

Faculty Folder

Marcos D. Caballero

Department of Physics and Astronomy
and CREATE for STEM Institute
Michigan State University

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1 One Page Summary of Recent Accomplishments

Research

I joined the faculty at MSU in the fall of 2013 – establishing the Physics Education Research Laboratory (PERL). PERL has become an integral part of the discipline education based research community at MSU, and, is quickly becoming recognized nationally as central player in PER. Major research activities and highlights include:

- Growing a research group in physics education, which has included 6 faculty (two full-time in PA, two affiliates each in PA/TE), 8 research scientists/post-doctoral researchers (5 current), 6 graduate students (four in PA, two in TE), and over a dozen undergraduates (9 current).
- Awarded \$4.1M in grant funding as PI, Co-PI, or project lead including, most recently:
 - A \$650k NSF REU grant for PA and NSCL, which re-envisioned our REU program as preparation for graduate school, industry, and other professional settings (Tessmer – PI, Pratt – Co-PI, Caballero – Co-PI, Westfall – Co-PI)
 - A collaborative \$1.2M NSF DUE grant (\$503,977 for MSU) to investigate computational instructional practices across physics (Caballero – PI, Roos – PI, Englehardt – PI, Lopez – PI, Hilborn – PI)
 - A collaborative \$220k NSF DUE grant (\$40,526 for MSU) to develop and to advertise computational materials for the physics curriculum (Caballero – PI, Chonacky – PI, Lopez – PI, Hilborn – PI)
 - A collaborative federally funded \$126k NSF DUE grant to study the state and implications of computational modeling instruction in physics. (Caballero – PI, Chonacky – PI, Hilborn – PI)
- 24 peer-reviewed publications including 8 in premier physics education journals (1 - Science, 4 - Phys. Rev. 2 - Am. J. Phys. & 1 - Eur. J. Phys.) and 14 in peer-reviewed proceedings.
- 23 invited talks including 7 at national meetings; 44 contributed abstracts (41 by advisees and collaborators).
- A systematic investigation of teaching practices in MSU's introductory science classes that includes course assessments, instructor practice, and classroom norms. This research documents course transformation efforts taken up by departments and aims to generalize them into a critically-needed study of institutional change.
- A qualitative study of students' collaboration practices in active-learning physics classrooms including laboratory settings. This research focuses on group dynamics in environments where collaboration is essential to productive learning.
- The development, implementation, and validation of an assessment instrument for sophomore-level Classical Mechanics. This tool is being used widely (~20 institutions). This research is informing investigations into student difficulties at the upper-division with a variety of concepts and practices (e.g., vector decomposition).
- Data collection (500 classroom video hours; 80 hours of interviews; 600 hours of students' screen casts) in a transformed group learning environment that will be analyzed for student use of computational modeling, students' modeling practices, and positioning by students and instructors. IRB restricted viewing of data until this summer. Initial data collection (20 hours of interviews) on students' physics identity development.
- Data collection (24 classroom video hours) on upper-division students' use of mathematics; analysis is on-going.

Teaching

Last spring, I was awarded a STEM Gateway Fellowship for my early efforts to strengthen the teaching mission of our department. In the summer of 2014, I developed a project-based introductory mechanics curriculum that includes computational modeling. For this work, I developed 28 in-class projects (6 that include computation) and 420 new homework problems that were coded into LON-CAPA. In the fall of 2014, this course was taught for the first time with great success; student performance on conceptual metrics were high. This course continues to be taught/developed and will be offered to twice as many students next fall. In spring 2015, I taught Lyman Briggs Calculus-Based Physics II. This past spring, I helped develop a revised E&M lab for life science students. Finally, I co-developed and have run a physics teaching assistant workshop for the past two summers.

I also currently mentor/co-mentor 5 postdocs, 6 graduate students, and 10 undergraduates in PER.

Service

In January 2014, I was elected to the chair line of the APS's Group in Physics Education Research (GPER) and am currently serving as chair-elect and program chair of GPER.

Last spring, I organized the AAPT sectional meeting for Michigan at MSU. This meeting brought together ~60 teachers, educators, and educational professionals for a full day of talks and workshops.

I have served on various departmental committees including the two lecture course transformation committees, the qualifying exam committee, and our recent instructor and LBC faculty search committees.

2 One Page Summary of Lifetime Accomplishments

- National leader in evidence-based course transformation in physics at the introductory and upper-level including the incorporation of computational thinking practices
- 32 peer-reviewed publications (8 as lead author; 10 as principal investigator) including 1 Science article, 7 Physical Review articles, 3 American Journal of Physics articles, and 17 Physics Education Research Conference proceedings papers.
- 36 invited talks including 8 at national meetings; 86 contributed abstracts including 56 by postdocs, graduate students, and collaborators.
- Awarded ~4.1M in funding as PI, Co-PI, or project lead (external: 3.7M; as PI: \$1.8M)
- Awarded NSF REU grant that re-envisioned the program as professional development for physics careers (Co-PI) (Total: \$652,201)
- Awarded NSF IUSE collaborative research grant for investigating the computational instructional practices (PI) (Total: \$1,279,209)
- Awarded NSF IUSE collaborative research grant for developing and advertising computational materials and teaching practices (PI) (Total: \$219,136)
- Awarded NSF IUSE collaborative research grant for investigating the state and role of computational instruction (PI) (Total: \$126,320)
- Co-authored HHMI proposal, which was awarded to shape laboratory instruction in MSU science departments (Physics project lead) (Total: \$1,500,000)
- Awarded 2 competitive MSU internal grants (1 as PI, 1 as Co-PI) (Total: \$325,000)
- Awarded 2015 Thomas H. Osgood Memorial Award for Faculty Excellence in Teaching
- Awarded the inaugural STEM Gateway Fellowship
- Most highly rated (SIRS) first-time PHY-AST professor; most highly rated introductory PHY-AST instructor (Fall 2013); consistently high SIRS scores
- Developed and implemented faculty-consensus and AAPT-inspired E&M laboratory course for life science students (DATA Lab)
- Developed and implemented the first project-based introductory mechanics course to incorporate computational modeling as a key aspect of the curriculum (Projects and Practices in Physics).
- Co-developed a one-day professional development workshop for graduate physics teaching assistants that espouses interactive engagement and reflective teaching practice
- Co-developed (w/ GA Tech collaborators) the first physics massively openly online course (MOOC) with an associated laboratory
- Developed the ACER analytical framework for investigating and cataloging students' use of mathematics in upper-division physics; used ACER to perform the first unpacking of student difficulties with mathematics in physics (as evidenced by written work) in Classical Mechanics/Math Methods contexts.
- Co-developed (w/ CU collaborators) an active learning sophomore-level Classical Mechanics/Math Methods curriculum including consensus learning goals, instructional materials, and assessments; developed a suite of empirically-tested and iteratively-improved computational homework problems suitable for this level.
- Co-authored an assessment of student learning for Classical Mechanics/Math Methods; performed the first pre-post measurements of student learning at this level.
- Developed a complete suite of empirically-tested and iteratively-improved computational homework problems suitable for an introductory mechanics course.
- Performed the first large-scale investigation of computational thinking practices in a university-level physics course.
- Performed the first large-scale comparative measurement of learning outcomes across introductory physics courses (Mechanics and E&M) in which core content (not the teaching pedagogy) differed.

3 Curriculum Vitae of Marcos D. Caballero

Contact Marcos D. Caballero
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East Lansing, MI 48823
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Phone: (517) 884 5657
Family: Partner (Jamie), Daughters (Juniper – 5, Evelyn – 3, Olivia – $\frac{1}{3}$)

Education

2000–2004 Study of Physics, University of Texas at Austin
2005–2011 Teaching and research assistant, Georgia Institute of Technology

Academic Degrees

2011 **PhD**, under the supervision of Prof. Michael Schatz
Georgia Institute of Technology
2006 **MS**, under the supervision of Prof. Michael Schatz
Georgia Institute of Technology
2004 **BS**, University of Texas at Austin

Positions

12/13 – Affiliated Faculty, CREATE for STEM Institute
Michigan State University, East Lansing, MI
08/13 – Assistant Professor, Department of Physics and Astronomy
Michigan State University, East Lansing, MI
08/11 – 08/13 Postdoctoral Researcher, Department of Physics
University of Colorado Boulder, Boulder, CO
08/11 – 08/13 Postdoctoral Affiliate, School of Physics
Georgia Institute of Technology, Atlanta, GA

Fellowships and awards

2015 Thomas H. Osgood Memorial Awards for Faculty Excellence in Teaching, MSU
2014 – STEM Gateway Fellow, College of Natural Science, MSU
2011 Tower Award, Georgia Institute of Technology
2010 CETL/BP Outstanding Graduate TA Award Finalist
Georgia Institute of Technology
2009 CETL/BP Outstanding Graduate TA Award
Georgia Institute of Technology
2007 – 2008 Teaching Assistant of the Year
American Association of Physics Teachers
2007 – 2011 Gozuieta Fellow, Georgia Institute of Technology
2007 Travel Grant, Technical University of Denmark
2006 Tower Award, Georgia Institute of Technology

Lifetime Scholarship

Peer-reviewed articles: 32; Invited talks: 36; Contributed abstracts: 86

4 Research

4.1 Publications Online

These methods do not capture all refereed publications (including the most current). Please review the list of all refereed publications that appears in Section 4.4.

4.1.1 Google Scholar

<http://goo.gl/9sU9gR>

Current summary: 179 Citations, h-index 7

4.1.2 NASA ADS

<http://goo.gl/VMcVFo>

Summary: 4 abstracts

Instructions:

- select Science Education Search.
- in the Author field enter Caballero, M.

4.1.3 ISI

<http://goo.gl/dTQs0n>

Summary: 18 articles

Instructions:

- Author=(caballero md)
- Address=(atlanta OR boulder OR lansing)

4.2 Grant Funding

Note: Some collaborative research grants have institutional-level principal investigators.

Title	Agency	Grant Period	Amount	PI's
Awarded (7 grants; Total: \$4,112,866; as PI: \$1,824,665)				
Research Experience for Undergraduates in Physics	NSF	06/01/16 - 05/31/21	652,201	S. Tessmer (PI) S. Pratt (Co-PI) M.D. Caballero (Co-PI) G. Westfall (Co-PI)
Learning Science by Doing Science: Project-based Learning through Urban Entomology	Science and Society at State	01/01/16 - 12/31/16	10,000	P. White (PI) D. Stroupe (Co-PI) M.D. Caballero (Co-PI)
Collaborative Research: Integrating Computation into Undergraduate Physics: A Faculty Development Approach to Community Transformation	NSF	09/01/15–08/31/19	1,279,209; 503,977 (MSU Part)	M.D. Caballero (PI, MSU) K. Roos (PI, Bradley) L. Engelhardt (PI, FMU) M. Lopez (PI, St. Thomas) R. Hilborn (PI, AAPT)
Collaborative Research: Fostering integration of computational methods in physics courses: A local communities approach	NSF	07/01/15 – 06/30/17	219,136; 40,526 (MSU Part)	M.D. Caballero (PI, MSU) N. Chonacky (PI, Yale) M. Lopez (PI, St. Thomas) R. Hilborn (PI, AAPT)

Transforming experiences for science and engineering students: Integrating scientific practices into introductory calculus-based mechanics	LPF-CMP 2	01/01/14–12/31/15	200,000	M.D. Caballero (PI) D. Stroupe (Co-PI) S. Tessmer (Co-PI)
InvestigAction: Underrepresented Middle School Youth Becoming Community Engineering Experts	LPF-CMP 2	01/01/14–05/01/15	125,000	A. Calabrese-Barton (PI) S. Calabrese-Barton (Co-PI) M.D. Caballero (Co-PI) B. Geier (Co-PI)
Collaborative Research: Surveying the state of computational physics in courses for physics majors	NSF	01/01/15–12/31/17	126,320; 21,380 (MSU Part)	M.D. Caballero (PI, MSU) N. Chonacky (PI, Yale) R. Hilborn (PI, AAPT)
LEVERS: Leveraging Engagement and Vision to Encourage Retention in STEM	HHMI	09/01/14–08/31/19	1,500,000	S. Chivukula (PI) M.D. Caballero (Co-author & Physics Project Lead)

Pending (1 grants; Total: \$284,984)

Investigating Students' Use of Computational Modeling in Introductory Physics	NSF	PENDING	284,984	M.D. Caballero (PI) P.W. Irving (Co-PI)
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Declined in the last year

Investigating Students' Use and Perceptions of Computational Modeling in Introductory Physics	NSF	08/01/15 - 07/31/18	599,131	M.D. Caballero (PI) D. Stroupe (Co-PI)
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4.3 Grant Resubmissions

Investigating Students' Use and Perceptions of Computational Modeling in Introductory Physics received strong reviews (1 Excellent; 3 Very Good; 1 Good), but was not funded, in part, due to the large number of proposals for the IUSE program of which physics proposals represent a small number of those funded: 3% of such proposals are physics-specific, and just above 10% are funded. In speaking with the program officer, it was a very highly reviewed proposal, but was likely not funded because two proposal for similar efforts were funded (see above). Because of its strong reviews, we were encouraged by the program officer to resubmit this proposal in the next IUSE round, which we have done. The resubmitted grant, *Investigating Students Use of Computational Modeling in Introductory Physics*, is still under review (see above).

4.4 Published Scholarly Works

4.4.1 Articles

15. *Cooper, M.M., Caballero, M.D., Ebert-May, D., Fata-Hartley, C.L., Jardeleza, S.E., Krajcik, J.S., Laverty, J.T., Matz, R.L., Posey, L.A., Underwood, S.M. ***Challenge faculty to transform STEM learning***, Science, 350 (6258), 281-282, 2015.
14. *Chasteen, S.V., Wilcox, B.R., Caballero, M.D., Perkins, K.K., Pollock, S.J., Wieman, C.E. ***Educational transformation in upper-division physics: The Science Education Initiative model, outcomes, and lessons learned***, Phys. Rev. ST Phys. Educ. Res., 11, 020110 (2015)
13. *Wilcox, B.R., Caballero, M.D., Baily, C., Sadaghiani, H., Chasteen, S.V., Ryan, Q.X., Pollock, S.J. ***Development and Uses of Upper-division Conceptual Assessments***, Phys. Rev. ST Phys. Educ. Res., 11, 020115 (2015)
12. *Caballero, M.D., Wilcox, B.R., Doughty, L., Pollock, S.J. ***Unpacking students' use of mathematics in upper-division physics***, Eur. J. Phys., 36, 065004, 2015

11. *L. Ding and M.D. Caballero **Uncovering the hidden meaning of cross-curriculum comparison results on the Force Concept Inventory**, Phys. Rev. ST Phys. Educ. Res., 10, 2014
10. *A.-M. Hoskinson, B. Couch, K. Hinko, B. Zwickl, and M.D. Caballero **Bridging Physics and Biology Teaching through Modeling**, Am. J. Phys., 82, 434, 2014
9. *M.D. Caballero and S.J. Pollock, *A Model for Incorporating Computation Without Changing the Course: An example from middle-division classical mechanics*, Am. J. Phys., 82, 231, 2014
8. *M.D. Caballero, J.B. Burk, J.M. Aiken, S.S. Douglas, E.M. Scanlon, B.D. Thoms, and M.F. Schatz, *Integrating Numerical Computation into the Modeling Instruction Curriculum*, Phys. Teach., 52, 38, 2014
7. *B.R. Wilcox, M.D. Caballero, and S.J. Pollock, *Analytic framework for students' use of mathematics in upper-division physics*, Phys. Rev. ST Phys. Educ. Res. 9, 020119, 2013
6. *A.-M. Hoskinson, M. D. Caballero, and J. Knight, **Can we improve problem solving in biology? Lessons from 30 years of physics education research**, CBE – LSE, 12, 153, 2013
5. *S.V. Chasteen, R.E. Pepper, M.D. Caballero, S.J. Pollock, and K.K. Perkins, *The Colorado Upper-Division Electrostatics (CUE) diagnostic: A conceptual assessment for the junior level*, Phys. Rev. ST Phys. Educ. Res. 8, 020108, 2012
4. *M.D. Caballero, M.A. Kohlmyer, and M.F. Schatz, *Implementing and assessing computational modeling in introductory mechanics*, Phys. Rev. ST Phys. Educ. Res. 8, 020106, 2012
3. *M.D. Caballero, M.A. Kohlmyer, M.F. Schatz, et al., *Comparing large lecture mechanics curricula using the Force Concept Inventory: A five thousand student study*, Am. J. Phys., 80, 7, 2012
2. *M.A. Kohlmyer, M.D. Caballero, M.F. Schatz, et al., *A Tale of Two Curricula: Performance of two thousand students in introductory electromagnetism*, Phys. Rev. ST Phys. Educ. Res. 5, 020105, 2009
1. *A.L. Cochran, E.S. Barker, M.D. Caballero, and J. Gyorsey-Ries, *Placing the Deep Impact Mission into Context: Two Decades of Observations of 9P/Tempel 1 from McDonald Observatory*, Icarus 199 (119), 2009

4.4.2 Peer-reviewed Papers from Learned Professional Organizations and Societies

17. *Caballero, M.D., **Computation across the curriculum: What skills are needed?**, Proceedings of the Physics Education Research Conference, pp. 79-82, 2015
16. *Irving, P.W., Sawtelle, V., and Caballero, M.D., **Troubleshooting Formative Feedback in P³ (A group-based learning environment)**, Proceedings of the Physics Education Research Conference, pp. 155-158, 2015
15. *Lavery, J.T., Cooper, M.M., and Caballero, M.D., **Developing the Next Generation of Physics Assessments**, Proceedings of the Physics Education Research Conference, pp. 187-190, 2015
14. *Pawlak, A., Irving, P.W., and Caballero, M.D., **Identification of a shared answer-making game in group context**, Proceedings of the Physics Education Research Conference, pp. 255-258, 2015
13. *Obsniuk, M.J., Irving, P.W., and Caballero, M.D., **A Case Study: Novel Group Interactions through Computational Physics**, Proceedings of the Physics Education Research Conference, pp. 239-242, 2015
12. *Turnbull, A., Doughty, L., Sawtelle, V. and Caballero, M.D., **Student Ideas around Vector Decomposition in the Upper-Division**, Proceedings of the Physics Education Research Conference, pp. 335-338, 2015
11. *L. Doughty, M.D. Caballero, **Rubric Design for Separating the Roles of Open-Ended Assessments**, Proceedings of the Physics Education Research Conference, pp. 71-74, 2014
10. *J.T. Lavery, S.H. Tessmer, M.M. Cooper, M.D. Caballero, **Engaging Physics Faculty in Course Transformation**, Proceedings of the Physics Education Research Conference, pp. 147-150, 2014

9. *S.F. Wolf, L. Doughty, P.W. Irving, E.C. Sayre, M.D. Caballero, **Just Math: A new epistemic frame**, Proceedings of the Physics Education Research Conference, pp. 275-278, 2014
8. *J.M. Aiken, S. Lin, S.S. Douglas, E.F. Greco, B.D. Thoms, M.D. Caballero, M.F. Schatz, **Student Use of a Single Lecture Video in a Flipped Introductory Mechanics Course**, Proceedings of the Physics Education Research Conference, pp. 19-22, 2014
7. *S.S. Douglas, S. Lin, J.M. Aiken, B.D. Thoms, E.F. Greco, M.D. Caballero, M.F. Schatz, **Peer Evaluation of Video Lab Reports in a Blended Introductory Physics Course**, Proceedings of the Physics Education Research Conference, pp. 75-78, 2014
6. *S. Lin, S.S. Douglas, J.M. Aiken, C. Liu, E.F. Greco, B.D. Thoms, M.D. Caballero, M.F. Schatz, **Peer Evaluation of Video Lab Reports in an Introductory Physics MOOC**, Proceedings of the Physics Education Research Conference, pp. 163-166, 2014
5. *M.D. Caballero and S.J. Pollock, **Assessing Student Learning in Middle-Division Classical Mechanics/Math Methods**, Proceedings of the Physics Education Research Conference, pp. 81-84, 2013
4. *J.M. Aiken, S. Lin, S.S. Douglas, E.F. Greco, B.D. Thoms, M.F. Schatz, and M.D. Caballero, **The Initial State of Students Taking an Introductory Physics MOOC**, Proceedings of the Physics Education Research Conference, pp. 53-56, 2013
3. *M.D. Caballero, B.R. Wilcox, R.E. Pepper, and S.J. Pollock, **ACER: A Framework on the Use of Mathematics in Upper-division Physics**, Proceedings of the Physics Education Research Conference, 1513, pp. 90-93, 2012
2. *B.R. Wilcox, M.D. Caballero, R.E. Pepper, and S.J. Pollock, **Upper-division Student Understanding of Coulomb's Law: Difficulties with Continuous Charge Distributions**, Proceedings of the Physics Education Research Conference, 1513, pp. 418-421, 2012
1. *J.M. Aiken, M.D. Caballero, S.S. Douglas, J.B. Burk, E.M. Scanlon, B.D. Thoms, and M.F. Schatz, **Understanding Student Computational Thinking with Computational Modeling**, Proceedings of the Physics Education Research Conference, 1513, pp. 46-49, 2012

4.4.3 Contributed papers (not peer-reviewed)

2. M.D. Caballero, M.A. Kohlmyer, and M.F. Schatz, **Fostering Computational Thinking**, Proceedings of the Physics Education Research Conference, 2011
1. K.R. Bujak, M.D. Caballero, M.F. Schatz, et al., **Comparing the Matter and Interactions Curriculum with a Traditional Physics Curriculum: A Think Aloud Study**, Proceedings of the 2011 AERA Annual Meeting, New Orleans, LA, 2011

4.5 Other scholarly works

4.5.1 Contributed talks, posters, workshops, and other abstracts (as primary author)

26. M.D. Caballero, **Computation across the curriculum: What skills are needed?**, Poster for 2015 Physics Education Research Conference, College Park, MD
25. M.D. Caballero, P.W. Irving, S.H. Tessmer, D. Stroupe, **Blending Content and Practice: Designing a New Introductory Mechanics**, Poster for 2014 AAPT Summer Meeting, Minneapolis, MN
24. M.D. Caballero, **Ubiquitous Professional Development with the Global Physics Department**, Michigan Section of the American Association of Physics Teachers Fall Meeting, Roscommon, MI
23. M.D. Caballero, **Ubiquitous Professional Development with the Global Physics Department**, Colorado/Wyoming Section of the American Association of Physics Teachers Spring Meeting, Highlands Ranch, CO
22. M.D. Caballero, B.R. Wilcox, R.E. Pepper, and S.J. Pollock, **A Framework on the Use of Mathematics in Upper-division Physics**, Poster for Physics Education Research Conference, Philadelphia, PA
21. M.D. Caballero, R.E. Pepper, and S.J. Pollock, **Tapping into Sophomores' Understanding of Classical Mechanics: Developing the Colorado Classical Mechanics/Math Methods Instrument (CCMI)**, Poster for Physics Education Research Conference, Philadelphia, PA

20. M.D. Caballero, B.M. Zwickl, and S.J. Pollock, *Teaching New Tools to Majors: Computational Instruction in Upper-division Physics*, American Association of Physics Teachers Summer Meeting, Philadelphia, PA
19. M.D. Caballero, *Computational Modeling: A tool we can teach*, Colorado/Wyoming Section of the American Association of Physics Teachers Spring Meeting, Aurora, CO
18. M.D. Caballero, R.E. Pepper and S.J. Pollock, *Why are Taylor Series So Tough?*, American Association of Physics Teachers Winter Meeting, Ontario, CA
17. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Fostering Computational Thinking*, Poster for Physics Education Research Conference, Omaha, NE
16. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Measurements of Students' Performance on Computational Exercises in Introductory Mechanics*, Poster for American Association of Physics Teachers Summer Meeting, Omaha, NE
15. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Assessing Student Affect in Learning Computation in Introductory Mechanics*, Poster for American Association of Physics Teachers Summer Meeting, Omaha, NE
14. M.D. Caballero, M.F. Schatz, J.B. Burk and M.A. Kohlmyer, *Fostering Computational Thinking: Computer Modeling Homework in Introductory Mechanics*, Poster for American Association of Physics Teachers Summer Meeting, Omaha, NE
13. M.D. Caballero, M.F. Schatz, J.B. Burk and M.A. Kohlmyer, *Fostering Computational Thinking: Computer Modeling Homework in Introductory Mechanics*, American Association of Physics Teachers Summer Meeting and the Physics Education Research Conference, Omaha, NE
12. M.D. Caballero, B. Suri, M.F. Schatz, and M.A. Kohlmyer, *Computational homework in introductory mechanics: What are the limits?*, Southern Atlantic Coast Section of the American Association of Physics Teachers Fall Meeting, Charleston, SC
11. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Developing, deploying, and evaluating computational homework in introductory mechanics*, Poster for American Association of Physics Teachers Summer Meeting and the Physics Education Research Conference, Portland, OR
10. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Computational homework in introductory mechanics*, American Association of Physics Teachers Summer Meeting, Portland, OR, July 2010
9. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Developing and deploying computational exercises in introductory mechanics*, Southern Atlantic Coast Section of the American Association of Physics Teachers Spring Meeting, Aiken, SC
8. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Computational Exercises in Introductory Mechanics*, American Association of Physics Teachers Winter Meeting, Washington, DC
7. M.D. Caballero, M.F. Schatz, and M.A. Kohlmyer, *Performance of 5000 students in introductory mechanics v.3*, Southeastern Section of the American Physical Society meeting, Atlanta, GA
6. M.D. Caballero, M.F. Schatz, *Introducing computational modeling in introductory physics*, Atlanta Metro Physics Teachers Network meeting, Atlanta, GA
5. M.D. Caballero, M.F. Schatz, *Performance of 5000 students in introductory mechanics v.2*, Southern Atlantic Coast Section of the American Association of Physics Teachers Fall Meeting, Augusta, GA
4. M.D. Caballero, M.F. Schatz, *Performance of 5000 students in introductory mechanics*, American Association of Physics Teachers Summer Meeting, Ann Arbor, MI
3. M.D. Caballero, M. A. Kohlmyer, M. F. Schatz, *Performance of 2000 Students on BEMA*, Matter and Interactions Summer Workshop, Atlanta, Ga
2. M.D. Caballero and M. F. Schatz, *Bouncers, Walkers and Virtual Drops [2.0]*, APS Division of Fluid Dynamics Annual Meeting, Salt Lake City, UT
1. M.D. Caballero and M. F. Schatz, *Bouncers, Walkers and Virtual Drops*, Complex Motion in Fluids Summer School, Humlebæk, Denmark

4.5.2 Contributed talks, posters, workshops, and other abstracts (as advisor or collaborator)

56. Michael J. Obsniuk, Paul W. Irving, Marcos D. Caballero, **A Case Study: Novel Group Interactions through Introductory Computational Physics**, CREATE for STEM Miniconference, East Lansing, MI (Poster)
55. Alanna Pawlak, Paul W. Irving, Marcos D. Caballero, **Students' engagement in modes of collaboration while solving problems in groups**, CREATE for STEM Miniconference, East Lansing, MI (Poster)
54. James T. Lavery, Rebecca L. Matz, Sonia M. Underwood, Sarah E. Jardeleza, Justin H. Carmel, Cori L. Fata-Hartley, Lynmarie Posey, Joseph S. Krajcik, Diane Ebert-May, Marcos D. Caballero, and Melanie M. Cooper, **Investigating Assessments in Gateway College Science Courses**, CREATE for STEM Miniconference, East Lansing, MI (Poster)
53. James Brian Hancock II, Vashti Sawtelle, Marcos D. Caballero, Alicia Alonzo, **Perceptions of Learning and Teamwork: Practice-based Introductory Physics**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster)
52. James T. Lavery, Melanie M. Cooper, Marcos D. Caballero, **Developing the Next Generation of Physics Assessments**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster/Talk)
51. Alanna Pawlak, Paul W. Irving, Marcos D. Caballero, **Students' Engagement in Modes of Collaboration While Solving Problems in Groups**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster)
50. Alanna Pawlak, Paul W. Irving, Marcos D. Caballero, **Identification of a shared answer-making game in group context**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster)
49. Paul W. Irving, Vashti Sawtelle, Marcos D. Caballero, **Troubleshooting Formative Feedback in P3 (A group-based learning environment)**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster/Talk)
48. Michael J. Obsniuk, Paul W. Irving, Marcos D. Caballero, **A Case Study: Novel Group Interactions through Introductory Computational Physics**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster/Talk)
47. Anna Turnbull, Leanne Doughty, Vashti Sawtelle, Marcos D. Caballero, **Student ideas around vector decomposition at the upper-division**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster/Talk)
46. Leanne Doughty, Marcos D. Caballero, **Examining student talk around the Dirac delta function in upper-division E&M**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster/Talk)
45. May Lee, Alicia C. Alonzo, Vashti Sawtelle, Marcos D. Caballero, and David Stroupe, **Positioning peers during group work in introductory mechanics**. Summer AAPT Meeting/PERC 2015, College Park, MD (Poster/Talk)
44. James T. Lavery, Sonia M. Underwood, Melanie M. Cooper, Marcos D. Caballero, Diane Ebert-May, Joseph S. Krajcik, Cori Fata-Hartley, Rebecca L. Matz, Lynmarie Posey, Sarah Jardeleza, **Characterizing Assessments Using the Three-Dimensional Learning Assessment Protocol (3D-LAP)**, NARST, Chicago, IL, Spring 2015 (Talk)
43. Rebecca L. Matz, James T. Lavery, Sarah Jardeleza, Claire M. Morrison, Zachary D. Nusbaum, Sonny A. Ly, Diane Ebert-May, Joseph S. Krajcik, Marcos D. Caballero, Melanie M. Cooper, **Investigating Change in Classroom Instruction of Scientific Practices, Crosscutting Concepts, and Core Ideas**, NARST, Chicago, IL, Spring 2015 (Talk)
42. Anna Turnbull, Leanne Doughty, Vashti Sawtelle, Marcos D. Caballero. **Students about vector decomposition in the upper-division**. MIAAPT Spring 2015 (Talk)
41. Sonny A. Ly, Sarah E. Jardeleza, Rebecca L. Matz, James T. Lavery, Sonia M. Underwood, Cori L. Fata-Hartley, Lynmarie Posey, Joseph S. Krajcik, Diane Ebert-May, Marcos D. Caballero, Melanie M. Cooper, **Questions in the Classroom: How Often do Students Respond?**, 2015 University Undergraduate Research and Arts Forum (UURAF), Michigan State University, East Lansing, MI (Poster)
40. Anna Turnbull, Leanne Doughty, Vashti Sawtelle, Marcos D. Caballero. **Rubrics design for separating the roles of open-ended assessments**. 2015 CREATE for STEM mini-conference, East Lansing, MI. (Poster)

39. Alanna Pawlak, Paul Irving, Marcos D. Caballero. **How students play the answer-making epistemic game while solving problems in groups.** 2015 CREATE for STEM mini-conference, East Lansing, MI. (Poster)
38. Lee, M., Sawtelle, V., Stroupe, D., Irving, P. W., Obsniuk, M. J., & Caballero, M. D.. **Negotiating positions within small groups in introductory physics.** 2015 CREATE for STEM mini-conference, East Lansing, MI. (Poster)
37. Michael J. Obsniuk, Paul W. Irving, Stuart H. Tessmer, David Stroupe, Marcos D. Caballero. **Blending Content and Practice: Designing a new introductory mechanics course,** 2015 CREATE for STEM Mini-Conference, East Lansing, MI (Poster)
36. James T. Lavery, Sonia M. Underwood, Rebecca L. Matz, Sarah E. Jardeleza, Cori L. Fata-Hartley, Lynmarie Posey, Joseph S. Krajcik, Diane Ebert-May, Marcos D. Caballero, Melanie M. Cooper, **Designing Three-Dimensional Learning Assessments for Introductory College Science Courses,** CREATE for STEM Mini-Conference, East Lansing, MI, Spring 2015 (Poster)
35. Zachary D. Nusbaum, Sonny A. Ly, Claire M. Morrison, Keenan L. Noyes, Sarah E. Jardeleza, Rebecca L. Matz, James T. Lavery, Sonia M. Underwood, Cori L. Fata-Hartley, Lynmarie Posey, Joseph S. Krajcik, Diane Ebert-May, Marcos D. Caballero, Melanie M. Cooper, **Comparing Teaching Activities in Gateway Science Courses,** CREATE for STEM Mini-Conference, East Lansing, MI, Spring 2015 (Poster)
34. Stephanie V. Chasteen, Marcos D. Caballero, Katherine K. Perkins, Carl E. Wieman. ***The CU Science Education Initiative: Examining the Model and its Impacts.*** Summer AAPT Meeting/PERC 2014 (poster).
33. Alanna Pawlak, Paul W. Irving, Marcos D. Caballero. **How Students Use Visual Representations When Solving Charge Distribution Problems.** Summer AAPT Meeting/PERC 2014 (poster).
32. Leanne Doughty, Marcos D. Caballero. **The Multiple Roles of Assessment: Rubric Design in the Upper-Division.** Summer AAPT Meeting/PERC 2014 (poster).
31. James T. Lavery, Marcos D. Caballero. **Integrating Practices and Core Ideas in Introductory Physics Courses.** Summer AAPT Meeting/PERC 2014 (poster).
30. Steven F. Wolf, Ying Chen, Paul W. Irving, Eleanor Sayre, Marcos D. Caballero. **It's "Just Math": A New Epistemic Frame.** Summer AAPT Meeting/PERC 2014 (poster).
29. J.M. Aiken, S. Lin, S.S. Douglas, E.F. Greco, B.D. Thoms, M.D. Caballero, M.F. Schatz. ***Student Use of a Single Lecture Video in a Flipped Introductory Mechanics Course.*** Summer AAPT Meeting/PERC 2014 (poster/talk).
28. S.S. Douglas, S. Lin, J.M. Aiken, B.D. Thoms, E.F. Greco, M.D. Caballero, M.F. Schatz. ***Peer Evaluation of Video Lab Reports in a Blended Introductory Physics Course.*** Summer AAPT Meeting/PERC 2014 (poster/talk).
27. S. Lin, S.S. Douglas, J.M. Aiken, C. Liu, E.F. Greco, B.D. Thoms, M.D. Caballero, M.F. Schatz. ***Peer Evaluation of Video Lab Reports in an Introductory Physics MOOC.*** Summer AAPT Meeting/PERC 2014 (poster/talk).
26. James T. Lavery, Steven F. Wolf, Marcos D. Caballero. **Integrating Practices and Core Ideas into Introductory Physics Courses.** MIAAPT Spring 2014 (Workshop)
25. Leanne Doughty, Alanna Pawlak, May Lee, and Marcos D. Caballero. **Mechanistic Reasoning in Introductory University Physics.** MIAAPT Spring 2014 (Talk)
24. Alanna Pawlak, Leanne Doughty, and Marcos D. Caballero. **How students choose and use visual representations in electricity and magnetism.** MIAAPT Spring 2014 (Talk)
23. James T. Lavery, Stuart H. Tessmer, Marcos D. Caballero. **Practices and Core Ideas into MSU's Introductory Physics Courses.** MIAAPT Spring 2014 (Poster)

22. Alanna Pawlak, Leanne Doughty, and Marcos D. Caballero. **How students choose and use productive visual representations when solving problems about charge distributions.** CREATE for STEM MiniConference Spring 2014 (Poster)
21. James T. Lavery, Melanie Cooper, Diane Ebert-May, Marcos D. Caballero, Joseph Krajcik. **Creating a Coherent Gateway for STEM Teaching and Learning at MSU.** CREATE for STEM MiniConference Spring 2014 (Poster)
20. James T. Lavery, Stuart H. Tessmer, Marcos D. Caballero. **Practices and Core Ideas into MSU's Introductory Physics Courses.** CREATE for STEM MiniConference Spring 2014 (Poster)
19. Shih-Yin Lin, John M. Aiken, Scott Douglas, Edwin F. Greco, Brian D. Thoms, Marcos D. Caballero, Michael F. Schatz. **Peer Evaluations of Video Lab Reports by Introductory Physics Students.** Winter AAPT 2014 (Poster/Talk)
18. John M. Aiken, Shih-Yin Lin, Marcos D. Caballero, Brian D. Thoms, Michael F. Schatz. **Describing Student Participation and Performance in an Introductory MOOC.** Winter 2014 AAPT meeting (talk).
17. B. Wilcox, M.D. Caballero, D. Rehn, S. Pollock. **An Analytic Framework for Students' Use of Mathematics in Upper-division Physics,** Global Physics Department - 2013, globalphysicsdept.org (Talk)
16. James T. Lavery, Marcos D. Caballero. **The First Steps to Transforming Introductory Physics at Michigan State.** MIAAPT Fall 2013 (Talk)
15. John M. Aiken, Shih-Yin Lin, Brian D. Thoms, Michael F. Schatz. *Computational Modeling Activities for High School.* Fall 2013 NCS-SACS AAPT meeting (talk).
14. Shih-Yin Lin, John M. Aiken, Scott Douglas, Edwin F. Greco, Brian D. Thoms, Marcos D. Caballero, Michael F. Schatz. *Evaluations of Video Lab Reports in an Introductory Physics MOOC.* Summer AAPT/PERC 2013 (Poster/Talk)
13. Scott S. Douglas, John M. Aiken, Shih-Yin Lin, Edwin F. Greco, Michael F. Schatz, Marcos D. Caballero. *Implementation of an Introductory Physics MOOC with a Lab.* Summer AAPT/PERC 2013 (poster)
12. S. Pollock, C. Baily, B. Wilcox, M.D. Caballero. *Helping Students acquire functional knowledge in upper-level physics courses.* 2013 Physics Education Research Conference (Poster Symposium)
11. John M. Aiken, Shih-Yin Lin, Scott S. Douglas, Brian D. Thoms, Marcos D. Caballero, Michael F. Schatz. *Computational Modeling Activities Designed in a Two Week Teacher Workshop.* Summer AAPT meeting 2013 (poster, talk).
10. John M. Aiken, Scott S. Douglas, Edwin Greco, Michael F. Schatz. *Intro Physics MOOC with a Real Lab.* Georgia Tech MOOC Showcase (Talk).
9. B. Wilcox, M.D. Caballero, R. Pepper, S. Pollock. *Upper-division Student Understanding of Coulomb's Law: Difficulties with Continuous Charge Distributions.* 2012 Physics Education Research Conference, Philadelphia, PA (Poster)
8. B. Wilcox, M.D. Caballero, S. Chasteen, B. Zwickl, C. Baily, S. Pollock. *Resources for Research-based Instruction in Upper-Division Physics.* American Association of Physics Teachers 2012 Summer Meeting, Philadelphia, PA (Talk)
7. Scott S. Douglas, Marcos D. Caballero, John M. Aiken, Michael F. Schatz. *Computational Modeling as a Promoter of Cognitive Transfer: Pilot Study.* Summer AAPT 2012. (poster, talk)
6. John M. Aiken, Marcos D. Caballero, John B. Burk, Scott S. Douglas, Michael F. Schatz, Erin M. Scanlon, Brian D. Thoms (2012), *Embedding Numerical Computation in the Modeling Instruction Curriculum*, Physics Education Research Conference 2012 (Poster).
5. John M. Aiken, John B. Burk, Marcos D. Caballero, Scott S. Douglas, Michael F. Schatz, Brian D. Thoms (2012), *Extending Modeling Instruction with Computational Modeling: A Pilot Study*, AAPT Summer Meeting (Talk, Poster).

4. John M. Aiken, John B. Burk, Scott S. Douglas, Marcos D. Caballero, Michael F. Schatz, Erin Scanlon, Brian D. Thoms (2012), *Implementing and Assessing Computational Modeling in Modeling Instruction Curriculum*, Spring SACS-AAPT Meeting (Talk).
3. John M. Aiken, Michael F. Schatz, John B. Burk, Scott S. Douglas, Marcos D. Caballero, Erin Scanlon, Brian D. Thoms (2012), *Assessing the Integration of Computational Modeling and ASU Modeling Instruction in the High School Physics Classroom*, APS April Meeting (Talk).
2. John M. Aiken, Michael F. Schatz, John B. Burk, Marcos D. Caballero, Brian D. Thoms (2012), *Computational Modeling Integrated with ASU Modeling Instruction: Implementation and Assessment*, AAPT Winter Meeting (Talk, poster).
1. John M. Aiken, John B. Burk, Marcos D. Caballero, Michael F. Schatz, Brian D. Thoms (2011), *Exploring the Integration of Computational Modeling in the ASU Modeling Curriculum*, Fall SACS-AAPT Meeting (Talk, poster).

4.5.3 Workshops Delivered at National/Regional Meetings

7. Apr 2016, *Integrating Computation Across the Curriculum*, workshop delivered with M. Lopez del Puerto at 2016 Spring Chesapeake Section of the AAPT meeting, Ashford, VA
6. Apr 2016, *Integrating Computation Across the Curriculum*, workshop delivered with L. Englehardt at 2016 Spring SACS-AAPT meeting, Atlanta, GA
5. Jan 2016, *Projects and Practices in Physics: Inquiry-based computational instruction*, workshop offered with P.W. Irving & M.J. Obsniuk at 2016 AAPT Winter Meeting, New Orleans, LA
4. July 2014, *Interactive Engagement in the Upper-division: Methods and Materials from CU-Boulder*, workshop offered with S.J. Pollock (CU Boulder) at 2014 AAPT Summer Meeting, Minneapolis, MN
3. July 2013, *Interactive Engagement in the Upper-division: Methods and Materials from CU-Boulder*, workshop offered with S.J. Pollock (CU Boulder) at 2013 AAPT Summer Meeting, Portland, OR
2. Jan 2013, *VPython-based Video Games to Teach Physics*, workshop offered with A. Titus (High Point University) at 2013 AAPT Winter Meeting, New Orleans, LA
1. July 2012, *Computation and the Modeling Curriculum*, workshop offered with M.F. Schatz (Georgia Tech) at 2012 AAPT Summer Meeting, Philadelphia, PA

4.6 Talks

4.6.1 Conference Invited Talks

8. American Association of Physics Teachers Summer Meeting, Sacramento, CA, Jul 2016
7. APS Division of Atomic, Molecular, and Optical Physics Meeting, Providence, RI, May 2016
6. American Association of Physics Teachers Winter Meeting, New Orleans, LA, Jan 2016
5. American Association of Physics Teachers Summer Meeting, College Park, MD, July 2015
4. American Association of Physics Teachers Winter Meeting, San Diego, CA, Jan 2015
3. American Association of Physics Teachers Summer Meeting, Minneapolis, MN, Jul 2014
2. American Association of Physics Teachers Winter Meeting, Orlando, FL, Jan 2014
1. American Association of Physics Teachers Winter Meeting, Ontario, CA, Feb 2012

4.6.2 Colloquium and Seminars

28. Departmental Colloquium, Texas State University, San Marcos, TX, Apr 2016
27. Departmental Colloquium, Central Michigan University, Mt. Pleasant, MI, Mar 2016
26. Departmental Colloquium, University of St. Thomas, St. Paul, MN, Feb 2016
25. Research Seminar, The Ohio State University, Columbus, OH, Apr 2015
24. Departmental Colloquium, Saginaw Valley State University, University Center, MI, Feb 2015
23. Teaching Essentials Workshop, Michigan State University - College of Natural Science, East Lansing, MI, Feb 2015
22. Research Seminar, Wayne State University, Detroit, MI, Jan 2015
21. Research Seminar, Michigan State University - Dept. of Physics and Astronomy, East Lansing, MI, Jan 2015
20. Research Seminar (w/ C. Schwarz and T. Long), Michigan State University - CREATE For STEM, East Lansing, MI, Nov 2014
19. Research Seminar (w/ V. Sawtelle), Michigan State University - Dept. of Physics and Astronomy, East Lansing, MI, Aug 2014
18. Research Seminar (w/ D. Stroupe), Michigan State University - CREATE For STEM, East Lansing, MI, Apr 2014
17. Departmental Colloquium, University of Maine, Orono, ME, Apr 2014
16. Research Seminar, Purdue University, West Lafayette, IN, Feb 2014
15. Departmental Colloquium, Indiana University Purdue University Indianapolis, Indianapolis, IN, Feb 2014
14. Research Seminar, American Natural History Museum, Dec 2013
13. Research Seminar, Global Physics Department, globalphysicsdept.org, Dec 2013
12. Keynote address, University of Edinburgh, Edinburgh, UK, May 2013
11. Research Seminar, University of Colorado Boulder, Boulder, CO, Apr 2013
10. Departmental Colloquium, University of Colorado Boulder, Boulder, CO, Mar 2013
9. Research Seminar, Michigan State University, East Lansing, MI, Mar 2013
8. Departmental Colloquium, Rochester Institute of Technology, Rochester, NY, Jan 2013
7. Research Seminar, Global Physics Department, globalphysicsdept.org, Sep 2012
6. Research Seminar, Global Physics Department, globalphysicsdept.org, Apr 2011
5. Departmental Colloquium, Georgia State University, Atlanta, GA, Apr 2011
4. Research Seminar, University of Colorado PER group, Boulder, CO, Mar 2011
3. Research Seminar, Massachusetts Institute of Technology RELATE group, Cambridge, MA, Feb 2011
2. Research Seminar, University of Minnesota PER group, Minneapolis, MN, Feb 2011
1. Departmental Colloquium, Spelman College, Atlanta, GA, Apr 2010

5 Teaching

5.1 Special Teaching Contributions

In the fall of 2013, I developed and implemented a suite of active learning activities for the large-lecture introductory mechanics course. The activities include discussion questions, conceptual clicker questions, choose-your-own adventure examples, and screen-casted examples. These materials have been cataloged, and archived for future instructor use. These preliminary materials have demonstrated learning gains that are higher than typical instruction (on traditional exams and end-of-course conceptual assessments), but they still require further development and testing. In the spring of 2014, I developed a similar suite of activities for the calculus-based E&M for life science students course that I taught in Lyman Briggs.

Over the summer and fall of 2015 as part of a funded research project, PERL developed a project-based learning introductory, calculus-based mechanics course called *Projects and Practices in Physics* (P^3). The course includes computational modeling projects, new pre-class and post-class homework, course notes and videos. All of the materials are available online: <http://pcubed.pa.msu.edu>. For this work, we developed 28 in-class projects (6 that include computational modeling) and 420 new homework problems (a mix of conceptual and mathematical), which were coded into LON-CAPA.

In the Fall of 2014, this course was taught for the first time with great success; student performance on conceptual metrics were high and the SIRS scores were good. As part of this offering, we developed a co-teaching model to bring new faculty into the teaching of this course. It was taught again by another faculty member, with a third faculty member co-teaching, in the spring of 2015 with similar learning gains and SIRS scores. This course continues to be developed and materials continue to be improved upon based on research efforts by PERL. The course has been offered to twice as many students this fall and spring with two additional faculty members co-teaching it. We will scale sections up to 100 students in the next year and this work is informing future developments of introductory course offerings in physics (i.e., a new E&M course and a new course for life science majors).

In the Fall of 2015 and Spring of 2016, I worked with PERL and departmental colleagues to develop and implement a new laboratory for life science students (252 lab) called Design, Analysis, Tools, Apprenticeship (DATA) lab. DATA lab uses a group-based and experimental-design-focused pedagogy to engage students in experimental physics practices. To do this, we developed 12 new laboratory activities as well as the structural elements to support student work in that environment (including homework, formative feedback, and lab notebook guidelines). Borrowing somewhat from P^3 , the lab includes formative feedback each week about students work in groups and their work using laboratory notebooks. Students also prepare and present aspects of their experiments twice per semester in abstract, poster, and/or oral presentation formats. DATA lab is modeled off professional science practice – a set of consensus goals developed from discussions with physics faculty in Fall of 2015 and further articulated in the document, *AAPT Recommendations for the Undergraduate Physics Laboratory Curriculum*. Presently, DATA lab is taught to roughly 60 students in 3 sections. This summer, we will teach all six sections of 252 (≈ 120 students) in the DATA lab format. Scaling up to more sections will occur in the fall and spring of next year. In addition, we will be developing DATA lab for 251 over the next year.

Because P^3 and DATA lab facilitates student learning in a group-based pedagogy, instruction for both require additional teaching staff. This is a challenge that many large universities have solved using undergraduate learning assistants. As part of this work, PERL has taken the lead and begun piloting a learning assistant (LA) program in physics. A robust LA program is part of the department's long-term plan to improve undergraduate instruction in physics. At present, we have 12 learning assistants who have taught P^3 . This fall, this program will continue to scale up and will begin to make use of a more coherent professional development program, which PERL will co-develop with departmental colleagues.

5.2 Post-doctoral associates

5.2.1 Main Supervisor

1. William Martinez, August 2015 –
2. Paul W. Irving, May 2014 –
3. James T. Laverty, August 2013 –

4. Leanne Doughty, January 2014 – January 2016
(Postdoctoral Researcher, University of Colorado Denver)
5. Steven F. Wolf (25%), August 2013 – August 2014
(Assistant Professor of Physics, Eastern Carolina University)

5.2.2 Co-supervised Post-doctoral associates

1. Brian Danielak, August 2015 – (w/ Brian O'Shea & Vashti Sawtelle)

5.3 Graduate Students

5.3.1 Graduate Students (Main Supervisor)

1. Alanna Pawlak (2013 –)
2. Michael Obsniuk (2013 –)

5.3.2 Graduate Students (Co-supervisor)

1. Kelsey Funkhouser (2015 – , w/ Asst. Prof. Vashti Sawtelle; has not selected advisor yet)
2. Abhilash Nair (2015 – , w/ Asst. Prof. Vashti Sawtelle; has not selected advisor yet)
3. John Aiken (Georgia State, Master's Thesis, 2013)

5.3.3 PhD students on temporary projects (summer etc)

1. Thomas Finzell (FAST Fellowship, 2013 – 2014)
2. Adam Fritsch (FAST Fellowship, 2013 – 2014)

5.3.4 Collaborating PhD students (Other Departments)

1. May Lee (Teacher Education, 2013 –)
2. James Brian Hancock II (Teacher Education, 2013 –)

5.3.5 Ph.D. Thesis Committee service (not supervised/co-supervised students)

1. Thomas Finzell (Astronomy, Observational)
2. Forrest Phillips (Physics, High Energy)
3. Christopher Minter (Chemistry, Education)
4. May Lee (Teacher Education)

5.4 Undergraduate Students

5.4.1 Undergraduate Students supervised on research

1. Kristy Griswold (MSU, Spring 2016)
2. Nathaniel Hawkins (MSU, Fall 2015, Spring 2016)
3. Anna Turnbull (MSU, Fall 2014, Spring 2015, Summer 2015, Fall 2015, Spring 2016)
4. Paul Hamerksi (REU – Carnegie Mellon University, Summer 2015, Fall 2015, Spring 2016)
5. Laura Hunter (REU – Mt. Holyoke College, Summer 2015)
6. Sonny Ly (MSU, Spring 2014, Summer 2014, Fall 2014, Spring 2015, Fall 2015, Spring 2016)
7. Claire Morrison (MSU, Fall 2013, Spring 2014, Summer 2014, Fall 2014, Spring 2015, Fall 2015, Spring 2016)
8. Keenan Noyes (MSU, Fall 2013, Spring 2014, Fall 2014, Spring 2015)
9. Zach Nusbaum (MSU, Fall 2013, Spring 2014, Summer 2014, Fall 2014, Spring 2015)
10. Brandon Ewert (MSU, Spring 2014)
11. Max Smith (MSU, Fall 2013, Spring 2014)

5.4.2 Undergraduate Students supervised on teaching

1. Madelyn Klinkoski (Fall 2015)
2. Brandon Bilinski (Fall 2015)
3. Lauren Constantini (Fall 2015)

4. Brandon Roek (Fall 2015)
5. Ashley O'Brien (Fall 2015)
6. Steven Collareno (Spring 2015, Fall 2015)
7. Katherine Wampler (Spring 2015, Fall 2015)
8. Melissa Buchelli (Spring 2015)
9. Tyler Hoffman (Spring 2015)
10. Karen Davidge (Spring 2014, Spring 2015)
11. Stephanie Schmidt (Spring 2015)

6 Service

6.1 University Committees

- MSU, University Committee on Undergraduate Education, Fall 2016 –
- MSU Dept. of Physics and Astronomy, Lyman-Briggs/PA Faculty Search Committee, Fall 2015 – Spring 2016
- MSU Dept. of Physics and Astronomy, Algebra-based Physics Review committee, Spring 2014 –
- MSU Dept. of Physics and Astronomy, Calculus-based Physics Review committee, Spring 2014 –
- MSU Dept. of Physics and Astronomy, Undergraduate Program committee, Fall 2013 –
- MSU Dept. of Physics and Astronomy, Instructor Search Committee, Fall 2014 – Spring 2015
- MSU Dept. of Physics and Astronomy, Qualifying Exam committee, Fall 2013 – Spring 2014
- MSU Dept. of Physics and Astronomy, Advising committees (other than own graduate students) for May Lee (Teacher Education)
- Thesis committee for John Aiken, Georgia State University, Atlanta, GA (Fall 2013)

6.2 National or International Advisory Committees other than Conferences

- Chair-Elect, Group on Physics Education Research for the American Physical Society (Fellowship Sub-committee), Winter 2016 –
- Vice-Chair, Group on Physics Education Research for the American Physical Society, Winter 2015 – Winter 2016
- Member, Research in Physics Education Committee for the American Associate of Physics Teachers, Winter 2015 –
- Chair of the Educational Technologies Committee for the American Association of Physics Teachers, Winter 2013 – Winter 2014 (Written report has shaped AAPT’s educational technology initiatives.)
- American Journal of Physics, Five Year Review Committee, 2012–2013 (Written report is shaping the journal’s online presence.)
- Educational Technologies Committee for the American Association of Physics Teachers, Winter 2010–Winter 2014

6.3 Conference Planning and Advisory Committees

- Michigan AAPT Section Spring Meeting, East Lansing, MI (2015).
- Physics Education Research Conference, Minneapolis, MN (2014).
- MSP Summer Science Academies Concepts in Physical Science (2011).
- Atlanta Metro Physics Teachers Network, Atlanta, GA (2011).
- Atlanta Metro Physics Teachers Network, Atlanta, GA (2010).
- MSP Summer Science Academies Concepts in Physical Science (2009).
- MSP Summer Science Academies Concepts in Physical Science (2008).

6.4 Review Panels, Referee

- Referee for Physical Review Special Topics - Physics Education Research, American Journal of Physics, The Physics Teacher, Computers and Education
- Referee for Physics Education Research Conference proceedings

6.5 Outreach Activities

- Physics and Astronomy Day, Impression 5 Science Museum, East Lansing, MI (2016)
- MSU Department of Physics & Astronomy, Physics Education Research Seminar coordinator (2014–).
- MSU Department of Physics & Astronomy, Graduate Teaching Assistant Workshop coordinator (2014–).
- Science Olympiad, Session coordinator, East Lansing, MI (2014–).
- Grandparent’s University at MSU, Session coordinator, East Lansing, MI (2014).