J. R. Thompson, "Students' interpretation and justification of 'backward' definite integrals," accepted for publication in *Proceedings of the 19th Annual Conference on Research in Undergraduate Mathematics Education* (Mathematical Association of America, 2016).

R. R. Bajracharya and J. R. Thompson, "Student application and understanding of the Fundamental Theorem of Calculus at the mathematics-physics interface," *Proceedings of the 17th Annual Conference on Research in Undergraduate Mathematics Education* (Mathematical Association of America, 2014).

J. W. Clark, J. R. Thompson, and D. B. Mountcastle, "Investigating Student Conceptual Difficulties in Thermodynamics Across Multiple Disciplines: The First Law and  $P$ - $V$  Diagrams," *Proceedings of 121st ASEE (American Society for Engineering Education) Annual Conference and Exposition* (2014). <http://www.asee.org/public/conferences/32/papers/10903/view>

J. W. Clark, J. R. Thompson and D. B. Mountcastle, "Comparing Student Conceptual Understanding of Thermodynamics in Physics and Engineering," in *2012 Physics Education Research Conference*, AIP Conference Proceedings **1513**, 102-105 (2013). doi:<http://dx.doi.org/10.1063/1.4789662>.

T. I. Smith, D. B. Mountcastle and J. R. Thompson, "Identifying Student Difficulties with Conflicting Ideas in Statistical Mechanics," in *2012 Physics Education Research Conference*, AIP Conference Proceedings **1513**, 386-389 (2013). doi:<http://dx.doi.org/10.1063/1.4789733>.

R. R. Bajracharya, T. M. Wemyss, J. R. Thompson, "Student interpretation of the signs of definite integrals using graphical representations," in *2011 Physics Education Research Conference*, AIP Conference Proceedings **1413**, 111-114 (2012).

**Finalist, 2011 PERC (Physics Education Research Conference) Proceedings Paper Award**, given by the Physics Education Research Leadership and Organizing Committee. Selected as a finalist because it is noteworthy in terms of the quality of research, readability and impact on the PER Community.)

T. M. Wemyss, R. Bajracharya, J. R. Thompson, and J. F. Wagner, "Student understanding of integration in the context and notation of thermodynamics: Concepts, representations, and transfer," in *Proceedings of the 14th Annual Conference on Research in Undergraduate Mathematics Education* (Mathematical Association of America, 2011).

T.I. Smith, J.R. Thompson and D.B. Mountcastle, "Addressing Student Difficulties with Statistical Mechanics: The Boltzmann Factor," in *2010 Physics Education Research Conference*, AIP Conference Proceedings **1289**, 305-308 (2010).

- **Finalist, 2010 PERC Proceedings Paper Award**

- **Cited in Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering**, Susan R. Singer, Natalie R. Nielsen, and Heidi A. Schweingruber, Editors; National Research Council (2012).

***Invited articles and conference proceedings***

- J. R. Thompson, C. A. Manogue, D. J. Roundy, and D. B. Mountcastle, "Representations of partial derivatives in thermodynamics," in *2011 Physics Education Research Conference*, AIP Conference Proceedings **1413**, 85-88 (2012).
- J. F. Wagner, C. A. Manogue, and J. R. Thompson, "Representation issues: Using mathematics in upper-division physics," in *2011 Physics Education Research Conference*, AIP Conference Proceedings **1413**, 89-92 (2012).

**SELECTED RECENT PRESENTATIONS*****Invited presentations***

- Seminar, Office of STEM Education, Rutgers University, New Brunswick, NJ, 27 April 2016, "Crossing field lines: Multidisciplinary STEM DBER efforts in research and community building."
- Colloquium, Department of Physics, University of Vermont, Burlington, VT, 28 October 2015, "Physics education research and its role in instructional reform."
- Colloquium, Department of Mathematics, West Virginia University, Morgantown, WV, 15 April 2015, "Investigating student understanding and application of mathematics needed in physics: Definite integrals and the Fundamental Theorem of Calculus."
- 2015 April Meeting of the American Physical Society, Baltimore, MD, 14 April 2015, "[Student learning of upper-level thermal and statistical physics: The derivation and use of the Boltzmann factor.](#)"
- Seminar, STEM Initiative, Bates College, Lewiston, ME, 22 January 2015, "Discipline-based education research (DBER) and its role in instructional reform: A view from physics."
- Colloquium, Department of Physics, University of Colorado – Boulder, 5 November 2014, "Student understanding at the upper division: Thermal physics and the related mathematics."
- Colloquium, Department of Physics, University of Central Florida, Orlando, FL, 11 October 2013, "Research on the learning and teaching of upper-level thermal and statistical physics."
- Transforming Research in Undergraduate STEM Education (TRUSE) 2012, University of St. Thomas, St. Paul, MN, 3-8 June 2012, "Investigating the transfer of mathematical knowledge using physicsless physics questions," J. R. Thompson, J. F. Wagner.
- Joint Colloquium, Department of Mathematics and Computer Science and Department of Physics, Xavier University, Cincinnati, OH, 24 October 2011, "Investigating student understanding of physics concepts and the underlying calculus concepts in thermodynamics."
- 2011 March Meeting of the American Physical Society, Dallas, TX, March 2011, "Research on student learning of upper-level thermal and statistical physics."
- Plenary speaker, *Foundations and Frontiers in Physics Education Research 2009* Conference (International), Bar Harbor, ME, June 15, 2009, "Student understanding of thermal physics and the associated mathematics: Challenging assumptions in physics education."
- Department of Physics and Materials Science, Uppsala University, Uppsala, Sweden, June 2, 2009, "Investigations of student understanding of thermal physics beyond the first year."
- School of Physics, University College Dublin, Dublin, Ireland, February 25, 2009, "Student understanding of thermal physics and associated mathematics concepts beyond the first year."

***Contributed presentations***

- 2016 April Meeting of the American Physical Society, Salt Lake City, UT, 16-19 April 2016, "The impact of conservative forces on student reasoning about graphical work," J.R. Thompson and J.W. Clark.
- 19th Annual Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA, 25-27 February 2016:
- "Physics students' construction and use of differential elements in multivariable coordinate systems," B. P. Schermerhorn and J. R. Thompson. (Poster.)
- "Student interpretation and justification of 'backward' definite integrals," V. L. Sealey and J. R. Thompson.

2015 Summer National Meeting of the AAPT, College Park, MD, 27-29 July 2015, “Changes in student reasoning about graphical work during introductory physics,” J. R. Thompson, J. W. Clark; 28 July 2015.

18th Annual Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA, 19-21 February 2015, “Students’ visual attention while answering graphically-based Fundamental Theorem of Calculus questions,” R. R. Bajracharya, J. R. Thompson, J. L. Docktor. (Poster.)

2014 Summer National Meeting of the AAPT, Philadelphia, PA, 28-30 July 2014:

“Student strategies solving graphically-based physics problems invoking the Fundamental Theorem of Calculus” retitled as “Solving graphically-based physics problems involving the Fundamental Theorem of Calculus: Identifying a new epistemic game,” R. R. Bajracharya, J. R. Thompson<sup>†</sup>.

“Conceptual Difficulties Interpreting  $P$ - $V$  Diagrams Across Physics and Engineering,” J. W. Clark, J. R. Thompson, D. B. Mountcastle.

“Eye-gazing behavior of students solving graphically-based problems,” R. R. Bajracharya, J. L. Docktor, J. R. Thompson<sup>†</sup>. (Poster.)

17th Annual Conference on Research in Undergraduate Mathematics Education, Denver, CO, 27 February – 1 March 2014, “Student Understanding Of The Fundamental Theorem Of Calculus At The Mathematics-Physics Interface,” R. R. Bajracharya, J. R. Thompson.

### ACTIVE GRANTS AND AWARDS

“Research on learning and teaching at the physics-mathematics interface,” NSF Education and Interdisciplinary Research (EIR), PHY-1405726; Collaborating PI, with M.E. Loverude (Lead PI), Calif. St. U. -Fullerton, J.F. Wagner (Collab. PI), Xavier U. (Mathematics), W.M. Christensen (co-PI), N. Dakota St. U.; \$236,357 at UMaine, 9/15/2014-9/14/2017.

“Research on learning and teaching at the physics-engineering interface: thermodynamics and electronics,” NSF TUES, DUE-1323426; PI, with M.R. Stetzer, co-PI, W.A. Friess, D.B. Mountcastle, Senior Personnel; \$599,999, 9/1/2013-8/31/2017.

“Maine Physical Sciences Curriculum Partnership: Research and Infrastructure for Ongoing Educational Improvement,” NSF Math–Science Partnership, DUE-0962805; Co-PI, with S. McKay (PI), M. Bruce (Chem), O. Maurais (Education), M. Wittmann (Phys); \$12,347,771; 07/01/10-06/30/16, with supplemental support (1550654) of \$2,060,084; 7/1/10-12/31/16.

**TEACHING EXPERIENCE** (<sup>M</sup>U. Maine; <sup>D</sup>Dublin Institute of Technology; <sup>G</sup>Grand Valley St. U.; <sup>W</sup>U. Washington)

#### Physics courses

*Introductory algebra-based mechanics.*<sup>W</sup>

*Introductory calculus-based physics.*<sup>G</sup>

*Introductory physics: Problem-Based Learning.*<sup>D</sup>

*Experimental Methods in Physics.*<sup>G</sup>

*Mathematical Methods for Physics.*<sup>M</sup>

*Intermediate Modern Physics*<sup>G</sup>/*Quantum*

*Mechanics*<sup>G</sup>/*Quantum and Atomic Physics.*<sup>M</sup>

*Physics Seminar II.*<sup>M</sup> (career preparation seminar.)

#### Courses related to K-12 teacher preparation, physics education, and physics education research

*Physics by Inquiry.*<sup>M,G,W</sup> (courses for preservice and in-service K-12 teachers)

Postgraduate Certificate courses in *Third-Level Teaching and Learning.*<sup>D</sup>

*Integrated Approaches to Physics Education I and II.*<sup>M</sup> (graduate courses in M.S. in Teaching)

*Graduate Seminar in Physics Education Research.*<sup>M</sup>

*Graduate Seminar: Group Teaching and Learning.*<sup>M</sup>  
*Research-related Curriculum Development in Science and Mathematics.*<sup>M</sup>

*Independent Study in Physics Education Research.*<sup>M</sup>

*Senior Project in Physics / Honors Thesis in Physics.*<sup>M</sup>  
*Seminar in Teaching Physics.*<sup>W</sup>

### SERVICE HIGHLIGHTS

Executive Committee, Topical Group on Physics Education Research (GPER), American Physical Society  
Vice Chair, 2016; Chair Elect, 2017.

Member, Editorial Board, *Physical Review Physics Education Research*, 1 January 2014 – 31 December 2016.

Co-Founder, Topical Group on Physics Education Research (GPER), American Physical Society; approved by APS Council 12 April 2013.

Physics Education Research Leadership and Organizing Council (AAPT), April 2009 – February 2012  
Chair, January 2011 – February 2012.

APS Forum on Education Executive Committee, Member-at Large, April 2008 – April 2011.

#### **Conference and conference session organization**

Co-organizer, “Integration in Multivariable and Vector Calculus,” Working Group on Education Research at the Interface of Mathematics and Physics, 19th Annual Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA, 25 February 2016.

Co-organizer, “Research on student conceptions of integration in math and physics,” Talk Symposium at 2015 Physics Education Research Conference, College Park, MD, 30 July 2015.

Co-organizer, *Integrating Science and Mathematics Education Research into Teaching: Knowledge of Student Thinking*, through Maine Center for Research in STEM Education, Orono, ME, June 20-22, 2012.

Co-organizer, *2012 Transforming Research on Undergraduate STEM Education (TRUSE)*, The University of St. Thomas, St. Paul, MN, June 3-7, 2012; and *Transforming Research on Undergraduate STEM Education (TRUSE)*, The University of Maine, Orono, ME, June 14-18, 2010; as co-PI of NSF grant DUE-0941191.

#### **Consulting and Advisory Committees**

Member of Advisory Board and Consulting Researcher, “Raising Calculus to the Surface,” NSF DUE-1246094, Aaron Wangberg (Winona St. U. (MN)), PI; 2015-2017.

Participating instructor, “An Interdisciplinary Investigation of Learning: Student Understanding of Linear Algebra in Physics,” NSF CAREER grant, Megan Wawro (Virginia Tech) PI, 9/1/2015-8/30/2020.

Sponsor, ADVANCE Sponsorship Grant, Vicki Sealey, Department of Mathematics, West Virginia U., PI; 10/1/2014-9/30/2015.

Member of Advisory Board and Consulting Researcher, “Paradigms in Physics: Representations of Partial Derivatives,” C. Manogue, PI; T. Dray, D. Roundy, E. van Zee, co-PIs; Oregon State University, NSF DUE-1323800; 2013-2016.

#### **Referee**

*American Journal of Physics*  
*Journal of Chemical Education*  
*Journal of Engineering Education*  
*Physical Review Special Topics –*  
*Physics Education Research*

*Physics Education Research, A Supplement to the*  
*American Journal of Physics*  
*Physics Education Research Conference*  
*Proceedings*  
*The Physics Teacher*

#### **AWARDS/HONORS**

Finalist, 2011 Physics Education Research Conference (PERC) Proceedings Paper Award

Finalist, 2010 PERC Proceedings Paper Award

Fulbright Scholar, 2008-2009, School of Physics, Dublin Institute of Technology, Dublin, Ireland

Dean’s Award of Excellence in Engineering Physics program, College of Engineering, 2007–2008

Honorary Engineer, Francis Crowe Society, College of Engineering, U. Maine

ΣΠΣ (Physics Honor Society)

#### **PROFESSIONAL MEMBERSHIPS**

American Association of Physics Teachers: Physics Education Research Topical Group; New Engl. Sec.

American Physical Society: Topical Group on Physics Education Research; Forum on Education; Forum on History of Physics; New Engl. Sec.