

# Ian David Beatty

## Curriculum Vitae

### Contact Information

Scientific Reasoning Research Institute  
University of Massachusetts Amherst  
710 N. Pleasant St. #B-416  
Amherst, MA 01003-9305 USA

+1.413.545.9483  
beatty@srri.umass.edu  
<http://srri.umass.edu/beatty>  
<http://ianbeatty.com>

### Education

Ph.D., Physics (2000), University of Massachusetts Amherst.

- Research area: physics education.
- Dissertation: *ConMap: Investigating New Computer-Based Approaches to Assessing Conceptual Knowledge Structure in Physics*.

B.S., Physics (1990), University of Massachusetts Amherst.

- *Summa Cum Laude* honors thesis:  $O_1^+ \rightarrow O_2^+$  Electron Scattering Form-Factors in  $^{40}\text{Ca}$  and  $^{48}\text{Ca}$  (nuclear theory).

### Appointments

Feb 2006 — present: Research Assistant Professor, UMass Amherst.

Jun 2002 — Feb 2006: Senior Postdoctoral Research Associate, UMass Amherst.

Jun 2000 — May 2002: Postdoctoral Research Associate, UMass Amherst.

Feb 1991 — May 2000 (intermittent): Research Assistant, UMass Amherst.

Sep 1991 — May 2000: Teaching Assistant, UMass Amherst.

### Research Interests

Physics education research and general science/mathematics education research, especially:

- developing comprehensive pedagogical theory.
- investigating teacher change and professional development strategies;
- theoretically modeling cognition and learning processes; and
- exploring innovative approaches to instruction and assessment.

Professional development of science and mathematics teachers, especially focused on:

- effective use of classroom response system technology;
- student-centered instructional strategies and classroom dynamics; and
- outreach to teachers, teacher educators, and educational researchers, especially in developing countries.

Instructional technology and software development, especially:

- conceptualizing next-generation classroom response systems;
- investigating the pedagogical implications of technology design;
- developing new web applications to support instruction; and
- exploring the pedagogic possibilities afforded by new technology.

## Grant Support

National Science Foundation grant ESI-0456124: *Teacher Learning of Technology-Enhanced Formative Assessment* (2004), \$2,499,968. Co-PIs: W. J. Leonard, W. J. Gerace, & A. P. Feldman.

Hewlett-Packard Corp. Applied Mobile Technology Solutions in Learning Environments 2003 Grant Initiative: *The Hewlett-Packard Classroom for Technology-Enabled Active Learning*, \$225,510 (2003). Co-PI: W. J. Gerace.

Microsoft Corp. external research grant for mobile computing in the classroom, \$52,098. (2003). Co-PI: W. J. Gerace.

## Experience

### Research on physics learning and assessment:

- Developed data-gathering instrumentation and research plan for a major research study on pedagogical change in secondary school science teachers; managed and largely directed the project; supervised graduate and undergraduate research assistants; designed and conducted professional development for in-service teachers; and led data analysis (2005 — present).
- Participated in a multi-university collaboration to design a "Sciences of Learning Center" focused on the development of a rich theoretical model of physics learning and knowledge use (2003 — 2004).
- Participated in panel discussions and working groups at invited conferences on the transfer of learning (*Transfer of Learning*, National Science Foundation, Arlington VA, March 2002), on the transformative potential of interactive pedagogies and classroom networks (*CATAALYST Workshop*, SRI International, Menlo Park CA, April 2004), and other topics.
- Advised graduate students in Physics Education Research (2002 — present).
- Conducted dissertation research on computer-based assessments of students' evolving conceptual knowledge structures (1995 — 2000).
- Collaborated on many other projects within the context of an active research group.

### International outreach work on science teacher professional development:

- Worked with science education researchers in Argentina (Universidad Nacional de Córdoba), South Africa (many), Cyprus (Ministry of Education), and Uganda (Makerere University) to conduct secondary science teacher professional development activities and develop curricula for teacher enhancement programs (1996 — present).
- Served as a visiting professor at the University of Fort Hare, Alice, Eastern Cape, South Africa (2006).

### **Curriculum design:**

- Co-designed and co-taught innovative, activity-based conceptual physics course for Singaporean hotel and restaurant industry professionals: UMass Physics 100, taught in Singapore in partnership with the Singapore Hotel Association's trade school SHATec (2005).
- Co-designed and co-taught postgraduate course in science pedagogy for future science faculty members: "Learning teaching: What every professor should know about science instruction" in the Facultad de Ciencias Químicas (Faculty of Chemical Sciences) of the Universidad Nacional de Córdoba, Argentina (2005).
- Created, taught, and refined a two-semester laboratory curriculum for introductory physics majors' sequence, consistent with current perspectives in physics education research and pedagogic philosophy (1992 — 1996).

### **Instructional software development:**

- Assisted in the design of the UMass OWL web-based homework system, representing the Physics Department to the system's creators in the Computer Science Department; developed software modules to extend OWL and collaborated in the design of OWL's plug-in architecture (1998 — 2004).
- Designed graphical user interfaces and developed software for the NSF-funded *Physics Analysis Workbench* project (DUE-9950323, 2001 — 2004).
- Developed *ConMap*, a suite of computer-based tools for assessing students' conceptual knowledge association, currently used by UMass graduate students for educational research projects (1996 — 2004).
- Project lead, software architect, and programming team manager for development of the *Knowledge Broker*, a next-generation classroom response system using tablet PCs and wireless networking (2003 — 2005).

### **Website authoring & web application development:**

- Developed and maintained websites, web applications, and course website frameworks for the UMass Physics Department, Physics Education Research Group, and Scientific Reasoning Research Institute (1996 — present).
- Developed a database-backed web application for the *Assessing-to-Learn* project (ESI-9730438), originally supporting project participants and now serving as a public resource (2000 — 2005).

### **Computer modeling:**

- In collaboration with the UMass Department of Wildlife and Fisheries Biology and the US Forest Service, developed a complex ecological computer model for multi-species forest growth and mortality and coarse woody debris accumulation in upland and riparian stands; co-wrote the accompanying user's guide (2002 — 2003).

## Professional Service

Manuscript reviewer for *The Physical Review: Special Topics in Physics Education Research* and *The American Journal of Physics* (2002 — present).

Web site designer, web site/server administrator, and network backup system administrator for UMass Scientific Reasoning Research Institute (2000 — present).

Web site designer and administrator for UMass Department of Physics (2000 — 2004).

## Publications

Beatty, I. D., Leonard, W. J., Gerace, W. J., & Dufresne, R. J. (2006), "Question based agile teaching: Teaching science (well) with an audience response system." In Banks, D. A. (Ed.), *Audience Response Systems in Higher Education: Applications and Cases*. Idea Group Inc., Hershey PA. ISBN 1-59140-947-0 (hardcover), 1-59140-948-9 (paperback), 1-59140-949-7 (e-book). <<http://srri.umass.edu/publications/beatty-2006qdi>>

Beatty, I. D., Leonard, W. J., Gerace, W. J., & Dufresne, R. J. (2006), "Designing effective questions for classroom response system teaching." *American Journal of Physics* 74(1) 31-39. <<http://srri.umass.edu/publications/beatty-2006deq>>

Gerace, W. J. & Beatty, I. D. (2005), "Teaching vs. learning: Changing perspectives on problem solving in physics instruction." Proceedings of the *9th Common Conference of the Cyprus Physics Association and Greek Physics Association: Developments and Perspectives in Physics—New Technologies and Teaching of Science* (invited), Nicosia, Cyprus, Feb 4-6. <<http://srri.umass.edu/publications/gerace-2005t1c>>

Beatty, I. D., Leonard, W. J., & Gerace, W. J. (2005), *Assessing-to-Learn in the Classroom*. Thomson Learning. <<http://physics.brookscole.com/a21c>>

Beatty, I. D. (2004), "Transforming Student Learning with Classroom Communication Systems." Educause Center for Applied Research (ECAR) Research Bulletin ERB0403, Feb 3. <<http://srri.umass.edu/publications/beatty-2004ts1>>

Beatty, I. D. & Gerace, W. J. (2002), "Probing physics students' conceptual knowledge structures through term association." *American Journal of Physics* 70 (7) 750-758. <<http://srri.umass.edu/publications/beatty-2002pps>>

Beatty, I. D. (2000), "ConMap: Investigating New Computer-Based Approaches to Assessing Conceptual Knowledge Structure in Physics." University of Massachusetts Amherst Ph.D. dissertation. <<http://srri.umass.edu/publications/beatty-2000cin>>

## Talks, Workshops & Posters

Beatty, I. D. (2008), "Modeling teacher change", an invited talk presented to the Bureau of Educational Research, Department of Educational Psychology, and Department of Physics at the University of Illinois, Urbana-Champaign, IL, May 13.

Beatty, I. D. (2008), "Modeling teacher change", an invited talk presented to the Department of Physics at the University of North Carolina, Greensboro, NC, Apr 22.

- Beatty, I. D., Feldman, A., Lee, H., St. Cyr, K. & Harris, R. (2008) "Teacher learning of technology-enhanced formative assessment," a special symposium presented at the Annual International Conference of the US National Association for Research in Science Teaching (NARST), Baltimore, MD, Apr 01.
- Beatty, I. D., Gerace, W. J., Leonard, W. J. & Feldman, A. (2008) "Teaching with classroom response technology ('clickers')," a workshop at the Annual National Conference of the US National Physics Teachers Association (NSTA), Boston, MA, Mar 29.
- Feldman, A., Beatty, Ian D., Leonard, William J. & Gerace, William J. (2008) "Technology-Enhanced Formative Assessment: An innovative approach to the teaching and learning of science," a contributed talk at the Annual Meeting of the American Educational Research Association (AERA), New York, NY, Mar 24.
- Phillis, Randall W. & Schneider, Stephen E. & Lavoie, Nathalie & Beatty, Ian D. & Maloy, Robert W. (2008) "Writing effective PRS questions," a workshop for the campus community by the "PRS Best Practice Fellows" project of the UMass President's Office and the UMass Amherst Center for Teaching, Amherst, MA, Mar 05.
- Feldman, A., Beatty, I. D., Leonard, W. J. & Gerace, W. J. (2008) "Technology-Enhanced Formative Assessment: An Innovative Approach To Student-Centered Science Teaching," a paper presented at the 2008 Association for Science Teacher Education (ASTE) International Conference, St. Louis, MO, Jan 10–12.
- Beatty, I. D. (2007) "Teacher Learning of Technology-Enhanced Formative Assessment: A research project involving secondary school science and math, classroom response systems, and teacher professional development," an invited colloquium for the UMass STEM Institute, Amherst, MA, Dec 4.
- Beatty, I. D. (2007) "A bleeding-edge early-adopter technophile's experience with web dissemination," an invited presentation for the "Short and Snappy Author Rights Colloquy," University of Massachusetts Amherst, Nov 29.
- Beatty, I. D. & Gerace, W. J. (2007) "Teaching Science with Technology-Enhanced Formative Assessment," an invited workshop for Bahamas public school science teachers organized by the Bahamas Ministry of Education, Nassau, Bahamas, Nov 16.
- Gerace, W. J. & Beatty, I. D. (2007) "Question driven instruction with classroom response technology," an invited workshop for Connecticut public school teachers, Greater Hartford Academy of Math and Science, Hartford, CT, Nov 6.
- Gerace, W. J. & Beatty, I. D. (2007) "Question driven instruction with classroom response technology," an invited workshop at the Fall 2007 Joint Meeting of the New England Sections of the American Physical Society and the American Association of Physics Teachers (AAPT), University of Connecticut, Storrs, CT, Oct 20.
- Leonard, W. J., Beatty, I. D. & Gerace, W. J. (2007) "Getting Started with TEFA," a four-day workshop for science and mathematics teachers from Northampton High School, Northampton, MA participating in the *Teacher Learning of Technology-Enhanced Formative Assessment* project, Aug 14–17.

- Beatty, I. D. (2007) "Pedagogical theme 1: Question Driven Instruction (QDI)," a mini-presentation as part of the "Getting Started with TEFA" workshop at Northampton High School, Northampton, MA, Aug 15.
- Beatty, I. D. (2007) "Pedagogical theme 2: Formative Assessment (FA)," a mini-presentation as part of the "Getting Started with TEFA" workshop at Northampton High School, Northampton, MA, Aug 16.
- Beatty, I. D. (2007) "Pedagogical theme 3: Dialogical Discourse (DD)," a mini-presentation as part of the "Getting Started with TEFA" workshop at Northampton High School, Northampton, MA, Aug 17.
- Ortiz, E. L., Beatty, I. D., Dufresne, R. J. & Gerace, W. J. (2007) "Using artificial neural networks to predict how students answer questions in physics," contributed poster CP-56 at the Physics Education Research Conference of the Summer Meeting of the American Association of Physics Teachers (AAPT), Greensboro NC, Aug 1.
- Beatty, I. D. & Gerace, W. J. (2007) "QDI+TEFA: A radical research-based pedagogy with radical results," a workshop for the Faculty of Education, University of Johannesburg, South Africa, June 4.
- Gerace, W. J. & Beatty, I. D. (2007) "Getting started with educational research," a seminar for postgraduate students in the RNA project, Faculty of Education, University of Johannesburg, South Africa, June 2.
- Beatty, I. D. & Gerace, W. J. (2007) "A research project on science teacher professional development," a workshop for the Faculty of Education, University of Johannesburg, South Africa, May 31.
- Gerace, W. J. & Beatty, I. D. (2007) "Constructivism: Implications for instruction and learning," part 1 of a workshop for the Faculty of Education, University of Johannesburg, South Africa, May 28.
- Beatty, I. D. & Gerace, W. J. (2007) "Formative assessment and dialogical discourse: Magic keys to constructivist, student-centered instruction," part 2 of a workshop for the Faculty of Education, University of Johannesburg, South Africa, May 28.
- Beatty, I. D. (2007) "De-trivializing classroom response systems," an invited seminar for the Physics Education Research Group, Department of Physics, The Ohio State University, Feb 12.
- Beatty, I. D. (2006) "Scaling physics the smart way: With guidance from PER — Physics Education Research for Students," guest lecture for Physics 185 (Freshman Colloquium), University of Massachusetts Amherst Department of Physics, Sep 18.
- Beatty, I. D., Leonard, W. J., Feldman, A., & Gerace, W. J. (2006) "Illuminating teacher learning of technology-enhanced formative assessment," contributed talk DH05 at the Summer Meeting of the American Association of Physics Teachers (AAPT), Syracuse NY, Jul 22–26. AAPT Announcer 36(2) 133. <<http://ianbeatty.com/blog/?p=23>>
- Beatty, I. D., Leonard, W. J., Gerace, W. J. & Feldman, A. (2006) "Teacher learning of technology-enhanced formative assessment," contributed poster EJ07–24 at the Summer Meeting of the

American Association of Physics Teachers (AAPT), Syracuse NY, Jul 22–26. <[http://ianbeatty.com/files/posters/AAPT\\_2006-06\\_Poster\\_EJ07-24.pdf](http://ianbeatty.com/files/posters/AAPT_2006-06_Poster_EJ07-24.pdf)>

- Ortiz, E. L., Gerace, W. J., Dufresne, R. J., & Beatty, I. D. (2006) "Investigating learning capabilities of artificial neural networks," contributed poster EJ04–01 at the Summer Meeting of the American Association of Physics Teachers (AAPT), Syracuse NY, Jul 22–26. AAPT Announcer 36(2) 150.
- Gerace, W. J. & Beatty, I. D. (2006) "Agile teaching of physics," a workshop for science teachers at the Makerere University experimental school, Kampala, Uganda, May 25.
- Gerace, W. J. & Beatty, I. D. (2006) "Agile teaching of physics," a workshop for faculty and in-service science teachers at the University of KwaZulu-Natal, Durban, South Africa, May 5.
- Gerace, W. J. & Beatty, I. D. (2005), "Learning to think with physics: A minds-on and hands-on approach to physics instruction," an invited seminar for the Pedagogical Institute, Nicosia, Cyprus, Nov 25.
- Gerace, W. J. & Beatty, I. D. (2005), "A constructivist approach to promoting active learning in secondary physics classes," a series of four invited workshops for physics teachers organized by the Cyprus Ministry of Education in Nicosia, Larnaka, Pafos, and Limassol, Cyprus, Nov 21–24.
- Beatty, I. D. (2005) "Formative assessment and agile teaching: Re-framing physics instruction," an invited talk at the 90th Reunión Nacional de Física of the Asociación Física Argentina, La Plata, Argentina, Sep 27.
- Gerace, W. J. & Beatty, I. D. (2005), "Learning versus Teaching: What every professor should know about science instruction," an intensive short graduate course for faculty and in-service teachers of the Facultad de Ciencias Químicas, Universidad Nacional de Córdoba, May 4–12.
- Beatty, I. D. (2005), "Methodologies for cognitive research in physics education," an invited seminar for the Grupo Enseñanza Ciencia y Tecnología, Universidad Nacional de Córdoba, Argentina, May 02.
- Gerace, W. J. & Beatty, I. D. (2005), "Teaching vs. Learning: A research-based approach to science instruction," an invited workshop for pre-service science teachers at Universidad Nacional de San Luis, April 29.
- Gerace, W. J. & Beatty, I. D. (2005), "Learning to think with physics: A minds-on and hands-on approach to physics instruction," a series of invited workshops for physics teachers organized by the Cyprus Ministry of Education, Feb 3–11.
- Beatty, I. D., Gerace, W. J., & Leonard, W. J. (2005), "Designing effective questions for classroom response system teaching," contributed talk BL05 at the Winter Meeting of the American Association of Physics Teachers (AAPT), Albuquerque NM, Jan 8–12. AAPT Announcer 34 (4), 84.
- Gerace, W. J., & Beatty, I. D. (2005), "Agile Teaching: Real-time formative assessment with a classroom response system," contributed talk BL03 at the Winter Meeting of the American Association of Physics Teachers (AAPT), Albuquerque NM, Jan 8–12. AAPT Announcer 34 (4), 84.

- Beatty, I. D., Leonard, W. J., Dufresne, R. J., & Gerace, W. J. (2004), "Bridging conceptual understanding to problem solving through qualitative analysis activities," invited talk DG03 at the Summer Meeting of the American Association of Physics Teachers (AAPT), Sacramento CA, Aug 2–5. *AAPT Announcer* 34 (2), 142.
- Gerace, W. J., Dufresne, R. J., & Beatty, I. D. (2004) , "Incorporating qualitative analysis in science instruction," an invited workshop for pre-service and in-service science teachers at the Facultad de Matemática, Astronomía y Física, Universidad Nacional de Córdoba, Argentina, June 4.
- Gerace, W. J., Dufresne, R. J., & Beatty, I. D. (2004) , "Current projects of the UMass Physics Education Research Group," an invited talk at the meeting *Cognitive processes involved in problem-solving: Theoretical and methodological issues and instructional implications*, Seminario el Meyor, Santa Maria, Cordoba, Argentina, May 29.
- Gerace, W. J., Dufresne, R. J., & Beatty, I. D. (2004) , "Agile Teaching (Enseñanza Ágil): Research-based strategies and practices for improving science instruction," an invited talk at the meeting *Cognitive processes involved in problem-solving: Theoretical and methodological issues and instructional implications*, Seminario el Meyor, Santa Maria, Cordoba, Argentina, May 27.
- Dufresne, R. J., Gerace, W. J., Leonard, W. J., & Beatty, I. D. (2002), "Assessing-to-Learn (A2L): Reflective formative assessment using a classroom communication system," invited paper at *Pathways to Change: An International Conference on Transforming Math and Science Education in the K16 Curriculum*, Crystal City, Arlington VA.
- Beatty, I. D. (2001), "Modeling knowledge structure and learning," an invited seminar for the Grupo Enseñanza Ciencia y Tecnología, Universidad Nacional de Córdoba, Argentina, Nov 14.
- Beatty, I. D., Dufresne, R. J. & Gerace, W. J. (2001), "ConMap: Investigating Computer-Based Approaches to Assessing Conceptual Knowledge Structure," contributed talk HA01 at the Joint Winter Meeting of the American Association of Physics Teachers (AAPT) and the American Astronomical Society (AAS), San Diego CA, Jan 6–11. *AAPT Announcer* 30 (4), 133.
- Beatty, I. D. (2000), "Assessing Conceptual Knowledge Structure through Term Association Probes," an invited seminar for the Scientific Reasoning Research Institute, University of Massachusetts Amherst, Nov 02.
- Leonard, W. J., Gerace, W. J., Beatty, I. D. & Lee, D. G. (1999), "Bring your brain! Demonstrations of science using common household items," 3 sets of interactive demonstrations for ~100 high school students at Naauwoort School, Rustenburg, South Africa, Aug 20.
- Leonard, W. J., Gerace, W. J., Beatty, I. D. & Lee, D. G. (1999), "Bring your brain! Demonstrations of science using common household items," 4 sets of interactive demonstrations for ~90 children ages 3–18 at St. Philomena's Home for Children, Durban (Sydenham), South Africa, Aug 16–17.
- Leonard, W. J., Gerace, W. J., & Beatty, I. D. (1996), "Demonstrations of scientific principles using common household items," 2 sets of interactive demonstrations for 8th grade students at St. Mary's School for Girls, Kloof, South Africa, Nov 29.



- Leonard, W. J., Gerace, W. J., & Beatty, I. D. (1996), "Demonstrations of scientific principles using common household items," an interactive demonstration for 7th grade students at Northcrest Primary School, Durban (Parkhill), South Africa, Nov 29.
- Leonard, W. J., Gerace, W. J., Beatty, I. D. & Lee, D. G. (1996), "Demonstrations of scientific principles using common household items," 3 sets of interactive demonstrations for children ages 3–18 at St. Philomena's Home for Children, Durban (Sydenham), South Africa, Nov 4–6.
- Leonard, W. J., Gerace, W. J., Beatty, I. D. & Lee, D. G. (1996), "Teaching scientific methods using common household items," a mini-workshop for grade 1–6 in-service teachers at The Foundation School, Johannesburg (Melville) South Africa, Oct 29.
- Leonard, W. J., Gerace, W. J., Beatty, I. D. & Lee, D. G. (1996), "Demonstrations of scientific principles using common household items," 7 sets of interactive demonstrations for students in grades 5–8 at The Foundation School, Johannesburg (Melville), invited and sponsored by the Department of Curriculum Studies at Rand Afrikaans University, Johannesburg, South Africa, Oct 28–29.
- Gerace, W. J., Beatty, I. D. & Poon, S. (1996), "Demonstrations of scientific principles using common household items," a workshop for teachers and gifted students at Bement School, Derfield, MA, July 8.

## Consulting

Consulted on research design, science pedagogy, and professional development for the *Teacher Development in Ecologies of Practice* project of the Center for Education Practice Research, Faculty of Education, University of Johannesburg, South Africa, May 23 2007 — present.

Facilitated and advised at a planning meeting for a joint project between the Universidad Nacional de Córdoba and Universidad Nacional de San Luis Physics Education Research groups, held outside San Luis, Argentina, April 27–28 2005.

Provided external assessment of student assessment for the Five College “Minds•On Physics” course through the *Western Massachusetts Partnership MMPS Project*, Aug 10–13 2004.

## Software & Web Products

EDC Scoring Tool: Developed a free, publicly available web application to help instructors use William Leonard's "Every Decision Counts" scheme for multiple marks on multiple-choice optically scanned exams. <<http://edc.physics.umass.edu>>

OWL Custom Inputs for Graphs & Free Body Diagrams: Developed Java-based plug-ins to extend the functionality of the UMass OWL web-based homework system. These plug-ins permit students to sketch a graph or free-body diagram as their answer to a homework question, and then grade their response by comparison to an instructor's graph or diagram. Available within UMass OWL Physics database. Can be installed into other databases by request to OWL administrators. <<http://owl.oit.umass.edu>>

NECWD: Developed simulation software implementing a complex forest growth and mortality model, the *New England Coarse Woody Debris* model, developed by UMass Forestry and

Wildlife Management graduate student Anna Patnode. (Lester, Anna (2004), "Predicting coarse woody debris dynamics in northeast forests," University of Massachusetts Amherst Masters Thesis.)

A2L: Developed a database-backed web repository of formative assessment questions for use in teaching physics with a classroom response system, as a product of the *Assessing-to-Learn (A2L)* project (NSF ESI-9730438). <<http://A2L.physics.umass.edu>>

OutlineRenderer: A free, publicly available tool for producing structured HTML documents from minimal-markup outlines in UserLand *Frontier*. (Obsolete, no longer supported.)