

BENEDIKT W. HARRER, PH.D.

Department of Physics and Astronomy

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EDUCATION

University of Maine, Orono, ME	Physics	Ph.D.	2013
Dissertation Title: <i>Identifying Productive Resources in Middle School Students' Discourse about Energy</i>			
Dissertation Advisors: Michael C. Wittmann, Rachel E. Scherr			
Ludwig Maximilians University, Munich, GER	Physics/Mathematics	LAG (eq. M.S.)	2009

APPOINTMENTS

San José State University, San José, CA

Assistant Professor, Department of Physics and Astronomy, August 2015 - present

University of California, Berkeley, CA

Lecturer, School of Education, August 2014 - August 2015

Lecturer, Cal Teach Berkeley, January 2014 - August 2015

Coordinator, Cal Teach Summer Research Institute, January 2014 - August 2015

University of Maine, Orono, ME

Graduate Research Assistant, September 2010 - December 2013

Graduate Teaching Assistant, September 2009 - December 2010

Ludwig-Maximilians-University, Munich, GER

Research Assistant, April 2006 - February 2009

Josef-Effner-Gymnasium, Dachau, GER

Substitute Physics Teacher, AY 2007/2008

Gabrieli-Gymnasium, Eichstätt, GER

Substitute Musical Instruments Teacher (trumpet, piano), AY 2004/2005

RESEARCH INTERESTS

Learning of scientific practices, esp. in physics

Learners' ideas in physics, their informal assessment, and responsive teaching

Physics pre- and in-service teacher learning in formal and informal professional development settings

PUBLICATIONS

PEER-REVIEWED RESEARCH ARTICLES

1. Flood, V.J., **Harrer, B.W.**, & Abrahamson, D. (2016). The interactional work of configuring a mathematical object in a technology-enabled embodied learning environment. In C.-K. Looi, J. L. Polman, U. Cress, & P. Reimann (Eds.), *Transforming Learning, Empowering Learners. The*

International Conference of the Learning Sciences (ICLS) 2016 (Vol. 1, pp. 122–129). Singapore: International Society of the Learning Sciences.

- Scherr, R.E., **Harrer, B.W.**, Close, H.G., Daane, A.R., DeWater, L.S., Robertson, A.D., Seeley, L., Vokos, S. (2016) "Energy Tracking Diagrams." *The Physics Teacher*, 54(2), 96-102.
- Flood, V.J., Amar F.G., Nemirovsky R., **Harrer, B.W.**, Bruce, M.R.M., and Wittmann, M.C. (2015) "Paying Attention to Gesture when Students Talk Chemistry: Interactional Resources for Responsive Teaching," *Journal of Chemical Education*, 92(1), 11-22. DOI: 10.1021/ed400477b
- Harrer, B.W.**, Flood, V.J., Wittmann, M.C. (2013) "Productive resources in students' ideas about energy: An alternative analysis of Watts' original interview transcripts," *Physical Review Special Topics - Physics Education Research* 9, 023101. DOI: 10.1063/1.4789677
- Harrer, B.W.**, Flood, V.J., Wittmann, M.C. (2013) "How Students Talk about Energy in Project-Based Inquiry Science," in AIP Conference Proceedings 1513, *2012 Physics Education Research Conference Proceedings*, 162-165. DOI: 10.1103/PhysRevSTPER.9.023101
- Harrer, B.W.**, Scherr, R.E., Wittmann, M.C., Close, H.G., Frank, B.W. (2012) "Elements of Proximal Formative Assessment in Learners' Discourse about Energy," in AIP Conference Proceedings 1413, *2011 Physics Education Research Conference Proceedings*, 203-206. DOI: 10.1063/1.3680030

ARTICLES IN PEER-EDITED JOURNALS

- Colicchia, G., Waltner, Chr., Wiesner, H., **Harrer, B.** (2010) "Wenn Klimabedingungen gefährlich werden können – die Gefahr des Hitzschlags." ("When climate conditions can become dangerous - danger of heat stroke") *Praxis der Naturwissenschaften Physik in der Schule*, 59(2), 16-25.
- Harrer B.**, Waltner, Chr., Siegmund Ch. (2009) "Sofortbild-Lochkamera." ("Instant film pinhole camera") *Naturwissenschaften im Unterricht. Physik*, 20(111 / 112), 80-83.
- Lang, M., **Harrer, B.** (2008) "Ist ein Fingerabdruck einzigartig? Eine Methode zur Herstellung einer Fingerabdruckattrappe." ("Is a fingerprint unique? A method for creating a fingerprint dummy") *Praxis der Naturwissenschaften Physik in der Schule*, 57(5), 44.
- Harrer, B.**, Lang, M., Hopf, M. (2008) "Blutnachweis mit Luminol." ("Blood detection with Luminol") *Praxis der Naturwissenschaften Physik in der Schule*, 57(5), 45.
- Harrer, B.**, Lang, M. (2008) "Farben, Licht und Kriminalistik – Auf Spurensuche mit Kommissar Licht." ("Colors, light and forensics - Crime scene investigation with detective Light") *Praxis der Naturwissenschaften Physik in der Schule*, 57(5), 31-36.
- Lang, M., **Harrer, B.** (2008) "Gefälscht! Eine Sammlung von Schüleraktivitäten zum Thema 'Fälschungen'." ("Bogus! A collection of student activities on the topic of forgeries") *Praxis der Naturwissenschaften Physik in der Schule*, 57(5), 27-30.
- Harrer, B.**, Lang, M., Hopf, M., Wiesner, H. (2008) "Bei Gewitter ist man im Auto sicher! Ein Modellversuch zum Faraday'schen Käfig." ("During a thunderstorm, you are safe in a car. A model experiment about the Faraday cage") *Praxis der Naturwissenschaften Physik in der Schule*, 57(2), 45-48.

RESEARCH ARTICLES IN PROGRESS

- Harrer, B.W.** (under review) "On the origin of energy: Metaphors and manifestations as resources for conceptualizing and measuring the invisible, imponderable." Submitted to the *American Journal of Physics* on 05/10/2016.
- Flood, V.J., **Harrer, B.W.** (in preparation). "I.R. Oops: The interactional work of transforming Initiation, Response, Evaluation sequences into student-led inquiry."

3. **Harrer, B.W.** (in preparation) "Instrumentation for video-based research in physics education." To be submitted to *Physical Review Physics Education Research*.
4. **Harrer, B.W.**, Flood, V.J. (in preparation) "Monkeys and Bananas: Tracing the situated productivity of resources in a classroom conversation about energy." To be submitted to the *Journal of Research in Science Teaching*.

INVITED TALKS

1. "Multimodal Analysis of the Interactional Work of Transforming Participation Structures in a Middle-School Classroom," **Harrer, B.W.** & Flood, V.J., Physics Education Research Conference (PERC) 2016, Sacramento, CA
2. "Physical Intuitions about Patterns of Motion: Investigating Balance, Oscillation, and Threshold with a Weighted Wheel," **Harrer, B.W.**, San José State University, Science 285 Seminar Series Spring 2015, San José, CA

CONTRIBUTED TALKS

1. "Monkeys and Bananas: Middle School Students' Productive Ideas About Energy," **Harrer, B.W.**, Flood, V.J., AAPT Winter Meeting 2015, San Diego, CA
2. "Categorizations of Energy: Forms, Carriers, Types, and Transfers," McKagan, S.B., **Harrer, B.W.**, Scherr, R.E., AAPT Winter Meeting 2013, New Orleans, LA
3. "Student-Teacher Interactions for Bringing Out Student Ideas About Energy," **Harrer, B.W.**, Wittmann, M.C., Scherr, R.E., AAPT Summer Meeting 2012, Philadelphia, PA
4. "How Students Talk about Energy in PBIS," **Harrer, B.W.**, Wittmann, M.C., Flood, V.J., National Conference on Integrating STEM Education Research into Teaching: Knowledge of Student Thinking 2012, University of Maine, Orono, ME.
5. "Two right answers: The difficulty of reconciling competing physics commitments," **Harrer, B.W.**, Scherr, R.E., Wittmann, M.C., Frank, B.W., Close, H.G., AAPT Summer Meeting 2011, Omaha, NE
6. "Finding Evidence for Teachers' Intentions in Video using Participation Frameworks," **Harrer, B.W.**, Scherr, R.E., Wittmann, M.C., Frank, B.W., Close, H.G., AAPT Winter Meeting 2011, Jacksonville, FL

INVITED POSTER

"Elements of Proximal Formative Assessment in Learners' Discourse about Energy," **Harrer, B.W.**, Scherr, R.E., Wittmann, M.C., Close, H.G., Frank, B.W., Physics Education Research Conference (PERC) 2011, Omaha, NE

CONTRIBUTED POSTERS

1. "Instrumentation for Video-Based Research in Physics Education," **Harrer, B.W.**, AAPT Summer Meeting 2016, Sacramento, CA
2. "Physics and the Berkeley Engineering Research Experience for Teachers (BERET)," **Harrer, B.W.**, Stone, E.M., AAPT Winter Meeting 2015, San Diego, CA
3. "Categorizations of Energy: Forms, Carriers, Types, and Transfers," McKagan, S.B., **Harrer, B.W.**, Scherr, R.E., AAPT Winter Meeting 2013, New Orleans, LA
4. "Student-Teacher Interactions for Bringing Out Student Ideas About Energy," **Harrer, B.W.**, Wittmann, M.C., Scherr, R.E., Physics Education Research Conference 2012, Philadelphia, PA

5. "It's not just about what people say: Multiple Ways of Seeing a Student's Thinking," **Harrer, B.W.**, Scherr, R.E., Wittmann, M.C., Foundations and Frontiers of Physics Education Research (FFPER) 2011, Bar Harbor, ME
6. "Finding Evidence for Teachers' Intentions in Video using Participation Frameworks," **Harrer, B.W.**, Scherr, R.E., Wittmann, M.C., Frank, B.W., Close, H.G., AAPT Winter Meeting 2011, Jacksonville, FL
7. "Describing Collaborative Activity in Terms of Substantive and Interactional Constraints," Frank, B.W., Kaczynski, A., **Harrer, B.W.**, Wittmann, M.C., AAPT Summer Meeting 2010, Portland OR

ROUNDTABLES

1. Collaborative Around Research Experience for Teachers (CARET) – Shared Metrics for Researching Outcomes of Research Experiences for Pre-Service and In-Service Teachers. Keller, J., Johnson, B., **Harrer, B.W.**, APLU SMTI Conference 2015, New Orleans, LA
2. Master Teacher Special Interest Group on Mobile Educational Technology. FitzPatrick, D., Bertrand, P., Andrew, J., Lewis, S., Williamson, C., **Harrer, B.W.**, 9th Annual UTeach Conference 2015, Austin, TX

PH.D. THESIS

Harrer, B.W. (2013). *Identifying productive resources in secondary school students' discourse about energy*. (Order No. 3579450, The University of Maine). *ProQuest Dissertations and Theses*. Retrieved from <http://search.proquest.com/docview/1506723946?accountid=14496>. (1506723946).

UNPUBLISHED

Harrer, B., "Kontextorientierter Physikunterricht – Physik in der Kriminalistik. Empirische Erhebung und Anwendungsbeispiel." ("Context oriented physics instruction - Physics in forensics. An empirical investigation and application example") Schriftliche Hausarbeit im Rahmen der ersten Staatsprüfung für das Lehramt an Gymnasien (Degree Thesis).

GRANTS

RSCA (RESEARCH, SCHOLARSHIP & CREATIVE ACTIVITY) SPRING 2016 PROPOSAL: WAVESIPP – WAVES AND SYNTHESIZERS IN PHYSICS PROJECT

Awarded \$4,933 for an exploratory study to investigate how tapping into students' experience, expertise, and interest in music and sound supports learning about waves using musical synthesizers.

NSF EEC #1542471: BERKELEY ENGINEERING RESEARCH EXPERIENCES FOR TEACHERS + COMPUTING (BERET⁺C) PROGRAM (CO-PRINCIPAL INVESTIGATOR)

Awarded \$599,120 over a three-year period. This RET Site will offer an intensive summer research program for a total of 54 K-12 STEM in-service and pre-service teachers in high needs school districts in Oakland and San Francisco.

VERIZON-UTEACH SUBAWARD COHORT II 2014/2015

Awarded \$18,175 and 37 tablet computers as one of four mini-grant sites. Co-wrote grant application; active as local program coordinator and master teacher for the duration of the grant to train pre-service STEM teachers in the use of educational technology in their respective field placements.

RESEARCH AFFILIATIONS/EXPERIENCE

PRINCIPAL INVESTIGATOR

Productive Interactions and Ideas in Physics Laboratory (PI/IP Lab), San José State University

Discover the multimodal, interactional resources learners and teachers use to develop and express their ideas together, and investigate how these resources are used to make significant progress toward disciplinary engagement with issues and practices in physics – to learn “how to do physics.”

GRADUATE RESEARCH ASSISTANT

University of Maine, Orono, ME

2012-2013 Assessing, Validating and Developing Content Knowledge for Teaching Energy, NSF grant # DRL 1222580

2010-2013 Maine Physical Sciences Partnership, NSF grant # DUE 0962805

Collect and analyze video data of teacher professional development courses and middle school classrooms for research on teachers' development of pedagogical content knowledge and content knowledge, and how such knowledge influences classroom practices and student achievement.

Seattle Pacific University, Seattle, WA

2011-2012 Energy Project, NSF grant # DRL 0822342

Analyze video data collected during teacher professional development courses at SPU and middle school classrooms, using methods of conversation and interaction analysis, in order to understand how to best teach the study of energy in K-12 primary and physics classrooms.

Ludwig-Maximilians-University, Munich, GER

2008-2009 Thesis Project

Develop a survey to investigate students' interest in physics instruction in the context of forensic sciences, perform statistical analysis, and develop curriculum introducing optics phenomena in the context of forensics for grade level 7.

2006-2009 K-12 Curriculum Development and Evaluation

Involvement in the ongoing research effort to develop and evaluate new physics curriculum for K-12 instruction, including demonstration and student laboratory experiments.

SEATTLE PACIFIC UNIVERSITY ENERGY PROJECT SUMMER RESEARCH INSTITUTE (EPSRI)

Scholar in the EPSRI 2010 and 2011, observing, documenting, and reflecting on the energy project summer professional development courses for K-12 teachers.

TEACHING INTERESTS

Introductory physics

Educational theory

Research methods in science and education

TEACHING AND MENTORING EXPERIENCE

UNDERGRADUATE

San José State University, San José, CA

Spring 2016:

Fundamentals of Physics 1

Lead instructor for the first semester algebra-based introduction to the principles of heat, energy, mechanics, and sound that used the Collaborative Learning through Active Sense-making in Physics (CLASP) curriculum to facilitate students' conceptual understanding of physics.

Fall 2015:

Fundamentals of Physics 1

Instructor for **one discussion section** of an algebra-based introduction to the principles of heat, energy, mechanics, and sound that used the Collaborative Learning through Active Sense-making in Physics (CLASP) curriculum to facilitate students' conceptual understanding of physics.

Fundamentals of Physics 2

Instructor for **one laboratory section** of the continuation of Foundations of Physics 1, in which students conducted experiments in the areas of electricity and magnetism, optics, and atomic structure.

University of California, Berkeley, CA

Spring 2015:

K-8 Teaching and Inquiry-Based Lesson Design in the Science and Mathematics Classroom (Lower Division)

This course surveys basic approaches to K-8 science and mathematics teaching through modeling inquiry-based teaching and discussion. Topics include inquiry-based pedagogy, assessment techniques, lesson plan design and revision, and child development.

Knowing and Learning in Mathematics and Science (Upper Division)

Issues of cognition, culture, and pedagogy emerge from participants' experience explaining their reasoning while engaging in a sequence of collaborative problem-solving and reflection activities to develop a coherent, effective approach to the teaching and learning of science and math.

Research Methods for Science and Mathematics K-12 Teachers (Upper Division)

Interactive learning activities (incl. labs) allow future teachers to practice specific techniques—including statistics, mathematical modeling, and scientific writing—needed to address scientific questions and enable them to guide their future students in the development of scientific skills.

Fall 2014:

Teaching Science with Middle School Students (Lower Division)

This course focuses on the fundamentals of sixth to eighth grade science education through demonstrations, skill modeling, and discussion. Topics include inquiry-based pedagogy, assessment techniques, empirically based lesson revision, and adolescent development.

Knowing and Learning in Mathematics and Science (Upper Division)

See Spring 2015.

Research Methods for Science and Mathematics K-12 Teachers (Upper Division)

See Spring 2015.

Summer 2014:

Knowing and Learning in Mathematics and Science (Upper Division)

See Fall 2014.

Integrating Research Methods into K-12 Teaching in Mathematics and Science (Upper Division)

This course for participants in the Cal Teach summer research institute is designed to provide connections between research experience in a research laboratory and teaching in the K-12 classroom. Hands-on inquiry-based science and math lessons are modeled and discussed.

Spring 2014:

Teaching Science with Middle School Students (Lower Division)

See Fall 2014.

Research Methods for Science and Mathematics K-12 Teachers (Upper Division)

See Fall 2014.

PROFESSIONAL/GRADUATE

University of California, Berkeley, CA

Spring 2014:

Apprentice Teaching

This course supports new science and mathematics teachers in earning a credential for teaching in California secondary schools. Effective teaching methods for science and math classrooms are emphasized, incl. lesson planning, assessment, and support for English language learners.

UNDERGRADUATE MENTORING

San José State University, San José, CA

Nigel Pasman (Spring 2016). Undergraduate Research Assistant in the Productive Interactions and Ideas about Physics Laboratory.

University of Maine, Orono, ME

Clarissa Lovegren, Seattle Pacific University (Summer 2012). Mentoring during a Research Experience for Undergraduates sponsored by the PhysTEC Noyce Scholarship program. Individual research project: Middle School Teachers' Use of Language while teaching Energy with Project-Based Inquiry Science.

WORKSHOPS

University of Maine, Orono, ME

High School Physics and Physical Science Teachers Meeting 2011: Argumentation and inquiry in the classroom using the example question "Are all the colors in the Rainbow?" together with Brian W. Frank.

High School Physics and Physical Science Teachers Meeting 2010: "Curvy Graphs: Using graphing to avoid doing math" based on materials from the Intuitive Quantum Physics curriculum (see below), together with Adam Kaczynski and Thomas Wemmys.

TEACHER PROFESSIONAL DEVELOPMENT

University of Maine, Orono, ME

2010-2012 Maine Physical Sciences Partnership, NSF grant #DUE 0962805

Co-design and co-lead activities about energy for middle school physical science teachers, especially in the context of the Project-Based Inquiry Science curriculum, during teacher collaboratives and summer professional development courses.

GRADUATE TEACHING ASSISTANT

University of Maine, Orono, ME

Fall 2010:

Descriptive Physics - Intuitive Quantum Physics

Instructor for **one laboratory section** of a one-semester “general education” course using materials developed by PERL at the University of Maine to help non-science majors develop insight into waves, probability, and energy to understand basic concepts in quantum physics.

Spring 2010:

General Physics II

Instructor for **one recitation section** of the continuation of General Physics I (see below) that used University of Washington tutorials to deepen students’ conceptual knowledge of physics, as well as **two laboratory sections**, in which students conducted experiments and presented their results.

Fall 2009:

General Physics I

Instructor for **one recitation section** of an algebra-based introduction to the principles of mechanics, energy, heat, sound and properties of matter that used University of Washington as well as Open Source Tutorials to deepen students’ conceptual knowledge of physics.

Descriptive Physics - Intuitive Quantum Physics

See Fall 2010. Instructor for **two laboratory sections** during the Fall 2009 semester.

Ludwig-Maximilians-University, Munich, GER

Summer 2006 - Winter 2008/09

Demonstration laboratories and physics education seminars for preservice teachers

Co-instructor for the **demonstration laboratory** and its accompanying **physics education seminar**, which are integral parts of the German pre-service physics teacher education. The two-semester sequence conveys results of practice-oriented physics education research.

SECONDARY SCHOOL TEACHER

Josef-Effner-Gymnasium, Dachau, GER

AY 2007/08, 7th grade Physics

Instructor for the physics portion of “Nature and Technology” in two 7th grade classes, an introduction to optics, electrodynamics and magnetism with the goal to enable students to explain phenomena like images of mirrors, phases of the moon, or simple electric circuits.

Gabrieli-Gymnasium, Eichstätt, GER

AY 2004/05, 6th and 8th grade Trumpet and Piano

PROFESSIONAL ACTIVITIES AND SERVICE

Reviewer for Physical Review Physics Education Research

Reviewer for the American Journal of Physics

Reviewer for The Physics Teacher

Co-organizer (with Luke Conlin, Stanford University) for “Methodologies for Video-Based Research in PER” at Physics Education Research Conference (PERC) 2016, Sacramento, CA

This invited talk symposium provided opportunities to examine a range of video-based research methodologies. Methods and their theoretical framing were discussed with a focus on kinds of questions, research design, and claims about knowledge and learning.

Coordinator of the Cal Teach Summer Research Institute and Co-Director of the Berkeley Engineering Research Experiences for Teachers (BERET) 2014 and 2015

The summer institute is a research experience for undergraduate pre-service STEM teachers from universities across the UC system. In the BERET program, undergraduate participants are paired up with in-service teachers to conduct research together in campus labs.

Reviewer of the Association of Public Land-Grant Universities/Science & Mathematics Teacher Imperative's Next Generation Science Standards Curriculum Alignment Tool (CAT), Spring 2014

Worked with faculty across the U.S. on reviewing the NGSS CAT for undergraduate STEM teacher preparation. Examined the materials and approaches used in teaching the course Research Methods at UC Berkeley in light of the Next Generation Science Standards.

Moderator for "Cultural Influences on Physics Teaching: Identifying Factors, Implementing Change" at Physics Education Research Conference (PERC) 2012, Philadelphia, PA

This invited poster symposium, organized by Natan Samuels (Florida International University, Miami), addressed cultural influences on physics teaching by presenting and discussing new findings from various physics learning contexts.

PROFESSIONAL AFFILIATIONS

National Science Teachers Association (NSTA), since 2014

National Association for Research in Science Teaching (NARST), since 2012

American Association of Physics Teachers (AAPT), since 2010

Deutsche Physikalische Gesellschaft (DPG, German Physical Society), since 2002

REFERENCES

PROF. MICHAEL KAUFMAN

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