JOHN R. THOMPSON

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EDUCATION

Brown University, Providence, RI — Ph.D., Physics, May 1998; Sc.M., Physics, May 1992

Rensselaer Polytechnic Institute, Troy, NY — B.S., Physics, May 1990

PROFESSIONAL EXPERIENCE

Professor of Physics — **September 2016 to present**
Member, Maine Center for Research in STEM Education
Cooperating Professor of STEM Education
***University of Maine*, Orono, ME**

Physics Education Research – research on the learning and teaching of physics – including research-based instructional materials development. Student understanding at the physics-mathematics interface, *i.e.,* how students mathematically model in physics contexts.

Chair, Department of Physics and Astronomy — **July 2017 to June 2022; July 2023 to present**

Associate Professor of Physics — **September 2008 to August 2016**
Member, Maine Center for Research in STEM Education
Cooperating Associate Professor of STEM Education
***University of Maine*, Orono, ME**

Visiting Professor, Fulbright Scholar — **September 2008 to June 2009**
School of Physics
***Dublin Institute of Technology* (now *Technological University Dublin*),**
Dublin, Ireland

Assistant Professor of Physics — **August 2002 to August 2008**
Member, Center for Science and Mathematics Education Research
Cooperating Assistant Professor of Education
***University of Maine*, Orono, ME**

Assistant Professor of Physics — **August 2000 to August 2002**
***Grand Valley State University*, Allendale, MI**

Research Associate, Department of Physics — **September 1997 to July 2000**
***University of Washington,* Seattle, WA**

Physics Education Group. Mentors: Lillian C. McDermott, Paula R. L. Heron, Peter S. Shaffer

Research Assistant, *Brown University,* Providence, RI — **June 1991 to September 1997**

Advisors: Peder J. Estrup & Peter M. Weber. Experimental Surface Physics.

TEACHING EXPERIENCE

([M]U. Maine; [D]Dublin Institute of Technology/Technological University Dublin; [G]Grand Valley St. U.; [W]U. Washington)
Physics content courses

Introductory algebra-based mechanics.[W] Mixture of lecture and small-group, research-based curriculum materials designed to improve student conceptual understanding (*Tutorials in Introductory Physics*, McDermott et al., Prentice Hall, 2002; *Peer Instruction,* Mazur, Prentice Hall, 1996).

Introductory calculus-based physics sequence.[G] Content included: (I) mechanics, simple harmonic motion and sound; (II) thermodynamics, electrostatics, electric circuits, magnetism. Lecture, discussion, laboratory. Included tutorials in discussion sections and ConcepTests in lectures. Designed several interactive discussion exercises.

Introductory physics: Problem-Based Learning.[D] All small-group, problem solving sections using context-rich problems. Developed problems targeting Newton's Third Law and Energy Conservation. Developed and adapted "tutor questions" to be used in class to probe student understanding of concepts needed to solve problems.

Experimental Methods in Physics.[G] Junior-level. Basic electronics and error analysis; experimental design and execution; development of scientific writing skills.

Mathematical Methods in Physics.[M] Junior-level. Mathematical concepts and techniques that are especially relevant to the physics contexts encountered in the upper division. Used some activities from Paradigms in Physics project (Oregon State University). Text: Boas.

Intermediate Modern Physics[G]*/Quantum Mechanics*[G]*/Quantum and Atomic Physics.*[M] Junior/senior quantum mechanics. Lecture (occasional student lectures as well) with some interactive exercises ("clicker" questions, tutorials) and simulations (Physlets™; PhET). Text: McIntyre (2014 and beyond); Griffiths (2014 and earlier).

Physics career preparation seminars

Introduction to Physics and Astronomy.[M] Seminar for first-year physics and engineering physics majors. Orientation to the major, faculty research, and university resources, with some emphasis on expert physicist skills.

Physics Seminar II.[M] Seminar for senior physics and engineering physics majors. Strong focus on technical writing and career preparation.

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

Physics by Inquiry.[M,G,W] Graduate- and undergraduate-level guided-inquiry, laboratory-based courses designed to improve content understanding of inservice or preservice K-12 teachers. Populations include preservice elementary teachers (primary population), preservice secondary mathematics and physics teachers, inservice K-12 teachers, and inservice elementary Science Resource Teachers. Additional attention paid to the pedagogical concern of adapting curriculum to be taught as a process of inquiry in the K-12 classroom. Used *Physics by Inquiry* (McDermott *et al.,* Wiley, 1996) as text. Content units taught include Properties of Matter (mass, volume, density, sinking and floating), Balancing (center of mass), Heat and Temperature, Electric Circuits, Magnets, Electromagnets, Kinematics, Relative Motion, Two-Dimensional Kinematics, Dynamics, Light and Color, Light and Optics, Sound (under development at U. Maine), Waves.

Integrated Approaches to Physics Education I and *II.*[M] Graduate courses, designed for students pursuing a Master of Science in Teaching, but also taken by graduate students in Physics and Astronomy, on methods and results in the field of Physics Education Research.

I. Content: Electric Circuits, Kinematics, Dynamics. Research Methods: Pre- and post-test analysis, question format, assessment of broad multiple-choice surveys.

II. Content: Sound, Waves, Work-Energy and Impulse-Momentum Theorems, Heat and Temperature. Methods: Interviewing techniques, classroom observations, curriculum design.

Graduate Seminar in Physics Education Research.[M] Readings course, aimed at introducing graduate students to the seminal works of the field and demonstrating the different areas of research therein.

Postgraduate Certificate courses in Third-Level Teaching and Learning.[D] Guest lectures in graduate certification course for university faculty and lecturers. Topics include: interactive teaching methods for lectures, interactive teaching methods for recitation and laboratory sections; assessment.

Research-related Curriculum Development in Science and Mathematics.[M] Co-instructor of graduate seminar for Master of Science in Teaching students and inservice secondary science teachers working as interns at The Jackson Laboratory (Bar Harbor, ME), a cancer and genetic research laboratory. Students develop a lesson/unit on a STEM topic, often related to the scientific research they are conducting. With Dr. Molly Schauffler.

Independent Study in Physics Education Research.[M]

(1) Supervised undergraduate elementary education major in project on student understanding of density and

buoyancy, and as a Peer Facilitator in *Physics by Inquiry* courses (2 semesters).
(2) Supervised undergraduate secondary education major in project on student understanding of the magnetic properties of refrigerator magnets and ferrofluid cards, and as a Peer Facilitator in a tutorial section of the second semester of the introductory algebra-based course.
(3) Supervised undergraduate elementary education major in project on student understanding of (DC) electric circuits, and as a Peer Facilitator in a *Physics by Inquiry* course.

Graduate Seminar: Group Teaching and Learning.[M] Co-instructor in course to provide graduate teaching assistants with professional development on facilitation of group learning, with special attention to the introductory level course. Video case studies, written analysis, instructional materials deconstruction.

Seminar in Teaching Physics.[W] Co-instructor in graduate course sequence (each quarter during the academic year) to help prepare graduate teaching assistants for instruction in the tutorial component of the introductory calculus-based physics course.

Honors and Awards

Fellow of the American Physical Society (2023)

ΦΚΦ (2021)

Outstanding Referee, *Physical Review* Journals, American Physical Society (2020)

Fulbright Scholar Grant award, 2008-2009, School of Physics, Dublin Institute of Technology (Technological University Dublin), 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 (2003)

ΣΠΣ (1989)

Publications

Manuscripts submitted for publication

A. R. Piña, Z. Topdemir, and J. R. Thompson, "Exploring the intersection of modeling and sensemaking in quantum mechanics," submitted to *Physical Review Physics Education Research* Focused Collection "Investigating and Improving Quantum Education through Research," May 2024.

A. R. Akinyemi, M. E. Loverude, and J. R. Thompson, "Solution evaluation strategies used by first-year physics students," submitted to *Physical Review Physics Education Research*, March 2023.

Peer-reviewed journal articles

W. D. Riihiluoma, Z. Topdemir, J. R. Thompson, "Comparative analysis of spins-first and wave functions-first students' understanding of expressions in quantum mechanics," *Physical Review Physics Education Research* 21, 010113 (2025). Part of the Focused Collection "Investigating and Improving Quantum Education through Research."

W. D. Riihiluoma, Z. Topdemir, J. R. Thompson, "Symbolic forms analysis of expressions for probability in Dirac and wave function notations for spins-first students *Physical Review Physics Education Research* 21, 010105 (2025). Part of the Focused Collection "Investigating and Improving Quantum Education through Research."

W. D. Riihiluoma, Z. Topdemir, J. R. Thompson, "Network analysis of students' conceptual understanding of mathematical expressions for probability in upper-division quantum mechanics," *Physical Review Physics Education Research* **20,** 020102 (2024).

M. Wawro, A. Piña, J. R. Thompson, Z. Topdemir, and K. Watson, "Student interpretations of eigenequations in linear algebra and quantum mechanics", *International Journal of Research in Undergraduate Mathematics Education* (2024). doi:10.1007/s40753-024-00241-7.

A. Piña, Z. Topdemir, and J. R. Thompson, "Student understanding of eigenvalue equations in quantum mechanics: Symbolic forms and sensemaking analysis," *Physical Review Physics Education Research* **20,** 010153 (2024).

B. P. Schermerhorn and J. R. Thompson, "Making context explicit in equation construction and interpretation: Symbolic blending," *Physical Review Physics Education Research* **19**, 020149 (2023). Editors' Suggestion.

R. R. Bajracharya, V. L. Sealey, and J. R. Thompson, "Student understanding of the sign of negative definite integrals in mathematics and physics," *International Journal of Research in Undergraduate Mathematics Education,* Special Issue on The Teaching and Learning of Definite Integrals, R. Ely & S. R. Jones, Eds. (2023). doi: 10.1007/s40753-022-00202-y.

S. Van den Eynde, B. P. Schermerhorn, J. Deprez, M. Goedhart, J. R. Thompson, and M. De Cock , "Dynamic conceptual blending analysis to model student reasoning processes while integrating mathematics and physics: a case study in the context of the heat equation," *Phys. Rev. Phys. Educ. Res.* **16**, 010114 (2020).

R.P. Springuel, M.C. Wittmann, and J.R. Thompson, "Reconsidering the encoding of data in physics education research," *Physical Review Physics Education Research* **15,** 020103 (2019). Part of the Focused Collection "Quantitative Methods in PER: A Critical Examination."

B. P. Schermerhorn and J. R. Thompson, "Physics students' construction of differential length vectors in an unconventional spherical coordinate system," *Phys. Rev. Phys. Educ. Res.* **15,** 010111 (2019).

B. P. Schermerhorn and J. R. Thompson, "Physics students' construction and checking of differential volume elements in an unconventional spherical coordinate system," *Phys. Rev. Phys. Educ. Res.* **15,** 010112 (2019).

R. R. Bajracharya and J. R. Thompson, "Analytical derivation: An epistemic game for solving mathematically based physics problems," *Phys. Rev. Phys. Educ. Res.* **12,** 010124 (2016).

T. I. Smith, D. B. Mountcastle, and J. R. Thompson, "Student understanding of the Boltzmann factor," *Physical Review Special Topics – Physics Education Research* **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, M. C. Wittmann, and J. R. Thompson, "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

S. Kanim and J. R. Thompson, "Magnetic field viewing cards," *The Physics Teacher* **43**(6), 355–359 (2005).

J. R. Thompson, P. M. Weber, and R. Hellmer, "Extended operation of a wide-range, all-magnetic bearing turbomolecular pump without backing," *J. Vac. Sci. Technol. A* **14**(5), 2965 (1996).

Peer-reviewed conference proceedings

A. Molinari, Z. Topdemir, J. R. Thompson, "Student understanding of the direction of vector dot products across contexts and levels," *26th Conference on Research in Undergraduate Mathematics Education*, Omaha NE (2024).

A. R. Piña, Z. Topdemir, J. R. Thompson, "Student reasoning in quantum mechanics examined through modeling and sensemaking," *26th Conference on Research in Undergraduate Mathematics Education*, Omaha NE (2024).

Z. Topdemir, M. E. Loverude, J. R. Thompson, "How students reason with derivatives of vector field diagrams," in T. Dreyfus, A. S. González-Martín, E. Nardi, J. Monaghan & P. W. Thompson (Eds.), *The Learning and Teaching of Calculus Across Disciplines – Proceedings of the Second Calculus Conference* (pp. 173-176) (2023). MatRIC. https://matriccalcconf2.sciencesconf.org/

A. Piña, Z. Topdemir, J. R. Thompson, "Student understanding of eigenvalue equations in quantum mechanics: Symbolic forms analysis," *Proceedings of the 25th Conference on Research in Undergraduate Mathematics Education*, Omaha NE, 90-98 (2023).

W. Riihiluoma, Z. Topdemir, J. R. Thompson, "Modifying symbolic forms to study probability expressions in quantum mechanics," *Proceedings of the 25th Conference on Research in Undergraduate Mathematics Education*, Omaha NE, 439-448 (2023).

Z. Topdemir, M. E. Loverude, J. R. Thompson, "Physics student understanding of divergence and curl and their constituent partial derivatives," *Proceedings of the 25th Conference on Research in Undergraduate Mathematics Education*, Omaha NE, 1098-1103 (2023).

W. Riihiluoma, Z. Topdemir, J. R. Thompson, "Applying a symbolic forms lens to probability expressions in upper-division quantum mechanics," *2022 PERC Proceedings* [Grand Rapids, MI, July 13-14, 2022], edited by B. W. Frank, D. Jones, and Q. Ryan (2022), doi:10.1119/perc.2022.pr.Riihiluoma.

W. Riihiluoma, Z. Topdemir, J. R. Thompson, "Using Network Analysis Techniques to Probe Student Understanding of Expressions Across Notations in Quantum Mechanics", in (Eds.) S. S. Karunakaran & A. Higgins, *Proceedings of the 24th Annual Conference on Research in Undergraduate Mathematics Education,* Boston, MA, 1124-1130 (2022). http://sigmaa.maa.org/rume/RUME24.pdf

M. Wawro, J. Thompson, and K. Watson, "Student Meanings for Eigenequations in Mathematics and in Quantum Mechanics", in (Eds.) S. S. Karunakaran, Z. Reed, & A. Higgins, *Proceedings of the 23rd Annual Conference on Research in Undergraduate Mathematics Education*. Boston, MA, 638-645 (2020). http://sigmaa.maa.org/rume/RUME23.pdf

B. P. Schermerhorn and J. R. Thompson, "Physics students' construction of differential length vectors for a spiral path," in (Eds.) A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown, *Proceedings of the 21st Annual Conference on Research in Undergraduate Mathematics Education,* San Diego, California, 1358-1364 (2018). http://sigmaa.maa.org/rume/RUME21.pdf

B. P. Schermerhorn and J. R. Thompson, "Connecting Physics Students' Conceptual Understanding to Symbolic Forms Using a Conceptual Blending Framework," in (Eds.) A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown, *Proceedings of the 21st Annual Conference on Research in Undergraduate Mathematics Education,* San Diego, California, 1607-1608 (2018). http://sigmaa.maa.org/rume/RUME21.pdf

J. R. Thompson, B. P. Schermerhorn, and J. C. Speirs, "Student Understanding of Elements of Multivariable Calculus," in (Eds.) A. Weinberg, C. Rasmussen, J. Rabin, M. Wawro, and S. Brown, *Proceedings of the 20th Annual Conference on Research in Undergraduate Mathematics Education,* San Diego, California. (ISSN 2474-9346), 1683-1684 (2017).

B. P. Schermerhorn and J. R. Thompson, "Student determination of differential area elements in upper-division physics," 2017 PERC Proceedings [Cincinnati, OH, July 26-27, 2017], edited by L. Ding, A. Traxler, and Y. Cao (2017), doi: 10.1119/perc.2017.pr.084.

B. P. Schermerhorn and J. R. Thompson, "Physics students' use of symbolic forms when constructing differential vector elements in multivariable coordinate systems," *Proceedings of the 20th Annual Conference on Research in Undergraduate Mathematics Education* [San Diego, CA, 23-25 February 2017] (ISSN 2474-9346), 895-902 (2017). http://sigmaa.maa.org/rume/RUME20.pdf

B. P. Schermerhorn and J. R. Thompson, "Students' use of symbolic forms when constructing differential length elements," 2016 PERC Proceedings [Sacramento, CA, July 20-21, 2016], edited by D. L. Jones, L. Ding, and A. Traxler (2016). doi:10.1119/perc.2016.pr.073.

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,* pp. 397-409 (Mathematical Association of America, 2016).

V. L. Sealey and J. R. Thompson, "Students' interpretation and justification of 'backward' definite integrals," in *Proceedings of the 19th Annual Conference on Research in Undergraduate Mathematics Education,* pp. 410-418 (Mathematical Association of America, 2016).

R. R. Bajracharya, J. R. Thompson, and J. L. Docktor, "Students' visual attention while answering graphically-based fundamental theorem of calculus questions," *Proceedings of the 18th Annual Conference on Research in Undergraduate Mathematics Education,* pp. 1011-1013 (Mathematical Association of America, 2015). http://sigmaa.maa.org/rume/RUME18-final.pdf

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,* pp. 43-54 (Mathematical Association of America, 2014). http://sigmaa.maa.org/rume/RUME17.pdf

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,* P.V. Engelhardt, A.D. Churukian, N.S. Rebello, eds., AIP Conference Proceedings **1513**, 102-105 (2013).

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,* P.V. Engelhardt, A.D. Churukian, N.S. Rebello, eds., 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,* C. Singh, N.S. Rebello, P. Engelhardt, eds., 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.

J. M. Hawkins, B. W. Frank, J. R. Thompson, and M. C. Wittmann, and T. M. Wemyss, "Probing student understanding with alternative questioning strategies," in *2011 Physics Education Research Conference,* C. Singh, N.S. Rebello, P. Engelhardt, eds., AIP Conference Proceedings **1413**, 207-210 (2012).

T. M. Wemyss, R. R. Bajracharya, J. R. Thompson, and J. F. Wagner, "Student understanding of integration in the context and notation of thermodynamics: Concepts, representations, and transfer," *Proceedings of the 14th Annual Conference on Research in Undergraduate Mathematics Education*, eds. S. Brown, S. Larsen, K. Marrongelle, M. Oehrtman (Mathematical Association of America, 2011), Vol. 2, 521-531.

J. M. Hawkins, J. R. Thompson, and M. C. Wittmann, E.C. Sayre, and B.W. Frank, "Students' responses to different representations of a vector addition question," in *2010 Physics Education Research Conference,* M. Sabella, C. Singh, N.S. Rebello, eds., AIP Conference Proceedings **1289**, 165-168 (2010).

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,* M. Sabella, C. Singh, N.S. Rebello, eds., 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; Committee on the Status, Contributions, and Future Directions of Discipline-Based Education Research; Board on Science Education; Division of Behavioral and Social Sciences and Education; National Research Council (2012); http://www.nap.edu/catalog.php?record_id=13362***

J. M. Hawkins, J. R. Thompson, and M. C. Wittmann, "Students' consistency of graphical vector addition method on 2-D vector addition tasks," in *2009 Physics Education Research Conference,* C. Henderson, M. Sabella, C. Singh, eds., AIP Conference Proceedings **1179**, 161-164 (2009).

T. I. Smith, W. M. Christensen, and J. R. Thompson, "Addressing student difficulties with concepts related to entropy, heat engines and the Carnot cycle," in *2009 Physics Education Research Conference,* C. Henderson, M. Sabella, C. Singh, eds., AIP Conference Proceedings **1179**, 277-280 (2009).

D. B. Mountcastle, B. R. Bucy, and J. R. Thompson, "Student estimates of probability and uncertainty in advanced laboratory and statistical physics courses," in *2007 Physics Education Research Conference,* L. Hsu, C. Henderson, L. McCullough, eds., AIP Conference Proceedings **951**, 152-155 (2007).

E. B. Pollock, J. R. Thompson, and D. B. Mountcastle, "Student understanding of the physics and mathematics of process variables in P-*V* diagrams," in *2007 Phys. Educ. Res. Conf.,* L. Hsu, C. Henderson, L. McCullough, eds., AIP Conference Proceedings **951**, 168-171 (2007).

B. R. Bucy, J. R. Thompson, and D. B. Mountcastle, "Student (mis)application of partial differentiation to material properties," in *2006 Phys. Educ. Res. Conf.,* L. McCullough, L. Hsu, P. Heron, Eds., AIP Conference Proceedings **883**, 157-160 (2007).

A. L. Traxler, K. E. Black, and J. R. Thompson, "Students' use of symmetry with Gauss' Law," in *2006 Phys. Educ. Res. Conf.,* L. McCullough, L. Hsu, P. Heron, Eds., AIP Conference Proceedings **883**, 173-176 (2007).

J. R. Thompson, B. R. Bucy, and D. B. Mountcastle, "Assessing student understanding of partial derivatives in thermodynamics," in *2005 Phys. Educ. Res. Conf.,* P. Heron, L. McCullough, J. Marx, Eds., AIP Conference Proceedings **818**, 77-80 (2006).

B. R. Bucy, J. R. Thompson, and D. B. Mountcastle, "What is entropy? Advanced undergraduate performance comparing ideal gas processes," in *2005 Physics Education Research Conference,* P. Heron, L. McCullough, J. Marx, Eds., AIP Conference Proceedings **818**, 81-84 (2006).

K. V. P. Menchen and J. R. Thompson, "Student understanding of sound propagation: Research and curriculum development," in *2004 Phys. Educ. Res. Conf.,* J. Marx, P. Heron, S. Franklin, Eds., AIP Conference Proceedings **790,** 81-84 (2005).

K. V. P. Menchen and J. R. Thompson, "Preservice teacher understanding of propagation and resonance in sound phenomena," in *2003 Phys. Educ. Res. Conf.,* J. Marx, S. Franklin, K. Cummings, Eds., AIP Conf. Proc. **720***,* 65-68 (2004).

J. T. Morgan, M. C. Wittmann, and J. R. Thompson, "Student understanding of tunneling in quantum mechanics: Examining interview and survey results for clues to student reasoning," in *2003 Phys. Educ. Res. Conf.,* J. Marx, S. Franklin, K. Cummings, Eds., AIP Conf. Proc. **720***,* 97-100 (2004).

E. Sayre, M. C. Wittmann, and J. R. Thompson, "Resource selection in nearly-novel situations," in *2003 Phys. Educ. Res. Conf.,* J. Marx, S. Franklin, K. Cummings, Eds., AIP Conf. Proc. **720***,* 101-104 (2004).

J. R. Thompson, P. M. Weber, and P. J. Estrup, "Pump-probe low energy electron diffraction," in *Time-Resolved Electron- and X-Ray Diffraction*, Peter M. Rentzepis, Ed., Proc. SPIE **2521**, 113-115 (1995).

Invited articles and conference proceedings

J. Thompson, M. Loverude, and J. Wagner, "Working Group on Education Research at the Interface of Mathematics and Physics," *Proceedings of the 19th Annual Conference on Research in Undergraduate Mathematics Education* (Mathematical Association of America, 2016).

J. Thompson, E. Brewe, N. Finkelstein, J. Hawkins, R. Scherr, "Introducing GPER," *Physics Today* Daily Edition, Points of View. Published June 24, 2013. http://www.physicstoday.org/daily_edition/points_of_view/introducing_gper

E. Brewe, J. Thompson, N. Finkelstein, "Toward establishing a Physics Education Research Topical Group within the American Physical Society," in *American Physical Society Forum on Education Newsletter*, Summer 2012 (2012). http://www.aps.org/units/fed/newsletters/summer2012/brewe.cfm

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,* C. Singh, N.S. Rebello, P. Engelhardt, eds., AIP Conference Proceedings **1413**, 85-88 (2012). Doi: https://doi.org/10.1063/1.3680000

J.F. Wagner, C.A. Manogue, and J.R. Thompson, "Representation issues: Using mathematics in upper-division physics," in *2011 Physics Education Research Conference,* C. Singh, N.S. Rebello, P. Engelhardt, eds., AIP Conference Proceedings **1413**, 89-92 (2012).

M.C. Wittmann and J.R. Thompson, Invited Reflection Essay and Summary of "Integrated approaches in physics education: A graduate level course in physics, pedagogy, and education research" (*Am. J. Phys.* 2008) for *Annals of Research in Engineering Education* **4**, (2) Winter 2009 (2009). http://www.areeonline.org/

M.C. Wittmann and J.R. Thompson, "A course on integrated approaches in physics education," in *American Physical Society Forum on Education Newsletter*, Spring 2006, 21-27 (2006).

J.R. Thompson and B.S. Ambrose, "A literary canon of Physics Education Research," in *American Physical Society Forum on Education Newsletter*, Fall 2005, 16-19 (2006).

Conference proceedings

W.M. Christensen and J.R. Thompson, "Investigating Student Understanding of Physics Concepts and the Underlying Calculus Concepts in Thermodynamics," in *Proceedings of the 13th Annual Conference on Research in Undergraduate Mathematics Education* (Mathematical Association of America, 2010).

J.R. Thompson, W.M. Christensen, E.B. Pollock, B.R. Bucy, and D.B. Mountcastle, "Student understanding of thermal physics concepts and the underlying mathematics in the upper division," in proceedings of *Frontiers in Science Education Research*, A. Bilsel and M.U. Garip, eds., 22-24 March 2009, Famagusta, North Cyprus, 177-186 (2009).

Grants and Awards

Active/Awarded

"Collaborative Research: Scaffolding the calculus in calculus-based physics," NSF IUSE, Engaged Student Learning: Level II, DUE-2336912; Collaborating PI, with M.E. Loverude (Lead PI), Calif. St. U. Fullerton, W.M. Christensen (co-PI), N. Dakota St. U.; $251,433 at UMaine, 10/1/24-9/30/27.

"Collaborative Research: Beyond procedures: a research-based approach to teaching mathematical methods in physics," NSF Education and Interdisciplinary Research (EIR), PHY-1912087; Collaborating PI, with M.E. Loverude (Lead PI), Calif. St. U. Fullerton, W.M. Christensen (co-PI), N. Dakota St. U.; $544,293 at UMaine, 9/1/2019-8/31/2025.

Previously funded

"Research on learning and teaching at the physics-mathematics interface," NSF (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, 9/15/2014-8/31/2021; PHY-1940013, $39,394 supplement to UMaine, 9/1/2019-8/31/2021.

"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, 9/1/2013-8/31/2019.

"Continuing the Conversation in DBER: The Transforming Research in Undergraduate STEM Education (TRUSE) Conference," NSF DUE-1551038; co-PI, with Warren Christensen (PI, North Dakota St. U.), C. Rasmussen (co-PI; San Diego St. U.), and M.H. Towns (co-PI, Purdue U.); $37,342; 4/1/16-3/31/19.

"Maine Physical Sciences Curriculum Partnership: Research and Infrastructure for Ongoing Educational Improvement," NSF Math and Science Partnership, DRL-0962805; Co-PI, with S.R. McKay (PI), M. Bruce (Chem), O. Maurais (Education), M. Wittmann; $12,347,771, with supplemental support (1550654) of $2,060,084; 7/1/10-10/23/17.

"Collaborative Research: Research and Curriculum Development in Thermal Physics," NSF Grant DUE-0817282, Directorate for Education and Human Resources, Division of Undergraduate Education, Course,

Curriculum, and Laboratory Innovation Program, Phase 2; Lead PI, with D.E. Meltzer (co-PI; Arizona St. U. Polytechnic), W.M. Christensen (co-PI, North Dakota St. U.), and M.E. Loverude (Collaborating PI, California St. U. Fullerton); D.B. Mountcastle (U. Maine), Senior Personnel; $337,214 at UMaine, 9/1/08–6/30/15.

"Collaborative Research: A Conference to Promote the Integration of Research on Undergraduate Mathematics, Physics, and Chemistry Education," NSF Grant DUE-0941191, CCLI, Phase 1; Co-PI, with C. Rasmussen (PI; San Diego St. U.), W.M. Christensen (North Dakota St. U.), and M.H. Towns (Lead PI, Purdue U.); $132,670 at SDSU, $67,193 at Purdue; 2/23/10–2/28/14.

"Investigating the transfer of mathematical knowledge using physicsless physics questions," subaward from NSF DUE-0941191 (see above); PI, with J.F. Wagner (Xavier U.), T.M. Wemyss (U. Maine); $5,000; 10/1/10-9/30/12.

"Collaborative Research: Paradigms in Physics: Creating and Testing Materials to Facilitate Dissemination of the Energy and Entropy Module," National Science Foundation (NSF) Grant DUE-0837214; NSF Directorate for Education and Human Resources, Division of Undergraduate Education, Course, Curriculum, and Laboratory Innovation Program, Phase 1; Collaborating PI; with D. Roundy (Lead PI) and C. Manogue, Oregon St. U., and M. Rogers, Ithaca College; $72,136 at UMaine, 1/1/09–12/31/11.

"Creation, coordination, and activation of resources in physics and mathematics learning," National Science Foundation (NSF) Grant DRL-0633951; Directorate for Education and Human Resources, Division of Research, Evaluation and Communication, Research and Evaluation on Education in Science and Engineering (REESE) Program; Co-PI, with M.C. Wittmann (PI), J.E. Donovan II (now at Plymouth St. U. (NH)); $662,914; 10/1/07–9/30/10.

"Integrating Science and Mathematics Education Research into Teaching: A Conference for K-12 science and mathematics teachers and university faculty," NSF Grant DRL-0736967, EHR, Elementary, Secondary and Informal Science Education Division, Discovery Research K-12 Program; co-PI, with S.R. McKay (PI), S. Norton (Earth Sciences), E. Pandiscio (Education), O. Maurais (Education); $100,000; 5/1/08–4/30/10.

"Studies of the learning and teaching of physics concepts and problem solving," Fulbright Scholar Program/Irish Fulbright Commission (for work at Dublin Institute of Technology (now Technological University Dublin), Dublin, Ireland); €37,000; 9/1/08–6/30/09.

"Collaborative Research: Research on the Learning and Teaching of Thermal Physics," National Science Foundation (NSF) Mathematical and Physical Sciences Directorate, Physics Division, Educational and Interdisciplinary Research Program; Collaborating PI, with D.E. Meltzer, Iowa St. U. (now at Arizona St. U. – Polytechnic); $107,381 at UMaine; 7/1/04–1/31/08.

"Revision of Group Science Major into an Integrated Science Program," Presidential Teaching Initiative Award, from the Pew Faculty Teaching and Learning Center, Grand Valley State University; to revise program for preservice K-8 teachers seeking Integrated Science certification for the state of Michigan; Summer 2002; $15,000; with 7 other faculty from the sciences.

"Improving Science Teaching Preparation for Non-science Majors at GVSU," Michigan Space Grant Consortium, Higher Education Incentive Program & Special Initiatives Augmentation Program; to develop science methods course taught by interdisciplinary team from Division of Science and Math and School of Education; Summer 2002; $9,700; with 5 other faculty from the sciences.

"Revitalization of the Introductory Calculus-Based Mechanics Laboratory"; Presidential Teaching Initiative Award, from the Pew Faculty Teaching and Learning Center, Grand Valley State University; Grant Administrator; Summer – Fall 2001; $14,500; with B. Ambrose and K. Gipson.

Completed Dissertations, Theses, and Undergraduate Projects Supervised

Doctoral Disserations

Andi R. Piña, "Student Mathematical Sensemaking in the Transition from Spins to Positions in Quantum Mechanics," Ph.D. (Physics), May 2024. Outstanding Graduating Student, College of Liberal Arts and Sciences, 2024.

William D. Riihiluoma, "Investigations of Student Understanding of Representations of Probability Concepts in Quantum Mechanics," Ph.D. (Physics), August 2023.

Abolaji R. Akinyemi, "An Investigation of Students' Use and Understanding of Evaluation Strategies," Ph.D. (Physics), August 2021. (Co-advised with M.E. Loverude, California State University Fullerton.)

Jeffrey M. Hawkins, "Using Question Variations to Access Alternate Student Thinking About the Same Physical Situations," Ph.D. (Physics), May 2019. (Co-advised with M.C. Wittmann.)

Benjamin P. Schermerhorn, "Investigating Student Understanding of Vector Calculus in Upper-Division Electricity and Magnetism: Construction and Determination of Differential Elements in Non-Cartesian Coordinate Systems," Ph.D. (Physics), May 2018. Outstanding Graduating Student, College of Liberal Arts and Sciences, 2018.

Rabindra R. Bajracharya, "Student Application of the Fundamental Theorem of Calculus in Mathematics and Physics," Ph.D. (Physics), August 2014. (Co-advised with N. M. Speer.)

Trevor I. Smith, "Identifying and Addressing Specific Student Difficulties in Advanced Thermal Physics," Ph.D. (Physics), May 2011.

R. Padraic Springuel, "Applying Cluster Analysis to Physics Education Research Data," Ph.D. (Physics), December 2010. (Co-advised with M.C. Wittmann.)

Brandon R. Bucy, "Investigations of Student Understanding of Entropy and of Mixed Second-Order Partial Derivatives in Upper-Level Thermodynamics." Ph.D. (Physics), August 2007.

Master's Theses

Daniel P. Laverty, "Investigating Teachers' Content Knowledge and Pedagogical Content Knowledge in a Middle School Physical Science Curriculum on Force and Motion," Master of Science in Teaching (M.S.T.), December 2015. (Co-advised with M.R. Stetzer.)

Rabindra R. Bajracharya, "Student Understanding of Definite Integrals with Relevance to Physics Using Graphical Representations," M.S.T., December 2012.

Evan B. Pollock, "Student Understanding of P-V Diagrams and the Associated Mathematics," M.S. (Physics), December 2008.

Glen A. Davenport, "The Reliability of the Force and Motion Conceptual Evaluation," M.S.T., August 2008.

Bhupendra S. Nagpure, "The Effects of Reasoning About Vector Components on Student Understanding of Two-Dimensional Acceleration," M.S.T., August 2008.

Joel Van Deventer, "Comparing Student Use of Mathematical and Physical Vector Representations," M.S.T., August 2008. (Co-advised with M.C. Wittmann.)

Earl C. Coombs, Jr., "Investigating Student Understanding of Sound as a Longitudinal Wave," M.S. (Physics), December 2007.

Roger E. Feeley, "Identifying Student Conceptions of Gravity." M.S.T., May 2007.

Jonathan C.R. Moyer, "A Comparative Study of How High School Students Understand Stem Cells." M.S.T., May 2007.

David N. Nelson, "Effect of a Concentrated In-service Elementary Teacher Force and Motion Workshop." M.S.T., August 2006.

Michael J. O'Brien, "An Investigation of the Effectiveness of 'Physics First' in Maine." M.S.T., May 2006.

Adrienne Traxler, "Assessment and Modification of an Introductory Astronomy Laboratory Lesson on Astronomical Time-Keeping." M.S.T., May 2006. (Co-advised with D.J. Batuski.)

Katherine V.P. Menchen, "Investigations of Student Understanding of Sound Propagation and Resonance." M.S.T., May 2005.

Undergraduate Research Projects

Brandon L. Clark, "ODE to applied physics: The intellectual pathway of differential equations in mathematics and physics courses: existing curriculum and effective instructional strategies," Undergraduate Thesis, Honors College, 2016-2017.

Ashley Ballanger, "Student understanding of density," 2012 Summer Undergraduate Research Assistant with Maine Physical Sciences Partnership, Summer 2012. (Co-advised with M.R. Stetzer.)

William Ferm, Jr., "Questioning questions: A method of understanding the way students think about work and energy," Senior Capstone Project, B.S. in Physics, Fall 2011. (Co-advised with M.C. Wittmann.)

Kelsey Rush, "Investigation of student understanding of magnets and magnetic fields," Undergraduate Thesis, Honors College, Spring 2008 – Spring 2009.

Timothy Fitzgibbon, "Investigation and implementation of magnetically sensitive film in physics classrooms," Senior Capstone Project, B.A. in Physics, Spring 2004.

Postdoctoral Research Associates Mentored

Zeynep Topdemir, 2021-2023
Carolina Alvarado, 2014-2015
Thomas M. Wemyss, 2010-2011
Brandon M. Bucy, 2007-2009
Warren M. Christensen, 2007-2009

Presentations

Upcoming invited presentations

American Physical Society (APS) Global Physics Summit, Anaheim, CA, March 2025, "Mathematical reasoning in undergraduate quantum mechanics: eigenvalue equations and probability expressions."

Upcoming contributed presentations

27th Conference on Research in Undergraduate Mathematics Education (RUME), Alexandria, VA, Feb 2025, "The impact of physics context on student thinking about vector product directions", A. Molinari, J. R. Thompson. (Poster.)

American Physical Society (APS) Global Physics Summit, Anaheim, CA, March 2025

"Probing the impact of graph-based salient distracting features on student reasoning," L. Martinez, M. R. Stetzer, J. R. Thompson.

"The impact of context on introductory student performance on vector product tasks", A. Molinari, J. R. Thompson.

Past presentations

(I) indicates invited presentations; * indicates undergraduate co-presenters; † indicates presenter, if not first author

American Physical Society (APS) April Meeting, Sacramento, CA, April 2024

"Student understanding of vector products: The effects of context and experience," A. Molinari, Z. Topdemir, J. R. Thompson.

"Improving student construction of quantum mechanical position eigenvalue equations: Preliminary findings," A. R. Piña, J. R. Thompson.

26th Conference on Research in Undergraduate Mathematics Education (RUME), Omaha NE, Feb 2024

"Student reasoning in quantum mechanics examined through modeling and sensemaking", A. R. Piña, Z. Topdemir, J. R. Thompson.

"Student understanding of the direction of vector dot products across contexts and levels," A. Molinari, Z. Topdemir, J. R. Thompson.

"Symbolic blending: Making context explicit in expression / equation construction in physics," as part of the Working Group at the Interface of Mathematics and Science Education.

CalcConf 2023, Calculus in the Disciplines, Bergen, Norway, June 2023, "How students reason with derivatives of vector field diagrams," Z. Topdemir, M. E. Loverude, J. R. Thompson†.

(I) U. Delaware Department of Mathematical Sciences Teaching Seminar, 4 May 2023, "Mathematical practices in undergraduate physics instruction regarding limits and infinitesimals," with M. E. Loverude.

APS April Meeting, Minneapolis, MN, April 2023

"Comparison of evaluation strategies in physics problem solving between first- and third-year students," A. Akinyemi, M. E. Loverude, J. R. Thompson.

"Student understanding of eigenvalue equations in quantum mechanics: Symbolic forms analysis," A. Piña, Z. Topdemir, J. R. Thompson.

"Comparing student understanding of quantum mechanics notations and expressions across curricula," W. Riihiluoma, Z. Topdemir, J. R. Thompson.

"Student reasoning about the signs of backward definite integrals in mathematics and physics," J. R. Thompson, R. R. Bajracharya, and V. L. Sealey.

"Student understanding of constituent derivatives of divergence and curl from vector field diagrams," Z. Topdemir, M. E. Loverude, J. R. Thompson.

X-DBER (virtual), April 2023

"Network analysis of students' conceptual interpretations of quantum mechanics expressions across curricula," W. Riihiluoma, Z. Topdemir, J. R. Thompson.

"Multidisciplinary perspectives on student evaluation of physics problem solutions," A. Akinyemi, M. E. Loverude, J. R. Thompson. (Poster.)

"Students' concept image of the negative definite integrals in the mathematics-physics interface," R. R. Bajracharya, and V. L. Sealey, J. R. Thompson. (Poster.)

25th Conference on Research in Undergraduate Mathematics Education (RUME), Omaha NE, Feb 2023

"Student understanding of eigenvalue equations in quantum mechanics: Symbolic forms analysis," A. Piña, Z. Topdemir, J. R. Thompson.

"Modifying symbolic forms to study probability expressions in quantum mechanics," W. Riihiluoma, Z. Topdemir, J. R. Thompson.

"Physics student understanding of divergence and curl and their constituent partial derivatives," Z. Topdemir, M. E. Loverude, J. R. Thompson.

"Limits and infinitesimals: We just do stuff that works; The view from (at least a subset of) physics," as part of the Working Group at the Interface of Mathematics and Science Education, with M.E. Loverude and T. I. Smith.

(I) Colloquium, Department of Physics & Astronomy, Texas Tech University, Lubbock, TX, 6 December 2022, "Student understanding at the physics-mathematics interface: mathematization and evaluation."

(I) Colloquium, Department of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, VA, 2 December 2022, "Student understanding at the physics-mathematics interface: mathematization and evaluation."

Fourth conference of the International Network for Didactic Research in University Mathematics, Hannover, Germany, October 2022: "Recognizing matrix equations as eigenequations or not: Examples of student reasoning in quantum mechanics", M. Wawro & J. Thompson. (Poster.)

2022 Physics Education Research Conference (PERC), Grand Rapids, MI, July 2022

"Interdisciplinary Perspectives on Evaluation Strategies," A. Akinyemi, M. E. Loverude, J. R. Thompson.

"Student-Constructed Eigenvalue Equations in Quantum Mechanics: Symbolic Forms and Mathematical Sensemaking Analysis," A. Piña, Z. Topdemir, J. R. Thompson.

"Applying a symbolic forms lens to probability expressions in upper-division quantum mechanics," W. Riihiluoma, Z. Topdemir, J. R. Thompson.

"Student reasoning about partial derivatives in divergence and curl in vector field graphical representations," Z. Topdemir, J. R. Thompson, M. E. Loverude.

2022 Summer AAPT Meeting, Grand Rapids, MI, July 2022

"Perspectives on Evaluation Strategies," A. Akinyemi, M. E. Loverude, J. R. Thompson.

"Student-Constructed Eigenvalue Equations in Quantum Mechanics: A Symbolic Forms Analysis," A. Piña, Z. Topdemir, J. R. Thompson.

"Network Analysis of Student Interpretations of Dirac Expressions Across Curricula," W. Riihiluoma, Z. Topdemir, J. R. Thompson.

"Student Understanding of the Partial Derivatives in Curl and Divergence," Z. Topdemir, M. E. Loverude, J. R. Thompson.

24th Conference on Research in Undergraduate Mathematics Education (RUME), hybrid, Boston, MA, 24-26 February 2022, "Using Network Analysis Techniques to Probe Student Understanding of Expressions Across Notations in Quantum Mechanics," W. Riihiluoma, Z. Topdemir, J. R. Thompson.

14th International Congress on Mathematical Education, Shanghai, China, July 2021 [presented virtually because of COVID-19] "Student reasoning about eigenequations in mathematics and quantum mechanics," M. Wawro, J. Thompson, & K. Watson.

2021 PERC, virtual, July 2021, "Using network analysis techniques to probe student connections between Dirac notation and wave function expressions," W. Riihiluoma, J. R. Thompson. (Poster.)

2021 Summer AAPT Meeting, virtual, July 2021, "Student conceptual connections within and between quantum notations," W. Riihiluoma, J. R. Thompson.

2020 PERC, virtual, July 2020

"Modeling the construction and interpretation of equations: Incorporating symbolic forms into a conceptual blend," B. P. Schermerhorn and J. R. Thompson, in Talk Symposium "Using the theory of conceptual blending at the mathematics-physics interface".

"Dynamic conceptual blending analysis to model student reasoning processes while integrating mathematics and physics," S. Van den Eynde, B. P. Schermerhorn, J. Deprez, M. Goedhart, J. R. Thompson, M. De Cock, in Talk Symposium "Using the theory of conceptual blending at the mathematics-physics interface".

"A tale of two approaches: Comparison of evaluation strategies in physics problem solving between first- and third-year students," A. R. Akinyemi, J. R. Thompson, and M. E. Loverude. (Poster.)

"Student Use of Dirac Notation to Express Probability Concepts in Quantum Mechanics," W. Riihiluoma, J. R. Thompson. (Poster.)

23rd Annual Conference on Research in Undergraduate Mathematics Education (RUME), Boston, MA, 27-29 February 2020

"Linking terms to physical significance as an evaluation strategy," A. R. Akinyemi, J. R. Thompson, and M. E. Loverude.

"Student Meanings for Eigenequations in Mathematics and in Quantum Mechanics," M. Wawro, J. R. Thompson, and K. Watson.

"A tale of two approaches: Comparison of evaluation strategies in physics problem solving between first- and third-year students," A. R. Akinyemi, J. R. Thompson, and M. E. Loverude. (Poster.)

"Student Use of Dirac Notation to Express Probability Concepts in Quantum Mechanics," W. Riihiluoma, J. R. Thompson. (Poster.)

2019 PERC, Provo, UT, July 2019

"Linking terms to physical significance as an evaluation strategy," A. R. Akinyemi, M. E. Loverude, and J. R. Thompson. (Poster.)

"Student Meanings for Eigenequations in Mathematics and in Quantum Mechanics," M. Wawro, J. Thompson, K. Watson.

2019 Summer AAPT Meeting, Provo, UT, July 2019

"Assigning Physical Significance to Elements in Mathematical Expressions," A. R. Akinyemi, M. E. Loverude, and J. R. Thompson.

(I) "Reconsidering the encoding of data in physics education research," R. P. Springuel, M. C. Wittmann, J. R. Thompson, in panel discussion "Quantitative Methods in PER: A Critical Examination."

"Student interpretation of eigenequations in mathematics and in quantum mechanics," M. Wawro, J. Thompson, K. Watson.

2018 Summer AAPT Meeting and 2018 PERC, Washington, DC, July 2018

"Introductory student interpretation of validity checks of expressions," A. R. Akinyemi and J. R. Thompson.

"Modeling student equation construction: Combining symbolic forms and conceptual blending," B. P. Schermerhorn and J. R. Thompson.

"Introductory student interpretation of validity checks of expressions: Different analytical perspectives," A. R. Akinyemi and J. R. Thompson. (Poster.)

"Connecting physics students' conceptual understanding to symbolic forms using a conceptual blending framework," B. P. Schermerhorn and J. R. Thompson. (Poster.)

Integrating Research & Practice: Using STEM Disciplines to Build 21st Century Workplace Skills; RiSE Center, UMaine, 24-26 June 2018, "Introductory student interpretation of validity checks of expressions: Different analytical perspectives," A. R. Akinyemi and J. R. Thompson. (Poster.)

2018 April Meeting of the American Physical Society, Columbus, OH, 14-17 April 2018, "Introductory student interpretation of validity checks of expressions," J. R. Thompson and A. R. Akinyemi.

(I) Colloquium, Department of Physics and Astronomy, University of North Carolina, 2 April 2018, "Investigating student understanding at the physics-mathematics interface."

21st Annual Conference on RUME, San Diego, CA, 22-24 February 2018:

"Physics students' construction of differential length vectors for a spiral path," B. P. Schermerhorn and J. R. Thompson.

"Connecting physics students' conceptual understanding to symbolic forms using a conceptual blending framework," B. P. Schermerhorn and J. R. Thompson. (Poster.)

(I) Colloquium, Department of Physics and Astronomy, University of Mississippi, Oxford, MS, 3 October 2017, "Student understanding at the physics-mathematics interface."

2017 Physics Education Research Conference, Covington, KY, 26-27 July 2017:

"A tale of two differential length vector constructions in non-Cartesian multivariable systems" B. P. Schermerhorn and J. R. Thompson, in Talk Symposium: Vectors and unit vectors in non-Cartesian coordinate systems.

"Student determination of differential areas in upper-division physics" B. P. Schermerhorn and J. R. Thompson. (Poster.)

2017 Summer National Meeting of the AAPT, Covington, KY, 24-26 July 2017. "Student mathematization and conceptual understanding of differential area elements," B. P. Schermerhorn and J. R. Thompson.

2017 Conference on Transforming Research in Undergraduate STEM Education, St. Paul, MN, 5-9 July 2017, "Student determinations of differential areas in upper-division physics," B. P. Schermerhorn and J. R. Thompson. (Poster.)

(I) Leuven Engineering and Science Education Center (LESEC) Science Education Research Symposium, Leuven, Belgium, 7 June 2017, "Education research at a disciplinary interface: Investigating student understanding of mathematics in physics."

20th Annual Conference on RUME, San Diego, CA, 23-25 February 2017:

"Physics Students' Use Of Symbolic Forms When Constructing Differential Elements In Multivariable Coordinate Systems," B. P. Schermerhorn and J. R. Thompson.

"Student Understanding of Elements of Multivariable Calculus," J. R. Thompson, B. P. Schermerhorn, and J. C. Speirs. (Poster.)

2017 April Meeting of the American Physical Society, Washington, DC, 28-31 January 2017, "Student construction of differential length elements in multivariable coordinate systems: A symbolic forms analysis," J. R. Thompson and B. P. Schermerhorn.

2016 Physics Education Research Conference, Sacramento, CA, 20-21 July 2016, "Student use of symbolic forms when constructing differential vector elements," B. P. Schermerhorn and J. R. Thompson. (Poster.)

2016 Summer National Meeting of the AAPT, Sacramento, CA, 18-20 July 2016:

"Student construction and use of three-dimensional coordinate system differential elements," B. P. Schermerhorn and J. R. Thompson.

"Student use of symbolic forms when constructing differential vector elements," B. P. Schermerhorn and J. R. Thompson. (Poster.)

Integrating Science and Mathematics Education Research into Teaching, Maine Center for Research in STEM Education, Orono, ME, 26-28 June 2016, "Student use of symbolic forms when constructing differential vector elements," B. P. Schermerhorn and J. R. Thompson. (Poster.)

(I) 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."

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 RUME, 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.

(I) Colloquium, Department of Physics, University of Vermont, Burlington, VT, 28 October 2015, "Physics education research and its role in instructional reform."

(I) 2015 Physics Education Research Conference, College Park, MD, 29-30 July 2015, "Student understanding of the definite integral using graphical representations," J.R. Thompson and R.R. Bajracharya. Part of Talk Symposium entitled "Research on student conceptions of integration in math and physics"; 30 July 2015.

2015 Physics Education Research Conference, College Park, MD, 29-30 July 2015, "Changes in student reasoning about graphical work during introductory physics," J.R. Thompson, J.W. Clark; 29 July 2015. (Poster.)

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.

"Changes in student reasoning about graphical work during introductory physics," J.R. Thompson, J.W. Clark; 28 July 2015. (Poster.)

(I) 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."

(I) 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." http://meetings.aps.org/Meeting/APR15/Session/Y11.3

18th Annual Conference on RUME, 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.)

(I) 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."

(I) Colloquium, Department of Physics, Oregon State University, Corvallis, OR, 17 November 2014, "Investigating student understanding at the upper division: Thermal physics and the related mathematics."

(I) Colloquium, Department of Physics, University of Colorado – Boulder, 5 November 2014, "Student understanding at the upper division: Thermal physics and the related mathematics."

2014 Physics Education Research Conference, Minneapolis, MN, 30-31 July 2014, "Spanning Student Reasoning about P-V Diagrams in Physics and Engineering," J.W. Clark, J.R. Thompson, D.B. Mountcastle. (Poster.)

2014 Summer National Meeting of the AAPT, Minneapolis, MN, 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†.

"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†. (Poster.)

"Students' framing and epistemic games in Fundamental Theorem of Calculus-based physics problems," R.R. Bajracharya, J.R. Thompson†. (Poster.)

"Spanning Student Reasoning about P-V Diagrams in Physics and Engineering," J.W. Clark, J.R. Thompson, D. B. Mountcastle. (Poster.)

121st American Scoiety for Engineering Education Annual Conference and Exposition, Indianapolis, IN, 17 June 2014, "Student Conceptual Difficulties in Thermodynamics across Multiple Disciplines," J.W. Clark, J.R. Thompson, D.B. Mountcastle.

17th Annual Conference on RUME, 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.

(I) Colloquium, Department of Mathematics and Statistics, University of Maine, 13 November 2013, "Investigating student understanding and application of mathematics needed in physics: Integration and the Fundamental Theorem of Calculus."

(I) 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."

2013 Physics Education Research Conference, Portland, OR, 17-18 July 2013, "Multiple Perspectives on Student Syntheses of Concepts in Thermal Physics," T. I. Smith, J. R. Thompson, D. B. Mountcastle. (Poster, 17 July 2013.)

2013 Summer National Meeting of the AAPT, Portland, OR, 13-17 July 2013, "Multiple Perspectives on Student Syntheses of Concepts in Thermal Physics," T. I. Smith, J. R. Thompson, D. B. Mountcastle. (Poster, 17 July 2013.)

Foundations and Frontiers of Physics Education Research 2013 (International), Bar Harbor, ME, 17-21 June 2013:

"Student Reasoning about a Fundamental Theorem of Calculus-based Graphical Question at the Mathematics-Physics Interface," R. R. Bajracharya, J. R. Thompson. (Poster.)

"P-V Diagram Representation of Thermodynamic Work: Student Reasoning Across Disciplines," J. W. Clark, J. R. Thompson, D. B. Mountcastle. (Poster.)

(I) 16th Annual Conference on RUME, Denver, CO, 21-23 February 2013, "Investigating student understanding of mathematics relevant to physics," in Working Group on Investigating Student Understanding of Cross-Cutting Concepts within Undergraduate Mathematics and Physics.

2013 TUES Principal Investigators Conference, Washington, DC, 23-25 January 2013, "Research on the learning and teaching of thermal physics," J. R. Thompson, D. B. Mountcastle. (Poster.)

2013 Winter National Meeting of the AAPT, New Orleans, LA, February 2013, "Influences on Student Reasoning Due to a Provided Outcome," J. M. Hawkins, J. R. Thompson, M. C. Wittmann.

2012 Physics Education Research Conference, Philadelphia, PA, 1-2 August 2012:

(I) "Identifying Student Difficulties with Conflicting Ideas in Statistical Mechanics," T. I. Smith, D. B. Mountcastle, J. R. Thompson, in Targeted Session entitiled "Research on the learning and teaching of Thermodynamics: Insight from many perspectives."

"Investigating students' understanding of the Fundamental Theorem of Calculus," R. R. Bajracharya, J. R. Thompson. (Poster.)

"Comparing Student Conceptual Understanding of Thermodynamics in Physics and Engineering," J. W. Clark, D. B. Mountcastle, J. R. Thompson. (Poster.)

"Students' Response Patterns to Research Tasks With Alternative Questioning Formats," J. M. Hawkins, B. W. Frank, M. C. Wittmann, J. R. Thompson. (Poster.)

"Preliminary investigations of physical science teacher content knowledge and PCK," D. P. Laverty, J. R. Thompson, M. R. Stetzer. (Poster.)

"Identifying Student Difficulties with Conflicting Ideas in Statistical Mechanics," T. I. Smith, D. B. Mountcastle, J. R. Thompson. (Poster.)

2012 Summer National Meeting of the AAPT, Philadelphia, PA, 30 July – 1 August 2012:

"Investigating students' understanding of the Fundamental Theorem of Calculus," R. R. Bajracharya, J. R. Thompson.

"Comparing Student Conceptual Understanding of Thermodynamics in Physics and Engineering," J. W. Clark, D. B. Mountcastle, J. R. Thompson.

"Student Justifications of Correct Responses to Commonly Used PER Tasks," J. M. Hawkins, B. W. Frank, M. C. Wittmann, J. R. Thompson.

"Preliminary investigations of physical science teacher content knowledge and PCK," D. P. Laverty, M. R. Stetzer, J. R. Thompson.

"Investigating students' understanding of the Fundamental Theorem of Calculus," R. R. Bajracharya, J. R. Thompson. (Poster.)

"Comparing Student Conceptual Understanding of Thermodynamics in Physics and Engineering," J. W. Clark, D. B. Mountcastle, J. R. Thompson. (Poster.)

"Students' Response Patterns to Research Tasks With Alternative Questioning Formats," J. M. Hawkins, B. W. Frank, M. C. Wittmann, J. R. Thompson. (Poster.)

"Preliminary investigations of physical science teacher content knowledge and PCK," D. P. Laverty, J. R. Thompson, M. R. Stetzer. (Poster.)

"Benefits of Pre-Tutorial Homework Assignments in Advanced Thermal Physics Courses," T. I. Smith, J. R. Thompson, D. B. Mountcastle. (Poster.)

Integrating Science and Mathematics Education Research into Teaching: Knowledge of Student Ideas, Maine Center for Research in STEM Education, University of Maine, Orono, ME, 20-22 June 2012:

"Student interpretation of definite integrals at the math-physics interface," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (Poster.)

"Students' Response Patterns to Research Tasks With Alternative Questioning Formats," J. M. Hawkins, B. W. Frank, M. C. Wittmann, J. R. Thompson. (Poster.)

"Preliminary investigations of physical science teacher content knowledge and PCK," D. P. Laverty, J. R. Thompson, M. R. Stetzer. (Poster.)

"Examples of Research on Teaching and Learning in the Maine Physical Sciences Partnership." (Poster.)

Transforming Research in Undergraduate STEM Education (TRUSE) 2012, University of St. Thomas, St. Paul, MN, 3-8 June 2012:

(I) "Investigating the transfer of mathematical knowledge using physicsless physics questions," J. R. Thompson, J. F. Wagner.

"Student interpretation of definite integrals at the math-physics interface," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (Poster.)

2012 Winter National Meeting of the AAPT, Ontario, CA, February 2012

(I) "A PER Course Emphasizing the Foundations of the Field," M.C. Wittmann, J.R. Thompson.

"Collaborations with present and future teachers in the Maine Physical Sciences Partnership," M. C. Wittmann, S. R. McKay, B. W. Frank, K. E. Black, S. Smith, J. McDonald, O. Maurais, F. G. Amar, M. A. Bruce, N. M. Speer, J. R. Thompson, B. Zoellick. (Poster.)

2012 Physics Teacher Education Coalition (PhysTEC) Conference, Ontario, CA, February 2012

"Examples of Research on Teaching and Learning in the Maine Physical Sciences Partnership." (Poster.)

"Collaborations with present and future teachers in the Maine Physical Sciences Partnership," M. C. Wittmann, S. R. McKay, B. W. Frank, K. E. Black, S. Smith, J. McDonald, O. Maurais, F. G. Amar, M. A. Bruce, N. M. Speer, J. R. Thompson, B. Zoellick. (Poster.)

MSP Learning Network Conference 2012: Framing Effective Teaching in STEM, Washington, DC, 22-24 January 2012 "The Maine Physical Sciences Partnership: Building meaningful collaborations," M.C. Wittmann, J.R. Thompson, S. R. McKay, M. Bruce, O. Maurais.

(I) Math and Physics Seminar, 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 Physics Education Research Conference, Omaha, NE, 3-4 August 2011:

(I) "Representations of partial derivatives in thermodynamics," J. R. Thompson, D. Roundy, D. B. Mountcastle, in session titled "Representation Issues: Using Mathematics in Upper-Division Physics." Poster Gallery. (4 August 2011)

"Student interpretation of definite integrals at the math-physics interface," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (Poster.) (3 August 2011)

"Probing student understanding with alternative questioning strategies," J. M. Hawkins, B. W. Frank, J. R. Thompson, M. C. Wittmann, T. M. Wemyss. (Poster.) (3 August 2011)

"Student difficulties with a Taylor series expansion in statistical mechanics," T. I. Smith, J. R. Thompson†, D. B. Mountcastle. (Poster.) (3 August 2011)

"TRUSE Conference: Integrating undergraduate physics, chemistry and mathematics education research," J. R. Thompson, W. M. Christensen, M. H. Towns, C. L. Rasmussen. (Poster.) (3 August 2011)

2011 Summer National Meeting of the AAPT, Omaha, NE, July-August 2011:

"Students' reasoning about the signs of definite integrals in graphical representations," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (1 August 2011)

"Probing student understanding with alternative questioning strategies," J. M. Hawkins, B. W. Frank, J. R. Thompson, M. C. Wittmann, T. M. Wemyss. (1 August 2011)

"Student knowledge and reasoning about Taylor series expansions in statistical mechanics," T. I. Smith, J. R. Thompson†, D. B. Mountcastle. (2 August 2011)

"Student interpretation of definite integrals at the math-physics interface," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (Poster.) (2 August 2011)

"Probing student understanding with alternative questioning strategies," J. M. Hawkins, B. W. Frank, J. R. Thompson, M. C. Wittmann, T. M. Wemyss. (Poster.) (2 August 2011)

"Student difficulties with a Taylor series expansion in statistical mechanics," T. I. Smith, J. R. Thompson†, D. B. Mountcastle. (Poster.) (2 August 2011)

Gordon Research Conference on Chemistry Education Research & Practice, Davidson College, Davidson, NC, 26 June – 1 July 2011, "Multiple Teacher-Faculty Collaborations in the Maine PSP," F. G. Amar, S. R. McKay, B. W. Frank, K. E. Black, S. Smith, J. McDonald, O. Maurais, B. Zoellick, J. R. Thompson, N. M. Speer, M. A. Bruce, M. C. Wittmann.

No Question Left Behind: Bringing Guided-Inquiry Curricula into Science and Mathematics Classrooms, Orono, ME, 23-24 June 2011:

"Student Difficulties with Definite Integrals at the Math-Physics Interface," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (Poster.)

"Probing Student Understanding with Alternative Questioning Strategies," J. M. Hawkins, B. W. Frank, M. C. Wittmann, J. R. Thompson, T. M. Wemyss. (Poster.)

"Multiple Teacher-Faculty Collaborations in the Maine PSP," M.C. Wittmann, S. McKay, B.W. Frank, K.E. Black, S. Smith, J. McDonald, O. Maurais, B. Zoellick, J. R. Thompson, N.M. Speer, M. Bruce, F.G. Amar. (Poster.)

Foundations and Frontiers of Physics Education Research 2011 (International), Bar Harbor, ME, 13-17 June 2011:

(I) "Towards understanding of mathematical representations: an example from definite integrals in thermodynamics," in invited "targeted poster" session titled "Methods for analyzing students' transfer of knowledge into physics: Investigations of mathematics in physics." One of 4 presenters on the topic.

"Student Difficulties with Definite Integrals at the Math-Physics Interface," R. R. Bajracharya, T. M. Wemyss, J. R. Thompson. (Poster.)

"Probing Student Understanding with Alternative Questioning Strategies," J. M. Hawkins, B. W. Frank, M. C. Wittmann, J. R. Thompson, T. M. Wemyss. (Poster.)

"TRUSE Conference: Integrating undergraduate physics, chemistry and mathematics education research," J. R. Thompson, W. M. Christensen, M. H. Towns, C. L. Rasmussen. (Poster.)

2011 April Meeting of the American Physical Society, Anaheim, CA, April-May 2011, "Student reasoning about graphical representations of (definite) integrals," J. R. Thompson, R. Bajracharya, T. Wemyss.

(I) 2011 March Meeting of the American Physical Society, Dallas, TX, March 2011, "Research on student learning of upper-level thermal and statistical physics."

Fourteenth Conference on RUME, Portland, OR, February 2011, "Student Understanding of Integration in the Context and Notation of Thermodynamics: Concepts, Representations, and Transfer," T. M. Wemyss, J.R. Thompson, R. R. Bajracharya, and J. F. Wagner.

2011 Winter National Meeting of the American Association of Physics Teachers (AAPT), Jacksonville, FL, 12 January 2011:

(I) "Investigating Math-Physics Connections in Upper-Division Thermal Physics," in session entitled "Making physical meaning with mathematics."

"TRUSE Conference: Integrating undergraduate physics, chemistry and mathematics education research," J. R. Thompson, W. M. Christensen, M. H. Towns, C. L. Rasmussen. (Poster.)

(I) Department of Physics, The University of New Brunswick, Fredericton, NB, Canada, 22 October 2010, "Research on the learning and teaching of thermal physics and the associated mathematics."

(I) Colloquium, Department of Chemistry, The University of Maine, Orono, ME, 23 September 2010, "Research on the learning and teaching of thermal physics and the associated mathematics."

2010 Physics Education Research Conference, Portland, OR, 21-22 July 2010:

"Students' responses to different representations of a vector addition question,' J M. Hawkins, J R. Thompson, M C. Wittmann, E C. Sayre, J Clark. (Poster.)

"Addressing student difficulties with statistical mechanics: The Boltzmann factor," T I. Smith, J R. Thompson, and D B. Mountcastle. (Poster.)

"Curriculum Development Addressing Multiplicity, Probability and Density of States in Statistical Physics," D.B. Mountcastle, J.R. Thompson, and T.I. Smith. (Poster.)

"Investigating student understanding of thermodynamics concepts and underlying integration concepts," J. R. Thompson, D. B. Mountcastle. (Poster.)

2010 Summer National Meeting of the AAPT, Portland, OR, July 2010:

(I) "Investigating student understanding of integrals in upper-division thermodynamics," in session entitled "Dealing with Mathematical Difficulties in Lower and Upper Division Physics Courses."

"Students' responses to different representations of a vector addition question," J. M. Hawkins, J. R. Thompson, M. C. Wittmann, E. C. Sayre, J. Clark.

"Student ideas relating to the Boltzmann factor and its derivation," T. I. Smith, J. R. Thompson, and D. B. Mountcastle.

"Students' responses to different representations of a vector addition question,' J. M. Hawkins, J. R. Thompson, M. C. Wittmann, E. C. Sayre, J. Clark. (Poster.)

"Addressing student difficulties with the Boltzmann factor: Preliminary results," T. I. Smith, John R. Thompson, and Donald B. Mountcastle. (Poster.)

"Curriculum Development Addressing Multiplicity and Probability in Statistical Physics," D.B. Mountcastle, J.R. Thompson, and T.I. Smith. (Poster.)

The University of Maine Center for Science and Mathematics Education Research, *Integrating Science and Mathematics Education Research into Teaching V*, Orono, ME, June 20-23, 2010:

"Students' responses to different representations of a vector addition question," J. M. Hawkins, J. R. Thompson, M. C. Wittmann, E. C. Sayre, and J. Clark. (Poster.)

"Curriculum Development Addressing Multiplicity and Probability in Statistical Physics," D. B. Mountcastle and J. R. Thompson. (Poster.)

"Addressing student difficulties with the Boltzmann factor: Preliminary results," T. I. Smith, J. R. Thompson, and D. B. Mountcastle. (Poster.)

Transforming Research in Undergraduate STEM Education (TRUSE) 2010, University of Maine, Orono, ME, June 14-18, 2010:

"Student understanding of slope and derivative after multivariable calculus," W. M. Christensen, J. R. Thompson. (Poster.)

"Students' responses to different representations of a vector addition question," J. M. Hawkins, J. R. Thompson, M. C. Wittmann, E. C. Sayre, and J. Clark. (Poster.)

"Curriculum Development Addressing Multiplicity and Probability in Statistical Physics," D. B. Mountcastle and J. R. Thompson. (Poster.)

"Addressing student difficulties with the Boltzmann factor: Preliminary results," T I. Smith, J R. Thompson, and D B. Mountcastle. (Poster.)

"Investigating student understanding of thermodynamics concepts and underlying integration concepts," J.R. Thompson, D.B. Mountcastle. (Poster.)

(I) The University of Maine Center for Science and Mathematics Education Research Seminar, April 19, 2010, "Thinking about the 'function' in 'state function': Investigating student understanding of the math behind the physics of state functions."

American Physical Society March Meeting 2010, Portland, OR, March 2010:

"Investigating student understanding of physics concepts and the underlying calculus concepts in thermodynamics," J.R. Thompson, W.M. Christensen, and D.B. Mountcastle.

"Student understanding of calculus within physics and mathematics classrooms," W.M. Christensen and J.R. Thompson.

"Exploring student difficulties with multiplicity and probability in statistical physics," D.B. Mountcastle, J.R. Thompson, and T.I. Smith.

Thirteenth Conference on RUME, Raleigh, NC, February 2010, "Investigating student understanding of physics concepts and the underlying calculus concepts in thermodynamics," J.R. Thompson and W.M. Christensen.

American Physical Society April Meeting 2010, Washington, DC, February 2010, "Investigations of student understanding of the Boltzmann factor and its applications," J.R. Thompson, T.I. Smith, and D.B. Mountcastle.

(I) 2010 Winter National Meeting of the AAPT, Washington, DC, February 2010, "Research on student learning of upper-level thermal and statistical physics."

2009 Physics Education Research Conference, Ann Arbor, MI, July 2009:

"Exploring student consistency in vector addition method choices," J. M. Hawkins, J R. Thompson, M C. Wittmann. (Poster.)

"Addressing student difficulties considering entropy and heat engines," T.I. Smith, W.M. Christensen, J.R. Thompson, D.B. Mountcastle. (Poster.)

"Conceptual Difficulties with Binomial Distributions in Statistical Physics," D.B. Mountcastle, J.R. Thompson, T.I. Smith. (Poster.)

"Comparing cluster analysis and traditional analysis methods in PER: More data," R.P. Springuel, A. Kaczynski, M.C. Wittmann, J.R. Thompson. (Poster.)

2009 Summer National Meeting of the AAPT, Ann Arbor, MI, July 2009:

(I) "Issues of diversity in physics education research: A report from the 2008 PER Conference," M.S. Sabella, J.R. Thompson, N.M. Gillespie.

"Curriculum adaptation in upper-level thermodynamics: entropy and the second law," W.M. Christensen, T.I. Smith, J.R. Thompson.

"Exploring the effect of presentation on student vector addition methods," J. Hawkins, J. R. Thompson, M. C. Wittmann.

"Exploring Student Difficulties with Multiplicity and Probability in Statistical Physics," D.B. Mountcastle, J.R. Thompson, T.I. Smith.

"Preliminary results of curriculum development in upper-level thermodynamics: heat engines," T.I. Smith, W.M. Christensen, J.R. Thompson, D.B. Mountcastle.

"Exploring student consistency in vector addition method choices," Jeffrey Hawkins, John R. Thompson, Michael C. Wittmann. (Poster.)

"Conceptual Difficulties with Binomial Distributions in Statistical Physics," D.B. Mountcastle, J.R. Thompson, T.I. Smith. (Poster.)

"Addressing student difficulties considering entropy and heat engines," T.I. Smith, W.M. Christensen, J.R. Thompson, D.B. Mountcastle. (Poster.)

"Comparing cluster analysis and traditional analysis methods in PER: More data," R.P. Springuel, A. Kaczynski, M.C. Wittmann, J.R. Thompson. (Poster.)

Foundations and Frontiers in Physics Education Research 2009 Conference (International), June 2009:

(I) "Student Understanding of Thermal Physics and the Associated Mathematics: Challenging Assumptions in Physics Education"; Plenary talk, June 15, 2009.

"Exploring student consistency in vector addition method choices," Jeffrey Hawkins, John R. Thompson, Michael C. Wittmann. (Poster.)

"Conceptual Difficulties with Binomial Distributions in Statistical Physics," D.B. Mountcastle, J.R. Thompson, T.I. Smith. (Poster.)

"Addressing student difficulties considering entropy and heat engines," T.I. Smith, W.M. Christensen, J.R. Thompson, D.B. Mountcastle. (Poster.)

"Student thinking regarding derivative and slope in multivariable calculus," W.M. Christensen and J.R. Thompson. (Poster.)

(I) Department of Physics and Materials Science, Uppsala University, Uppsala, Sweden, June 3, 2009, "Investigations of student understanding of thermal physics and the associated mathematics."

(I) Department of Physics and Materials Science, Uppsala University, Uppsala, Sweden, June 2, 2009, "Investigations of student understanding of thermal physics beyond the first year."

(I) School of Physics, Dublin Institute of Technology, Dublin, Ireland, May 28, 2009, "Physics education and physics education research: What do we know about teaching and learning in physics?"

(I) School of Physics, Dublin Institute of Technology, Dublin, Ireland, April 2, 2009, "Investigations of student understanding of thermal physics beyond the first year."

Frontiers in Science Education Research 2009 (FISER'09), Famagusta, North Cyprus, 22-24 March 2009: "Student understanding of thermal physics concepts and the underlying mathematics in the upper division," J.R. Thompson, W.M. Christensen, E.B. Pollock, B.R. Bucy, and D.B. Mountcastle.

American Physical Society March Meeting 2009, Pittsburgh, PA, March 2009, "Student thinking regarding derivative and slope concepts in multivariable calculus," W.M. Christensen and J.R. Thompson.

2009 Conference on the Preparation of Physics and Physical Science Teachers (Physics Teacher Education Coalition), Pittsburgh, PA, March 2009, "Graduate student ideas about common student thinking concerning force and motion," W.M. Christensen, J.R. Thompson, and M.C. Wittmann. (Poster)

(I) School of Physics, University College Dublin, Dublin, Ireland, February 25, 2009, "Student understanding of thermal physics and associated mathematics concepts beyond the first year."

(I) Centre for the Advancement of Science Teaching and Learning, Dublin City University, Dublin, Ireland, Nov. 25, 2008, "Investigating student understanding of thermal physics and associated mathematics concepts beyond the first year."

Science and Mathematics Education Conference (SMEC) 2008, Dublin City University, Dublin, Ireland, 11-12 Sept. 2008; "Student understanding of P-V diagrams and related conceptions about integration," J.R. Thompson, E.B. Pollock, B.R. Bucy, and D.B. Mountcastle. (Poster)

2008 Physics Education Research Conference, Edmonton, Alberta, July 2008:

"Identifying and addressing partial differentiation difficulties in calculus and thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Assessing the concepts of integration and differentiation in multivariable calculus," W.M. Christensen, J.R. Thompson, D.B. Mountcastle. (Poster)

"Student understanding of P-V diagrams and conceptions about integration," E.B. Pollock, B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"The difficulties in turning students into numbers," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

"Assessing knowledge in a graduate course on PER," J.R. Thompson, W.M. Christensen, and M.C. Wittmann. (Poster)

2008 Summer National Meeting of the AAPT, Edmonton, Alberta, July 2008:

"Addressing thermodynamics students' partial differentation difficulties through research-based curriculum development," B.R. Bucy, J.R. Thompson, D.B. Mountcastle.

"Student difficulties concerning deriviative and slope concepts in multivariable calculus," W.M. Christensen, J.R. Thompson, D.B. Mountcastle.

"Student conceptions of integration and their impact on thermodynamic work," E.B. Pollock, J.R. Thompson, B.R. Bucy, and D.B. Mountcastle.

"How different is 'not the same'?" R.P. Springuel, J.R. Thompson, and M.C. Wittmann.

"Identifying and addressing partial differentiation difficulties in calculus and thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Assessing the concepts of integration and differentiation in multivariable calculus," W.M. Christensen, J.R. Thompson, D.B. Mountcastle. (Poster)

"Student understanding of P-V diagrams and conceptions about integration," E.B. Pollock, B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"The difficulties in turning students into numbers," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

"Assessing knowledge in a graduate course on PER," J.R. Thompson, W.M. Christensen, and M.C. Wittmann. (Poster)

The University of Maine Center for Science and Mathematics Education Research, *Integrating Science and Mathematics Education Research into Teaching: Resources and Tools for Improved Learning*, Orono, ME, June 2008:

"Addressing student difficulties with aspects of partial differentiation in upper-level thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Assessing the evolution of content knowledge and pedagogical content knowledge in a graduate course in physics, pedagogy, and education research," W.M. Christensen, J.R. Thompson, and M.C. Wittmann. (Poster)

"The consistency of student answers on the force and motion conceptual evaluation," G.A. Davenport and J.R. Thompson. (Poster)

"Identifying student concepts of gravity," R.E. Feeley and J.R. Thompson.

"Identifying student concepts of gravity," R.E. Feeley and J.R. Thompson. (Poster)

"The effect of reasoning about vector components on student understanding of two-dimensional acceleration," B. Nagpure and J.R. Thompson. (Poster)

"Relating student understanding of thermodynamic work and of integration," E.B. Pollock, B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Comparing student use of mathematical and physical vector representations," J. Van Deventer, J.R. Thompson, and M.C. Wittmann. (Poster)

University of Maine Graduate Student Government Research Exposition, Orono, ME, April 2008:

"Research on the learning and teaching of the first law of thermodynamics and the associated mathematics," E.B. Pollock and J.R. Thompson.

"The effect of reasoning about vector components on student understanding of two-dimensional acceleration," B. Nagpure and J.R. Thompson. (Poster.)

American Physical Society April Meeting 2008, St. Louis, MO, April 2008:

"Identifying student difficulties with aspects of partial differentiation in upper-level thermodynamics," J.R. Thompson, B.R. Bucy, and D.B. Mountcastle.

"Addressing student difficulties with aspects of partial differentiation in upper-level thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle.

(I) Rochester Institute of Technology Physics Department Colloquium, Rochester, NY, April 11, 2008, "Investigating student understanding of physics and mathematics concepts in upper-level thermal physics."

2008 Conference on the Preparation of Physics and Physical Science Teachers (Physics Teacher Education Coalition), Austin, TX, February-March 2008, "Assessing the evolution of content knowledge and pedagogical content knowledge in a graduate course in physics, pedagogy, and education research," J.R. Thompson, W.M. Christensen, and M.C. Wittmann. (Poster)

(I) 2008 Winter National Meeting of the American Association of Physics Teachers (AAPT), Baltimore, MD, January 2008, "Research on learning and teaching of thermal and statistical physics."

Foundations and Frontiers in Physics Education Research 2007 Conference (National), College of the Atlantic, Bar Harbor, ME, August 2007:

(I) "PER Lemonade, Maine style" (Targeted Poster)

"Comparing advanced undergraduate reasoning about entropy across disciplines," B.R. Bucy, J.R. Thompson, D.B. Mountcastle. (Poster)

"Student Estimates of Probability and Uncertainty in Advanced Laboratory and Statistical Physics Courses," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson. (Poster)

"Comparing student understanding of physics and mathematics in *P-V* diagrams," E.B. Pollock, J.R. Thompson, B.R. Bucy, D.B. Mountcastle. (Poster)

"Comparing cluster analysis and traditional analysis," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

2007 Physics Education Research Conference, Greensboro, NC, August 2007:

"Comparing advanced undergraduate reasoning about entropy across disciplines," B.R. Bucy, J.R. Thompson, D.B. Mountcastle. (Poster)

"Student Estimates of Probability and Uncertainty in Advanced Laboratory and Statistical Physics Courses," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson. (Poster)

"Comparing student understanding of physics and mathematics in *P-V* diagrams," E.B. Pollock, J.R. Thompson, B.R. Bucy, D.B. Mountcastle. (Poster)

"Comparing cluster analysis and traditional analysis," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

2007 Summer National Meeting of the AAPT, Greensboro, NC, July/August 2007:

"Interpretations of entropy among advanced undergraduates across disciplines," B.R. Bucy, J.R. Thompson, D.B. Mountcastle.

"Comparing advanced undergraduate reasoning about entropy across disciplines," B.R. Bucy, J.R. Thompson, D.B. Mountcastle. (Poster)

"Investigating mathematical fluency among upper-division physics students," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson.

"Student Estimates of Probability and Uncertainty in Advanced Laboratory and Statistical Physics Courses," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson. (Poster)

"Comparing student understanding of physics and mathematics in *P-V* diagrams," E.B. Pollock, J.R. Thompson, B.R. Bucy, D.B. Mountcastle. (Poster)

"Using cluster analysis to group written 2-D kinematics," R.P. Springuel, M.C. Wittmann, and J.R. Thompson.

"Comparing cluster analysis and traditional analysis," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

No Question Left Behind: Bringing Guided-Inquiry Curricula into Science and Mathematics Classrooms, hosted by UMaine Center for Science and Mathematics Education Research and The Jackson Laboratory, Belfast, ME, June 2007:

"An Inquiry-Based High School Curriculum Unit in Geometrical Optics," B. Nagpure, M. Schauffler, and J.R. Thompson. (Poster)

"Identifying student concepts of gravity," R.E. Feeley and J.R. Thompson. (Poster)

"Effect of a Concentrated In-service Elementary Teacher Force and Motion Workshop," D.N. Nelson and J.R. Thompson†. (Poster)

"An Investigation into the Effectiveness of Physics First in Maine," M.J. O'Brien and J.R. Thompson†. (Poster)

"Recruitment of Physical Science Teachers through a Content-Rich, Research-Based Master's Program: The University of Maine's Master of Science in Teaching," S.R. McKay, J.R. Thompson†, M.C. Wittmann. (Poster)

(I) Kansas State University Physics Department Colloquium, Manhattan, KS, April 2007, "Student understanding of relationships between physics and mathematics concepts in upper-level thermodynamics."

University of Maine Graduate Student Government Research Exposition, Orono, ME, April 2007, "Comparing student understanding of physics and mathematics in *P-V* diagrams," E.B. Pollock, J.R. Thompson, B.R. Bucy, D.B. Mountcastle. (Poster)

Joint Meeting of the New England Sections of the AAPT and APS (regional), University of Maine, Orono, ME, April 2007:

"Investigating the reliability of the Force and Motion Conceptual Evaluation," G.A. Davenport and J.R. Thompson.

"Student understanding of magnetic fields, flexible refrigerator magnets, and magnetically sensitive film," G.D. Kranich* and J.R. Thompson.

"Using cluster analysis on written responses to 2-D kinematics questions," R.P. Springuel, M.C. Wittmann, and J.R. Thompson.

"Comparing student understanding of physics and mathematics in *P-V* diagrams," E.B. Pollock, J.R. Thompson, B.R. Bucy, D.B. Mountcastle. (Poster)

"Student Estimates of Probability and Uncertainty in Electronics Laboratory and Statistical Physics Courses," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson. (Poster)

(I) University of Maine Physics & Astronomy Colloquium, Orono, ME, April 2007, "Student understanding of relationships between physics and mathematics concepts in upper-level thermodynamics."

2007 March APS Meeting, Denver, CO, March, 2007, "Student application of integration when considering *P-V* diagrams," J.R. Thompson, B.R. Bucy, D.B. Mountcastle, E.B. Pollock.

2007 Conference of the Physics Teacher Education Coalition, Boulder, CO, March 2007, "Recruitment of Physical Science Teachers through a Content-Rich, Research-Based Master's Program: The University of Maine's Master of Science in Teaching," S.R. McKay, J.R. Thompson, M.C. Wittmann. (Poster)

(I) Twenty-seventh State-wide Meeting of High School Physics Teachers, U. Maine, Orono, ME, March 2007, "What do pre-service teachers get in a reform-based content course?"

2007 Winter National Meeting of the AAPT, Seattle, WA, January 2007:

(I) "Investigating student connections between mathematics and thermal physics."

"Student Estimates of Probability and Uncertainty in Statistical Physics," D.B. Mountcastle, B.R. Bucy, and John R. Thompson. (Poster)

(I) Purdue University Chemical Education Seminar, Purdue University, West Lafayette, IN, November 2006, "Investigations of upper-division student understanding of thermodynamics."

19th Biennial Conference on Chemical Education, Purdue U., West Lafayette, IN, August 2006, "Investigating Upper-Division Student Understanding of Thermal Physics," J.R. Thompson, B.R. Bucy, D.B. Mountcastle.

2006 Physics Education Research Conference, Syracuse U., Syracuse, NY, July 2006:

(I) "Thermal physics as a context for investigating student use of multivariable calculus." (Poster)

"Analysis of student understanding of symmetry in Gauss' law," K. Black, A. Traxler, J.R. Thompson, and M.C. Wittmann. (Poster)

"Student (mis)application of partial differentiation to material properties," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Student estimates of probability and uncertainty in statistical physics," D.B. Mountcastle and B.R. Bucy, and J.R. Thompson. (Poster)

"Effects of changing representations in two-dimensional motion," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

2006 Summer National Meeting of the American Association of Physics Teachers (AAPT), Syracuse U., Syracuse, NY, July 2006:

(I) "Seeing what works: An empirical approach to PER." (Poster)

"Student use of integration in the context of *P-V* diagrams," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle.

"Analysis of student understanding of symmetry in Gauss' law," K. Black, A. Traxler, J.R. Thompson†, and M.C. Wittmann. (Poster)

"Student (mis)application of partial differentiation to material properties," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Effect of a concentrated in-service elementary teacher force and motion workshop," D.N. Nelson and J.R. Thompson†. (Poster)

"An investigation into the effectiveness of *Physics First* in Maine," M.J. O'Brien and J.R. Thompson†. (Poster)

"Effects of changing representations in two-dimensional motion," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

The University of Maine Center for Science and Mathematics Education Research, *Integrating Science and Mathematics Education Research into Teaching*, Orono, ME, June 2006:

(I) "Investigations of upper-division student understanding of thermal physics."

"Student understanding of differentials and the Maxwell relations in thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Student (mis)application of partial differentiation to material properties," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Student estimates of probability and uncertainty in statistical physics," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson. (Poster)

"A comparative study of how high school students understand stem cells," J. Moyer, J.R. Thompson, M. Tyler, and M.C. Wittmann. (Oral presentation and poster)

"Student understanding of flexible refrigerator magnets and magnetically sensitive film," G.D. Kranich*, J.R. Thompson, and T.A. Fitzgibbon*. (Poster)

"Effect of a concentrated in-service elementary teacher force and motion workshop," D.N. Nelson and J.R. Thompson. (Oral presentation and poster)

"An investigation into the effectiveness of *Physics First* in Maine," M.J. O'Brien and J.R. Thompson. (Poster)

"Effects of changing representations in two-dimensional motion," R.P. Springuel, J.R. Thompson, and M.C. Wittmann. (Poster)

"Analysis of student understanding of symmetry in Gauss' Law," A. Traxler, K. Black, and J.R. Thompson. (Poster)

2006 Gordon Research Conference on *Physics Research and Education: Electromagnetism,* Mt. Holyoke College, South Hadley, MA, June 2006:

"Analysis of student understanding of symmetry in Gauss' Law," K. Black, A. Traxler, and J.R. Thompson. (Poster)

"Student understanding of flexible refrigerator magnets and magnetically sensitive film," G.D. Kranich*, J.R. Thompson†, and T.A. Fitzgibbon*. (Poster)

(I) American Physical Society April Meeting 2006, Dallas, TX, April 2006, "Investigating student understanding in advanced thermal physics courses."

Joint American Physical Society (APS)/American Association of Physics Teachers (AAPT) Regional Meeting, New England Section, Boston University, Boston, MA, March/April 2006:

"Analysis of student understanding of symmetry in Gauss' Law," K.E. Black, A.L. Traxler, and J.R. Thompson.

"Student (mis)application of partial differentiation to material properties," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle.

"Student understanding of differentials and the Maxwell relations in thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"An investigation into the effectiveness of *Physics First* in Maine," M.J. O'Brien and J.R. Thompson.

(I) Physics Education Research Seminar (local), University of Maryland, College Park, MD, February 2006, "Are they constant or are they fixed? Student difficulties with partial derivatives in thermodynamics."

2006 Winter National AAPT Meeting, Anchorage, AK, January 2006, "Uneven development of students' reasoning regarding concepts in thermal physics," D.E. Meltzer (U. Washington), W.M. Christensen (Iowa St. U.), and J.R. Thompson.

Foundations and Frontiers in Physics Education Research Conference (National), College of the Atlantic, Bar Harbor, ME, August 2005:

(I) "Towards a Literary Canon of PER," J.R. Thompson and B.S. Ambrose (Grand Valley St. U.).

"What is entropy? Assessing advanced undergraduate performance comparing ideal gas processes," B.R. Bucy, J.R. Thompson†, and D.B. Mountcastle. (Poster)

"Student understanding of partial differentiation in thermal physics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle†. (Poster)

2005 Physics Education Research Conference, U. of Utah, Salt Lake City, UT, August 2005:

"What is entropy? Assessing advanced undergraduate performance comparing ideal gas processes," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

"Student understanding of partial differentiation in thermal physics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

2005 Summer National Meeting of the American Association of Physics Teachers (AAPT), U. of Utah, Salt Lake City, UT, August 2005:

"Learning entropy and the Second Law of Thermodynamics as juniors," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle.

"Identifying student difficulties with partial derivatives in thermodynamics," J.R. Thompson, B.R. Bucy, and D.B. Mountcastle.

206th Meeting of the American Astronomical Society, Minneapolis, MN, May/June 2005, "Student Understanding of time in an introductory astronomy laboratory," A.L. Traxler, D.J. Batuski, N.F. Comins, and J.R. Thompson. (Poster)

University of Maine Association of Graduate Students Research Exposition, Orono, ME, April 2005, "Investigating student understanding of entropy and the Second Law of Thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle. (Poster)

Joint American Physical Society / American Association of Physics Teachers (APS/AAPT) Regional Meeting, New England Section, MIT, Cambridge, MA, April 2005:

"Investigating student understanding of entropy and the Second Law of Thermodynamics," B.R. Bucy, J.R. Thompson, and D.B. Mountcastle.

"Assessing student mathematical peparation for thermal physics," D.B. Mountcastle, B.R. Bucy, and J.R. Thompson. (Poster)

2004 Physics Education Research Conference, Sacramento, CA, August 2004:

"Identifying student concepts of 'gravity'," R.E. Feeley, J.R. Thompson, and M.C. Wittmann. (Poster)

"Student understanding of sound propagation: Research and curriculum development," K.VP. Menchen and J.R. Thompson†. (Poster)

129th National AAPT Meeting, Sacramento, CA, August 2004:

"Identifying student concepts of 'gravity'," R.E. Feeley, J.R. Thompson, and M.C. Wittmann.

"Student understanding of sound propagation: Research and curriculum development," K.VP. Menchen and J.R. Thompson†.

The University of Maine Center for Science and Mathematics Education Research, *Integrating Science and Mathematics Education Research into Teaching*, Orono, ME, June 2004:

"Learning about teaching physics: A graduate course in physics education research," J.R. Thompson and M.C. Wittmann.

"Identifying student concepts of 'gravity'," R.E. Feeley, J.R. Thompson, and M.C. Wittmann. (Poster)

"Preparing teachers to teach sound: Research and curriculum development," K.VP. Menchen and J.R. Thompson. (Poster)

"Measuring student understanding of density, with geological applications," E.L. Klingler, S.A. Norton, J.R. Thompson, and J.C. Owen. (Poster)

2004 Gordon Research Conference on Physics Research and Education: Classical Mechanics and Nonlinear Dynamics, Mt. Holyoke College, South Hadley, MA, June 2004, "The contextual dependence of student understanding of acceleration in two dimensions." (Poster)

University of Maine Association of Graduate Students Research Exposition, Orono, ME, April 2004:

"Identifying student conceptions of gravity," R.E. Feeley, J.R. Thompson, and M.C. Wittmann. (Poster)

"Teacher understanding of propagation and resonance phenomena in sound," K.VP. Menchen and J.R. Thompson. (Poster)

(I) 128th National Meeting of the American Association of Physics Teachers (AAPT), Miami Beach, FL, January 2004, "A graduate course in physics education research at the University of Maine."

Joint American Physical Society (APS)/American Association of Physics Teachers (AAPT) Regional Meeting, New England Section, Bates College, Lewiston, ME, October 2003:

"Investigating student learning of kinematics: A new twist on two-dimensional motion."

"Teacher understanding of sound propagation," K.VP. Menchen and J.R. Thompson.

2003 Physics Education Research Conference, Madison, WI, August 2003:

(I) "Promoting the understanding of teaching and learning in physics: Graduate courses in physics education research."

"Context dependence of student understanding of simple graphs," T.L. Lyons, M.C. Wittmann, and J.R. Thompson. (Poster)

"Teacher understanding of propagation and resonance phenomena in sound," K.VP. Menchen and J.R. Thompson. (Poster)

"Student understanding of tunneling in quantum mechanics: Examining survey results," J.T. Morgan, M.C. Wittmann, and J.R. Thompson. (Poster)

"Resource selection in nearly-novel situations," E. Raulerson, M.C. Wittmann, and J.R. Thompson. (Poster)

127th National AAPT Meeting, Madison, WI, August 2003:

"Teacher understanding of propagation and resonance phenomena in sound," K.VP. Menchen and J.R. Thompson.

"Context dependence of student understanding of simple graphs," T.L. Lyons, M.C. Wittmann, and J.R. Thompson.

(I) Twenty-third State-wide Meeting of High School Physics Teachers, Orono, ME, May 2003, "Research on student understanding in physics: an example from two-dimensional kinematics."

(I) The University of New Hampshire Analytical/Physical Chemistry Seminar, Durham, NH, May 2003, "Discipline-based education research as a guide to teaching and learning: examples from physics."

University of Maine Association of Graduate Students Research Exposition, Orono, ME, April 2003, "An investigation into student understanding of tunneling," J.T. Morgan, M.C. Wittmann, and J.R. Thompson. (Poster)

Joint APS/AAPT Regional Meeting, New England Section, Williams College, Williamstown, MA, April 2003, "Promoting understanding of teaching and learning in physics: A graduate course in physics education research," J.R. Thompson and M.C. Wittmann.

(I) The University of Maine Center for Science and Mathematics Education Research Brown Bag Seminar, April 2003, "Promoting the understanding of teaching and learning in physics," S.J. Kaback, J.R. Thompson, and M.C. Wittmann.

The University of Maine Center for Science and Mathematics Education Research, Conference on *Integrating Science and Mathematics Education Research into Teaching*, Orono, ME, June 2002:

(I) "Identifying and addressing student difficulties with two-dimensional kinematics."

"Preparing inservice and preservice elementary teachers to teach sound: A research-based approach." (Poster)

"A course in physics education research for teachers, scientists, and researchers," M.C. Wittmann and J.R. Thompson.

2001 Physics Education Research Conference, Rochester, NY, July 2001, "Preparing inservice and preservice elementary teachers to teach sound: A research-based approach." (Poster)

123rd National AAPT Meeting, Rochester, NY, July 2001, "Preparing inservice and preservice elementary teachers to teach sound: A research-based approach."

(I) The Ohio State University, Physics Education Research Group Seminar, Columbus, OH, May 2001, "Preparing inservice and preservice elementary teachers to teach sound: A research-based approach."

AAPT Regional Meeting, Michigan Section, Midland, MI, April 2001, "Preparing inservice and preservice elementary teachers to teach sound."

AAPT Regional Meeting, Michigan Section, Lansing, MI, October 2000, "Student understanding of two-dimensional kinematics: Identifying and addressing student difficulties," J.R. Thompson and B.S. Ambrose.

APS Northwest Section Meeting, University of Oregon, Eugene, OR, May 2000, "The iterative process of research-based curriculum development: an example from two-dimensional kinematics," J.R. Thompson, P.R.L. Heron, P.S. Shaffer, and L.C. McDermott.

120th National AAPT Meeting, Kissimmee, FL, January 2000, "Investigating student understanding of the wave nature of sound," J.R. Thompson, P.S. Shaffer, S. Vokos, and L.C. McDermott.

(I) 1999 Physics Education Research Conference, San Antonio, TX, August 1999, "Elementary Teacher Preparation and Enhancement Projects at the University of Washington."

119th National AAPT Meeting, San Antonio, TX, August 1999, "Preparing in-service teachers to teach physics and physical science: Examples from *Physics by Inquiry*," C.P. Constantinou, L.S. DeWater, J.R. Thompson, and L.C. McDermott.

APS Centennial Meeting, Atlanta, GA, March 1999, "Pilot-testing as part of the curriculum development process: Examples from *Physics by Inquiry* and *Tutorials in Introductory Physics*," J.R. Thompson, P.S. Shaffer and L. C. McDermott.

117th National AAPT Meeting, Lincoln, NE, August 1998, "Development and assessment of curriculum," J.R. Thompson, Paula R.L. Heron, Peter S. Shaffer, and Lillian C. McDermott.

University of Washington Physics Education Group Faculty Development Workshop, July 1998, "Research as a guide to the assessment of instruction."

SERVICE (SEE ALSO OUTREACH ACTIVITIES)

Physics Education Research, Physics Education, Physics, and K-12 Teacher Preparation and Professional Development Communities

Service on national professional committees

Member, (Inaugural) Planning Committee, Online Physics Education Research Journal Club, Fall 2022-present. Joint effort of *Physical Review Physics Education Research* (PRPER) and American Physical Society Topical Group on Physics Education Research (GPER).

Moderator of session on "Physics Inventory of Quantitative Literacy: A tool for assessing mathematical reasoning in introductory physics", S. White Brahmia, A. Olsho, T. I. Smith, A. Boudreaux, P. Eaton, and C. Zimmerman; 30 March 2023.

Chair line, American Physical Society Topical Group on Physics Education Research (GPER) Executive Committee (nationally elected office): Vice Chair, 2016; Chair-Elect, 2017; Chair, 2018; Past Chair, 2019.

Member, Editorial Board, *Physical Review Special Topics – Physics Education Research,* 1 January 2014 – 31 December 2016. Discuss policy; review manuscripts and referee reports to provide input to Editor.

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

Member, American Physical Society Forum on Education Excellence in Physics Education Award Selection Committee, June – August 2013.

Member, Physics Education Research Leadership and Organizing Council (nationally elected office), April 2009 – February 2012; Chair, January 2011 – February 2012.

Member-at-Large, American Physical Society Forum on Education Executive Committee (nationally elected office), April 2008 – April 2011.

Member of Programs Committee: provided input for sessions for March and April meetings; 2009, 2010, 2011; Organized PER Focus Sessions at April 2009, March 2010, April 2011 meetings.

Member, AAPT Committee on Research in Physics Education, January 2004 – January 2007.

Professional advocacy

Participant, Congressional Visits Day, American Physical Society, Washington, DC: 25 January 2017; 1 Feb 2018; 7 June 2018; 2 June 2021 (virtual).

Conference and conference session organization and facilitation

Session chair, Student Learning in Laboratory and Classroom Settings, American Physical Society 2023 April Meeting, Minneapolis, MN, April 2023.

Co-facilitator, Discussion session on "Future directions for research on mathematical problem solving and reasoning in physics", with E. Kuo, APS 2023 April Meeting, Minneapolis, MN, April 2023.

Co-presenter, "We just do stuff that works: The view from (at least a subset of) physics," with T.I. Smith and M.E. Loverude, for the Working Group on Education Research at the Interface of Mathematics and Physics: Limits and Infinitesimals across the STEM Disciplines, 25th Conference on Research in Undergraduate Mathematics Education (RUME), Omaha NE, Feb 2023.

Co-organizer, 2017 Physics Education Research Conference, "Mathematization in Physics Education Research," Covington, KY, 26-27 July 2017.

Co-organizer, *2017 Transforming Research on Undergraduate STEM Education,* The University of St. Thomas, St. Paul, MN, 5-9 July 2017; as co-PI of NSF grant DUE-1551038.

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-presenter, "Review of literature on teaching and learning of (topics related to) multivariable and vector integration," with B. P. Schermerhorn, 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-facilitator, "Calculus ideas in physics learning," Working Group at 2015 Foundations and Frontiers of Physics Education Research, Bar Harbor, ME, 15 & 16 June 2015.

Presenter, "Eigentheory in Quantum Mechanics," Working Group on Education Research at the Interface of Mathematics and Physics, 18th Annual Conference on Research in Undergraduate Mathematics Education, Pittsburgh, PA, 19 February 2015.

Co-organizer, *2013 Maine Physical Sciences Partnership Summer Academy,* through Maine Center for Research in STEM Education; Schoodic Education Research Center, Winter Harbor, ME, June 25-28, 2013.

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 19-22, 2012.

Co-organizer, *2012 Transforming Research on Undergraduate STEM Education,* The University of St. Thomas, St. Paul, MN, June 3-7, 2012; as co-PI of NSF grant DUE-0941191.

Co-presenter, "Research Projects in the Maine PSP," 2012 Maine Physical Sciences Partnership Summit, Point Lookout, Northport, ME, 19 May 2012.

Co-organizer, "Representation Issues: Using Mathematics in Upper-Division Physics," 2011 Physics Education Research Conference, August 4, 2011; with C. A. Manogue, Oregon St. U.; Poster Gallery.

Organizer, "Research in Undergraduate Mathematics Education," 2011 Summer Meeting of the American Association of Physics Teachers, Omaha, NE, August 3, 2011; invited session.

Organizer, "Physics Education Research: Solved Problems and Open Questions," 2011 April Meeting of the American Physical Society, Anaheim, CA, April 30-May 3, 2011; invited session.

Co-organizer, *Transforming Research on Undergraduate STEM Education,* The University of Maine, Orono, ME, June 14-18, 2010; as co-PI of NSF grant DUE 0941191.

Facilitator, Targeted Session, "Calculus in the Disciplines"

Co-organizer, *Integrating Science and Mathematics Education Research into Teaching V* through Maine Center for Research in STEM Education, Orono, ME, June 20-23, 2010.

Session Chair, Mathematics in Science (Session S3).

Co-facilitator, "Approaches to promote graphing literacy in science class," workshop at *Integrating Science and Mathematics Education Research into Teaching V* through Maine Center for Research in STEM Education, Orono, ME, June 20-23 2010; with T. Wemyss.

Co-organizer, 2008 Physics Education Research Conference: "Physics education research with diverse student populations," Edmonton, Alberta, Canada, July 2008; with M.S. Sabella, Chicago State University, and N.M. Gillespie, Knowles Science Teaching Foundation.

Session Chair, Banquet (DT) and Contributed Poster (CP) Session; Session Co-Chair, Panel Discussion (PD.01); Session Co-Chair, "PER Dating Service" (DS).

Co-organizer, *Integrating Science and Mathematics Education Research into Teaching: Resources and Tools for Improved Learning,* Conference and Summer Academy, through The University of Maine Center for Science and Mathematics Education Research, Orono, ME, 22-27 June 2008.

Session Chair, Physics Instruction (Session S8).

Facilitator, Targeted Poster Session "Making PER [Physics Education Research] Lemonade," *Foundations and Frontiers in Physics Education Research 2007* Conference, College of the Atlantic, Bar Harbor, ME, August 2007.

Local Organizing Chair, Joint Meeting of the New England Sections of the AAPT and APS (regional), University of Maine, Orono, ME, April 2007.

Organizer, Crackerbarrel for (Junior) Faculty in Physics Education Research at National Meetings of the American Association of Physics Teachers (AAPT):

- 2007 Summer Meeting, Greensboro, NC, July 2007.
- 2007 Winter Meeting, Seattle, WA, January 2007.
- 2005 Summer Meeting, Salt Lake City, UT, August 2005.
- 130th National Meeting, Albuquerque, NM, January 2005.
- 129th National Meeting, Sacramento, CA, August 2004.

Co-facilitator, Working Group on "A Literary Canon of Physics Education Research," *Foundations and Frontiers in Physics Education Research* Conference (National), College of the Atlantic, Bar Harbor, ME, August 2005, with B.S. Ambrose, GVSU.

Referee for manuscripts

- *American Journal of Physics*
  - *Physics Education Research, A Supplement to the American Journal of Physics*
- *International Journal of Research in Undergraduate Mathematics Education*
- *Journal of Chemical Education*
- *Journal of Engineering Education*
- *Physical Review Physics Education Research* & *Physical Review Special Topics – Physics Education Research*
- *The Physics Teacher*
- *Physics Education Research Conference Proceedings*
- *Proceedings of the Conference on Research in Undergraduate Mathematics Education*

Reviewer for grant proposals

- National Science Foundation: Integrative Activities in Physics Program, Mathematics and Physical Sciences Division, Ad Hoc reviewer
- Research Foundation – Flanders (Belgium; Fonds Wetenschappelijk Onderzoek)

Consulting and Advisory Committees

External Advisory Board, Department of Physics and Astronomy, KU Leuven, Leuven, Belgium, 2024-2028.

Consultant / Advisor, Knowles Teacher Initiative, interview selection committee for Teaching Fellowship finalists, February/March of each year, 2005–2008, 2010–2023; Content Chair for Physical Science, 2011, 2013. Roundtable discussion on the current landscape of secondary science and mathematics teaching, January 2024.

Advisory board member, "Research Initiation: Facilitating Knowledge Transfer within Engineering Curricula," NSF EEC-2205022, PFE: Research Initiation in Engineering Formation program, A. J. DeRosa (Stevens Institute of Technology, NJ) PI, T. Reed, co-PI; 9/1/2022-8/31/2025.

Survey pilot tester, Department chair survey, in "A Guide to Effective Practices for Physics Programs (EP3)", April 2022.

Reviewer, "Upper-level physics curriculum section" in "A Guide to Effective Practices for Physics Programs (EP3)", S. McKagan, D. A. Craig, M. Jackson, and T. Hodapp, Eds., (American Physical Society, College Park, MD, Version 2021.1), 2021. https://ep3guide.org/

Advisory board member, "Collaborative Research: Research as a base to develop adaptable curricula bridging instructional paradigms in quantum mechanics," NSF DUE IUSE grant; Steven Pollock (U. Colorado, Boulder), Gina Passante (California St. U. Fullerton), Homeyra Sadaghiani (Cal Poly Pomona), co-PIs; 10/1/2016-9/30/2020.

Participating instructor, "An Interdisciplinary Investigation of Learning: Student Understanding of Linear Algebra in Physics," NSF CAREER grant, Megan Wawro (Virginia Tech) PI, 9/1/2015-8/30/2022.

Member of Review Panel for Irish Fulbright Student Awards, December 2018.

Advisory Board Member and Consulting Researcher, "Raising Physics to the Surface," NSF DUE-1246094, Elizabbeth Gire (Oregon State U.), Aaron Wangberg (Winona St. U. (MN)), PIs; 2017-2019.

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

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

Advisory Board Member 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.

Advisory Board Member, "Paradigms in Physics: Interactive Electromagnetism Curricular Materials," T. Dray, PI; C. Manogue, E. van Zee, co-PIs; Oregon St. U., NSF DUE-1023120; 2010-2014.

Member of Scientific Organizing Committee, Workshop on the Status of the Upper-Division Physics Curriculum (5-7 June 2014), supported by an NSF (WIDER) supplement to "Paradigms in Physics: Interactive Electromagnetism Curricular Materials," Oregon St. U.; 2013-2014.

Member of advisory group, assessing physics teacher effectiveness, American Association of Physics Teachers and Physics Teacher Education Coalition, July 21, 2010.

Expert reviewer, NSF-funded Teacher Professional Continuum Grant project developing instructional and assessment tools for middle school teachers; reviewed tools for Particulate Nature of Matter unit; project collaboration between Seattle Pacific University and FACET Innovations (Seattle, WA); March-April 2010.

Advisory Committee Member, "Creating Innovative Physics Learning Environments in the Urban Classroom," NSF EHR Course, Curriculum and Laboratory Improvement (CCLI) Phase 1 (Exploratory), DUE-0632563, M. Sabella, (PI) S. Bowen, K. Coble, Chicago State University, Spring 2007 – 2010; site visits April 2008, October 2009.

Advisory Committee Member, "Improving Student Understanding of Physics at an Inner-City University through the use of Concept and Activity-Based Tutorials," M. Sabella and S. Bowen, Chicago State University, NSF EHR DUE – Course, Curriculum and Laboratory Improvement - Adaptation and Implementation Track, DUE-0410068, Spring 2005 – Spring 2007; site visit April 2005.

Guest facilitator, SMT 588 (Seminar in Science and Mathematics Education Research), Fall 2005, Fall 2009.

Consultant, co-developer of graduate-level course in Physics Education Research for Master's of Science in Teaching Program, University of Maine, Orono, ME, May 2002.

State of Maine

Member of Education Team, Maine Science Festival (inaugural Festival March 20-22, 2015), September 2013 – 2017.

Organizer or co-organizer, State-Wide Meetings of High School Physics and Physical Science Teachers, at UMaine

Co-organizer, Thirty-fifth, May 11, 2015.

Co-organizer, Thirty-fourth, May 30, 2014.

Organizer, Twenty-eighth, March 2008.

Organizer, Twenty-fifth, May 2005.

Organizer, Twenty-fourth, May 2004.

Co-organizer, Twenty-third, May 2003.

Judge, 2014 Science Olympiad, Division C, Circuit Lab, UMaine, March 29, 2014.

Judge, Maine State Science Fair, Bangor, ME, March 22, 2014.

Facilitator, "Expectations for students in 9th grade science classes," Roundtable discussion at 31st Annual Statewide Meeting of Physics and Physical Science Teachers, Orono, ME, March 11, 2011.

Invited member of selection panel for finalists for Presidential Award for Excellence in Mathematics and Science Teaching in Maine, Augusta, ME, June 2007.

U. Maine and the regional community

Chair, Department of Physics and Astronomy, July 2017 – June 2022; July 2023 – present.

Search committee, mathematics education tenure-track position, Department of Mathematics and Statistics, 2016-2017.

Lead faculty (one of three), proposal to designate STEM Education as a Signature Research Area at UMaine; Spring 2014. (With M.C. Wittmann and J.T. Shemwell.)

Committee participation and service, UMaine

Department of Physics and Astronomy

Society of Physics Students Advisor, Fall 2020 – Summer 2022.

Ad Hoc Graduate Admissions Committee, annually.

Written Graduate Examination Committee, Spring 2014–Spring 2015; Fall 2016–Fall 2017.

Peer Committee, Fall 2005–Spring 2006; Fall 2009–Summer 2012; February–September 2014.

Tenure-track search committee, Summer 2003.

Laboratory Curriculum Committee, Fall 2002.

College of Liberal Arts and Sciences

Chemistry Department Chair Search, Spring 2024.

Dean's Promotion and Tenure Advisory Council, Fall 2018 – Spring 2021.

Art Department Chair Search, Fall 2018.

Review of CLAS Dean, Spring 2017.

Interdisciplinary BA Committee, Fall 2013 – Spring 2015.

Committee on learning outcomes and objectives in MAT 101, Fall 2010.

Communications Committee, Fall 2007 – Summer 2008.

Office of the Provost

Administrative Barriers Task Force, 2023-2024.

Maine College of Engineering and Computing

Awards Committee, 2017 – 2022

Maine Center for Research in STEM Education (Maine RiSE Center)

Chair, search committee for postdoctoral research associate, 2010-2011.

Search committee for postdoctoral research associate, July 2005 – April 2007.

Maine Physical Sciences Partnership

Grade 6-9 Research and Implementation Group, Fall 2012–Summer 2015

Head, Research Committee, Fall 2011–April 2012

Executive Committee, Fall 2011–April 2012

University Course Reform Committee, Fall 2010–Fall 2012; University Research and Implementation Group, Fall 2012–Fall 2014

Leadership Team, Fall 2010–July 2013

College of Education and Human Development

Tenure-track search committee, science education faculty position, 2010-2011.

Committee participation, University of Maine System

Maine College of Engineering, Computing, and Information Sciences Undergraduate Education Committee, 2021–2022

UMS TRANSFORMS initiative, Student Success and Retention initiative, Gateways to Success working group, 2023-2024

Professional Development and Facilitation: Seminars, Workshops, Guest Classes

Guest speaker, PHYS 2703, Physics Outreach and Education, University of New Brunswick, 15 March 2016 (via Skype).

Panel member, "Science and Faith," for UMaine Honors College, 25 March 2015; in connection with Penobscot Theatre Company's production of *End Days*, in conjunction with the 2015 Maine Science Festival.

Panel member, *Questioning and Discussion Strategies,* STEM Teaching Assistant Professional Development, 9 October 2014, through Maine RiSE Center and the Maine Physical Sciences Partnership, Orono, ME.

Guest facilitator, STEM Teaching Assistant Orientation, First day teaching activity, 30 August 2013.

Guest facilitator, SMT 590 (Seminar in Student Teaching), 6 March 2012: Assessment and Questioning Strategies.

Co-organizer and/or co-facilitator, STEM Teaching Assistant Professional Development, 2012-2013, through Maine Center for Research in STEM Education and the Maine Physical Sciences Partnership, Orono, ME; with N. Speer:

- STEM Teaching Assistant Orientation, Natasha Speer, John Thompson, 28 & 31 August 2012.
- "Issues related to grades and grading," Natasha Speer, John Thompson, 6 December 2012.
- Helping Students Learn in Small Groups, Natasha Speer, John Thompson, 14 February 2013.
- "What Can We Learn From Student Feedback Surveys?", Natasha Speer, John Thompson, 27 March 2013.
- "Facilitating Collaborative Groupwork," John Thompson, Natasha Speer, 25 April 2013.

Co-organizer and/or co-facilitator, STEM Teaching Assistant Professional Development, 2011-2012, through Maine Center for Research in STEM Education and the Maine Physical Sciences Partnership, Orono, ME; with N. Speer and M. Bruce:

- STEM Teaching Assistant Orientation, Natasha Speer, John Thompson, Mitchell Bruce, 23 & 26 August 2011.
- "What learning happens outside the classroom? Students' study skills and the role of homework in learning," Natasha Speer, John Thompson, Mitchell Bruce, 27 October 2011.
- "Making Things 'Click' in the Classroom: Uses of Personal Response Systems (Clickers) in the College Classroom," Michelle Smith and Frank Dudish, 10 November 2011.
- "Scaffolding Undergraduate Peer Facilitation: The Maine Learning Assistant Program," MacKenzie Stetzer, François Amar, Mitchell Bruce, 30 November 2011.
- "Inquiry-based labs: Allowing students to be scientists, even in large courses on tight budgets," Mary Tyler, 2 February 2012.
- "Using free-response questions to probe student thinking," MacKenzie Stetzer and John Thompson, 14 March 2012.

Co-organizer and/or co-facilitator, STEM Teaching Assistant Professional Development, 2010-2011, through Maine Center for Research in STEM Education and the Maine Physical Sciences Partnership, Orono, ME; with N. Speer:

- STEM Teaching Assistant Orientation, Natasha Speer and John Thompson, 24 & 27 August 2010.
- "Adjusting Our Mirrors: Communicating Effectively To Motivate Our Students," Jeffrey St. John, 11 November 2010.
- "Grading in Science and Mathematics," Natasha Speer and John Thompson, 16 February 2011.
- "Student-centered Instruction in Lecture Settings (in STEM)," John Thompson and Natasha Speer, 31 March 2011.
- "Rules and reasons: Different meanings of 'understand' in teaching and learning," Natasha Speer and John Thompson, 13 April 2011.

Co-facilitator, "Approaches to promote graphing literacy in science class," workshop at *Integrating Science and Mathematics Education Research into Teaching V* through Maine Center for Research in STEM Education, Orono, ME, June 20-23 2010; with T. Wemyss, June 2010.

Guest discussant, Workshop on College Algebra course, Husson University, Oct. 3, 2009, Bangor, ME.

Run weekly curriculum review and TA preparation meetings for inquiry-based physics course for elementary education majors, with graduate TA and undergraduate Peer Facilitator to discuss class progress and upcoming curricular issues (student difficulties, equipment, review curriculum, etc.), Fall 2006, Fall 2007.

Coordinator for preparation of Teaching Assistants and Peer Facilitators for introductory algebra-based physics course recitation sections, Fall 2002 – Fall 2007 (except Fall 2006).

Guest facilitator, SMT 588 (Seminar in Science and Mathematics Education Research), Fall 2005.

Participant in ABET Assessment Workshop, College of Engineering, June 2004.

Co-faciliator, workshops with Center for Teaching Excellence

- Hands-On Active Learning Techniques, March 2003.
- Workshop for the development of Templates for Embedded Assessment for General Education courses in Science and Mathematics, October 2003; co–facilitated discussions, January 2004 and March 2004.

Community events

Co-host, Science Trivia Night (Maine Public News & Brews), 2024 Maine Science Festival, 20 March 2024, Bangor, ME.

Panel moderator, "The Maine Space Complex: Engaging Maine in the New Space Economy," 2023 Maine Science Festival, 25 March 2023, Bangor, ME.

Presenter, "The Physics of Sound and Music," Maine Masonic College Celebration of Arts and Sciences, 3 April 2021, virtual.

Co-presenter, "Physics of Bicycles," Maine Science Festival Pop-up Event, with Walk-n-Roll Bangor and Bicycle Coalition of Maine, 29 May 2019.

Panel moderator, "Science of Voice," 2019 Maine Science Festival, 16 March 2019, Bangor, ME.

Panel moderator, "Implicit Bias Explained," 2018 Maine Science Festival, 17 March 2018, Bangor, ME.

Presenter, "The Good, the Bad, and the Ugly: Science in Film," 2017 Maine Science Festival, 17 March 2017, Bangor, ME.

Panel moderator, "Smart Brass" (science of brass instruments), 2016 Maine Science Festival, 18 March 2016, Bangor, ME.

Panel member, "String Theory Redux" (science of stringed instruments), 2015 Maine Science Festival, 22 March 2015, Bangor, ME.

Panel member, "Science and Faith," Penobscot Theatre Company, 2015 Maine Science Festival, 22 March 2015, Bangor, ME.

Presenter, College of Liberal Arts and Sciences *Great Conversations* series, "Not your (grand)father's physics class: How education research is informing college science teaching," May 2008, Orono, ME.

Organizer, Local Area High School Physics Teacher Collaborative, Fall 2002 – Spring 2008.

Judge, Association of Graduate Students Research Exposition, Orono, ME, April 2005.

Physics and Astronomy Representative for College of Liberal Arts & Sciences, UMaine Open House, Winter 2004, Winter 2005, Winter 2015.

President's Working Group on K-12 Education, Fall 2002.

GVSU

Science and Math Division Teaching Effectiveness Committee, Fall 2001 – Winter 2002.

Science and Math Division Space Planning Task Force, Winter 2001.

Physics Department Search Committee, Winter 2001, Winter 2002.

Teacher Education Advisory Committee, Winter 2001 – Winter 2002.

Science Education Group, Fall 2000 – Summer 2002.

OUTREACH ACTIVITIES

Guest lecturer, Bangor High School mathematics classes

Linear algebra: How quantum mechanics uses linear algebra (ish); May 2016, May 2019.

Multivariable calculus: How divergence and curl are used in physics; 27 May 2015.

Facilitator, professional development for density activities for middle school physical science, via Maine STEM Partnership, University of Maine, 11 February 2017.

Proctor, Maine Association of Math Leagues (MAML) meet: Bangor High School, annually in March, 2011-2017; Brewer HS, November 2015; Old Town HS, January 2016.

Co-facilitator, "Sound," Maine Discovery Museum After Dark series, Bangor, ME, 20 January 2016.

Discussion of and activities related to the science related to the book *A Wrinkle in Time*; 4th Grade Gifted/Talented Language Arts classroom, Mary Snow School, Bangor, ME: 18 January 2012; 6 March 2013; 10 January 2014; 29 January 2015.

March 2011 Facilitator, "Expectations for students in 9th grade science classes," Roundtable discussion at 31st Annual Statewide Meeting of Physics and Physical Science Teachers, Orono, ME.

June 2010 Co-facilitator, "Approaches to promote graphing literacy in science class," workshop at *Integrating Science and Mathematics Education Research into Teaching V* through Maine Center for Research in STEM Education, Orono, ME, June 20-23 2010; with T. Wemyss.

April 2010 "What is a scientist?"; 1st Grade class, Abraham Lincoln School, Bangor, ME, 28 April 2010.

October 2009 Guest discussant, Workshop on College Algebra course, Husson University, Bangor, ME, Oct. 3, 2009.

June 2009 Faculty of Engineering, Dublin Institute of Technology, Dublin, Ireland. Workshop facilitator, "Using physics education research to improve student understanding of hydrostatics."

February 2009 Faculty of Engineering, Dublin Institute of Technology, Dublin, Ireland. "Interactive Student-centred Lectures using 'Clickers'," with R. Howard and B. Bowe.

January 2009 Dublin Institute of Technology Learning Showcase, Dublin Institute of Technology, Dublin, Ireland. "Interactive Student-centred Lectures using 'Clickers'," with R. Howard.

May 2008 Presenter, College of Liberal Arts and Sciences *Great Conversations* series, "Not your (grand)father's physics class: How education research is informing college science teaching," Orono, ME.

Fall 2002 – Spring 2008 Organizer, Local Area High School Physics Teacher Collaborative
Meet approximately monthly to discuss topics pertinent to physics teaching and learning at the HS level.

June 2005 "No Question Left Behind: Bringing Guided-Inquiry Curricula into Science and Mathematics Classrooms," hosted by UMaine Center for Science and Mathematics Education Research and The Jackson Laboratory, Northport, ME. Co-facilitator for two workshops:

- "Examples of research-based guided inquiry curricula in physics," with Fred Goldberg, San Diego St. U.
- "What are the observables of an inquiry-based classroom?" with Susan R. McKay, U. Maine

May 2005 Twenty-fifth state wide meeting of high school physics teachers, Orono, ME. Organized meeting

May 2004 Twenty-fourth state wide meeting of high school physics teachers, Orono, ME. Organized meeting

October 2003 Center for Teaching Excellence, University of Maine. Ran workshop for the development of Templates for Embedded Assessment for General Education courses in Science and Mathematics

May 2003 Twenty-third state wide meeting of high school physics teachers, Orono, ME

- Co-organized meeting
- Co-facilitator, *Small Group Learning Tools* workshops, with M.C. Wittmann
  - "The relativity of simultaneity"
  - "Waves, interference, and wave-particle duality"

May 2003 New England Regional Conference of the American Society of Engineering Education, Orono, ME. Designed and co-facilitated Active Learning Workshop entitled "Using Physics Education Research to Improve Student Understanding of Hydrostatics," with M.C. Wittmann.

March 2003 DownEast Educational Partnership, Schoodic Point, ME
Designed and co-facilitated 2-hour content/pedagogy workshop on Astronomy for grades 6-12 teachers, with D.A. Batuski.

March 2003 Center for Teaching Excellence, University of Maine. Designed and co-facilitated faculty development "mini class" for workshop on Hands-On Active Learning entitled "Research-based curriculum in introductory optics," with M.C. Wittmann.

December 2002 Lego League, University of Maine. Staffed Demonstration Table for physics at middle school lego competition.

January-February 2002 Regional Math and Science Center, Grand Valley State University
Designed and co-facilitated 10-hour workshop on *Designing Inquiry* for elementary teachers. Part of a 3-workshop series on Inquiry.

January 2002 Regional Math and Science Center, GVSU
Designed and co-facilitated 10-hour content workshop on *Magnets, Magnetic Fields, and Electromagnets* for upper elementary and middle school teachers.

August 2001 Seattle (WA) School District K-5 Summer Institute
Modified curriculum for 20-hour, 1-week workshop on *Sound* for 3rd Grade classroom teachers.

January 2001 *Science Odyssey 2001: The Real Millenium,* GVSU
Assembled hands-on experiments and activities dealing with spinning and balancing for members of the community to experiment with and learn from. Designed accompanying question-and-answer placards for informational and instructional purposes.

January 2001 Pew Faculty Teaching and Learning Center Winter Teaching Conference, GVSU
Designed and co-facilitated faculty development workshop entitled "Using Research on Student Understanding as a Guide for Instruction: An example in introductory optics," with B.S. Ambrose.

August 2000 Seattle School District K-5 Summer Institute
Revised curriculum for 20-hour, 1-week workshop on Sound for 3rd Grade classroom teachers.

August 1999 Seattle School District K-5 Summer Institute
Wrote curriculum for and facilitated 15-hour, 1-week workshop on Sound for 3rd Grade classroom teachers. Assisted with Electric Circuits workshop for separate group of 3rd Grade classroom teachers.

August 1998 Seattle School District K-5 Summer Institute
Assisted in adapting curriculum for and facilitated half-day, 1-week workshop on Electric Circuits for 3rd Grade classroom teachers.

PROFESSIONAL MEMBERSHIPS

American Physical Society (1992–2003; 2005–present)

Topical Group on Physics Education Research

Co-founder (2013)

Chair line, Executive Committee (Nationally elected position): Vice Chair, 2016; Chair-Elect, 2017; Chair, 2018; Past Chair, 2019

Fellow, 2023

Forum on Education

Member-at-Large, Executive Committee (Nationally elected position; April 2008–April 2011)
Programs Subcommittee
Forum on Physics and Society; New England Section
American Association of Physics Teachers (1997–present)
Member, Physics Education Research Leadership and Organizing Council
(Nationally elected position; April 2009–January 2012; Chair January 2011 – February 2012)
Physics Education Research Topical Group (2006-present; begun 2006); New England Section
American Association for the Advancement of Science (1995–2000; 2023–present)