

## **Tina A. Grotzer**

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### **TEACHING AND RESEARCH FOCUS**

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Cognition and Learning; Learning Sciences, Innovative Pedagogies; Science Education; Complex Causal Reasoning; Development; Curriculum and Instructional Design; Leveraging Technology to Teach Complex Concepts; Climate Change and Sustainability

### **PROFESSIONAL EXPERIENCE AND ACADEMIC AFFILIATIONS**

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*Principal Research Scientist and Member of the Faculty of Education*, Harvard University, 2016 to present.

*Principal Investigator*, Project Zero, Harvard Graduate School of Education, 1996 to present. Director, Next Level Lab/ Cognition in a Complex World Lab.

*Associate Professor of Education*, Harvard Graduate School of Education, 2010 to 2016.

*Faculty*, Center for Health and the Global Environment (CHGE), Harvard School of Public Health, 2008 to 2016.

*Assistant Professor of Education*, Harvard Graduate School of Education, 2006 to 2010.

*Lecturer*, Harvard Graduate School of Education, 2005 to 2006.

### **EDUCATION**

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Harvard University, Ed.D., Human Development and Psychology, Dissertation: *Children's Understanding of Complex Causal Relationships in Natural Systems*.

Harvard University, Ed.M., Human Development

Vassar College, B.A., Developmental Psychology

### **HONORS AND AWARDS**

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Morningstar Teaching Award, Harvard Graduate School of Education, 2013

Presidential Early Career Award for Scientists and Engineers (PECASE), U.S. Government, 2010

*\*Highest honor given by the United States Government to professionals beginning their independent research careers*

Career Award, National Science Foundation, 2009

Margaret Floy Washburn Graduate Fellowship, Vassar College

Ryland and Kendrick Graduate Fellowship, Vassar College

### **SELECTED AWARDS FOR PAPERS AND PRODUCTS DEVELOPED**

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Honorable Mention for Best Paper in the Association for Childhood Education International (ACEI) 2016 Distinguished Education Research Award Program, *Journal of Research in Childhood Education*.

Best Paper Award for 2015: Applied Research in Immersive Environments for Learning (ARIEL) SIG, American Educational Research Association.

"Race to the Top" Exemplary Curriculum Featured on Massachusetts Dept. of Education Website, 2014

Global Mobile Awards for EcoMOBILE, 2012

Association for Educational Communications and Technology (AECT) for EcoMUVE - 1<sup>st</sup> Place for the Interactive Category of the Immersive Learning Award, 2011

## **GRANTS AND FUNDED PROJECTS**

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Principal Investigator, *Next Level Lab: Applied Learning Sciences for Access, Innovation, and Mastery*, 8/15/20-8/14/22, Accenture Corporate Citizenship, \$762,000.

Principal Investigator, *Witness Tree Climate Change Project*, Harvard Forest, Climate Change Solutions Fund, Harvard University, 2/1/20-1/31/23, \$75,000 (on behalf of former PI, Dr. Timothy Rademacher).

Co-Principal Investigator (with Chris Dede and Karen Brennan), *EcoMOD: Integrating Computational Thinking in Ecosystem Science Education via Modeling in Immersive Virtual Worlds*, 9/15/2016-12/31/20, National Science Foundation, DRL-1639545, \$2,442,889.

Co-Principal Investigator (with Chris Dede), *EcoXPT: Affordances for Experimentation in an Immersive World to Support Learning of Ecosystems Science and Complex Causality*, 9/1/2014-2/29/20, National Science Foundation, DRL-1416781, \$2,915,750.

Co-Principal Investigator (with Chris Dede), *EcoMOBILE: Blended Real and Virtual Immersive Experiences for Learning Complex Causality and Ecosystems Science*, (9/1/2011-8/31/15), National Science Foundation, DRL-1118530, \$2,489,657.

Principal Investigator, *CAREER: Learning About Complex Causality in the Classroom*, 07/01/09-06/30/14, National Science Foundation, NSF#0845632, \$750,544.

Co-Principal Investigator (with Chris Dede), *Advancing Ecosystems Science Education via Situated Collaborative Learning in Multi-User Virtual Environments*, 07/01/08-06/30/12, Institute of Education Sciences, IES#R305A080514, \$1,500,000.

Principal Investigator, *Learning to RECAST Students' Causal Assumptions in Science Through Interactive, Multimedia Professional Development Tools*, 07/01/05-4/30/12, National Science Foundation #ESI-0455664, \$1,383,472.

Principal Investigator, *Extending the Understandings of Consequence Project: Investigating Strategic Challenges*, 07/01/01-06/30/05 National Science Foundation #REC-0106988, \$885,237.

Co-Principal Investigator (with David Perkins), *The Challenge of Developing Systems Thinkers: How Misconceptions about Complex Causality Contribute to Fundamental Problems in Scientific Learning*, 07/01/98-06/30/01 National Science Foundation #REC-9725502, \$837,690.

Co-Principal Investigator (with Shari Tishman and Steve Seidel), *Advanced Studies Research Group Planning Grant*, Spencer Foundation, \$50,000.

Principal Investigator, *Parent Partners Child Development Project* with the Brazelton Institute, Children's Hospital, Boston and Child Development Studies at UMASS Amherst (Kaplan) \$400,000.

Co-Principal Investigator (with Shari Tishman), *ArtWorks for Schools* with DeCordova Museum and Underground Railway Theater, Massachusetts Cultural Council (MCC), \$65,000, National Endowment for the Arts (NEA) \$10,000.

## **SELECTED K-12 LEADERSHIP AND TEACHING EXPERIENCE**

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*Educational and Pedagogical Advisor*, Developing and supporting the implementation of "Living Curriculum" Supporting Agentive Ambitions and Aims using Forward Design. Collaborative Learning Project, Concord, MA. 2017-2021.

*Professional Development Coordinator/Instructional Leader*, Burlington Public Schools, Burlington, MA. 1993-95. Led a district-wide focus on thinking-centered learning.

*District-Level Program Director/Teacher*, Elementary Academic Challenge and Enrichment Programs, Arlington Public Schools, Arlington, MA. 1987-93. *Teacher*, 1984-87.

*Advisor/Teacher*, Poughkeepsie Day School, Poughkeepsie, NY, 1981-84. Developed and implemented primary core program using child-centered, organic curriculum approach.

*Program Supervisor for Minority and Urban Youth*, Poughkeepsie Family DCCC, Poughkeepsie, NY. 1981. Developed/ran program for underserved, minority inner-city youth, ages 9-14.

*Title VII Integration Program Counselor for Urban Youth*, Poughkeepsie School District, Poughkeepsie, NY. 1979. Taught program to foster racial and ethnic awareness among entering middle schoolers.

## **PROFESSIONAL SERVICE**

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### **NATIONAL ADVISORY ROLES:**

- Advisory Board, MIT Woodrow Wilson Academy Biology Education Working Group, 2015- 2017.
- Invited Expert Reviewer, *Next Generation Science Standards*, Science, 2012-2013
- Advisory Board, *MEDScience*, Harvard Medical School, 2014 to present.
- Advisory Board, *Life on Earth*, E.O. Wilson, Biodiversity Project, 2010 to 2013.
- National Council Member, *Coastal Studies for Girls*, 2007 to 2017.
- Education Content Co-Director, *WGBH Sustainability Project*, 2008 to 2015.
- Advisory Board, *SciPlay*, *New York Hall of Science*, 2009 to 2011
- Advisory Board, *PBSKids Next Generation National Board*, 2006-2010.
- Editorial Advisory Council, *Wondertime Magazine*, Disney Publishing, 2005-2009.
- Panel Member and Reviewer, *American Academy of Arts and Sciences, Education and Evidence-Based Policy Project*: 2006-2007.
- Educational Advisor and Consultant, *Children's Television*, *Jim Henson Co.*, *Disney/ABC*, *Jumbo Pictures*, *Shadow Projects*, *PBS*- Advisor on science content, developmental appropriateness, and education: Plum Landing; Sesame Street; Electric Company; Stanley; Big, Big World; Bear in the Big Blue House; Book of Pooh; Jojo's Circus; Construction Site; PB&J Otter, two Emmy nominated shows for best children's program, and one winner of an environmental media award, 1996-present.
- Educational Advisor and Consultant, *Disney Education and Disney Interactive*, 1994-1997.

### **SELECTED REVIEW PANELS AND ADVISORY BOARDS:**

- Review Panelist, *National Science Foundation Advisory Panels, Directorate for Education and Human Resources (EHR); Division of Environmental Biology-* OERI Program, REPP/ROLE, ECR, SLC, LTER, EPSCoR, DRK12, 1998 to present.
- Advisor, Harvard Forest, *Witness Tree Climate Change Project*, 2020-present.
- Advisor, *Student Reasoning about Variation and Covariation: What do we Know, and What do we Need to Find Out?*, P.I.: Susan Kowalski, BSBC Science Learning, 2019- 2021.
- Advisor, *Building Systems from Scratch*, P.I. Gilly Puttick, TERC, 2015- 2020.
- Advisor, *CAREER: Causal Reasoning in Daily Life and its Role in Science Literacy*, P.I: Ben Rottman, University of Pittsburgh, LRDC, 2017- 2022.
- Invited Expert Review Panelist, Standing Member, Cognition and Basic Processes, *Institute for Education Sciences*, 2012-2015.
- Advisor, *EAGER: Cyberlearning: Towards virtual worlds that afford knowledge integration across project challenges and disciplines*. P.I. Janet Kolodner, Concord Consortium, 2015-2017.
- Advisor, *Development of Diagnostic Reasoning and Scientific Thinking*, P.I. David Sobel, Cognitive and Linguistic Sciences, Brown University, 2012-2016,
- Advisor, *Confronting the Challenges of Climate Literacy*, P.I. Tamara Ledley, TERC, Michigan State, Mississippi State, University of Texas, Institute of Geophysics, & SERC, Carleton College. 2010-2016.
- Advisor, *Data Explorations in Ecology Project*, P.I. Alan Berkowitz, Cary Institute for Ecosystems Study, 2010-2014.
- Advisor, *Curiosity, Exploratory Play, and the Foundations of Scientific Inquiry*, P.I. Laura Schulz, The Early Childhood Cognition Lab, MIT, NSF, 2008-2014.

- Advisor, *Tool Systems to Support Progress toward Expert-Like Teaching by Early Career Science Educators*, P.I.s Mark Windschitl, Jessica Thompson, and Melissa Braaten, The University of Washington, Seattle, NSF, 2008-2012.
- Advisor, *Mathematics and Science Partnership, Professional Development for Teachers*; P.I. Robbie McCarty, Southwestern Oklahoma State University, Math Science Partnership (MSP), 2009-2011.
- Advisor, *Sources of Mathematical Thinking*, P.I.s Liz Spelke, Susan Carey, Marc Hauser, Harvard, NSF, 2001.
- Advisor and Contributor, *Essential Science Series*- P.I. Matt Schneps, Harvard Smithsonian Science Media Group, Annenberg Foundation, 2001-05.
- Advisor and Contributor, *Everyday Classroom Tools*, P.I.s Christine Jones Forman and Eric Mandel, Harvard Smithsonian Center for High Energy Astrophysics, NASA, 1995-98.
- Advisor, *E.O. Wilson CD-ROM Project*, P.I. Dan Perlman, Harvard Conservation Biology Department, Island Press, 1996-99.

#### **JOURNAL EDITOR AND REVIEWERSHIPS:**

- Editorial Advisory Board, *Studies in Science Education*, Routledge
- Reviewer, *Journal of Research in Science Teaching*, Wiley
- Reviewer, *Mind, Brain, and Education*, Wiley
- Reviewer, *Cognition and Instruction*, Routledge
- Reviewer, *Frontiers in Developmental Psychology*, Frontiers
- Reviewer, *Child Development*, Wiley-Blackwell
- Reviewer, *Science & Education*, Springer
- Reviewer, *Science Education*, Wiley
- Reviewer, *Bioscience*, American Institute of Biological Sciences
- Reviewer, *Applied Environmental Education and Communication*, Taylor
- Reviewer, *Cognition and Instruction*, Taylor & Francis
- Reviewer, *Instructional Science*, Springer
- Reviewer, *Journal of the Learning Sciences*, Taylor & Francis
- Reviewer, *Journal of Biological Education*, Routledge

#### **SELECTED K-12 ADVISORY AND CURRICULUM REVIEW:**

- Subject to Climate, Advisory Board, Cambridge, MA. 2021-present.
- Education Committee Chair, *Tremont School*, Concord, MA. 2017-2021.
- Board of Directors, *Collaborative Learning Project*, Lexington, MA. 2015-2019.
- Science Curriculum Review, *Poughkeepsie Day School*, Poughkeepsie, NY. 2008-2009.
- Education Committee Chair, *Fayerweather Street School*, Cambridge, MA. 2008-2010.
- Science Panel, *Banneker School*, Cambridge, MA.
- Science Education Review Committee, *Arlington Public Schools*, Arlington, MA 1990-94.

#### **UNIVERSITY SERVICE**

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##### **TEACHING:**

T802A: Teaching Climate Change: Understanding the Challenges

T803A: Teaching Climate Change: Developing Curriculum and Other Educational Innovations

H110L: Becoming an Expert Learner

HT113: Research Practicum for Microschools: Developing Innovative Schools based on Neuroscience and Cognitive Science Principles

T543: Applying Cognitive Science to Teaching and Learning

T-227: Advancing the Learning and Teaching of Science: Methods Course

T800: Research and Evidence: Framing Scientific Research for Public Understanding

T540: Cognition and the Art of Instruction

**LABS:**

Next Level Lab: <https://nextlevellab.gse.harvard.edu/>

Cognition in a Complex World Lab: <http://clic.gse.harvard.edu/>

**CURRENT DISCUSSION GROUPS AND LECTURE SERIES:**

*Discussions in Climate Education Group (DiCE):* An on-going monthly discussion group for all interested students (2021-present).

*Next Level Lab Distinguished Speaker Series:* A speaker series open to the Harvard Community that brings distinguished guests in the Learning Sciences, Education, and Workforce Development to HGSE (Spring 2022).

*Community of Practice for K12 and Workforce Development:* Bi-monthly sessions including presentations and discussions for practitioners focused on applying the learning sciences to education in K12 and the workforce. (2020-present).

**MENTORSHIP AND COLLEGIALITY:****Post-Doctoral Research Fellows:**

- ♦ Amanda Dickes 2017-2019 (Co-mentored with Chris Dede)
- ♦ Meredith Thompson, 2014-2016
- ♦ M. Shane Tutwiler, 2014-2016
- ♦ Amy M. Kamarainen, 2009-2012, (Co-mentored with Chris Dede).

**Visiting Scholars:**

- ♦ Lydia Cao (Cambridge University)
- ♦ Maggie Minhong Wang (The University of Hong Kong)
- ♦ Abu Turab Rizvi (University of Vermont, Honors College)
- ♦ Carlos Vasco (Distinguished Scholar, Bogota, Colombia)
- ♦ Anat Zohar (Hebrew University)

**Doctoral Student Advisees (Harvard University):**

- ♦ Megan Powell Cuzzolino, Dissertation: "Experiences of Transformative Awe and the "Small Self" in Scientific Learning and Discovery" May 2019.
- ♦ Saida Lynne Solis, Dissertation: "Sociocultural Context of Play: Experiences of Indigenous Children in the Sierra Nevada de Santa Marta, Colombia" May 2018. Recipient of the Early Education/Child Development Dissertation Award from American Educational Research Association (AERA) May 2019.
- ♦ Maleka Iman Donaldson, Dissertation: "Teaching and Learning from Mistakes: Teachers' Responses to Student Mistakes in the Kindergarten Classroom" May 2017.
- ♦ Debbie Yu-Tzu Liu, Dissertation: "Understanding Systems Problem Solving: What Sets Expert vs. Competent Players Apart in High-Level Gameplay" May 2017.
- ♦ Laura Edwards, Dissertation: "Neural Processes of Language in Infants at High Risk for Autism Spectrum Disorder," November 2015.
- ♦ Vanessa Rodriguez, Dissertation: Exploring Social Cognition and Physiologic Synchrony during Teaching Interactions, May 2016.
- ♦ M. Shane Tutwiler, Dissertation: "Trends in the Salience of Data Collected in a Multi-User Virtual Environment: An Exploratory Study," November 2014.
- ♦ Rose Ellen Honey, Dissertation: "Bitterroots & Bull Trout: Traditional Culture in Science Classrooms on the Flathead Indian Reservation" May 2013.
- ♦ Kelly Leahy Whitney, Dissertation: "Exploring Traditional and Technological Enrichment: Preschool Parents and Emerging Digital Products," May 2013.
- ♦ Kathleen Kury Farrell, Dissertation: "Push the World Aside: Creating Space for Self-Reflection in Undergraduate Education," May 2013.

**Doctoral Committee Member (Harvard University Unless Otherwise Noted):**

- ♦ Eileen McGivney, in process.
- ♦ Joseph Reilly, Dissertation, “Dynamic Feedback as Automated Scaffolding to Support Learners and Teachers in Guided Authentic Scientific Inquiry Settings.” May 2020.
- ♦ Bryan Mascio, Dissertation, “Learning to Teach: A Mixed-Methods Study of Interns Learning the Skills of Teaching” May 2018.
- ♦ Luke Shors, Dissertation: “An Investigation into the Effectiveness and Potential Limitations of Analogy and Metaphor Use in Biology Textbooks.” November 2016.
- ♦ Juhong Park, (Massachusetts Institute of Technology) Dissertation: “Synthetic Apprenticeship: Profiling Students and Tailoring Pedagogic Solutions in Design Scripting Education,” July 2015.
- ♦ Caroline J. Courter (University of North Carolina, Wilmington), “Implications of EcoMUVE Conversations Considering the Intersection of Critical Thinking and STEM Education,” May 2015.
- ♦ Leslie J. Duhaylongsod, QP: “Taking a Stand in History: Urban Middle School Students’ Argumentation in Classroom Debate,” 2013.
- ♦ Rebecca Miller, QP: “Natural Sciences 4 and the Shaping of Postwar America,” 2009.
- ♦ Ralph Ian Campbell, Dissertation: “Looking at Science Learning in Classrooms from the Perspective of Basil Bernstein’s Theory of the Structure of Pedagogic Discourse,” 2011.
- ♦ Adrienne Tierney, QP: “Understanding Variability in Using EEG to Study Autism: Lessons Learned and the Potential Role for Development in Guiding Future Research,” 2009.
- ♦ Cassie Bowman, Dissertation: “Animated Pedagogical Agents as Virtual Scientist Mentors: A Mixed Methods Study,” 2008.

**COMMITTEE SERVICE:**

2020-2021: Special Studies Program Advisor; Climate Change Solutions Fund Proposal Review Panel; Campus Sustainability Innovation Fund Review Committee; MedScience Advisory Board, Harvard Medical School; Project Zero Steering Committee; Harvard Forest Witness Tree Advisor

2019-2020: Admissions; Special Studies Program Advisor; Climate Change Solutions Fund Proposal Review Panel; Campus Sustainability Innovation Fund Review Committee; MedScience Advisory Board, Harvard Medical School; Project Zero Steering Committee

2018-2019: Admissions; Teacher Education Program Advisor; Climate Change Solutions Fund Proposal Review Panel; Campus Sustainability Innovation Fund Review Committee; MedScience Advisory Board, Harvard Medical School; Project Zero Steering Committee

2015-2016: Admissions; HILT Faculty Advisory Group; Climate Change Solutions Fund Proposal Review Panel; Center for Health and the Global Environment, Advisory Board HSPH; MedScience Advisory Board, Harvard Medical School; Project Zero Steering Committee

2014-2015: Teaching Work Group, Faculty Chair; Admissions; Committee on Rights and Responsibility; Curriculum Planning Committee; Climate Change Solutions Fund Proposal Review Panel; Center for Health and the Global Environment, Advisory Board HSPH; MedScience Advisory Board, Harvard Medical School; Project Zero Steering Committee; Harvard Extension School Masters Theses Advisor

2013-2014: Committee on Curriculum and Instruction, Faculty Chair; Admissions; University Hearing Pool; Center for Health and the Global Environment, Advisory Board HSPH; EdLD Learning and Teaching Think Tank; Teacher Education Committee; Technology Working Group; Harvard Initiative on Global Health; Project Zero Principal Investigator; Harvard Extension School Masters Theses Advisor; J-Term Session on Writing Successful Fellowship Proposals

2006-2013: [On Leave Fall, 2012] Faculty Work Group on Human Development, Learning and Teaching for the PhD committee; Center for Health and the Global Environment, Advisory Board HMS; Admissions; Dean’s Summer Fellowship Committee; Doctoral Fellowship Proposal Committee, Chair of Committee on Curriculum and Instruction; HSPH Health Communication Concentration Speaker Series, Green Carpet Awards for Sustainability; HILT Proposal Faculty Review Committee to Advise President Faust; Board of Overseers Presentation; Learning Technology Faculty Search; Center for Health and the Global Environment, Advisory Board HMS; J-Term Session-Writing Successful Fellowship Proposals; Committee on Curriculum and Instruction; Teaching and Learning Circle Co-chair (with Bridget Terry Long).

**PUBLICATIONS (student names italicized)**

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- Grotzer, T.A., Gonzalez, E., & *McGivney, E.* (in press). Teaching students to grasp complexity in biology education using a “Body of Evidence” approach. In O. Ben-Zvi Assaraf & M.C.P.J. Knippels (Eds.) *Complexity in Biology Education*, NY: Springer Nature.
- Bonte, M., et al. (2022). ‘*Foundations of academic knowledge*’ in Bugden, S. & Borst, G. (eds.) *Education and the learning experience in Reimagining education: The International Science and Evidence based Education Assessment* [Duraiappah, A.K., Atteveldt, N.M. van et al. (eds.)]. New Delhi: UNESCO MGIEP.
- Grotzer, T.A. (2021, November). Deeper Learning Towards What?: The Nature of Deep Understanding, *Creative Teaching and Learning*, Imaginative Minds, Birmingham, UK.
- Grotzer, T.A. (2021, August). From Engaged to Agentive: Why Is It Time to Raise Learning to the Next Level? *Creative Teaching and Learning*, Imaginative Minds, Birmingham, UK.
- Grotzer, T.A. Gonzalez, E., & *Forshaw, T.* (2021, July). What is Next Level Learning and why does it matter? *Creative Teaching and Learning*. Imaginative Minds, Birmingham, UK.
- Kamarainen, A. Grotzer, T., Thompson, M., *Sabey, D.* & *Haag, B.* (2021). Teacher views of experimentation in ecosystem science, *Journal of Biological Education*, DOI: [10.1080/00219266.2021.1933130](https://doi.org/10.1080/00219266.2021.1933130)
- Chen, J., Wang, M.W., Dede, C.J., & Grotzer, T.A. (2021). Analyzing student-constructed concept maps and their association with student learning outcomes in an inquiry learning context, *Instructional Science*, 49(3), 287-312.
- Grotzer, T.A., Gonzalez, E., & Schibuk, E. (2021). Cause and Effect: Mechanism and Prediction. In J. Nordine & O. Lee (Eds.) *Crosscutting Concepts: Strengthening Science and Engineering Learning*. NSTA: Arlington, VA.
- Gonzalez, E., Grotzer, T.A., *McGivney, E.*, & *Reilly, J.* (2021). Details matter: How contrasting design features in two MUVES impact learning outcomes. *Technology, Knowledge, and Learning*. DOI: 10.1007/s10758-021-09513-6.
- Grotzer, T.A., Gonzalez, E., & *Forshaw, T.* (2021). *How fast fish sink or swim: Adopting an agentive view of learners*. The Next Level Lab at the Harvard Graduate School of Education. President and Fellows of Harvard College: Cambridge, MA.
- Grotzer, T.A., & *Forshaw, T.* (2021). *How next level learning enables a more powerful vision for transfer*. The Next Level Lab at the Harvard Graduate School of Education. President and Fellows of Harvard College: Cambridge, MA.
- Grotzer, T.A., *Forshaw, T.*, & Gonzalez, E. (2021). *Developing Adaptive Expertise for Navigating New Terrain: An Essential Element of Success in Learning and the Workplace*. The Next Level Lab at the Harvard Graduate School of Education. President and Fellows of Harvard College: Cambridge, MA.
- Grotzer, T.A., & *Forshaw, T.* (2021). *Reframing conceptions of transfer by Applying Learning Sciences to Workforce Development*. Next Level Lab. President and Fellows of Harvard College.
- Reilly, J.*, *McGivney, E.*, Dede, C.J., & Grotzer, T.A. (2020) Assessing science identity exploration in immersive virtual environments: A mixed methods approach. *The Journal of Experimental Education*. <https://doi.org/10.1080/00220973.2020.1712313>.
- Grotzer, T.A. (2020, April). Beyond wonder and care – Becoming a green thinker. Tomorrow’s Earth Stewards. <https://sites.tufts.edu/earthstewards/2020/04/08/beyond-wonder-and-care-becoming-a-green-thinker/>
- Solis, S. L.*, Grotzer, T.A. & Curtis, K.N. (2019). “There must be a cat nearby”: Kindergarteners’ reasoning about ‘Action at an Attentional Distance.’ *Journal of Educational and Developmental Psychology*, 9(2), 182-202.

- Dede, C., Grotzer, T., Kamarainen, A., & Metcalf, S. (2019). Designing immersive authentic simulations that enhance motivation and learning: EcoLearn. In R. Feldman (Ed.), *Learning science: Theory, research, practice*. New York: McGraw Hill.
- Metcalf, S.J., Chen, J. A., Kamarainen, A M., Frumin, K., Vickrey, T.L., Grotzer, T.A. & Dede, C.J. (2019). Transitions in student motivation during a MUVE-based ecosystem science curriculum: An evaluation of the novelty effect, In K. Becnel. (Ed.) (pp 96-115) *Emerging Technologies in Virtual Learning Environments*, IGI Global.
- Kamarainen, A. M., & Grotzer, T.A. (2019). Constructing causal understanding in complex systems: Epistemic strategies used by ecosystem scientists, *BioScience*, 69(7), 533–543.
- Reilly, C.M., Yang, S.Y., Grotzer, T.A., Joyal, J.A., & Oriol, N.E. (2019). Pedagogical moves and student thinking in technology-mediated medical problem-based learning: Supporting novice-expert shift, *British Journal of Educational Technology*, 50(5).
- Dickes, A. C., Kamarainen, A., Metcalf, S., Gün-Yildiz, S., Brennan, K., Grotzer, T. & Dede, C. (2019). Scaffolding ecosystems science practice by blending immersive environments and computational modeling, *British Journal of Educational Technology*, 50(5), 2181-2202.
- Grotzer, T.A., Vaughn, D., Wilmot, W. (2019). *The seven principles of "Living Curriculum."* Independent School Magazine on Reimagining Schools. Spring 2019, National Association of Independent Schools (NAIS).
- Grotzer, T.A. (2019). The quest for deeper understanding. *Creative Teaching and Learning*, 8(4), 8-15.
- Cuzzolino, M.P., Grotzer, T.A. Tutwiler, M.S., & Torres, E.W. (2019). An agentic focus may limit learning about complex causality and systems dynamics: A study of seventh graders' explanations of ecosystems. *Journal of Research in Science Teaching*. 56(8), 1083-1105.
- Chen, J., Wang, M., Grotzer, T.A., Dede, C. (2018). Using a three-dimensional thinking graph to support inquiry learning, *Journal for Research in Science Teaching*. 55(9) 1239-1263. (SSCI, Impact Factor 3.210, ranked 11/238 in Education, Nominated for the Research Worth Reading Award by the U.S. National Association for Research in Science Teaching, 2019).
- Dede, C., Grotzer, T., Kamarainen, A., Metcalf, S., Olney, A. M., Rus, V. & Wang, M. (2018). Graphical supports for collaboration: Constructing shared mental models. In R. A. Sottolare, A. C. Graesser, X. Hu, & A. M. Sinatra (Eds.), *Design Recommendations for Intelligent Tutoring Systems: Teams* (Vol. 6, pp. 33–43). Orlando, FL: U.S. Army Research Laboratory.
- Dickes, A., Metcalf, S., Kamarainen, A., Reilly, J., Brennan, K., Grotzer, T. & Dede, C. (2018). EcoMOD: Integrating computational thinking into ecosystems science education via modeling in immersive virtual worlds. *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*, 1076-1076.
- Kamarainen, A.M., Reilly, J., Metcalf, S., Grotzer, T.A. & Dede, C. (2018). Using Mobile Location-Based Augmented Reality to Support Outdoor Learning in Undergraduate Ecology and Environmental Science Courses. *Bulletin of the Ecological Society of America*, 99 (2) (April): 259–276.
- Kamarainen, A.M., Thompson, M.M., Metcalf, S.J., Grotzer, T.A., Tutwiler, M.S., Dede, C. (2018). Prompting Connections between Content and Context: Blending Immersive Virtual Environments and Augmented Reality for Environmental Science Learning. In Beck, D., Allison, C., Morgado, L., Pirker, J., Khosmood, F., Richter, J., & Gütl, C. (Eds.). (2018). *Immersive Learning Research Network: Fourth International Conference*, iLRN. June 24–29, 2018. Proceedings (Vol. 840). Springer.
- Metcalf, S., Kamarainen, A., Torres, E., Grotzer, T., & Dede, C. (2018). EcoMUVE: A case study on the affordances of MUVEs in ecosystem science education, In Y. Qian (Ed.) *Integrating Multi-User Virtual Environments in Modern Classrooms* (pp.1-25), Hershey, PA, IGI Global, DOI: 10.4018/978-1-5225-3719-9.

- Metcalfe, S.M., Kamarainen, A.M., King, J., Grotzer, T.A., & Dede, C. (2018). Supports for deeper learning of inquiry-based ecosystem science in virtual environments: Comparing virtual and physical concept mapping. *Computers in Human Behavior* (87) 459-469.
- Chen, J., Wang, M., Grotzer, T.A., Dede, C. (2017). Design of a Three-Dimensional Cognitive Mapping Approach to Support Inquiry Learning. *Educational Technology & Society*, 20(4), 191–204.
- Dede, C., Grotzer, T., Kamarainen, A., & Metcalfe, S. (2017). EcoXPT: Designing for deeper learning through experimentation in an immersive virtual ecosystem. *Journal of Educational Technology & Society*, 20(4) 166-178.
- Dede, C., Grotzer, T., Kamarainen, A., & Metcalfe, S. (2017). Virtual reality as an immersive medium for authentic simulations: The case of EcoMUVE. In D. Liu, C. Dede, R. Huang, & J. Richards. (Eds.). *Virtual reality, augmented reality, and mixed reality in education*. (pp. 133-156.) Hong Kong: Springer.
- Grotzer, T.A., Solis, S.L., Tutwiler, M.S., & Powell, M.M. (2017). A study of students' reasoning about probabilistic causality: Implications for understanding complex systems and designing instructional support. *Instructional Science*, 45(1), 25-52.
- Grotzer, T.A., Solis, S.L., & Derbiszewska, K. (2017). Leveraging fourth and sixth graders' experiences to reveal understanding of the forms and features of distributed causality. *Cognition and Instruction* 26(1), 1-47.
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### **Papers Published in Peer-Reviewed Conference Proceedings:**

Kamarainen, A., Grotzer, T., Dede, C., Chen, J., Metcalf, S. & Tutwiler, M.S. (2020). Not all Novelty Effects are Created Equal: Differential Gains in Self-Efficacy and Online Behavior. National Association for Research in Science Teaching, Portland, OR.

Metcalf, S. J., Dickes, A. C., Reilly, J. M., Kamarainen, A. M., Brennan, K. A., Grotzer, T.A., & Dede, C. J. (2020). Impact of a Blended Immersive and Computational Modeling Tool on Elementary Ecosystems Science Learning. American Educational Research Association Conference.

Thompson, M., Tutwiler, M.S., Bressler, D., Chen, J., Kamarainen, A., Metcalf, S., Grotzer, T., Dede, C., Uz-Bilgin, C., Klopfer, E., & Anteneh, M. (2020). National Association of Research in Science Teaching, Portland OR.

McGivney, E., Gonzalez, E., De Los Santos, S., Kamarainen, A. & Grotzer, T.A. (2019, April). Improving understanding of teaching practice for student learning: A holistic measure of fidelity of implementation. Presented to the National Association for Research in Science Teaching, April 2, Baltimore, MD.

Reilly, J., Kamarainen, A.M., Metcalf, S., Dede, C. & Grotzer, T.A. (2019, April). The importance of time and sequence on learning in mobile augmented reality. Presented at the National Association for Research in Science Teaching Conference, April 2, 2019, Baltimore, MD.

Metcalf, S., Reilly, J., Studwell, J., Kamarainen, A.M., Grotzer, T.A. & Dede, C. (2019, April). Linking evidence and concept maps in virtual environment for ecosystems science learning. Presented at the National Association for Research in Science Teaching Conference, April 2, 2019, Baltimore, MD.

Kamarainen, A.M., Thompson, M.M., Metcalf, S.J., Grotzer, T.A., Tutwiler, M.S., Dede, C. (2018, June). Prompting Connections between Content and Context: Blending Immersive Virtual Environments and Augmented Reality for Environmental Science Learning. In Beck, D., Allison, C., Morgado, L., Pirker, J., Khosmood, F., Richter, J., & Gütl, C. (Eds.). (2018). *Immersive Learning Research Network: Fourth International Conference, iLRN 2018, Proceedings (Vol. 840)*. Springer.

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Kamarainen, A., Weathers, K., Grotzer, T., Metcalf, S., Dede, C. (2017, August). *Learning about Material Cycling Across Scales and Contexts through Mobile and Immersive Technologies*. Ecological Society of America Conference, Portland, OR.

Grotzer, T.A., Metcalf, S.J., Tutwiler, M.S., Kamarainen, A.M., Thompson, M. & Dede, C. (2017, April). *Teaching the Systems Aspects of Epistemologically Authentic Experimentation in Ecosystems through Immersive Virtual Worlds*, National Association for Research in Science Teaching, San Antonio, TX.

Cuzzolino, M.P., Tutwiler, M.S., Torres, E., & Grotzer, T.A. (2107, April). *How Problem Features Interact with the Ways that Seventh Graders Frame Agency in Ecological Problems*. National Association for Research in Science Teaching Conference, San Antonio, TX.

- Kamarainen, A., Grotzer, T.A., Metcalf, S.J., & Dede, C. (2017, April). *Using Expert Perspectives to Inform the Design of Instruction about Ecosystem Science Practices*. National Association for Research in Science Teaching Conference, San Antonio, TX.
- Metcalf, S.J., Kamarainen, A., King, J., Grotzer, T.A., & Dede, C. (2017, April). *Inquiry-Based Ecosystem Science Learning in Virtual Environments – Comparing Virtual and Physical Concept Mapping*. National Association for Research in Science Teaching Conference, San Antonio, TX.
- Reilly, J., Kamarainen, A., Metcalf, S.J., Grotzer, T.A., Tutwiler, M.S., & Dede, C. (2017, April). *Evaluating Middle School Students' Integration of Variable Data in Scientific Explanations*. American Educational Research Association Conference, San Antonio, TX
- Dede, C., Grotzer, T.A., Metcalf, S.J., Kamarainen, A., & Tutwiler, M.S. (2017, April) *EcoXPT: Learning Through Experimentation in an Immersive Virtual Ecosystem*. American Educational Research Association Conference, San Antonio, TX
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- Solis, S.L., Grotzer, T.A., Powell, M.M., Tutwiler, M. & Duhaylongsod, L. (2016, April). *Characterizing shifts in students' reasoning about probabilistic causality: A microgenetic study*. American Educational Research Association Conference, Washington D.C.
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- Thompson, M., Tutwiler, M.S. Kamarainen, A., Metcalf, S. Grotzer, T., & Dede, C. (2016, April). *A blended assessment strategy for EcoXPT: An experimentation-driven ecosystems science-based multi-user virtual environment*, American Educational Research Association Conference, Washington D.C.
- Grotzer, T.A., Tutwiler, M.S. Kamarainen, A.M., Derbiszewska K.M, Metcalf, S.J., & Dede, C.J. (2016, April) *Students' Reasoning Tendencies about the Causal Dynamics of Ecosystems and the Impacts of MUVE vs. Non-MUVE Instructional Contexts*, The Next Phase of Research in Complex Systems in Science Education, American Educational Research Association Conference, Washington D.C.
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- Kamarainen, A., Metcalf, S.J., Grotzer, T.A., Thompson, M.M., Tutwiler, M.S., & Dede, C. (2016, April). *Supporting ecosystem science knowledge and practices using immersive virtual environments and mobile augmented reality*, American Educational Research Association Conference, Washington D.C.
- Donaldson Gramling, M., Solis, S.L. & Grotzer, T.A. (2016, April). *Testing a curriculum designed to build students' understanding of distributed causality*. National Association for Research in Science Teaching Conference, Baltimore, MD.
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- Kamarainen, A.M., Sabey, D., Grotzer, T.A., Thompson, M., Shultis, E. (2016, April). *Viewpoints on experimentation from the perspectives of teachers and students*. National Association for Research in Science Teaching Conference, Baltimore, MD.
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- Cooke, C.B., Kamarainen, A.M., Bressler, D., Metcalf, S.J., Grotzer, T.A. & Dede, C. (2016, April). *Collecting and interpreting highly variable real-world data using a mobile technology-enabled ecosystem science field trip*, National Association for Research in Science Teaching Conference, Baltimore, MD.
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- Kamarainen, A.M., Metcalf, S., Grotzer, T.A., & Dede, C.J. (2015, April). *Mobile technologies support student understanding of variability in messy real-world data in ecosystem science*, American Educational Research Association Conference, Chicago, IL.
- Powell, M.M., Tutwiler, M.S., Grotzer, T.A. Metcalf, S.J., Kamarainen, A.M., Dede, C.J. (2015, April). *The relationship between scripting and student data collection behaviors in a multi-user virtual environment*. American Educational Research Association Conference, Chicago, IL.
- Donaldson Gramling, M. & Grotzer, T.A. (2015, April). *Whole-group question-asking in two classrooms during a complex causal science curricular intervention*. American Educational Research Association Conference, Chicago, IL.
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- Powell, M.M., Grotzer, T.A. Kamarainen, A.M., & Metcalf, S.J. (2015, April). *Investigating student reasoning about agency in ecosystems science*. National Association for Research in Science Teaching Conference, Chicago, IL.
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- Kamarainen, A.M., Metcalf, S.J., Grotzer, T.A. & Dede, C.J. (2014, April). *Blending virtual and augmented immersive experiences to aid learning of ecosystems science*. American Educational Research Association Conference, Philadelphia, PA.
- Tutwiler, M.S. & Grotzer, T.A. (2014, April) *Salience and selection: Using growth modeling to explore student causal data collection in a Multi-user Virtual Environment*, American Educational Research Association Conference, Philadelphia, PA.
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- Donaldson, M.G., Solis, S.L., Derbiszewska, K.M., Grotzer, T.A. (2014, March). *Testing a curriculum for teaching action at a distance to sixth graders*, National Association for Research in Science Teaching Conference, Pittsburgh, PA.
- Derbiszewska, K.M., Solis, S.L., Donaldson, M.G., Grotzer, T.A. (2014, March). *Fourth and sixth graders conceptions of distributed causality*, National Association for Research in Science Teaching Conference, Pittsburgh, PA.
- Tutwiler, M.S., & Grotzer, T.A. (2014, March). *Comparing paths: Bayesian sequence analyses in a microgenetic study of student learning*. National Association for Research in Science Teaching Conference, Pittsburgh, PA.
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- Tutwiler, M.S. & Grotzer, T.A. (2013, June). *Learning across space, time, and scale: A Bayesian perspective*. Presented at the Conference on Computer Supported Collaborative Learning Conference, Madison, Wisconsin.
- Metcalf, S.M., Kamarainen, A., Grotzer, T.A. & Dede, C. (2013, June) *Collaborative learning in virtual environments: Role-based exploration of causality in ecosystems over time and scale*. Conference on Computer Supported Collaborative Learning Conference, Madison, Wisconsin.
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- Metcalf, S.J., Tutwiler, M.S, Kamarainen, A., Grotzer, T.A., & Dede, C.J. (2013, April). *Multi-User virtual environments to promote middle school ecosystem science learning and attitudes about science*, American Educational Research Association Conference, San Francisco, CA.
- Metcalf, S.J., Chen, J.A., Kamarainen, A.M., Frumin, K.M., Vickrey, T.L., Grotzer, T.A., Dede, C.J. (2013, April). *Shifts in Student Motivation During Usage of a Multi-User Virtual Environment for Ecosystem Science*, National Association of Research in Science Teaching Conference, Puerto Rico.

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- Grotzer, T.A., Tutwiler, M.S., Metcalf, S.J., Kamarainen, A., Dede, C. (2013, April). *Using a virtual world to reveal students' intuitive causal assumptions about ecosystems*, National Association of Research in Science Teaching Conference, Puerto Rico.
- Tutwiler, M.S., & Grotzer, T. (2012, July) Irreducible complexity: How Do Causal Bayes Nets theories of human causal inference inform the design of a virtual ecosystem? *International Conference of the Learning Sciences*, Sydney, Australia.
- Grotzer, T.A., Kamarainen, A., Tutwiler, M.S., Metcalf, S., Dede, C. (2012, April). *Learning to focus on processes and steady states in ecosystems dynamics using a virtual environment*. American Educational Research Association Conference, Vancouver.
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- Tutwiler, M.S., Grotzer, T.A., Kamarainen, A., Metcalf, S. Dede, C. (2011, July). *Exploring student understanding of complex causality in an ecosystems-based multi-user virtual environment*. Conference on Computer-Supported Collaborative Learning, Hong Kong July 4-8 2011
- Kamarainen, A., Metcalf, S., Grotzer, T., Dede, C. (2011, July). *EcoMUVE: Integrating visualizations into an immersive ecological multi-user virtual environment*. Poster. GRC Visualization in Science and Education Conference.
- Grotzer, T.A., Powell, M., Carr, E. & Cooke, C. (2011, April). *Enhancing pedagogical content knowledge: Supporting teachers' efforts to teach underlying causal structure in density*. American Educational Research Association Conference, New Orleans.
- Grotzer, T.A., Duhaylongsod, L. & Tutwiler, M.S. (2011, April). *Developing explicit understanding of probabilistic causation: Patterns and variation in young children's reasoning*. American Educational Research Association Conference, New Orleans, LA.
- Grotzer, T.A., Tutwiler, M.S., Solis, L.S. & Duhaylongsod, L. (2011, April). *Interpreting probabilistic causal outcomes in science: A microgenetic study of sixth graders' patterns of reasoning*. Presented at the National Association of Research in Science Teaching Conference, Orlando, FL.
- Grotzer, T.A., Tutwiler, M.S., Dede, C. Kamarainen, A., & Metcalf, S. (2011, April). *Helping students learn more expert framing of complex causal dynamics in ecosystems using EcoMUVE*. Presented at the National Association of Research in Science Teaching Conference, Orlando, FL.
- Metcalf, S.J., Tutwiler, M.S. Kamarainen, A., Grotzer, T.A. & Dede, C. (2011, April). *Learning complex causality in ecosystems via a multi-user virtual environment*. American Educational Research Association Conference, New Orleans, LA.
- Metcalf, S.J., Kamarainen, A., Grotzer, T.A. & Dede, C. (2011, April). *Ecosystem science learning via multi-user virtual environments*. American Educational Research Association Conference, New Orleans, LA.
- Grotzer, T.A. (2010, August). *Conceptual challenges in climate change education: Reasoning across time scales*. Ecological Society of America Annual Meeting, Pittsburgh, PA (August 2, 2010).
- Kamarainen, A., Metcalf, S., Dede, C. & Grotzer, T.A. (2010, August). *EcoMUVE: Promoting ecosystems science learning via multi-user virtual assessments*. Ecological Society of America Annual Meeting, Pittsburgh, PA (August 3).

- Liu, D. & Grotzer, T.A. (2010, March). *Teaching 21st Century Science*. National Association of Research in Science Teaching Conference, Philadelphia, PA.
- Honey, R., & Grotzer, T.A. (2009, April). *Cultural diversity in the classroom: Salish/Kootenai students' perceptions of ecosystems relationships*. Presented at the National Association of Research in Science Teaching Conference, Garden Grove, CA.
- Grotzer, T.A., Dede, C., Metcalfe, S., & Clarke, J. (2009, April). *Addressing the challenges in understanding ecosystems: Why getting kids outside may not be enough*. National Association of Research in Science Teaching Conference, Orange Grove, CA.
- Metcalfe, S., Dede, C., Grotzer, T.A., Kamarainen, A. (2010, May). *EcoMUVE: Design of Virtual Environments to Address Science Learning Goals*. American Educational Research Association Conference, Denver, Co.
- Grotzer, T.A. (2008, August). *EcoMUVE: Challenges in understanding ecosystems concepts and how simulated environments can support real world learning*. Ecological Society of America Conference, Milwaukee, WI.
- Grotzer, T.A. & Honey, R. (2008, August). *Tacit assumptions that limit understanding of ecosystems*, Ecological Society of America Conference, Milwaukee, WI.
- Grotzer, T.A. (2007, April). *Reflections on fostering complex scientific reasoning*. Fostering Complex Scientific Reasoning Symposium, Invited Discussant, American Educational Research Association. Chicago, IL.
- Grotzer, T.A. (2007, March). *The interaction of causal concepts and science learning*. Connecting Cognitive Science and Science Education: The Case for Causality Symposium, Society for Research in Child Development, Boston, MA.
- Grotzer, T.A. (2005, April). *Transferring structural knowledge about the nature of causality to isomorphic and non-isomorphic topics*. Paper presented at the American Educational Research Association Conference, Montreal.
- DeVito, B., & Grotzer, T.A. (2005, April). *Characterizing discourse in two science classrooms by the cognitive processes demonstrated by students and teachers*. National Association of Research in Science Teaching Conference, Dallas, TX.
- Grotzer, T.A. (2003, March). *Transferring structural knowledge about the nature of causality: An empirical test of three levels of transfer*. National Association of Research in Science Teaching Conference, Philadelphia, PA.
- Mittlefehldt, S., & Grotzer, T.A. (2003, March). *Using metacognition to facilitate the transfer of causal models in learning density and pressure*. National Association of Research in Science Teaching Conference, Philadelphia, PA.
- Ritscher, R., Lincoln, R., & Grotzer, T.A. (2003, March). *Understanding density and pressure: How students' meaning-making impacts their transfer of causal models*. National Association of Research in Science Teaching Conference, Philadelphia, PA.
- Basca, B. & Grotzer, T.A. (2001, April). *Focusing on the nature of causality in a unit on pressure: How does it affect students understanding?* American Educational Research Association Conference, Seattle, WA.
- Grotzer, T.A. (2001, April). *How causal and epistemic complexity creates difficulties for science learners*. The Conceptual Change and Complex Causality Symposium at the American Educational Research Association Conference, Seattle, WA.
- Basca, B. & Grotzer, T.A. (2001, April). *Focusing on the nature of causality in a unit on pressure: How does it affect students understanding?* American Educational Research Association Conference, Seattle, WA.

- Grotzer, T.A. (2001, April). *How causal and epistemic complexity creates difficulties for science learners*. The Conceptual Change and Complex Causality Symposium at the American Educational Research Association Conference, Seattle, WA.
- Grotzer, T.A. (2000, April). *How conceptual leaps in understanding the nature of causality can limit learning: An example from electrical circuits*. American Educational Research Association Conference, New Orleans, LA.
- Perkins, D.N. & Grotzer, T.A. (2000, April). *Models and moves: Focusing on dimensions of causal complexity to achieve deeper scientific understanding*. (Complex Causality Symposium) American Educational Research Association Conference, New Orleans, LA.
- Grotzer, T.A. & Perkins, D.N. (2000, April). *A taxonomy of causal models: The conceptual leaps between models and students' reflections on them*. National Association for Research in Science Teaching Conference, New Orleans, LA.
- Houghton, C., Record, K. Bell, B. & Grotzer, T.A. (2000, April). *Conceptualizing density with a relational systemic model*. National Association for Research in Science Teaching Conference, New Orleans, LA.
- Edgar, M. & Grotzer, T.A. (2000, April) *Causal dimensions that create difficulty in understanding evolution*. National Association for Research in Science Teaching Conference, New Orleans, LA.
- Bell, B., Grotzer, T.A., Donis, K, & Shaw, S. (2000, April). *Combining domino and relational causality to analyze ecosystems: Realizing that what goes around comes around*. National Association for Research in Science Teaching, New Orleans, LA.
- Grotzer, T.A. & Sudbury, M. (2000, April). *Moving beyond underlying linear causal models of electrical circuits*. National Association for Research in Science Teaching, New Orleans, LA.
- Grotzer, T.A. (1997, April). *Children's understanding of complex causality in natural systems*. American Educational Research Association Conference, Chicago, IL.

### **Curriculum Materials:**

- Grotzer, T.A., & Gonzalez, E. (2020). *EcoXPT Teachers Guide and Resource Materials*. Cambridge, MA: President and Fellows of Harvard College.
- Sagar, S., Gonzalez, E., & Grotzer, T.A. (2020). *Bridging the Gap: Helping Students Use Claims, Evidence and Reasoning (CER) to Formulate Causal Explanations*. Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A. Derbiszewska, K., Gramling, M.D., Solis, L.S., & Bialik, M. (2015). *Becoming Responsible Individuals: Understanding Distributed Causality*, Causal Learning in the Classroom (CLIC) Modules, Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A. Derbiszewska, K., Gramling, M.D., & Solis, L.S. (2015). *Becoming Global Thinkers: Thinking about Distant Causes and Effects*, Causal Learning in the Classroom (CLIC) Modules, Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A., Basca, B., & Donis, K. (2011). *Causal patterns in ecosystems: Lessons to infuse into ecosystems units: Second Edition*. Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A. (2010). *Reasoning about causal complexity in science and beyond*. Cambridge, MA: President and Fellows of Harvard College.
- Wong, A., Morris, L., Jasti, C., Liu, D, & Grotzer, T.A. (2009). *Nature of scientific thinking: Lessons designed to develop understanding of the nature of science and modeling*. Cambridge, MA: President and Fellows of Harvard College.

- Grotzer, T.A., Houghton, C.A., Basca, B., *Mittlefehldt, S. Lincoln, R.*, & MacGillivray, D. (2005). *Causal patterns in density: Lessons to infuse into density units*. Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A., Basca, B., & Sudbury, M. (2004). *Causal patterns in simple circuits: Lessons to infuse into electricity units*. Cambridge, MA: President and Fellows of Harvard College.
- Basca, B.B. & Grotzer, T.A. (2003). *Causal patterns in air pressure-related phenomena: Lessons to infuse into air pressure units*. Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A., Basca, B., & Donis, K. (2002). *Causal patterns in ecosystems: Lessons to infuse into ecosystems units*. Cambridge, MA: President and Fellows of Harvard College.
- Grotzer, T.A., Howick, L., Tishman, S., & Wise, D. (2002). *Art works for schools: A curriculum for teaching thinking in and through the arts*. Lincoln, MA: DeCordova Museum.
- Grotzer, T.A. (1998). *The keys to inquiry*, Hypertext Document, Everyday Classroom Tools Website: Harvard Smithsonian. Available: <<http://hea-www.harvard.edu/ECT>>

## WEBSITES

- Next Level Lab: <https://nextlevellab.gse.harvard.edu/>
- Cognition in a Complex World Lab: <http://clic.gse.harvard.edu/>
- Causal Patterns in Science Professional Development Website (with the Harvard Smithsonian Science Media Group and funded by NSF; includes Causal Patterns in Science Curriculum and Causal Learning in the Classroom Curriculum): [www.causalpatterns.org](http://www.causalpatterns.org)
- EcoLearn Projects (EcoMUVE, EcoMOBILE, EcoXPT, EcoMOD): <http://ecolearn.gse.harvard.edu/>
- Curriculum materials with Annenberg/CPB and Harvard Smithsonian, Essential Science Series at: <http://www.learner.org/channel/courses/essential/physicalsci/session5/classroom.html> (featured as teacher in model lesson) and <http://www.learner.org/courses/essential/life/session8/>
- Curriculum materials that I co-developed for the Everyday Classroom Tools Project with funding from NASA are available at: <http://hea-www.harvard.edu/ECT>

## SELECTED PRESENTATIONS AND PANELS

- Climate Communications*, Invited Panelist, Climate Leaders Program, Harvard Center for the Environment, Cambridge, MA, Feb. 17, 2022.
- How the Cognitive Architecture of the Human Mind Interacts with Understanding Climate Change and Causal Complexity*, Keynote Address, Tackling the Climate Crisis: Interdisciplinary Perspectives on Climate Change Education and Communication, Swiss GeoScience Meeting, Geneva, Switzerland, Nov. 20, 2021, (Virtual).
- EcoXPT*, EdTech Expo, Institute for Education Studies, Washington DC. (Virtual) June 1-4, 2021.
- Cause and Effect: Mechanism and Explanation*, Crosscutting Concepts: A Professional Book Study for K-12 Educators (Virtual) Arlington, VA, May 20, 2021.
- Innovative Pedagogies: How Online Learning Underscores the Importance of Developing Self-Directed Learners*, Shanghai International Curriculum Forum, Institute of Curriculum and Instruction, East China Normal University, Shanghai, China (Virtual). November 7, 2020.
- Immersive Simulations and Stealth Assessment*, Silver Linings for Learning, (Virtual) August 22, 2020.
- Research from Cognitive Science on Environmental Awareness, Understanding, and Inclination and How Technology Can Help Us to Leverage It*. Invited Panel Presentation to the Advisory Committee for Environmental Research and Education, National Science Foundation, Alexandria, VA, Nov. 2019.
- Developing Expert Learners in a Complex and Changing World*, Leadership: An Evolving Vision Conference, Harvard University, July 2019.

- Reasoning in a Complex World: Why We Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2019.
- Teaching Complex Causal Dynamics: A Cross Disciplinary Overview and a Discipline-Specific Example in Ecosystems Science Using a Multi-User Virtual Environment.* The International Academic Program (IAP), June 2019. symposium Innovative Leadership: Transforming Higher Education in the Digital Age in collaboration with the David Rockefeller Foundation.
- Climate Justice is Social Justice: Why We Need to Think Differently about Climate Change,* Climate Change Initiative. Cambridge, MA., May 2019.
- Learning to Think About Ecosystems Using the NGSS Crosscutting Concepts.* Harvard Ed Portal, Cambridge, MA, Feb. 2019.
- The Impact of Learning About Epistemologically Authentic Experimentation in Ecosystems Science on Students' Explanations of the Causal Dynamics,* The Undiscovered Conference, Radcliffe institute, Cambridge, MA. Oct. 2018.
- Learning to Attend to and Reason About Climate Change.* Warming Warning, Science Center, Harvard University. Oct. 2018.
- A Living Curriculum Approach to Teaching and Learning,* Project Zero Summer Institute, Harvard, Cambridge, MA, with Bill Wilmot, July 2018.
- Reasoning in a Complex World: Why We Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2018.
- Helping Students Learn the Thinking Skills in the NGSS Crosscutting Themes.* National Science Foundation PI Meeting, Washington DC, June 2018.
- EcoXPT.* Digital Learning Arcade, NSF PI Meeting, Washington DC, June 2018.
- Thinking About Causality in a Complex World.* International Conference on Thinking, (May 18). Florida International University, Miami, Florida, May 2018.
- Learning to Reason about the Complex Causality of Climate Change the Affordances of Technology for Understanding Action at an Attentional Distance and other Cognitive Challenges.* HUCE Graduate Consortium on Energy and Environment, Cambridge, MA, Feb. 2018.
- The Cognitive Challenges of Reasoning About Climate Change.* Climate Reckoning Conference, November 17-19, Harvard University, Nov. 2017.
- Reasoning in a Complex world: Why We Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2017.
- Equipping Students to Think About Complex Problems: Using Virtual Reality to Teach Ecosystems Dynamics.* The Coalition for National Science Funding and AERA to Members of the United States Congress. Washington DC, May 16, 2017.
- Current Developmental Perspectives on Adolescence.* Seminar Series, Microschools Network, March 2017.
- Mindset and its Implications for Learning.* Seminar Series, Microschools Network, March 2017.
- New Perspectives on the Relationship between Affect and Cognition.* Seminar Series, Microschools Network, April 2017.
- The Self-Regulated Learner.* Seminar Series, Microschools Network, April 2017.
- Learning to Reason about Causality in Complex Problem Spaces: The Affordances of Virtual Environments for Understanding Action at an Attentional Distance and other Aspects of Complexity.* The Developmental Science Colloquium, Psychological and Brain Sciences, Boston University, Nov. 2016.
- The Living Curriculum: A Conversation about Learner Agency and Dynamic, Negotiated Curriculum.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA with Bill Wilmot, July 2016.
- Reasoning in a Complex World: Why we Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2016.

*Applying Principles from Cognitive Science Research to Instruction Encouraging Active Processing Towards Deep Understanding and Adaptive Expertise.* Science Initiative: Summer Institute on Active Learning, University of Wyoming, Laramie, June 2016.

*EcoXPT: Learning about Ecosystems Science and Complex Causality through Experimentation in a Virtual World.* Poster Presentation, NSF PI Meeting, Washington DC, June 2016.

*Environmental Thinking and Learning.* Learning Environments for Tomorrow Conference, Harvard University, Cambridge, MA, May 2016

*Are We Teaching STEM Wrong? A panel discussion with Arthur Levine (President of Woodrow Wilson Academy) and Chris Rogers (Professor, Tufts University) MIT SOLVE Initiative and Google,* Cambridge, MA, Jan. 2016.

*Immersive Technology for Next Generation Science: Teaching Complex Causality and Ecosystems Dynamics.* Future of Learning Summer Institute, Harvard, Cambridge, MA. Aug. 2015.

*Reasoning in a Complex World: Why we Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2015.

*How Chemistry Education May Support Mechanism Knowledge as a Lever for Understanding Complex Causality.* Invited Plenary Speaker, Gordon Research Conference: Chemistry Education Research and Practice, Bates College, Lewiston, Maine, June 21-26, 2015.

*Thinking about Complexity: Cultivating Mindsets for a Complex World.* Center for the Advancement and Study of international Education, Plenary Talk, Think-Create-Innovate, Atlanta, GA. May 9, 2015.

*Environmental Thinking and Learning.* Learning Environments for Tomorrow Conference, Harvard University, with MaryAnn Thompson. Cambridge, MA, April 9, 2015.

*Learning to Reason about Causality in Complex Problem Spaces: The Affordances of Virtual Environments for Understanding Action at an Attentional Distance.* Northwestern, University: Evanston, Ill November 20, 2014.

*Critical Thinking in Science: Learning Causal Patterns.* Inter-America Educational Network, Organization of American States: Washington D.C. October 30, 2014.

*Immersive Technology for Next Generation Science: Teaching Complex Causality and Ecosystems Dynamics.* Future of Learning Summer Institute, Harvard, Cambridge, MA, with Sarah Blodgett, August 2014.

*Reasoning in a Complex World: Why We Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2014.

*Assessing Complex Causal Understanding: Puzzles and Promise.* Project Zero, Harvard University, Cambridge, MA. May 22, 2014.

*Thinking about Causality in Global Contexts: Are We Up to the Task?,* One Harvard: Lectures that Last Graduate, Graduate Student Council (Nominated/Invited). Cambridge, April 9, 2014.

*Gamification and Learning Panel.* Across Boundaries: How can Edtech Scale Students Success? Learn Launch Conference, Harvard University, Cambridge, MA. Feb. 28-March 1, 2014.

*Getting Beyond the Test: Finding Out how Learners Actually Engage with Complexity.* HDE-EPLIP Lecture Series, Harvard University, Cambridge, MA, Oct. 2013.

*Interactions between Human Cognitive Architecture, the Challenges of Complex Causal Induction in Science Learning, and the Affordances of the Digital World,* Science Education in the Digital Era, Eighth Course of the International School on Mind, Brain and Education, Ettore Majorana Centre for Scientific Culture, Erice, Italy, July 30- August 4, 2013.

*Reasoning in a Complex World: Why we Need a Curriculum on the Nature of Causality.* Plenary Address, Project Zero Summer Institute, Harvard, Cambridge, MA, July 2013.

*Digital Tools for Teaching Complex Causality and Ecosystems Dynamics.* Project Zero Summer Institute, Harvard, Cambridge, MA with Sarah Blodgett, July 2013.

- Cross-Cutting Concepts: The Role of Cause and Effect in the Next Generation Science Standards (NGSS)*. National Science Teachers Association (NSTA) Invited Webinar. Featured Segment: <http://www.youtube.com/watch?v=nC83UTrdQsY> Available: [http://learningcenter.nsta.org/products/symposia\\_seminars/Ngss/webseminar20.aspx](http://learningcenter.nsta.org/products/symposia_seminars/Ngss/webseminar20.aspx); March 5, 2013.
- Patterns of Cognitive Engagement that Interact with the Nature of Science to Complicate Understanding of Complexity and Scientific Research*. NSF-Sponsored Conference on the History and Philosophy of Science, Boston University, Boston, MA. December 2012.
- Mapping Environmental Literacy: DRK-12 Projects*, NSF PI Meeting, Arlington VA June 2012.
- Learning about Complex Causality in the Classroom*. NSF PI Meeting, Arlington VA, June 2012.
- How the Features of Complex Causality Interact with Decisions about Risk*. Health Communication Concentration Speaker Series, Harvard School of Public Health, Feb 2012.
- Teaching Causal Complexity in Science: Learning for Today and Tomorrow*. Future of Learning Conference, HGSE, Cambridge, MA. August 2011.
- Patterns of Reasoning that Impede Understanding in Science and Beyond*. Project Zero Summer Institute, HGSE, Cambridge, MA, July 2011.
- Bridging between Everyday and Expert Causal Reasoning in Framing Ecosystems Concepts*. TERC, Cambridge, MA, July 2011
- Patterns of Engagement with the Nature of Causality that Interact with Public Understanding of Complexity and Science*. Invited NSF/DFG Conference on the Public Understanding of Science, NY, June 2011.
- Teaching Causal Complexity in Science: A Professional Development Website for Teachers*. NSTA Conference, San Francisco, CA, with Therese Arsenault and Megan Powell, March 12, 2011.
- Why Everyday Causal Reasoning falls Short in a Complex World*, Depts. of Teaching and Learning and School of Environmental and Biological Sciences., Rutgers University, NJ. Nov. 11, 2010.
- The Difference between Everyday Causal Reasoning and Understanding the Nature of Causality: Why Educational Opportunities Matter*. Applied Developmental and Educational Psychology Colloquium, Boston College, Boston, MA, Nov. 8, 2010.
- Reasoning about Causal Complexity: Climate Change and Other Complex Problems*, UMass Amherst, STEM Ed Institute, October 5, 2010.
- Teaching Causal Complexity in Science: Learning for Today and Tomorrow*. Future of Learning Conference, HGSE, Cambridge, MA. August 6, 2010.
- Bottlenecks to Understanding in Science and Beyond*. Project Zero Summer Institute, HGSE, Cambridge, MA. July 26 and 27, 2010.
- Learning about Causal Complexity and Climate Change*, CEEO Engineering Symposium, Tufts University, Medford, MA, June 8, 2010.
- Teaching Primary and Secondary Science in American Schools: The Northern Africa Project*, Delegation sponsored by the Department of State, Harvard University: Cambridge, MA, March 2010.
- Teaching Causal Complexity in Science: Learning for Today and Tomorrow*. Future of Learning Conference, HGSE, Cambridge, MA, August 6, 2009.
- Default Patterns of Reasoning about the Nature of Causality and the Implications for Education*. Mind, Brain, and Education Conference, HGSE, Cambridge, MA, July 2, 2009.
- Patterns of Reasoning that Impede Understanding in Science and Beyond*. Project Zero Summer Institute, HGSE, Cambridge, MA, August 6, 2009.
- Causal Patterns in Density and Ecosystems: Teacher Professional Development Website*. National Science Teachers Association, New Orleans, LA. Debbie Liu and Amanda Wong-Heffner. March 2009.
- Reaching from Appian Way into the Future: Developing the Scientific Minds of Tomorrow*. HGSE Reunion Luncheon, Cambridge, MA June 2008.

- Looking to the Future: Considering Trends in Science Education and Tendencies that Contribute to Determining Future Focusing Events.* Lessons from Sputnik: Focusing Events and the Shaping of Science Education, Askwith Symposium, HGSE, Cambridge, MA October 4, 2007.
- Learning and Instructional design: What Cognitive Science Research tells us about how People Learn,* Executive Leadership Program for Educators (ExEL), Harvard University/ The Wallace Foundation, July 23, 2007.
- Climate Change: The Conceptual Challenges of Understanding and Informed Action.* Project Zero Forum: Future of Education, Cambridge, MA. May 16, 2007.
- How Children's Notions of Causality Interact with Deep Understanding in Science: Puzzles and Possibilities.* Fulcrum Science Series, Tufts University, Medford, MA. Nov. 16, 2006.
- Paths to Learning: Moving from Research-based Pedagogies to Effective On-line Professional Development environments.* Teacher Professional Continuum Principal Investigators Conference, National Science Foundation, Reston, VA, May 2006.
- Research-based Professional Development Tools for NSF's Teacher Professional Development Continuum,* National Science Teachers' Association, Anaheim, CA, with Sheila Jasalavich, April 7, 2006.
- How Causal Reasoning Patterns Impact Student Learning in Science.* Harvard Smithsonian Center for Astrophysics, Cambridge, MA, Oct. 25, 2005.
- Patterns of Reasoning that Impact Students' Science Understanding and the Implications for Education.* Plenary Address, Conference for Experienced Middle School and High School Science Teachers, International Baccalaureate Organization, Barcelona, Spain, Oct. 22, 2005.
- Assessment that Builds Understanding,* Conference for Experienced Middle School and High School Science Teachers, International Baccalaureate Organization, Barcelona, Spain, Oct. 23, 2005.
- What Learning Research Suggests about Achieving Deep Understanding of Causal Patterns in Ecology: Teaching with the Challenges in Mind.* Pathways to Scientific Teaching in Ecology Symposium, Ecological Society of America Annual Meeting, Montreal Canada, with Sarah Mittlefehldt.
- Helping Students Understand the Forms of Causality Implicit in Scientifically Accepted Explanations.* Chemistry Department Colloquium Series, University of Massachusetts, Boston, May 4, 2005.
- How RECAST Activities can help your Students Achieve Deep Understanding of Ecosystems,* National Science Teachers Association, Atlanta, GA, with Sarah Mittlefehldt and Rebecca Lincoln, April 2004.
- Using RECAST activities to help your Students Understand Air Pressure,* National Science Teachers Association, Atlanta, GA, with Sarah Mittlefehldt and Rebecca Lincoln, April 2004.
- Helping Students Understand the Nature of Causality Implicit in Scientifically Accepted Explanations.* The Institute of Ecosystem Studies, Millbrook, NY, January 16, 2004.
- Using Causality to Deepen Students' Understanding in Science.* Massachusetts Association of Science Teachers Annual Conference, Worcester, MA, with Sarah Mittlefehldt, November 7, 2003.
- The Understandings of Consequence Project: What Have We Learned?* National Science Foundation, REC PI Meeting, October. 27-28, 2003.
- Patterns of Reasoning that Impede Understanding,* International Schools Conference, Harvard University, Cambridge, MA, July 1, 2003.
- The Understandings of Consequence Project: An Overview of the Investigations, Findings, and Products,* Center for Technology in Learning, SRI International, Menlo Park. CA, May 1, 2003
- How Children Develop Deeper Understanding Using Causality: The role of Metacognition and Meaning-Making in Middle School Science Classrooms.* Student Research Conference and International Forum, Cambridge MA with Regina Ritscher, Sarah Mittlefehldt and Rebecca Lincoln, Feb. 28, 2003.
- What are RECAST Activities and Why are They Essential for Developing Deep Understanding in Science?* Massachusetts Association of Science Teachers Annual Conference, Worcester, MA, with Sarah Mittlefehldt, November 6, 2002.

*Understanding Fundamental Physics Concepts.* Harvard Smithsonian Science Media Group, Cambridge, MA, July 16, 2002.

*The Understandings of Consequence Project: What Have We Learned and Why Should it Matter to Schools?* International Schools Conference, Harvard University, Cambridge, MA, July 1, 2002.

*The Understandings of Consequence Project: Research Findings,* National Science Foundation, REC Principal Investigators' Meeting. May 16-17, 2002.

*Helping Students Achieve Deep Understanding in Science by Focusing on the Nature of Causality.* Yale University, New Haven, CT, with Belinda Basca, May 4, 2001.

*Response to Lambert and Bernhard on the Application of Psychological Knowledge to Educational Reform,* NSF-Sponsored Symposium, Invited Discussant, American Psychological Association Conference, Washington, D.C., August 2000.

*Teaching about Domino and Cyclic Causality to Help Students Understand Ecosystems.* National Science Teachers Association Conference, Orlando, FL, with Kiki Donis and Belinda Bell, March 2000.

*Helping Students Learn about Electricity by Examining their Causal Stories.* National Science Teachers Association Conference, Orlando, FL. with Margot Sudbury and Belinda Bell March 2000.

*How Causal Models can Help or Hinder an Understanding of Force and Motion Concepts.* National Science Teachers Association Conference, Orlando, FL with Rich Carroll and Belinda Bell, March 2000.