Vita

May, 2022

Patrick W. Thompson
Professor Emeritus, Mathematics Education
Arizona State University
School of Mathematical & Statistical Sciences
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Areas of Research Activity

Learning, teaching, curriculum, and professional development in the areas of:

- Algebraic reasoning in elementary and secondary mathematics
- Development of quantitative reasoning in mathematics and science
- Development of teachers' and students' understandings of calculus
- Relationships among probabilistic, statistical, and quantitative reasoning
- Mathematical meanings for teaching secondary mathematics
- Technology in mathematics education

Education

University of Georgia, 1977 - 1982, Ed.D. Mathematics Education (Dissertation title: *A Theoretical Framework for Understanding Young Children's Concepts of Whole Number Numeration*, L. P. Steffe, Advisor.)
University of Georgia, 1975 - 1977, M.Ed. Mathematics Education
Central Washington State College, 1968 - 1972, B.Sc. Mathematics (Cum Laude)

Experience

Professor of Mathematics Education, *School of Mathematical and Statistical Sciences, Arizona State University (2005-2020)*
Director of Research, Center for Research on Education in Science, Mathematics, Engineering and Technology; *Arizona State University (2005-2008)*
Professor of Mathematics Education, *Peabody College, Vanderbilt University (1997-2005*)
Chair, Department of Teaching and Learning, *Peabody College, Vanderbilt University (2000 - 2003)*
Founder and co-director, *Vanderbilt Program for Talented Youth, (1998-2000)*

Professor of Mathematical Sciences, Emeritus, *Department of Mathematical Sciences, San Diego State University (1999-present)*
Director, Joint Ph.D. in Mathematics and Science Education, *San Diego State University and University of California, San Diego (1995-1997)*
Professor of Mathematical Sciences, *Department of Mathematical Sciences, San Diego State University (1992-1997)*
Associate Professor of Mathematical Sciences, *Department of Mathematical Sciences, San Diego State University (1990-1992)*
Associate Professor of Mathematics Education, *Department of Mathematics, Illinois State University (1985-1990)*
Assistant Professor of Mathematical Sciences, *Department of Mathematical Sciences, San Diego State University (1982-1985)*
Lecturer, *Department of Mathematical Sciences, San Diego State University (1980-1982)*
Research Assistant, *Department of Mathematics Education, University of Georgia (1977-1980)*
Program Mathematics Educator, *West African Regional Mathematics Program, USAID (1973-1975)*
Peace Corp Volunteer, *Uganda and Sierra Leone (1972-1973*)

Honors and Affiliations

Honors

Fellow of the Israel Academy for Humanities and Social Sciences (Oct-Nov, 2019)
Distinguished Lecture, Cal Poly, Pomona (May, 2019)
Invited Lecture in the Felix Klein Lecture Series, ICME, Hamburg (July, 2016)
Distinguished lecture, Northern Illinois University Department of Mathematics, Dekalb, IL (April 2016)
Symposium on the work of Patrick Thompson, James J. Kaput Center for Mathematics Education, University of Massachusetts-Dartmouth (March, 2016)
Meritorious Citation for Best Paper Award, 2015 Conference of the MAA Special Interest Group for Research in Undergraduate Mathematics Education
Featured Guest, Mathematics Education Student Association (September, 2012)
Finalist, ASU Parents' Association Professor of the Year (2011)
Fellow, American Educational Research Association (Elected 2010)
Senior Scholars in Mathematics Education Lecture, Brigham Young University (December 2008)
Featured Guest, Mathematics Education Student Association (November, 2008)
Honored Guest, Japan Society of Mathematics Education (September, 2007)
Visiting Scholar, Singapore National Institute of Education (July, 2006)
University of Georgia College of Education Distinguished Alumni Award for Professional Achievement (2006)
Maseeh Lecture, Portland State University (2006)
Fullbright Senior Specialist, Israel. (2004)

Fullbright Senior Specialist, Israel, (2002).
Spencer Mentor for Dissertation Fellow Awardees, Spencer Foundation (2000)
Runner-up, Article of the Year, Journal for Research in Mathematics Education (1994)
AMS-MAA Joint Invited Address (1993)
Initiative Award. Recognized by Illinois State University for outstanding work in initiating significant research programs. (1987)
Recognition Award for contributions to research in the Illinois State University Laboratory School. (1987)
Leadership Award, San Diego and Imperial Counties Teacher Education and Computer Center. Awarded for outstanding contributions to the improvement of mathematics teaching and learning. (1984)

Plenary Lectures

Thompson, P. W. (2020, March). *Project DIRACC's foundation in Newton, Leibniz, and Robinson.* Plenary address given at the 30th National Conference of Research and Teaching in Mathematics, Sonora, Mexico.
Thompson, P. W. (2019, August). *Making the Fundamental Theorem of Calculus fundamental to students' calculus*. Plenary address given at the International Conference on Calculus in Upper Secondary and Beginning University, University of Adger, Kristiansand, Norway.
Thompson, P. W. (2019, May), *Developing and Investigating a Rigorous Approach to Conceptual Calculus (DIRACC)*. Distinguished lecture given to the Department of Mathematics, California Polytechnic University, Pomona, CA.
Thompson, P. W. (2018, November). *Computational mathematics in grades K-12.* Plenary address given at the Conference on Computational Mathematics in Schools, University of Delaware, Newark, DE.
Thompson, P. W. (2015, November). *Teachers' Coherent Mathematical Meanings as a Source of Students' Learning.* Plenary lecture given at the International Conference on Mathematics Education, Seoul, Korea.
Thompson, P. W. (2015, January). *The Fundamental Theorem of Calculus Must Be Fundamental to the Calculus We Teach and Assess.* Plenary lecture to the Conference on Formative Assessment in Mathematics, Weizmann Institute, Rehovot, Israel.
Thompson, P. W. (2014, December). *Making the Fundamental Theorem of Calculus Fundamental to Calculus.* Keynote address to the International Conference on Mathematics in Undergraduate Study Programs, Oberwolfach, Germany.
Thompson, P. W. (2014, June). *Hidden Obstacles to Mathematics Education Reform.* Plenary address given at the Association for Public and Land-grant Universities Mathematics Teacher Education Partnerships, Milwaukee, WI.
Thompson, P. W. (2014, January). *Mathematics Education Reform and the Common Core State Standards.* Banquet address, Mathematics for America, San Diego, CA.
Thompson, P. W. (2013, June). *Schemes for Thinking with Magnitudes.* Keynote address given at the Conference on Epistemic Algebra Students, Athens, GA.

Thompson, P. W. (2013, February). *Under the Radar: Foundational Meanings that Math Professors (Mistakenly) Assume Students Have.* Plenary address given at the annual meeting of the MAA Special Interest Group on Research in Undergraduate Mathematics Education.

Thompson, P. W. (2013, January). *Fostering Students' Critical and Creative Thinking in Mathematics.* Featured address given at the International Science, Mathematics, and Technology Conference, Bangkok, Thailand.

Thompson, P. W. *Advances in Quantitative Reasoning*. (2012, May). Plenary presentation given at the Conference on Quantitative Reasoning and Mathematical Modeling: A Driver for STEM Integrated Education, Savannah, GA.

Thompson, P. W. (2012, April) *Mathematics and Mathematics Education.* Plenary panel at the International Conference on Mathematics and Mathematics Education, Ben-Gurion University, Israel.

Thompson, P.W. (2012, January) *The Professional Development of Secondary Mathematics Teachers: A Tribute to Judy Sowder.* Keynote address at the Conference to Honor the Career of Judith Threadgill-Sowder.

Thompson, P. W. (2010, November). *Research As Professional Development: The Role Of Research In Reforming Mathematics Instruction At Two-Year Colleges.* Keynote address given at the annual meeting of the American Mathematical Association of Two-Year Colleges.

Thompson, P. W. (2010, September). *Quantitative Reasoning And Mathematical Modeling.* Keynote address given at the Invitational Planning Conference for the Wyoming Institute for the Study and Development of Mathematical Education, Laramie, WY.

Thompson, P. W. (2010, March). *School Mathematics Is Largely Useless For Learning Physics. But It Needn't Be.* Keynote address given at the annual meeting of the American Physical Society, Portland, OR.

Thompson, P. W. (2009, April). *Rate Of Change And The Fundamental Theorem Of Calculus.* Keynote address at the Institute for Mathematics and Education Workshop on Calculus Learning, Tucson, AZ.

Thompson, P. W. (2008, December). *In The Absence Of Meaning*. Senior Scholars in Mathematics Education Lecture on the Future of Mathematics Education, Brigham Young University.

Thompson, P. W. (2008, November). *A Unified Vision Of Learning And Teaching Mathematics K-16*. Featured lecture, Mathematics Education Student Association, University of Georgia.

Thompson, P. W. (2008, July). *Conceptual Analysis Of Mathematical Ideas: Some Spadework At The Foundations Of Mathematics Education*. Plenary paper presented at the Annual Meeting of the International Group for the Psychology of Mathematics Education, Morelia, Mexico.

Thompson, P. W. (2007, September). *Constructivism In Mathematics Education*. Japan Society of Mathematics Education, Hiroshima.

Thompson, P. W. (2007, September). *A New Perspective On Mathematical Literacy*. Japan Society of Mathematics Education, Hiroshima.

Thompson, P. W. (2007, February). *Epistemology, Ontology, And Method.* Paper delivered at the International Workshop on Guided construction of knowledge in classrooms, Hebrew University, Jerusalem.

Thompson, P. W. (2006, March). *Where Is The Mathematics In Mathematics Education.* Invited address in the Maseeh Lecture Series, Portland State University, Portland, Oregon.

Thompson, P. W. (2006, February). *Democracy And Mathematics: The Legacy Of Jim Kaput In Mathematics Education Research.* Invited address, Mathematical Association of America Annual Conference on Research in Undergraduate mathematics Education, Rutgers University, Piscataway, NJ.

Thompson, P. W. (2005, February). *What It Means To Understand What It Means To Understand A Mathematical Idea Deeply.* Invited opening address, Mathematical Association of America Annual Conference on Research in Undergraduate Mathematics Education, Phoenix, Arizona.

Thompson, P. W. (2004, June*). Cross-Talk and Miscommunication in Teaching Mathematics*. Plenary address given at the Maine Symposium on Research in Mathematics and Science Education, University of Maine, Orono, Maine.

Thompson, P. W. (2004, May). *The Concept Of Tool In Mathematics Teaching.* Fullbright lecture given at the Weizmann Institute of Technology, Rehovot, Israel.

Thompson, P. W. (2004, May). *The Many Faces Of Multiplicative Reasoning.* Fullbright lecture given at the University of Tel Aviv, Tel Aviv, Israel.

Thompson, P. W. (2004, May). *The Tangled Web Of Probabilistic Reasoning.* Fullbright lecture given at the Technion University, Haifa, Israel.

Thompson, P. W. (2002, June). *Making Sense Of Interviews.* Invited plenary address given at the Conference on The Role of Research in Science and Mathematics Education Reform, Orono, Maine.

Thompson, P. W. (2001, September). *What Is The Probability That Al Gore Will Be Elected President In 2004 Given That He Lost The 2000 Election? Or, Why Probabilistic Reasoning Is So Hard*. Invited opening address, Mathematical Association of America Annual Conference on Research in Undergraduate Mathematics Education, Chicago, Illinois.

Thompson, P. W. (1999). *Representations and Evolution: A Discussion Of Duval's And Kaput's Papers*. Plenary discussant at the Twenty-first Annual Meeting of the Psychology of Mathematics Education, North America. Cuernavaca, Mexico.

Thompson, P. W., & Cobb. P. (October, 1998). *On Relationships Between Psychological And Sociocultural Perspectives In Mathematics Education.* Invited plenary address given at the Annual Meeting of the International Group for the Psychology of Mathematics Education – North America. Raleigh, NC.

Thompson, P. W. (1996, November). *If You Say It, Will They Hear? Or, The Relevance To Teaching Mathematics Of Research On Mathematics Learning And Comprehension*. Invited featured session at the Annual Meeting of the American Mathematical Association of Two Year Colleges, Long Beach, CA.

Thompson, P. W. (1996, July). *Technology And Curriculum Reform: Designing For Emergence, Or Making Students, Curricula, And Instruction Meet Where None Of Them Is, Or You Can't Teach Them What You Want Them To Learn*. Keynote Address given to the Working Group on Technology and Curriculum Reform, International Congress of Mathematical Education, Seville, Spain.

Thompson, P. W., & Sfard, A. (October, 1994). *Problems Of Reification: Representations And Mathematical Objects.* Invited plenary address given at the Annual Meeting of the International Group for the Psychology of Mathematics Education – North America. Baton Rouge, LA.

Thompson, P. W. (1994, March) *Concepts of Function, Concepts of Rate, and Newton's Fundamental Theorem of Calculus.* Invited plenary address at the Center for Investigations in Mathematics Education, Mexico City.

Thompson, P. W. (1993, January). *Students, Functions, And The Undergraduate Mathematics Curriculum.* Invited plenary address given at the Joint Meeting of the American Mathematical Society and the Mathematical Association of America. San Antonio, TX.

Thompson, P. W. (1984, April). *Computer Environments For Diagnosing Concept Formation.* Invited plenary address given at the Annual Meeting of the Research Council on Diagnostic and Prescriptive Mathematics, San Francisco.

Offices

Elected

At-large member of the Executive Board, International Group for the Psychology of Mathematics Education – North American Chapter, 1998-2001.

Co-chair, Special Interest Group for Research in Mathematics Education of the American Educational Research Association, 1988-1990

Appointed

Research Advisory Committee of the National Council of Teachers of Mathematics (1993-1996; Chair, 1995-1996)

Co-chair Division C, Section 2 Program Committee of the American Educational Research Association, 1992

National Committees and Advisory Boards

College Board SAT Mathematics Subject Tests Writing Committee (2011-2014)

Writing Team, Common Core State Standards – Mathematics (2009-2010)

Institute for Mathematics Education, University of Arizona (*Executive Board, 2007-present*)

James J. Kaput Center for Research and Innovation in Mathematics Education (*Advisory Board, 2007-2012*)

Mathematical Association of America, Working Group for Algebra as a Gateway to a Technological Future. (2006)

American Statistical Association, Committee to Establish Guidelines for Statistics in Mathematics Education Research (2004-2006)
National Research Council Committee on Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations (2002-2004)
College Entrance Examining Board, Committee for the Organization of the Graduate Record Exam Quantitative Reasoning Measure (1993-1994)

Journal Editorial Activity

Editor

ZDM Mathematics Education Vol 53, Issue 3 (with Guershon Harel). *Calculus learning and teaching around the world.*
International Journal of Research in Undergraduate Mathematics Education, Volume 1, Number 1 (guest editor, with editors-in-chief)
Research in Collegiate Mathematics Education (co-editor, 2006-2008; editor, 2008-2012)
Cognition and Instruction (associate editor; 2002-2007)
Journal for Research in Mathematics Education (Appointed 2002; withdrew for health reasons)

Editorial Boards

International Journal of Science and Mathematics Education (*2010-present*)
Open Mathematical Education Notes—Online journal of the Scientific Society of Mathematicians of Banja Luka, Bosnia (*2010-present*)
Educational Researcher (*2000-2003*)
Educational Studies in Mathematics (*1992-1996; 2000-2004*)
International Journal of Computers in Mathematics Learning (*1999-2010*)
Peabody Journal of Education (*1997-2005*)
Journal of Artificial Intelligence in Education (*1989-1992*)
Journal of Computers in Mathematics and Science Teaching (*1992-1995*)

Reviewer

Australian Research Council
Canadian Research Council
Cognition and Instruction
European Journal of Learning and Instruction
Journal for Research in Mathematics Education
Journal of the Learning Sciences
Mathematics Teacher
National Science Foundation:
Applications of Advanced Technology
Research on Learning and Evaluation
Research on Teaching and Learning

Teacher Professional Continuum
Research in Undergraduate Mathematics Education
Spencer Foundation

Memberships in Professional Organizations

American Educational Research Association
Association of Mathematics Teacher Educators
National Council of Teachers of Mathematics
Mathematical Association of America
International Group for the Psychology of Mathematics Education

Grant Activity

Research Grants

Principle Investigator (with Fabio Milner and Mark Ashbrook), National Science Foundation, *Project DIRACC: Developing and Investigating a Rigorous Approach to Conceptual Calculus.* ($810,000, September 2016 – August 2019)

Co-Principle Investigator (with Karen Draney), Institute of Educational Sciences: *Mathematical meanings that matter* ($1.6 million, July 2016 – June 2019).

Co-Principal Investigator (with Marilyn Carlson), National Science Foundation: *Pathways to Preparing Future Mathematics Faculty to Transform Undergraduate Mathematics Teaching and Learning* ($2.05 million, September 2013 – August 2018).

Principal Investigator, National Science Foundation: *Project Aspire: Defining and Assessing Mathematical Knowledge for Teaching Mathematics.* ($1.95 million, September 2011 – August 2015).

Principal Investigator (with Marilyn Carlson). National Science Foundation: Developing a Professional Learning Community Model for Secondary Precalculus Teachers: A Model for Teacher Professional Growth ($4.5 million, May, 2004-April, 2010).

Co-Principal Investigator (with R. Lehrer, L. Schauble, R. Hall). National Science Foundation Grant: *Modeling Data, Creating Worlds.* ($1.8 million, January 2004-December 2006).

Principal Investigator, National Science Foundation Grant: *Multiplicative reasoning as a foundation for the teaching and learning of stochastic reasoning.* ($670,000, January 1999 – June 2004). (Accompanied by a $12,000 gift of software from Data Description and Key Curriculum Press).

Co-Principal Investigator (with J. Lobato and J. Bowers), National Science Foundation Instructional Laboratory Improvement grant, $345,000.(1996)

Co-Principal Investigator (with J. Sowder), National Science Foundation Grant: Reforming the preparation and professional development of elementary and middle school mathematics teachers. ($550,000; 1994-1998)

Principal Investigator, National Science Foundation Grant: *Quantitative Concepts as a Foundation for Algebra*. ($826,000; 1989-1994).

Principal Investigator, Apple Computer Office of External Research: *Improving Students' Concepts in Algebra* ($33,000 equipment; 1987-1989).

Principal Investigator, National Science Foundation Grant: *Cognitive Effects of Multiple Representation of Mathematical Concepts.* ($87,000; 1987-1988, $12,000; 1988-1989).

Principal Investigator, San Diego State University Foundation Grant: *Modeling students' cognitions in understanding integers.* (1984).

Faculty Associate, NSF Grant, E. A. Silver (Director), San Diego State University: Synthesis of cognitive science and mathematics education literatures on mathematical problem solving. (1980-1982).

Instructional Grants

Co-Principal Investigator, National Science Foundation: *Reforming the preparation and professional development of elementary and middle school mathematics teachers* (J. Sowder and A. Thompson, Co-PIs; $650,000; 1994-1998).

Co-Principal Investigator (with J. Lobato & J. Bowers). National Science Foundation Grant: Enhancing Prospective Teachers' Mathematical Understanding Through Computer-Based Modeling. ($100,00 equipment grant; 1997-1999)

Principal Investigator, Illinois State University Instructional Development Project Grant: *Improving undergraduates' understanding of numerical algorithms.* (1986).

Publications

Books

Karagöz Akar, G., Özgür Zembat, I., Selahattin, A., & Thompson, P. W. (Eds.) *Quantitative reasoning in mathematics and science education.* Berlin: Springer.

Thompson, P. W., Ashbrook, M., & Milner, F. A. (2019). *Calculus: Newton, Leibniz, and Robinson Meet Technology.* (http://patthompson.net/ThompsonCalc)

Confrey, J., Grouws, D., Thompson, P. W., Saari, D., Castillo-Chavez, C., Schmidt, W., Mahone, C., Valez, W. (2004). *On evaluating curricular effectiveness: Judging the quality of K-12 mathematics evaluations.* Washington, DC: National Academies Press.

Edited Books

Oberwolfach papers

Hitt, F., Holton, D., Thompson, P. W. (Eds.) (2010) *Research in Collegiate Mathematics Education VII* (Issues in Mathematics Education, Vol. 16). Washington, DC: American Mathematical Society.

Steffe, L. P., & Thompson, P. W. (Eds.), (2000). *Radical constructivism in mathematics and science education: Essays in honor of Ernst von Glasersfeld*. London: Falmer Press.

Articles in Refereed Publications

Thompson, P. W., & Harel, G. (2021). Ideas foundational to calculus learning and their links to students' difficulties. *ZDM – Mathematics Education*, 53(3), 507–519. https://doi.org/10.1007/s11858-021-01270-1

Frank, K., & Thompson, P. W. (2021). School students' preparation for calculus in the United States. ZDM – Mathematics Education, 53(3), 549–562. https://doi.org/10.1007/s11858-021-01231-8

Yoon, H., & Thompson, P. W. (2020). Secondary teachers' meanings for function notation in the United States and South Korea. *Journal of Mathematical Behavior, 60*, 100804. https://doi.org/10.1016/j.jmathb.2020.100804.

Byerley, C. , & Thompson, P. W. (2017). Secondary teachers' meanings for measure, slope, and rate of change. *Journal of Mathematical Behavior,* 48, 168-193.

Thompson, P. W., Hatfield, N., Joshua, S., Yoon, H., & Byerley, C. (2017). Covariational reasoning among U.S. and South Korean Secondary Mathematics Teachers. *Journal of Mathematical Behavior*, 48, 95-111.

Weber, E., & Thompson, P. W. (2014). Students' images of two-variable functions and their graphs. *Educational Studies in Mathematics, 86*, 67-85. doi: 10.1007/s10649-014-9548-0

Saldanha, L. A., & Thompson, P. W. (2014). Conceptual issues in understanding the inner logic of statistical inference: Insights from two teaching experiments. *Journal of Mathematical Behavior, 35*, 1-30. doi: 10.1016/j.jmathb.2014.03.001

Thompson, P. W. (2013). Constructivism in mathematics education. *Encyclopedia of mathematics education [online].* Berlin: Springer. doi: 10.1007/SpringerReference_313210 2013-05-10 00:00:07 UTC.

Thompson, P. W. (2013, September). "Why use $f(x)$ when all we really mean is y?". *OnCore—The Online Journal of the Arizona Association of Mathematics Teachers*.

Thompson, P. W, Byerley, C., & Hatfield, N. (2013). A conceptual approach to calculus made possible by technology. *Computers in the Schools*, *30*, 124-147.

Weber, E., Tallman, M., Byerley, C., & Thompson, P. W. (2012). Introducing the derivative via calculus triangles. *Mathematics Teacher*, *104*(4), 274-278.

Liu, Y., & Thompson, P. W. (2009). Mathematics teachers' understandings of proto-hypothesis testing. *Pedagogies, 4*(2), 126-138.

Thompson, P. W. (2008). On professional judgment and the National Mathematics Panel report. *Educational Researcher*, *37*(9), 582-587.

Silverman, J., & Thompson, P. W. (2008). Toward a framework for the development of mathematical knowledge for teaching. *Journal of Mathematics Teacher Education, 11*, 499-511.

Thompson, P. W., Carlson, M. P., & Silverman, J. (2007). The design of tasks in support of teachers' development of coherent mathematical meanings. *Journal of Mathematics Teacher Education,* **10**, 415-432.

Liu, Y., & Thompson, P. W. (2007). Teachers' understandings of probability. *Cognition and Instruction, 25*(2-3), 113-160.

Saldanha, L. A. and Thompson, P. W. (2007). Exploring connections between sampling distributions and statistical inference: An analysis of students' engagement and thinking in the context of instruction involving repeated sampling, *International Electronic Journal of Mathematics Education,* 2(3), 270-297.

Saldanha, L., & Thompson, P. W. (2002). Students' conceptions of samples and their relationship to statistical inference. *Educational Studies in Mathematics, 51*(3), 257-270.

Thompson, P. W. (2001). Holistic perspectives on instructional design [Review of *Symbolizing and Communicating in Mathematics Classrooms*, P. Cobb, E. Yackel, & K. McClain (Eds.)] *Journal for Research in Mathematics Education.*

Thompson, P. W. (2000). What is required to understand fractal dimension? *Mathematics Educator*, 10(2), 33-35.

Steffe, L. P., & Thompson, P. W. (2000). Interaction or intersubjectivity? A reply to Lerman. *Journal for Research in Mathematics Education*, 31(*2*), 191-209.

Thompson, A. G., & Thompson, P. W. (1996, January). Talking about rates conceptually, Part II: Mathematical knowledge for teaching. *Journal for Research in Mathematics Education*, *27*(1), 2-24.

Dugdale, S., Thompson, P. W., et. al (1995). Technology and algebra curriculum reform: Current issues, potential directions, and research questions. *Journal of Technology in Mathematics*, *14*(3), 325-358.

Kaput, J. J., & Thompson, P. W. (1994). Technology in mathematics education research: The first 25 years in *JRME*. *Journal for Research in Mathematics Education*, *25*(6), 676-684.

Thompson, P. W. (1994). Students, functions, and the undergraduate mathematics curriculum. In E. Dubinsky, A. H. Schoenfeld, & J. J. Kaput (Eds.), *Research in Collegiate Mathematics Education, 1* (Issues in Mathematics Education Vol. 4, pp. 21-44). Providence, RI: American Mathematical Society.

Thompson, P. W., & Thompson, A. G. (1994). Talking about rates conceptually, Part I: A teacher's struggle. *Journal for Research in Mathematics Education*, *25*(3), 279-303.

Thompson, P. W. (1994). Images of rate and operational understanding of the Fundamental Theorem of Calculus. *Educational Studies in Mathematics*, *26*(2-3), 229-274.

Thompson, P. W. (1994). Concrete materials and teaching for mathematical understanding. *Arithmetic Teacher*, *41*(9), 556-558.

Thompson, P. W. (1993). Quantitative reasoning, complexity, and additive structures. *Educational Studies in Mathematics*, *25*(3), 165-208.

Thompson, P. W. (1993). Yes, Virginia, some children do grow up to be mathematicians. [Review of *Advanced Mathematical Thinking*, D. Tall (Ed.)]. *Journal for Research in Mathematics Education*, *24*(3), 279-284.

Thompson, P. W. (1992). Notations, conventions, and constraints: Contributions to the effective use of concrete materials in elementary mathematics. *Journal for Research in Mathematics Education*, *23*(2), 123-147.

Thompson, P. W. (1990). Review of Interactive Physics, The Mathematics Teacher, 83(2).

Thompson, P. W., & Dreyfus, T. (1988, March). Integers as transformations. *Journal for Research in Mathematics Education*, *19*, 115-133.
Thompson, P. W. (1985). A Piagetian approach to transformation geometry via microworlds. *Mathematics Teacher*, *78*(6), 465-472.
Thompson, P. W. (1984). Content versus method. *College Mathematics Journal*, *15*(5), 394-395.
Thompson, P. W. (1982). Were lions to speak, we wouldn't understand. *Journal of Mathematical Behavior*, *3* (2), 147-165.

Chapters in Books

Thompson, P. W. (2022). Quantitative reasoning as an educational lens. In Karagöz Akar, G., Özgür Zembat, I., Selahattin, A., & Thompson, P. W. (Eds). *Quantitative reasoning in mathematics and science education.* Berlin: Springer.
Thompson, P. W., & Milner, F. (2018). Teachers' meanings for function and function notation in South Korea and the United States. In H.-G. Weigand, W. McCallum, M. Menghini, M. Neubrand & G. Schubring (Eds.), *The Legacy of Felix Klein* (pp. 55-66). Berlin: Springer.
Thompson, P. W., & Carlson, M. P. (2017). Variation, covariation, and functions: Foundational ways of thinking mathematically. *Compendium for Research in Mathematics Education* (pp. 421-456). Reston, VA: National Council of Teachers of Mathematics.
Thompson, P. W. (2016). Researching teachers' mathematical meanings for teaching mathematics. In L. English & D. Kirshner (Eds.), *Third Handbook of International Research in Mathematics Education* (pp. 435-461). New York: Taylor and Francis.
Thompson, P. W., Carlson, M. P., Byerley, C., & Hatfield, N. (2014). Schemes for thinking with magnitudes: A hypothesis about foundational reasoning abilities in algebra. In K. C. Moore, L. P. Steffe & L. L. Hatfield (Eds.), *Epistemic algebra students: Emerging models of students' algebraic knowing*. WISDOMe Monographs (Vol. 4, pp. 1-24). Laramie, WY: University of Wyoming.
Thompson, P. W., Artigue, M., Törner, G., & de Shalit, E. (2014). Collaboration between mathematics and mathematics education. In M. Fried & T. Dreyfus (Eds.), *Mathematics and mathematics education: Searching for common ground* (pp. 313-333). Berlin: Springer.
Thompson, P. W. (2013). In the absence of meaning. In K. Leatham (Ed.), *Vital directions for research in mathematics education* (pp. 57-93). New York: Springer.
Thompson, P. W. (2013). Constructivism in mathematics education. In S. Lerman (Ed.), *Encyclopedia of mathematics education [online]*. Berlin: Springer. doi: 10.1007/SpringerReference_313210 2013-05-10 00:00:07 UTC.
Thompson, P. W. (2012). Advances in research on quantitative reasoning. In R. Mayes, R. Bonillia, L. L. Hatfield & S. Belbase (Eds.), *Quantitative reasoning: Current state of understanding*, WISDOMe Monographs (Vol. 2, pp. 143-148). Laramie, WY: University of Wyoming.

Thompson, P. W. (2011). Quantitative reasoning and mathematical modeling. In L. L. Hatfield, S. Chamberlain & S. Belbase (Eds.), *New perspectives and directions for collaborative research in mathematics education*, WISDOMe Monographs (Vol. 1, pp. 33-57). Laramie, WY: University of Wyoming.

Thompson, P. W. (2010). Foreword. Introduction to Steffe, L. P., & Olive, J. *Children's Fraction Knowledge* (pp. i-iv). New York: Springer.

Oehrtman, M. C., Carlson, M. P., & Thompson, P. W. (2008). Foundational reasoning abilities that promote coherence in students' function understanding. In M. P. Carlson & C. Rasmussen (Eds.), *Making the connection: Research and practice in undergraduate mathematics* (pp. 27-42). Washington, DC: Mathematical Association of America.

Thompson, P. W., & Silverman, J. (2008). The concept of accumulation in calculus. In M. Carlson & C. Rasmussen (Eds.), *Making the connection: Research and teaching in undergraduate mathematics* (pp. 43-52). Washington, DC: Mathematical Association of America.

Thompson, P. W., Liu, Y., & Saldanha, L. A. (2007). Intricacies of statistical inference and teachers' understandings of them. In M. Lovett & P. Shaw (Eds.), *Thinking with data* (pp. 207-231). Mahwah, NJ: Erlbaum.

Smith III, J. P., & Thompson, P. W. (2007). Quantitative reasoning and the development of algebraic reasoning. In J. J. Kaput, D. W. Carraher & M. L. Blanton (Eds.), *Algebra in the early grades* (pp. 95-132). New York: Erlbaum.

McCallum, W., Thompson, P. W., Harel, G., Blaire, R., Dance, R., Nolan, E., et al. (2007). Intermediate algebra. In V. J. Katz (Ed.), *Algebra: Gateway to a technological future* (pp. 19-27). Washington, DC: Mathematical Association of America.

Thompson, P. W., & Saldanha, L. (2003). Fractions and multiplicative reasoning. In J. Kilpatrick & G. Martin (Eds.), *Research companion to the NCTM Standards.* Washington, DC: National Council for Teachers of Mathematics.

Thompson, P. W. (2002). Didactic objects and didactic models in radical constructivism. In K. Gravemeijer, R. Lehrer, B. van Oers, L. Verschaffel (Eds.), *Symbolizing and modeling in mathematics education.* Dordrecht, The Netherlands: Kluwer.

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Articles in Refereed Proceedings

Moore, K. C., & Thompson, P. W. (in press). *Ideas of calculus, and graphs as emergent traces*. Proceedings of the 13th International Congress on Mathematical Education, Hamburg, Germany.

Thompson, P. W., & Dreyfus, T. (2016). A coherent approach to the Fundamental Theorem of Calculus using differentials. In R. Biehler & R. Hochsmuth (Eds.), *Proceedings of the Conference on Didactics of Mathematics in Higher Education as a Scientific Discipline* (pp. 350-359). Hannover, Germany: KHDM.

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Liu, Y., & Thompson, P. W. (2005). Teachers' understanding of hypothesis testing. In S. Wilson (Ed.), *Proceedings of the Twenty-seventh Annual Meeting of the International Group for the Psychology of Mathematics Education*, Roanoke, VA. Vicksburg, VA: Virginia Tech.

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Reports

Thompson, P. W., Castillo-Chavez, C., Culbertson, R. J., Flores, A., Greely, R., Haag, S., et al. (2007). Failing the future: Problems of persistence and retention in science, techhnology, engineering, and mathematics majors at Arizona State University. Tempe, AZ: Office of the Provost.

Published Software

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Thompson, P. W. (1986). *MOTIONS: A microworld for exploring transformation geometry.* Published by Cosine, Inc., W. Lafayette, IN. and Control Data Publishing, Australia.

Thompson, P. W. (1984). *INTEGERS: A microworld for integers and introductory algebra.* Published by Cosine, Inc., W. Lafayette, IN. and Control Data Publishing, Australia.

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Thompson, P. W. (1984). *CIRCUITS: A microworld for exploring the logic of equivalence.* Published by Cosine, Inc., W. Lafayette, IN. and Control Data Publishing, Australia.

Thompson, P. W. (1984). *INSIDE LOGO: A microworld for exploring the inner workings of Logo.* Published by Cosine, Inc., W. Lafayette, IN. and Control Data Publishing, Australia.

Invited Testimony

Thompson, P. W. (2007, April). Invited testimony given to the President's National Mathematics Panel. Aurora, Il.

Refereed Presentations or Papers (not in Proceedings)

Thompson, P. W. (2016, August). *Thinking with structure: An International Comparison*. Presentation given to the Arizona Department of Education.

Thompson, P. W., Joshua, S., Yoon, H., Byerley, C., Musgrave, S., & Hatfield, N. (2015, April). *High School Teachers' Preparedness to Teach the Common Core State Standards.* Symposium organized for the NCTM Research Meeting, Pittsburgh, PA.

Thompson, P. W. (2015, August). *Epistemlogical Obstacles to Students' Modeling in Calculus.* Presentation given in the Symposium on Mathematical Modeling, Mathfest.

Thompson, P. W. (2014, April). *Connecting Data with Chance Through Modeling: A Commentary.* Symposium discussant at the annual Research Presession of the National Council of Teachers of Mathematics, New Orleans, LA.

Thompson, P. W. (2013, October). *Weak Meanings Lead to Weak Learning: The Problem of Inattention to Students' Mathematical Meanings in Undergraduate Mathematics.* Invited colloquium given to the School of Mathematical and Statistical Sciences, Arizona State University.

Thompson, P. W. (2013, April). *Recognizing Proportional Relationships: A Commentary.* Symposium discussant at the annual Research Presession of the National Council of Teachers of Mathematics, Denver, CO.

Thompson, P. W. (2012, April). *Fractions, Units, and the Common Core State Standards for Mathematics*. Symposium discussant at the annual Research Presession of the National Council of Teachers of Mathematics, Philadelphia, PA.

Thompson, P. W. (2012, April). *Current Thinking on Trig Concepts Worth Knowing: This is Not SOH-CAH-TOA.* Symposium discussant at the annual Research Presession of the National Council of Teachers of Mathematics, Philadelphia, PA.

Thompson, P. W. (2010, April). *Rethinking Mathematical Knowledge For Teaching.* Paper presented at the Research Presession to the annual meeting of the National Council of Teachers of Mathematics, San Diego, CA.

Thompson, P. W. (2010, April). *Toward A Foundation Of Mathematics Education.* Paper presented at the annual meeting of the American Educational Research Association, Denver, CO.

Thompson, P. W. (2009, April). *The Role Of Meaning In The Reform Of School Arithmetic And Algebra.* Paper presented at the annual Research Presession of the National Council of Teachers of Mathematics, Washington, DC.

Thompson, P. W. (2009, April). *Exercising Professional Judgment In Mathematics Curriculum Reform.* Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Thompson, P. W. (2008, April). *Affecting Teachers' Images Of What And Who They Teach.* Paper presented at the Research Presession to the Annual Meeting of the National council of Teachers of Mathematics, Salt Lake City, UT. (Also, organizer of research symposium by the same name.)

Thompson, P. W. (2007, April). *The Design Of Tasks To Promote Coherence In Classroom Mathematics.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

Thompson, P. W., & Carlson, M. P. (2006, June). *Affecting Teachers' Learning Communities By Affecting Their Mathematical Knowledge.* Paper presented at the China-U.S. Educational Leadership Conference, Beijing, China.

Thompson, P. W. (2006, April). *Measurement: The Lost Strand In Elementary Mathematics.* Discussant for the symposium *Constructing Data, Modeling Worlds*. Annual Meeting of the American Educational Research Association, San Francisco, CA.

Liu, Y. & Thompson, P. W. (2006, April). *Teachers' Understandings Of Probability And Their Implications For Teacher Professional Development.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Thompson, P., & Carlson, M. P. (2006, April). *Mathematical Thinking And Intersubjective Operations: A Lens On The Creation Of Mathematical Learning Communities*. Paper presented at the Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics. St. Louis, MO.

Thompson, P. W. (2005, October). *Affecting Teachers' Practices Through Their Mathematical Knowledge.* Presentation given at the Twenty-Seventh Annual Meeting of the Psychology of Mathematics Education—North America. Roanoke, VA.

Thompson, P. W. (2005, April). *On Evaluating Curricular Effectiveness: Judging The Quality Of Mathematics K-12 Curriculum Evaluations.* Presentation given at the Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics. Ahaheim, CA.

Thompson, P. W. (2005, April). *Creating Data, Modeling Worlds, Changing Practices.* Presentation given at the Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics. Anaheim, CA.

Thompson, P. W. (2005, April. Discussant for symposium, *Unexpected Findings About How Young Students Learn Algebra.* Presentation given at the Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics. Anaheim, CA.

Carlson, M. P., & Thompson, P. W. (2005, April). *The Reflexive Relationship Between Individual Cognition And Classroom Practices: A Covariation Framework And Problem Solving Research Informs Calculus Instruction*. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Quebec.

Thompson, P. W. (2005, March). *Issues In Algebra Learning, Teaching, And Curricula.* Invited address given at the annual meeting of the Appalachian Mathematics and Science Project, Lexington, KY.

Thompson, P. W., Saldanha, L. A., & Liu, Y. (2004, April). *Why Statistical Inference Is Hard To Understand.* Paper presented at the annual meeting of the American Educational Research Association, San Diego.

Thompson, P. W., Milner, R., & Liu, Y. (2004, April). *Teacher Reflection And Reflective Abstraction: Viewing Mathematics Teachers' Struggles From Two Perspectives*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Thompson, P. W. (2004, April). Discussant, *Symposium On Mathematics Learning.* American Educational Research Association, San Diego, CA.

Thompson, P. W., & Liu, Y. (2002, April). *What Is The Probability My Car Is Red? Tensions In The Development Of Probabilistic Reasoning.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Thompson, P. W. (2002, April) *Methodology: A Quest for Knowledge*. Discussant for the Symposium on Teaching Experiments as Research Methodologies, Research Presession to the Annual Meeting of the National Council of Teachers of Mathematics, Las Vegas, NV.

Thompson, P. W. (2001, August). *Helping Students Find Meaning In Measures Of Association*. Presentation given at the Annual Joint Meeting of the Statistical Associations, Atlanta, GA.

Thompson, P. W. (2001, April). *Students' Probabilistic Reasoning.* Symposium presentation given at the American Educational Research Association Annual Meeting, Seattle, WA.

Thompson, P. W. (2001, April). *Do Computers Make A Difference In Students' Mathematical Learning?* Symposium presentation given at the American Educational Research Association Annual Meeting, Seattle, WA.

Thompson, P. W. (2001, January). *Multiplicative Reasoning As A Foundation For Probabilistic And Statistical Reasoning*. Poster presentation given at the National Science Foundation Directors Meeting.

Thompson, P. W. (2000, April). *The Essential Role Of Quantitative Reasoning In The Development Of Algebraic Competence.* (And organizer of symposium by the same title.) Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics, Chicago, IL.

Thompson, P. W. (1998, March). Discussant for *A New Vision of Calculus*, research symposium at the Research Presession of the Annual Meeting of the National Council of Teachers of Mathematics, Washington, DC.

Thompson, P. W. (1998, April). *Symbols And Tools As Occasions To Talk.* Presentation given as part of *Perspectives on the Role of Tools and Artifacts in Mathematical Learning*, a research symposium held at the Annual Meeting of the American Educational Research Association.

Thompson, P. W., & Thompson, A. G. (1992, April). *Images Of Rate.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco.

Thompson, P. W. (1991, March). *Quantitative Reasoning, Complexity, And Additive Structures.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago.

Thompson, P. W. (1991, March). *Representations, Principles, And Constraints: Contributions To The Effective Use Of Concrete Manipulatives In Elementary Mathematics*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago.

Thompson, P. W. (1989, March). *A Cognitive Model Of Quantity-Based Algebraic Reasoning.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco.

Thompson, P. W. (1988, March). *Preparing School Students For Algebra: Are Textbook Publishers And Teacher Education Programs Part Of The Solution Or Part Of The Problem?* Paper presented at the Research Presession to the Annual Meeting of the National Council of Teachers of Mathematics, Chicago.

Thompson, P. W. (1982, March). *Children's Schemata For Understanding And Solving Problems Of Whole Number Numeration.* Paper presented at the Annual Meeting of the American Educational Research Association, New York.

Thompson, P. W. (1982, March). *Cognitive Objectives For Instruction In Whole Number Numeration.* Paper presented at the Annual Meeting of the American Educational Research Association, New York.

Invited Papers and Addresses

Thompson, P. W. (2019, November). *Structure, like beauty, is in the eye of the beholder.* Invited lecture given at Weizmann University as Fellow of the Israel Academy of the Humanities and Social Sciences.

Thompson, P. W. (2019, November). *Taking quantitative reasoning seriously in calculus.* Invited lecture given at the University of Haifa as Fellow of the Israel Academy of the Humanities and Social Sciences.

Thompson, P. W. (2019, November). *Mathematical Meanings for Teaching Mathematics.* Invited lecture given at Tel Aviv University as Fellow of the Israel Academy of the Humanities and Social Sciences.

Thompson, P. W. (2019, November). *US high school students' preparation for calculus.* Invited lecture given at Ben Gurion University as Fellow of the Israel Academy of the Humanities and Social Sciences.

Thompson, P. W. (2016, July). *Teachers' meanings for functions in the USA and South Korea.* Invited presentation in the Legacy of Felix Klein symposium, International Congress of Mathematical Education, Hamburg, Germany.

Thompson, P. W. (2016, April). *An approach to calculus that is rooted in the Fundamental Theorem of Calculus.* Invited colloquium given to the Mathematics Education Research Group, Department of Mathematics, Northern Illinois University, Dekalb, IL.

Thompson, P. W. (2015, March). *What teachers need to mean: An alternative perspective on Mathematical Knowledge for Teaching secondary mathematics.* Invited presentation given at *Mathematics Matters in Education: A workshop in honor of Dr. Roger Howe.* Texas A&M University, College Station, TX.

Thompson, P. W. (2014, March). *A Bachelor of Science in Mathematics that Emphasizes Mathematical Meanings for Teaching Mathematics.* Invited presentation given at the Mathematical Sciences Research Institute, University of California, Berkeley, Berkeley, CA.

Thompson, P. W. (2013, November). *Weak Meanings Lead To Weak Learning.* Invited colloquium given at the School of Mathematical and Statistical Sciences, Arizona State University, Tempe, AZ.

Thompson, P. W. (2013, September). *Why Function Notation Is Important And Why It Is Hard To Understand.* Invited presentation given at the annual meeting of the Arizona Association of Teachers of Mathematics, Tempe, AZ.

Thompson, P. W. (2013, January). *Assessing Teachers Mathematical Meanings for Teaching Secondary Mathematics: Implications for Math and Science Partnerships*. Invited presentation at the NSF Learning Network Conference, Washington, D.C.

Thompson, P. W., & Hatfield, N. (2012, March). *Technology and Calculus Reform.* Invited address given at the Central Regional Meeting of the Mathematical Association of America (presented by N. Hatfield).

Thompson, P. W. (2012, October). *A Calculus Course That Focuses On Students' Understanding Of The Fundamental Theorem Of Calculus*. Invited colloquium for the Department of Mathematics, Virginia Tech.

Thompson, P. W. *High School Teachers' Mathematical Meanings For Teaching Secondary Mathematics.* Invited colloquium for the University of Arkansas mathematics department, Oct 2012.

Thompson, P. W. *Mathematical MEANINGS For Teaching Secondary Mathematics Vs. Mathematical KNOWLEDGE For Teaching Secondary Mathematics.* Invited colloquium for the Mathematics Education Student Association, Sep 2012.

Thompson, P. W. *Assessing High School Mathematics Teachers' Mathematical Meanings For Teaching Secondary Mathematics.* Invited colloquium for the Mathematics Education Student Association, Sep 2012.

Thompson, P. W. (2010, November). *Calculus Reform.* Invited presentation given to the First Year Mathematics Faculty, Arizona State University, Tempe, AZ.

Thompson, P. W. (2010, August). *Professional Development By Researching One's Own Teaching.* Invited presentation to the Department of Mathematics, Scottsdale Community College.

Thompson, P. W. (2010, April). *The Mathematics In Mathematics Education Research.* Invited presentation at the Research Presession to the annual meeting of the National Council of Teachers of Mathematics, San Diego, CA.

Thompson, P. W. (2009, November). *Mathematical Knowledge For Teaching: The Central Problem In Mathematics Education Reform.* Invited presentation, College of Education, University of North Carolina, Chapel Hill, NC.

Thompson, P. W. (2009, August). *The Didactic Triad In Mathematics Teacher Professional Development.* Invited presentation given at the University of Michigan College of Education, Ann Arbor, MI.

Thompson, P. W. (2008, September). *What Is "Higher" About Higher Cognition In School Students?* Invited presentation at the National Science Foundation Workshop on higher cognition in adolescents and young adults.

Thompson, P. W. (2008, July). *Learning Without Understanding And Its Implications For The Mathematics That Teachers Teach*. Invited presentation at Mathfest 2008, Madison, WI. (Also, invited organizer of the symposium Implications for teaching of research on learning mathematics.)

Thompson, P. W. (2008, May). *The Problem Of Scaling Up Versus The Problem Of Researching The Scaling Process.* Invited presentation given to the Education and Human Services Directorate, National Science Foundation, Washington, D. C.

Thompson, P. W., Castillo-Garsow, C., & Moore, K, & Carlson, M. P. (2007, June). *Quantitative Reasoning As A Foundation For "Algebra As Modeling".* Invited paper presented at the Pathways to Algebra Conference, Evron, France.

Thompson, P. W. (2008, May). *Quantity And Magnitude As A Foundation For Algebraic Reasoning Throughout The Grades.* Invited workshop given at the Mathematical Sciences Research Institute, Berkeley, CA.

Thompson, P. W. (2007, February). *Epistemology, Ontology, And Method.* Invited paper presented at the International Workshop on Guided Construction of Knowledge in Classrooms, Hebrew University, Jerusalem, Israel.

Thompson, P. W. (2006, July). *A Cognitive Foundation For Affecting The Ways Professional Learning Communities Work.* Invited presentation given at the National Institute of Education, Singapore.

Carlson, M. P., & Thompson, P. W. (2005, October). *Assessing Conceptual Knowledge Of Function In Secondary Mathematics.* Invited presentation at the U.S. Department of Education and National Science Foundation Joint Conference for State Mathematics and Science Partnership Directors. Washington, DC.

Thompson P. W. (2005, January). *Statistics In Education Research: Issues From Mathematics And Science Education.* Invited presentation given to the American Statistical Association Meeting on Using Statistics in Mathematics and Science Education Research, Washington DC.

Thompson, P. W., Liu, Y., Saldanha, L. A. (2004, June). *Intricacies Of Statistical Inference And Teachers' Understandings Of Them.* Invited paper presented at the Carnegie Symposium on Cognition, Carnegie Mellon University, Pittsburgh, PA.

Thompson, P. W. (2001, August). *Understanding Sampling Distributions And Margin Of Error.* Presentation given at the 2nd Conference on Statistics Reasoning, Teaching, and Literacy, Armidale, Australia.

Thompson, P. W. (2001, August). *Helping Students Find Meaning In Measures Of Association.* Presentation given at the Joint Statistical Meetings, Atlanta, GA.

Thompson, P. W. (2001, July). *Investigating Students' Understanding Of Big Ideas: The Case Of Distributions Of Sample Statistics.* Presentation given at the Park City Mathematics Institute, Park City, UT.

Thompson, P. W. (2001, February). *Epistemological Analysis: Creating Epistemic Subjects.* Presentation given at the Wisconsin Education Research Center, Madison, WI.

Thompson, P. W. (2000, January). *High School Students' Understandings Of Sampling Distributions.* Invited presentation given to the Department of Mathematical and Computer Sciences, San Diego State University.

Thompson, P. W. (1999, May). *Making Warranted Claims From Small Samples: Types Of Generalizations From Small Samples.* Invited address given at the National Science Foundation Project Directors' Meeting, Washington, DC.

Thompson, P. W. (1999, October). *Tensions And Dilemmas In Designing A Mathematics Education Ph.D. Program*. Presentation given to the Conference on the future of mathematics education Ph.D. programs. University of Missouri, Columbia, MO.

Thompson, P. W. (1999, October). *Some Remarks On Conventions, Representations, And The Danger Of Attributing Too Much To Evident Agreement.* Invited paper presented to the Working Group on Representations, PME-XXI, Cuernavaca, Mexico.

Thompson, P. W. (1998, October). *Multiplicative Reasoning As A Cultural Artifact.* Invited address given to the Mathematics Education Research Group, University of Colorado, Boulder.

Thompson, P. W. (1998, June). *Didactic Objects and Didactic Models in Radical Constructivism.* Invited paper presented at the International Conference on Symbolizing and Modeling in Mathematics Education, Freudenthal Institute, University of Utrecht, Utrecht, The Netherlands.

Thompson, P. W. (1998, May). *Multiplicative Reasoning and the Development of Post-Additive Numbers and Operations.* White paper developed for the National Council of Teachers of Mathematics as background for their Standards 2000 project.

Thompson, P. W. (1998, January). *Mutliplicative Foundations Of Probabalistic Reasoning.* Invited address given to the Department of Mathematics, East Carolina University.

Thompson, P. W. (1997, November). *Chaos, Fractals, And Art.* Seventh grade, Grassland Elementary School, Williamson County, Tennessee.

Thompson, P. W. (1996, April). *What does it mean to really understand rate?* Invited presentation given at the Annual Meeting of the National Council of Teachers of Mathematics, San Diego.

Thompson, P. W., Thompson, A. G., Philipp, R., Clement, L., & Bernhard, J. (1996, April). *Reform in mathematics teaching: Its many aspects and difficulties.* Presentation given at the Research Presession to the Annual Meeting of the National Council of Teachers of Mathematics, San Diego.

Thompson, P. W. (1995, October). *Making sense of what students learn from instruction: Perspectives from mathematics education research.* Invited presentation given at the Annual Meeting of the Norhern California Section of the Mathematical Association of America, San Luis Obispo, Ca.

Thompson, P. W. (1995, May). *What is a fractal and how do you make one?* Sixth-grade, Dailard Elementary School, San Diego.

Thompson, P. W. (1995, February). *Fundamental difficulties and insights in learning the calculus.* Department of Mathematics Education, University of Georgia, Athens, GA.

Thompson, P. W. (1994, June). *Algebraic transformations of the elementary mathematics curriculum.* National Center for Research in Mathematical Sciences Education, University of Wisconsin, Madison.

Thompson, P. W. (1993, October). *Imagery, process, function, rate: Helping students see what Newton saw.* Invited special presentation given at the Annual Meeting of the International Group for the Psychology of Mathematics Education, North American Chapter, Asilomar, CA.

Thompson, P. W. (1992, February). *Research on algebra and its implications for textbook reform.* Presentation made to the Joint Conference of the American Association of Publishers and the National Council of Teachers of Mathematics.

Thompson, P. W. (1992, August). *Imagery and the development of mathematical reasoning.* Paper presented at the Seventh International Congress on Mathematical Education, Quebec City, Canada.

Thompson, P. W. (1992, August). *Computers in teaching and learning mathematics.* Invited presentation given at the Technology Colloquium Series of the Seventh International Congress of Mathematical Education, Québec City, Québec, Canada.

Thompson, P. W. (1991, December). *Coping with a conceptual curriculum.* Paper presented at the 2nd NCTM Standards Research Catalyst Conference, Miami.

Thompson, P. W., & Thompson, A. G. (1991, May). *The Quantitative Reasoning Project*. Presentation made to the Wisconsin Center for Research on Learning and Teaching Mathematics Working Group on Quantities, San Diego.

Thompson, P. W. (1990, October).*What is quantitative reasoning and why is it important for understanding algebra?* Invited presentation made at the University of Hawaii Research and Development Center, Honolulu.

Thompson, P. W. (1990, October). *Why do we expect so little of our students?* Plenary address given at the Annual Meeting of the Hawaii Council of Teachers of Mathematics, Honolulu.

Thompson, P. W. (1990, October). *One dimensional areas and volume*. Paper presented at the NSF Director's Meeting, Washington, D. C.

Thompson, P. W. (1990, April). *Quantitative reasoning and algebra.* Colloquium presented to the Department of Mathematical Sciences, San Diego State University.

Thompson, P. W. (1989, July). *Design issues in mathematics software.* Paper presented at the conference *Designing for Learning*, Apple Computer, Cupertino, CA.

Thompson, P. W. (1989, April). *Notes on technology and curriculum reform.* Working paper distributed at the symposium *New Technology's Challenges to Curriculum, Pedagogy, and Evaluation*, Research Presession to the Annual Meeting of the National Council of Teachers of Mathematics, Orlando.

Thompson, P. W. (1988, March).*Two views of algebra.* Colloquium presented at the Center for Research in Mathematics and Science Education, San Diego State University.

Thompson, P. W. (1988, February). *Achieving competence in introductory algebra by building competence in arithmetical problem solving.* Presentation given at Success for Everyone, a conference on diagnosis and remediation in high school mathematics topics, University of Illinois at Chicago.

Thompson, P. W. (1987, October). *Symbolic computation in mathematics teacher education*. presentation given to the Illinois Council of Teachers of Mathematics, Urbana.

Thompson, P. W. (1987, March). *Artificial intelligence, advanced technology, and learning and teaching algebra*. Paper presented at the Research Agenda Conference on Algebra, University of Georgia, Athens.

Thompson, P. W. (1987, February). "Direct Engagement" Software in Teaching Mathematics. Paper presented at Computers in Education VII, Chicago.

Thompson, P. W. (1987, December).*Transitions to Algebra.* Invited lecture given to the Department of Mathematical Sciences, Northern Illinois University.

Thompson, P. W. (1986, March). *Mathematical microworlds and intelligent computer-assisted instruction.* Invited presentation at the Army Research Institute's Conference on ICAI and military training.

Thompson, P. W. (1986, April). *Creating a technology of mathematics education: Or, there is nothing more practical than a good theory.* Rutgers University President's Lecture Series, Center for Mathematics and Science Education, Rutgers University, New Brunswick.

Thompson, P. W. (1985, February). *Microworlds: A bridge between computer-assisted instruction and intelligent computer-assisted instruction.* Paper presented at the Invitational Workshop on Intelligent Computer-Assisted Instruction, San Diego.

Thompson, P. W. (1985, April). *Microworld inquiries into sixth-graders' concepts of integers.* Paper given at the Research Presession to the Annual Meeting of the National Council of Teachers of Mathematics, San Antonio, TX.

Software Developed for Research on Mathematics Learning and Teaching

Over & Back	A program for students to use in exploring the concepts of speed and average speed.
Blocks Microworld	A program that allows students to explore concepts of numeration and the operations of addition, subtraction, multiplication, and division in either of two representational systems for whole numbers and decimals (on Dienes' blocks or on digits of numerals) and which reflects the student's actions in the other representational system. Students can work in any base from two to ten.
Word Problem Analyzer.	An implementation of a cognitive model for quantity-based arithmetic and algebraic reasoning. The program lets users represent arithmetic and algebra word problems in terms of their quantitative structures, and it solves a problem (i.e., infers arithmetical operations or derives equations) as soon as the described situation is well-represented.
Expressions/Equations	A program that allows students to manipulate arithmetical and algebraic expressions and equations by acting directly on their operational structure (as depicted in expression trees).

Major Course and Program Development

Arizona State University

Calculus redesign (present)
Technology and Mathematical Visualization (present)
Mathematics Curriculum and Assessment in Grades 7-12 (present)
The Development of Mathematical Thinking (present)
Bachelor of Science, Mathematics, with Concentration in Mathematics Education (2011)
Bachelor of Arts in Education, Secondary Mathematics Education (2010)
Ph. D. in Mathematics Education, School of Mathematical and Statistical Sciences (2009)

Teaching

Arizona State University

Extended analysis of functions 1
Extended analysis of functions 2
Research in Undergraduate Mathematics Education I
Research in Undergraduate Mathematics Education II
Research in Undergraduate Mathematics Education III
Research in Undergraduate Mathematics Education IV
Advanced Methods of Teaching Secondary School Mathematics

Piaget's Genetic Epistemology
Calculus I
Calculus II
Technology and Mathematical Visualization

Vanderbilt University

Cognition, computers, and mathematics curriculum
Research on multiplicative reasoning
Piaget's Genetic Epistemology.
Methods of teaching secondary mathematics
Methods of teaching elementary mathematics
Computers, teaching, and mathematical visualization.
Seminar on mathematics student teaching
Secondary mathematics student teaching
Technology and Conditions for Teaching and Learning.

San Diego State University

Teacher preparation courses

Transformation geometry
Computers and calculators in elementary/junior high mathematics
Computer-extended secondary mathematics
Logo in mathematics

Graduate courses

Research in mathematics education
Seminar on Multiplicative Reasoning
Construction of computerized mathematical environments
Seminars in artificial intelligence and LISP programming
Research on learning and teaching algebra

Graduate Students

Doctoral Students

Advisor

Surani Joshua (Ph.D. 2019). Dissertation title: *Conceptualizing and Coordinating Frames of Reference: Three Studies*
Hyunkyoung Yoon (Ph.D. 2019). Dissertation title: *Relationships Between Meanings United States And Korean Teachers Hold and Meanings Their Students Construct*
Neil Hatfield (Ph.D., 2019). Dissertation title: *Students' Meanings for Stochastic Process While Developing a Conception of Distribution*

Matt Weber (Ph.D. 2019). Dissertation title: *Investigating the Advancement of Middle School Mathematics Teachers' Meanings for Partitive Division by Fractional Values of Quantities*

Kristin Frank (Ph.D., 2017). Dissertation title: *Examining the Development of Students' Covariational Reasoning in the Context of Graphing*

Cameron Byerley (Ph.D., 2016) Dissertation title: *Secondary Teachers' and Calculus Students' Meanings for Fraction, Measure and Rate of Change*

Eric Weber (Ph.D. 2012). Dissertation title: *Students' Understandings of Two-Variable Functions and Rate of Change*

Ana Lagaramirez (Ph.D. 2011). Dissertation title: *Mathematical Knowledge for Teaching: Exploring a Teacher's Sources of Effectiveness*

Carlos Castill-Garsow (Ph.D. 2010). Dissertation title: *Teaching the Verhulst Model: A Teaching Experiment in Covariational Reasoning and Exponential Growth*

Scott Courtney (Ph.D. 2010). Dissertation title: *Exploring Teachers' Capacity to Reflect on Their Practice: An Investigation Into the Development of Mathematical Knowledge for Teaching*

Edward (Ted) Coe (PhD., 2007). Dissertation title: *Modeling teachers' ways of thinking about rate of change.*

Yan Liu (PhD, 2006). Dissertation title: *Teachers' understandings of probability and statistical inference and their implications for professional development* (Otto Bassler award for Outstanding Dissertation)

Jason Silverman (PhD, 2006) Dissertation title: *An investigation of content knowledge for teaching: Understanding its development and its influence on pedagogy*

Luis Saldanha (PhD, 2005). Dissertation title: *Is this sample unusual?": An investigation of students exploring connections between sampling distributions and statistical inference*. (Otto Bassler award for Outstanding Dissertation)

<u>Dissertation Committee</u>

Portia Botchway (Ph.D., 2019)
Erika David (Ph.D., 2019)
Alan O'bryan (Ph.D. 2018)
Emily Kuper (Ph.D. 2018)
Frank Marfai (Ph.D., 2017)
Krystin Pampel (Ph.D., 2017)
Michael Tallman (PhD, 2015)
Stacey Bowling (Ph.D., 2014)
Aviva Halani (Ph.D., 2013)
Ah Young (Ph.D., 2010)
Kevin Moore (Ph.D., 2010)
April Strom (Ph.D., 2008)
Nanci Smith (Ph.D., 2008)
Jana Viskovska (Ph. D., 2008)
Nicole Engelke (Ph.D., 2007)
Lynn Chrystal Dean (PhD, 2005)

Jose Cortina (PhD, 2005)
Samuel Katz (EdD, 2004)
Randall Bouldin (PhD, 2004)
Maggie McGatha (Ph.D, 2003)
Lynn Hodge (PhD, 2003)
Inge Poole (PhD, 2003)
Kirsten Ellenbogen (PhD, 2002)

Masters Students

Hsinyi Huang Smith (MNS Mathematics, 2009). Thesis title: *Teaching and learning function transformations.*

Ashlee John (MNS Mathematics, 2009). Thesis title: *Parametric functions in Algebra II: Implications of a covariational approach to teaching functions.* (Jointly with Shannon Bishop)

Shanon Bishop (MNS Mathematics, 2009). Thesis title: *Parametric functions in Algebra II: Implications of a covariational approach to teaching functions.* (Jointly with Ashlee Duncan)

Christopher Lowber (MA Math Education, 2003, Comprehensive exam)

Tiffany Dale (MA Math Education, 1999). Comprehensive exam.

Eun Jong Kim (MS Computer Science, 1995). Thesis title: *A computer environment for helping students to understand the structure of expressions.*

Eric Knuth (MS Math Education, 1995). Comprehensive exam.

Elizabeth Nagel (MS Math Education, 1994). Thesis title: *Effects of graphing calculators on college algebra students' understanding of functions and graphs.*

Donna Troy (MS Mathematics Education, 1993). Thesis title: *Future teachers' imagery while reasoning quantitatively.*

James Love (MS Computer Science, 1985). Thesis title: *A computer microworld for teaching operations on structured data.*

Barbara Boyd (MS Math Education, 1992; co-advised with Alba Thompson). Thesis title: The relationship between mathematics subject matter knowledge and instruction: A case study.

Undergraduate Honors Students

Whitmire, B. J. (B.Sc. Mathematics, 2014). Thesis title: *Undergraduate students' development of covariational reasoning.*

Mullen, K. (B.Sc. Mathematics, 2007). Thesis title: *Students' conceptions of time as a variable.*

Service

Professional Service

Organizing Committees for Conferences

Mathematics in Undergraduate Study Programs: Challenges for Research and for the Dialogue between Mathematics and Didactics of Mathematics, *Mathematisches Forschungsinstitut Oberwolfach (December, 2014)*

Workshop on Calculus Reform, *Institute for Mathematics and Education, University of Arizona (2008-2010*)
Pathways to Algebra, *Evron, France, 2008*.
American Educational Research Association Division C (mathematics), 1995
Conference on Constructivism in Mathematics and Science Education, *Atlanta, April 1994*
NCTM Regional Meeting, *San Diego, April 1985*
San Diego Council of Teachers of Mathematics, *February 1984*

Advisory Boards

(lost track of advisory boards after 2000)

Purdue University , Calumet, NSF project on learning differential equations. (1999, 2000)

University of Georgia, NSF project on children's reasoning about fractions (1998, 1999, 2000)

University of Michigan, INTASC analysis of teacher videotapes (1999)

East Carolina University, consultant on developing a PhD program in mathematics education (1998)

A Conference on the Future of Ph. D. Programs in Mathematics Education. NSF Funded project, Robert Reys, Director. (1998-2000)

University of Colorado (1998)

Maxwell Laboratories. Advise on the design and development of multi-media software for teaching secondary science and mathematics. (1994-1996)

NSF Grant, Vanderbilt University (Paul Cobb, Director). Advise on design of teaching experiments to investigate children's emerging use of symbols in their mathematical reasoning. (1995-1996)

NSF Grant, U. Georgia (Leslie P. Steffe, Director). Advise on theoretical constructs used to develop models of children's understanding of fractional quantities and rational numbers. (1995-1996)

NSF Grant, U. Massachussetts (James J. Kaput, Director). Advise on conceptual foundations of interface design for SIMCALC—calculus simulations for mathematics learning. (1993)

Member, NCTM's Research Catalyst Group: Develop research programs to investigate aspects of implementation of NCTM's Curriculum and Evaluation Standards. (1993)

Science Applications International Corporation. Advise on qualification proposal to the National Security Administration for development of educational software. (1992)

NSF Grant, Purdue University (Paul Cobb, Director). To advise on the use of computers in research on socialization in 3rd-grade mathematics classrooms. (1989)

NSF Grant, A. G. Thompson & C. A. Thornton (Co-directors). To develop new courses and new software for a model middle-school teacher training program. (1986-1989)

Cosine, Inc., an educational software company. Advised on issues of design, implementation, and marketing. (1983-1985)

San Diego City Schools Program for the Gifted and Talented. Developed evaluation instrument for an instructional program to teach mathematical problem solving. (1982-1983)

NSF Grant, M. G. Kantowski (Director), University of Florida. Advised on the design and evaluation of software for teaching and learning mathematical problem solving. (1979-1981)

University Service

Arizona State University

Member, Bylaws Advisory Committee, SoMSS (2014)

Chair, Ad Hoc Committee to Advise the Director on Statistics in SoMSS. (2013-2014)

Chair, Freshman Science, Technology, Engineering, and Mathematics Improvement Committee. An ad hoc committee of the Vice President and Provost. (2007-2008)

Department of Mathematics and Statistics

Member, Graduate Committee (2005-2013)

Vanderbilt University

Member, University Academic Computing and Information Technology Committee (2004-2006)
Co-founder and co-director, *Vanderbilt Program for Talented Youth* (1998-2000)
Member, Chancellor's Council on Teacher Education (2000-2003)
Member, Peabody Curriculum Committee (2004-2007)
Chair, Ad Hoc Committee on Technology. (2002-2003)
Member, *Budget Resource Committee*, a subcommittee of the Faculty Senate. (1997-1998)
Member, *Research committee*; a subcommittee of the Faculty Senate (2000-2002)

Chair, Search Committee for Department of Teaching and Learning Chair and Professor of Teacher Education (1998-2000)
Member, Department mentoring committee (1999-2000)
Chair, Search Committee for Department of Teaching and Learning Chair and Professor of Teacher Education (1998-1999)
Member, Department graduate admissions committee (1999-2000)
Chair, Department of Teaching and Learning Search Committee for Mathematics Education (1998-2000)

San Diego State University

Director, Ph.D. Program in Mathematics and Science Education, Joint-doctoral program of San Diego State University and University of California, San Diego (1995-1997).
Director, *Master of Science in mathematics education*, Illinois State University (1989).
Chair, *Calculus Reform Committee*, Department of Mathematics (*1991-1992*).
Organizer and leader, *College of Sciences Course Study Program* (a program of "internal sabbaticals" funded by the Dean's office to support faculty research of student learning in college science and mathematics courses; *1994*).
Member, College of Sciences Teacher Preparation Committee (1993-1995).
Director, University Developmental Math Lab (1980-1982).

Community Service

President and Founder, *Ralph P. Dailard School Foundation*. (1993-1994; Treasurer, 1994-1995)
Member, Governance Team for Ralph P. Dailard Elementary School, San Diego Unified School District. (1993-1995)
Member, School Site Council of Ralph P. Dailard Elementary School, San Diego Unified School District. (1993-1995)
Organizer, Committee for the integration of computers and instruction, Ralph P. Dailard Elementary School, San Diego Unified School District. (1993-1995)
Member, Reconfiguration Task Force, San Diego Unified School District (1995)