

Michelene (Micki) T. H. Chi
Curriculum Vitae
September 24, 2023

PERSONAL DATA

Birth Place: Chiang-Mai, Thailand
Immigrant: Immigrated from Indonesia, with mother and brothers
Citizenship: Naturalized U.S. citizen at age 16

Home Address

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EDUCATION

1970 B.Sc. in Mathematics, Carnegie-Mellon University
1975 Ph.D. in Psychology, Carnegie-Mellon University
Thesis: *The Development of Short-term Memory Capacity*
Mentors: Prof. Herbert Simon (Nobel Laureate in Economics),
Prof. David Klahr, Prof. Patricia Carpenter

RESEARCH AND TEACHING POSITIONS

1970-1974 NIE Trainee, supervised by Prof. David Klahr, Cognitive Developmental Group, Dept. of Psychology, Carnegie Mellon University.

1974-1975 Post-Doctoral Trainee, The Experimental Group, supervised by Profs. Mike Posner & Steve Keele, Department of Psychology, University of Oregon

1975-1977 Post-Doctoral Fellow, supervised by Prof. Robert Glaser, Learning Research and Development Center (LRDC), University of Pittsburgh

1977-2008 Research Associate to Senior Scientist LRDC, University of Pittsburgh

1982-1990 Assistant to Associate to Full Professor, Department of Psychology, University of Pittsburgh

1990-2008 Professor of Psychology, Department of Psychology, University of Pittsburgh

1994-1998 Cognitive Program Chair, Department of Psychology, University of Pittsburgh

1996-2001 Adjunct Faculty Member, Section of Medical Informatics, University of Pittsburgh Medical Center

2008-2010 Professor, Psychology in Education, Graduate School of Education, Arizona State University (ASU)

2010-2012 Professor, Dept. of Psychology, College of Liberal Arts and Sciences, ASU

2012-present Foundation Professor, MLF Teachers College, ASU

2013-2015 Director, Learning Sciences Institute, ASU

2013 – present	Director, Learning and Cognition Lab, MLF Teachers' College, ASU
2015 - present	Dorothy Bray Endowed Professor of Science and Teaching, ASU
2016 - present	Cognitive Science Affiliate at the Department of Psychology, ASU
2018 - present	Regents' Professor, ASU
2021 – present	Endorsed faculty, Engineering Education Systems and Design Program, Ira A. Fulton Schools of Engineering, The Polytechnic School.

HONORS, PRIZES, RECOGNITION (Post Ph.D.)

Distinguished Prizes and Lifetime Achievement Awards

2015	Edward Lee Thorndike Career Achievement Award for Distinguished Contribution to Education, American Psychological Association, in recognition for original, scientific, and empirically-based research that contributes significantly to knowledge, theory, or practice in educational psychology.
2016	The Distinguished Contributions to Research in Education Award, from the American Educational Research Association. This is a career award for the premier acknowledgment of outstanding achievement and success in education research. It is designed to publicize, motivate, encourage, and suggest models for education research at its best.
2018	The David E. Rumelhart Prize, from the Cognitive Science Society, for significant contributions to the theoretical foundations of human cognition, funded by Robert J. Glushko and Pamela Samuelson Foundation.
2020	The Harold W. McGraw Jr. Prize in Education, for pioneering research in the learning sciences to promote active and engaged student learning.
2021	The William James Fellow Award from the Association for Psychological Science, in recognition of a lifetime of significant intellectual contributions to the fields of learning science, cognitive science, and education.
2023	American Psychological Association Distinguished Scientific Award for the Applications of Psychology, for theoretical or empirical advances in psychology leading to the understanding or amelioration of important practical problems.

Notable Honors, Awards and Recognition

1977-1982	Spencer Fellowship, awarded by the National Academy of Education, for promising research and professional development contributing to the theory and practice of education.
1982	Boyd R. McCandless Young Scientist Award, presented by Division 7 of APA, for distinguished theoretical contribution and programmatic research efforts in the field of developmental psychology
2000	Highlighted in "Reach for the Stars," a basic research poster session that showcased the research careers of distinguished scholars, AERA.

- 2001 Cited in Carnegie-Mellon University's Centennial Magazine as one of its 87 most successful undergraduates
- 2006 Chancellor's Distinguished Research Award, Senior Category, for "innovative research of landmark impact in several research areas", University of Pittsburgh
- 2013 Faculty Achievement Award, for excellence in defining edge research/creative activities, Professional Application, ASU
- 2014 MLF Teachers College Outstanding Research Achievement with Impact Award
- 2016 Cited as the third of 10 most influential scholars in education research in a report by John T. Bruer, called *Mapping education research and judging influence*, Vol 1 (17), May 2016, Brookings Institution study. <https://www.brookings.edu/wp-content/uploads/2016/07/influence-in-research2.pdf>
- 2018 Conferred the title "Regents' Professor", the highest faculty honor, reserved for 3% of professors with exceptional achievements with national and international distinction, ASU.

Recognition of the Impact of Specific Research Papers

- 1993 Chi, Feltovich & Glaser (1981, Publication #15 in the reference list on the nature of expertise), was identified as a Citation Classic only 12 years after its publication.
- 2000 Chi (1997) (Publication #65), was noted in the editorial of the *Journal of the Learning Sciences* (Kolodner, 2000, p. 2), as one of its "most cited papers" on a coding methodology to quantify qualitative data.
- 2002 Chi (1978) (Publication #12) was voted as the 7th "Most Fascinating Studies in Child Psychology," as surveyed by the Society for Research in Child Development, published in their Oct. newsletter.
- 2006 Chi, Feltovich & Glaser (1981, #15) and Chi, Bassok et al. (1989, #41) were ranked 1st and 7th most highly cited papers published in *Cognitive Science*, (from Goldstone's 2006 Editor's report).
- 2007 Bedard & Chi (1992, #49) was noted by the journal *Auditing: A Journal of Practice and Theory*, as one of its most frequently cited authors.
- 2007 Self-explanation is one of the seven robust principles recommended for classroom implementation, published in the practice guide by Pashler, et al., 2007, in the What Works Clearinghouse (IES).
- 2013 Sylvia Scribner Award, AERA, Division 3. The award recognizes the self-explanation program of work that has significantly influenced thinking and research in the field of learning and instruction.

- 2014 Menekse, Stump, Krause & Chi (2013, Publication #110) received the William Elgin Wickenden Award from the American Society for Engineering Education, recognizing it as representing “the highest standards of scholarly research in engineering education published in the *Journal of Engineering Education*.”
- 2016 “Commonsense conceptions of emergent processes: Why some misconceptions are robust” (2005, Publication #88) was listed as one of the most cited papers on science education in the Web of Science database, ranked first under the subcategory, “Student’s thinking about science”.
- 2017 Chi, M. T. H. (2009). Active-Constructive-Interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science*, 1, 73-105. (Publication #100) was the #1 most downloaded paper from the publisher’s website, at 3521 times, as of Sept. 2017.
- 2017 Seminal Papers in Educational Psychology: Paul A. Kirschner’s report from a crowd sourced survey asking colleagues in the community *What article or articles do you feel are seminal articles our field that every (young) research should be aware of?* Two papers: Chi (1997, Publication #65) on Quantifying qualitative analyses of verbal data, and Chi Feltovich & Glaser (1981, Publication #15), *Categorization and representation of physics problems by experts and novices*, were included among the 50.
- 2017 The Chi & Wylie ICAP paper (2014, Publication #118) has been translated and published in Chinese. Titled “Engagement Means Competence: A Summary of the Research and Value of the ICAP Framework” written by QunLi Sheng—a professor at Zhejiang University. The article is published on Open Education Research in Chinese, Volume 23, No. 2, April 2017.
- 2018 Two blogs @ ICAP at Great Britain: One by Grainne Canole, the other by Adam Abdulla
- 2018 Chi, Kang & Yaghmourian (2017, Publication #121), published in the *Journal of the Learning Sciences*, received the Inaugural Best Paper Award from the International Society of the Learning Sciences.
- 2019 YouTube in French about ICAP: Vellut, D. (2019). Apprentissage actif ou passif? Élargissez vos horizons avec les 4 modes d’engagement cognitif du modèle ICAP. Louvain Learning Lab. Retrieved from: <https://www.louvainlearninglab.blog/apprentissage-actif-engagement-cognitif-icap-michelene-chi/>
- 2019 Publications #41, #47, #65, #70, #73, #88, #107, #118, #121, #124, #127, and #129, are lead or extended lead articles.
- 2021 Google Scholar Page: Total citations 62,677, h-index 75, h-index 52 since 2018. <http://scholar.google.com/citations?user=AIW99VQAAAAJ&hl=en>

Honorary Fellowships and Scholar (all elected or invited)

1986	Fellow, Division 7, American Psychological Association
1992	Fellow, Association for Psychological Science
1996 - 1997	Resident Fellow, Center for Advanced Study in the Behavioral Sciences, Stanford, CA
2002 - 2005	Fellow, Center for Philosophy of Science, Univ. of Pittsburgh
2003	One of the 7 inaugural Fellows, Cognitive Science Society
2010	Fellow, National Academy of Education
2013	Fellow, American Educational Research Association (AERA)
2016	Centennial Knowledge Forum Scholar, to give a talk on ICAP as part of the "Ed-Talk" video series. https://www.youtube.com/watch?v=uC-9lViDGL0&feature=youtube , to engage with policy leaders in a forum about educational research.
2016	Fellow, American Academy of Arts and Sciences

Invited Keynote or Plenary Speaker (titles of early talks shown starting on p. 20)

1993	Keynote: The 10th International Conference on Machine Learning
1995	Keynote: The 17 th Annual Conference of the Cognitive Science Society
1999	Keynote: Annual meeting of the American Society for Engineering Education, St. Louis, June.
2003	Keynote: The 10 th European Association for Research on Learning and Instruction, Padova, Italy.
2006 & 2007	Lead discussant on Transfer (2006) and Expertise (2007), at the National Science Foundation meetings, Oct. 2006, 2007.
2008	Keynote: The VI European Meeting in Conceptual Change, Turku, Finland
2010	Lead speaker: Communication Analysis Workshop, Tempe, AZ
2011	"Highlighted Session Speaker" at International Conference on Computers in Education, for the sub-conference track Computer-supported Collaborative Learning, Chiang-Mai, Thailand, Nov.
2012	Invited talk for practitioners at the <i>Mastering Leadership Conference</i> , sponsored by Pearson, Scottsdale, March.
2013	Colloquium speaker: "Self-explanations improve understanding: But do they promote conceptual change?" Presented at the Department of Psychology, Princeton University, Princeton, February.
2013	Colloquium speaker: "Can misconceptions in science be removed?" Graduate Institute of Science Education, National Taiwan Normal University, Taipei, Taiwan, March.
2013	Invited keynote, "Using the ICAP hypothesis to Design Instruction and Student Assignments," presented at the 2013 Gordon Research Conference on Chemistry Education Research and Practice, Newport, RI, June.

- 2013 Keynote speaker: "The role of self-explanations as a form of knowledge construction." At the *Tenth International Conference on Machine Learning*, Amherst, June. (The Machine Learning conference invites a keynote speaker each year from an outside discipline. Other cognitive psychologists invited in the past were Doug Medin, Mike Posner, and so forth.)
- 2014 Sylvia Scribner Award Address, "Differentiating 4 Modes of Engagement in Active Learning: From theory to practice." Sylvia Scribner Award lecture, AERA, April.
- 2014 Plenary speaker on "Conceptual Change Across Domain: Science," for the Conceptual Change Sig on *Generic and Specific Issues in Conceptual Change in Science*, Bologna, Italy, August.
- 2015 "Modeling and correcting students' misunderstanding for conceptual domains (especially in science)." Featured speaker at the Rice Workshop on Personalized Learning, Houston, TX, April.
- 2015 Colloquium speaker "Differentiating four modes of engagement in active learning." Colloquium speaker at the *Learning Sciences Research Institute*, University of Illinois at Chicago Circle: April 3.
- 2015 Invited by Sanjay Sarma, Dean of Digital Learning at MIT, along with a panel of 3 (with Prof. Chuang of Physics at MIT; Prof. Ho of Education at Harvard; and Pat Wasley, CEO of the Teaching Channel), at a convening of 20 Deans of Schools of Education, sponsored by the Carnegie Corporation, to address how fundamental principles of cognitive science, technology and data impact K-12 teaching and learning. NY, June.
- 2015 Award address: E.L. Thorndike Career Achievement Award, American Psychological Association, "ICAP: A theoretical framework for ways of engaging students to promote deeper learning." Colorado, July.
- 2015 "Differentiating four modes of engagement for active learning: The ICAP framework." A university-wide talk sponsored by the Schreyer Institute for Teaching Excellence, Penn State University, State College, PA: October 20.
- 2016 Public Scholarship Ed-Talk, presented at an AERA Presidential Session on *Challenging Common Sense Conceptions of Learning*, Feb.
- 2016 Centennial colloquium speaker, "ICAP: A theoretical framework for active learning." at 100th Anniversary Colloquium Series at Carnegie Mellon University Psychology Department. Pittsburgh, PA: April 19.
- 2016 Keynote speaker: "Counter-intuitive Findings and Implications for Teaching from the Sciences of Learning." Snell Conference: Practicing the Art and Science of Teaching, Center for the Art and Science of Teaching, Oct.
- 2017 A featured scholar in the Wisconsin Ideas in Education Series (WIES) at the University of Wisconsin-Madison to present a talk titled: "ICAP: A theoretical framework for how to engage students to promote deeper

- learning," Feb.
- 2017 Plenary speaker on "Teaching Emergence: An Attempt at Differentiating Science Concepts of Processes" at the National Association for Research in Science Teaching (NARST) conference for *Challenges in Learning Science Concepts*. April.
- 2017 Special presentation, at AERA Presidential Session on *Acquired Wisdom. Lessons Learned by Distinguished Researchers* with the session paper:
- 2017 AERA award address, presented at the Distinguished Contributions to Research in Education Award session: "Translating ICAP on Student Engagement into Practice." April.
- 2017 Chi, M.T.H. Plenary speaker, "Teaching Emergence: An attempt at differentiating science concepts of processes." National Association for Research in Science Teaching, Baltimore, April.
- 2017 Keynote at the TRUSE (Transforming Research in Undergraduate STEM Education) conference on STEM education hosted at St. Thomas University with the talk, "ICAP: How to Promote Deeper Active Learning Engagement." June.
- 2017 Keynote speaker at the National Conference on Technology-Enhanced Learning hosted by the National University of Singapore. Keynote titled, "Implications of ICAP, a Theory of Student Engagement, for Technology-enhanced Practices". Singapore, Nov.
- 2017 Chi, M.T.H. Colloquium speaker, "ICAP: How to promote deeper active learning engagement," National Institute of Education, Singapore, Nov.
- 2018 Keynote speaker, "Conceptual change in understanding collective causality versus cumulative causality," at the 2nd Interdisciplinary REASON Spring School hosted by the Munich Center of the Learning Sciences in Munich, Germany, March 2018.
- 2018 Workshop speaker, at the 2nd REASON Spring School hosted by the Munich Center of the Learning Sciences, Munich, Germany, March 2018.
- 2018 Keynote speaker, "Teachers Translating a Theory of Cognitive Engagement into Practice," at the 11th Annual Subway Summit hosted by Columbia University, Teachers' College, New York, NY, June.
- 2018 Keynote speaker, "How to Promote Deeper Learning by Engaging Students Cognitively" at the College of Developmental and Educational psychology, Key Laboratory of Modern Teaching Technology, Ministry of Education Shaanxi Normal University in China. Oct.
- 2018 Keynote speaker, "ICAP: How to Promote Deeper Learning by Engaging Students Cognitively," at the 6th Computational Behavior Science Summit—Behavioral Data Analysis and Application in Wuhan, China, Oct.
- 2018 Colloquium: "Why is it Important for Students to be *Constructive* While Learning?" presented to the Graduate College, Central China Normal University in Wuhan, China, Oct.

- 2018 Colloquium: "ICAP: How to Promote Deeper Learning by Engaging Students Constructively." Talk presented to the Tsinghua Institute of Education at Tsinghua University
- 2019 Plenary speaker, "ICAP: How to Promote Deeper Learning by Engaging Students Cognitively" at the Chicago Symposium Series on Excellence in Teaching Mathematics and Science at Northern Illinois University, Naperville, IL, Feb.
- 2019 Rumelhart Prize Address, "Translating the ICAP Theory of Cognitive Engagement into Practice" at the 41st Annual Conference of the Cognitive Science Society at Montreal, Canada July.
- 2019 Keynote speaker, "ICAP: How to promote deeper learning by engaging students constructively and co-constructively" at the Annual Conference of the International Association for Medical Education in Vienna, Austria, August.
- 2019 Keynote speaker, "ICAP: A framework for active learning," presented at the curriculum retreat of Penn State Medical School, Hershey, PA, October.
- 2019 Plenary speaker, invited by the Provost's office for the Simon Initiative Distinguished Lecture: "ICAP: How to Promote Deeper Learning by Engaging Students Cognitively," Carnegie-Mellon University, Pittsburgh, November.
- 2020 Plenary speaker, "ICAP: How to promote deeper learning by engaging students cognitively" at the 42nd Annual National Institute on the Teaching of Psychology (NITOP) in St. Pete Beach, Florida, January, 2020.
- 2021 Invited Zoom special lecture about ICAP for teachers, administrators, people in business, researchers and students, at the workshop *Agents for Bridging Learning Research and Educational Practice*, supported by Uchida Yoko, invited by Mutsumim Imai, Japan, Nov.
- 2021 Special Zoom panel member for the online symposium "Interaction and Collaboration Learning" at *How Innovations Flourish: An International Symposium* by Catalyst @ Penn GSE and the Harold W. McGraw, Jr. Prize in Education on June 8-10th.
- 2022 One of the invited luminaries for a Fireside Chats on *Theory-Theory turns 30-something: Reflections and new directions* at the pre-conference Cognitive Development Society workshop. Madison, April.
- 2022 Invited by David Oxtoby, President of the American Academy of Arts and Sciences to speak on student engagement and learning at the *Higher Education Forum* at the American Academy of Sciences, Aspen Meadows Resort, Aspen, June 13-16. Title of talk: "How to foster active learning."
- 2022 "Co-constructive Collaborative Learning." Invited keynote presented at the lecture series for the Transregional Collaborative Research Center on *Constructing Explainability*, at Universitat Paderborn, Germany, July.
- 2022 Keynote Speaker, "Using ICAP to Guide Teacher-Student Dialogs," presented at the international conference on *Advancing (digital) learning*

discourse in teaching, teacher education and teachers' professional development." organized by the University of Zurich, at the Centro Stefano Franscini at Monte Verita, Switzerland, Sept. 4-9.

- 2023 Invited speaker by the Teaching Community of Practice: a group of about 100 faculty who meet regularly to discuss ideas related to engineering education. "ICAP: A framework for defining active learning and prescribing ways to apply it to design and evaluate instruction."
- 2023 Colloquium speaker, "ICAP: A framework for active learning and ways to apply it," to be presented at UC San Diego Psychology Colloquium series. April 6, 2023.

EXTERNAL FUNDING (Total \$6,470,826 awarded to ASU with M. Chi as P.I. on 7 grants, since arriving at Arizona State University in 2008)

- Using a Cognitive Framework of Differentiated Overt Learning Activities (DOLA) for Designing Effective Classroom Instruction in Materials Science and Nanotechnology. **M.T.H. Chi (P.I.)** & S. Krause (co-P.I.) (Materials Science Engineering), NSF Engineering Education Program, Award No. 0935235, \$400,000, Sept. 1, 2009 to Aug. 31, 2012.
- Comprehension SEEDING: Comprehension through Self-Explanation, Enhanced Discussion, and Inquiry Generation. Rodney D. Nielsen (P.I.) (Boulder Language Technologies, CO) and **M.T.H. Chi (co-P.I.)**, Institute of Education Science (R305A110811), 2011-2014. Budget for ASU sub-award to Chi, \$409,003. (Coeus Award No. 024969-001).
- Learning from Observing Learning with Dynamic Simulations. **M.T.H. Chi (P.I.)**, The Spencer Foundation Major Grant Program, Award No. 200800196, \$500,000, 2008-2012.
- Developing Guidelines for Optimizing Levels of Students' Overt Engagement Activities. **M.T.H. Chi (P.I.)**, & Roy Levy (co-P.I.), Institute of Education Science, (R305A110090), \$1,399,212. (Coeus Award No. 024405-001). 2011-2014
- Learning from Dialog versus Monolog Videos. **M.T.H. Chi (P.I.)**, & Sara Brownell (co-PI), National Science Foundation, \$249,995, April 1, 2016 to March 31, 2019.
- Developing and Revising Instructional Activities to Optimize Cognitive Engagement. **M.T.H. Chi (P.I.)**. Institute of Education Sciences, \$1,456,185. (R305A150432) Aug. 16, 2015 to Aug. 15, 2019.
- *Teaching the Crosscutting Concept of Emergent Cause-and- Effect to Overcome Misconceptions.* **M.T.H. Chi (P.I.)**. Institute of Education Sciences, \$1,456,431. (R305A150336) Aug. 16, 2015 to Aug. 15, 2021.
- *Improving Online Learning from Tutorial Dialog Videos.* **M.T.H. Chi (P.I.)** & Yi-chun Hong (co-P.I.). NSF IUSE Proposal 1915150. \$600,000. Oct. 1, 2019 to Sept. 30, 2022.
- *Teaching How to Learn: Promoting Self-regulated Learning in STEM Classes.* \$370,640 (USD) from Australian Research Council DP190102366, 20188-2022. S. Vosniadou, Chief Investigator (CI), M. Lawson, CI, L. Graham, CI, C. Dignath van Ewijk, Partner Investigator, **M. Chi**. This grant supports international collaboration with funds for M. Chi to travel to Australia.

RESEARCH PROJECTS

Below is a brief description of the projects carried out in my Learning and Cognition Lab for the last decade.

1) Differentiating Active Engagement: The ICAP Project

ICAP is a science of learning theory that defines active learning in terms of a set of four differentiated over behavioral modes of engagement (Interactive, Constructive, Active, Passive) that students can undertake while learning in a variety of instructional contexts across a variety of content domains. Thus, ICAP provides a framework to differentiate students' learning activities when interacting with instruction. Moreover, based on the conjectured learning processes underlying each mode, the four modes predict different levels of learning. ICAP provides operational definition for cognitive engagement based on how students interact with instruction behaviorally, leading to different levels of learning. For example, ICAP predicts significantly greater learning for activities such as taking notes (a Constructive activity) than activities such as copying notes. (an Active activity).

The operational definition of cognitive engagement based on behavioral interactions can be translated into simple heuristics that instructors can easily adopt and use, for designing lessons, evaluating assessment questions and digital tools, coding videos, and so forth. Professional development modules can be provided for K-12 as well as college faculty.

Misunderstanding Emergent Processes with a Linear Causal Structure rather than a Collective a-Causal structure: The PAIR-C project

PAIR-C is a theory we developed that explains why students have persistent misconceptions about the cause-effect relations of many scientific processes, such as diffusion and natural selection. PAIR-C conjectures that many of these misconceived kinds of "emergent" science processes have a "collective a-causal" underlying structure. An "emergent" process is one in which the visible pattern one sees are *not* caused by an antecedent incidence(s) or agents' actions, but rather, the pattern one sees simply emerged from the collective summing of all the interactions of the agents participating in the process. For example, although the V-shape formation of airplanes at an air show is created by the lead pilot in telling the other pilots what positions to fly in, the similar V-shape formation of geese flocking is not dictated by a leader goose. The V-pattern merely emerges from the vector summing of the locations and directions of all the geese's interactions over time.

In order for students to learn and understand emergent processes, they must first understand the nature of a "collective a-causal" structure. I have identified the features and characteristics of a collective a-causal structure for emergent processes and noticed that the characteristics are diametrically opposite of those for sequential kind of processes with an underlying a linear or "individualistic causal" structure, suggesting that they are ontologically distinct. My hypothesis is that misconceptions occur when a student incorrectly uses a more familiar "individualistic" causal structure in which one or more individuals can be identified to have caused the observable pattern, whereas the cause-effect relations for emergent kind of science processes need to be explained by a "collective a-causal" kind of structure, in which all the individuals are responsible. The hypothesis of this project is that students need to learn about the underlying collective a-causal structure, knowledge of which is needed for them to understand an emergent kind of science processes that are commonly taught in school curricula. Our preliminary results show that the module that we have developed to explain a collective a-causal structure was helpful for students in understanding simple emergent processes such as diffusion of ink in water, heat transfer, and natural selection.

New Format of Presenting Instructional Materials for Online Video Learning: The Dialog-Monolog project

The NSF-funded Dialog-Monolog video project introduces a new paradigm for online learning that was developed and tested in several lab studies, undertaken several years ago. This new instructional format was derived from ICAP. The idea was to use tutorial dialog videos to get across instructional knowledge and skills, rather than the standard knowledge-telling didactic monolog videos that instructors typically create. The assumption was that students watching such a dialogue video can learn more deeply if they were given a constructive task to do while watching, and that watching a tutee in the video struggle was motivating. The goal of the project was to test this novel instructional video format in authentic, large, on-line and in-person college science classrooms. We found significant learning benefits of dialog videos compared to didactic monolog videos across all the 4 large college STEM classrooms that we tested. The results from this project could have compelling implications for developing digital materials to facilitate STEM learning, in terms of new ways to deliver online instruction to college students.

PUBLICATIONS [The 25 publications with citations greater than 500 as of March 1, 2023 are indicated with their Google counts. Postdocs and students' names are underlined.]

Edited Books

1. Chi, M. T. H. (Ed.). (1983). *Trends in memory development research*. (Vol. 9). Basel: NY: S. Karger.
2. Chi, M. T. H., Glaser, R., & Farr, M. (Eds.). (1988). *The nature of expertise*. Hillsdale, NJ: Erlbaum. [Google citations: 4080]
3. Durso, F. T., Nickerson, R. S., Schvaneveldt, R. W., Dumais, S. T., Lindsay, D. S., Chi, M. T. H. (Eds.) (1999). *Handbook of Applied Cognition*. England: John Wiley & Sons.

Papers

4. Chi, M. T. H., & Chase, W. G. (1972). Effects of modality and similarity on context recall. *Journal of Experimental Psychology*, 96, 219-222.
5. Chi, M. T. H., & Klahr, D. (1975). Span and rate of apprehension in children and adults. *Journal of Experimental Child Psychology*, 19, 434-439.
6. Chi, M. T. H. (1975). *The development of short-term memory capacity*. Doctoral dissertation, Carnegie-Mellon University, Pittsburgh, PA.
7. Chi, M. T. H. (1976). The representation of knowledge. *Contemporary Psychology*, 21, 784-785. (Review of Norman and Rumelhart's *Exploration in cognition*.)
8. Chi, M. T. H. (1976). Short-term memory limitations in children: Capacity or processing deficits? *Memory & Cognition*, 4, 559-572. [Google citations: 504]
9. Chi, M. T. H. (1977). Age differences in memory span. *Journal of Experimental Child Psychology*, 23, 266-281.
10. Kail, R. V., Chi, M. T. H., Ingram, A. L., & Danner, F. W. (1977). Constructive aspects of children's reading comprehension. *Child Development*, 48, 684-688.

11. Chi, M. T. H. (1977). Age differences in the speed of processing: A critique. *Developmental Psychology*, 13, 543-544.
12. Chi, M. T. H. (1978). Knowledge structures and memory development. In R. Siegler (Ed.), *Children's Thinking: What Develops?* (pp. 73-96). Hillsdale, NJ: Erlbaum.
Reprinted in: (1993) *Worlds of Childhood Reader*, Wozniak R (ed.), 232-239. **[Google citations: 1,844]**
13. Chi, M. T. H. (1979). The growth and development of knowledge. *Contemporary Psychology*, 24, 760-761. (Review of P. Ornstein (Ed.), *Memory Development in Children*.)
14. Chi, M. T. H., & Glaser, R. (1980). The measurement of expertise: Analysis of the development of knowledge and skill as a basis for assessing achievement. In E. L. Baker & E. L. Quellmalz (Eds.), *Design, Analysis, and Policy in Testing and Evaluation* (pp. 37-48). Beverly Hills, CA: Sage Publications.
(Abstract also published in *Evaluation Comment*, 1978, 5, 9.)
15. Chi, M. T. H., Feltovich, P., & Glaser, R. (1981). Categorization and representation of physics problems by experts and novices. *Cognitive Science*, 5, 121-152. (a citation classic) **[Google citations: 8,680]**
16. Chi, M. T. H. (1981). Sources of memory development. *Proceedings of the North American Society for the Psychology of Sport and Physical Activity Annual Conference*.
17. Chi, M. T. H. (1981). Knowledge development and memory performance. In M. Friedman, J. P. Das, & N. O'Conner (Eds.), *Intelligence and Learning* (pp. 221-230). New York, NY: Plenum Press.
18. Chase, W. G., & Chi, M. T. H. (1981). Cognitive skill: Implications for spatial skill in large-scale environments. In J. Harvey (Ed.), *Cognition, Social Behaviors, and the Environment* (pp. 111-136). Hillsdale, NJ: Erlbaum.
19. Chi, M. T. H., Glaser, R. & Rees, E. (1982). Expertise in problem solving. In R. Sternberg (Ed.), *Advances in the Psychology of Human Intelligence* (Vol. 1, pp. 7-76). Hillsdale, NJ: Erlbaum. **[Google citations: 3,753]**
20. Chi, M. T. H., & Gallagher, J. D. (1982). Speed of processing: A developmental source of limitation. Special Issue, H. Lee Swanson (Ed.), *Topics in Learning and Learning Disabilities*, 2, 23-32.
21. Chi, M. T. H. (1983). The role of knowledge on problem solving and consumer choice behavior. In R. P. Bagozzi & A. M. Tybout (Eds.), *Advances in Consumer Research* (Vol. X).
22. Chi, M. T. H. (1983). Knowledge-derived categorization in young children. In D. R. Rogers & J. A. Sloboda (Eds.), *The acquisition of symbolic skills* (pp. 327-334). New York, NY: Plenum Press.
23. Chi, M. T. H., & Koeske, R. (1983). Network representation of a child's dinosaur knowledge.

Developmental Psychology, 19, 29-39. [Google citations: 763]

24. Chi, M. T. H. & Rees, E. (1983). A learning framework for development. In M. T. H. Chi (Ed.), *Trends in memory development research* (Vol. 9, pp. 71-107), Basel, New York, NY: S. Karger.
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(Also reprinted in F. E. Weinert & R. H. Kluwe (Eds.) (1987). *Metacognition, motivation and understanding* (pp. 211-232). Hillsdale, NJ: Erlbaum.)
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1990

Colloquium on *The Nature of Self-Explanations*, University of Colorado, January.

Workshop speaker on *Learning and Problem Solving in Students*. The Pittsburgh Area Independent School Teachers Association Annual Conference, Sewickley Academy, Pittsburgh, October.

1991

Workshop speaker on *Construction and revision of mental models during learning*. The Third Biannual Workshop on Cognition and Instruction, Pittsburgh, PA.

1992

Chi, M. T. H., de Leeuw, N., Chiu, M. H., & LaVancher, C. "Self-explanations improve learning." Poster presented at the NATO Advance Study Institute on Psychological and Educational

Foundations of Technology-Based Learning Environments. Orthodox Academy, Kalymbari, Greece, July, 1992.

Chair/Discussant of the session on *Capturing and Modeling the Process of Conceptual Change in the Physical Sciences*. At the NATO Advance Study Institute on Psychological and Educational Foundations of Technology-Based Learning Environments. Orthodox Academy, Kalymbari, Greece, July, 1992.

1993

Lecturer: "Self-explanations improve learning." At the Research Center of Cognitive Studies, National Chung Cheng University's conference on math education, Chia-yi, Taiwan, March.

Exhibit: "Constructing knowledge: How talking to yourself may improve learning." Carnegie Science Center, Pittsburgh, May 2-15.

Panel Discussant: "Conceptual change and the acquisition of expertise." *The Third International Workshop on Human and Machine Cognition*, Seaside, Florida, May. (I was the panel member invited to represent the cognitive science view. Other members represented views from A.I., anthropology, situated cognition, and so forth.)

Paper Presenter: "Barriers to conceptual change in learning science concepts: A Theoretical Conjecture." *Cognitive Science Conference*, Boulder, June.

Symposium presenter: "Cascade and self-explanations." For the symposium *Cognitive models of problem solving*, Cognitive Science Conference, Boulder, June.

Workshop participant and speaker: "Teaching for understanding." *Harvard Project Zero*, Boston, October.

1994

Invited Speaker: "What is learned in context?". Naturalistic Decision Making Conference, Dayton, Ohio, June.

Symposium speaker: "Stolen knowledge: Knowledge acquired through practice". Third Practical Aspects of Memory Workshop. University of Maryland, College Park, MD, August.

Colloquium speaker. "Self-explaining: An effective general learning skill?" New Mexico State University. Las Cruces, NM, December.

1995

Invited speaker: "Acquisition of concepts of processes." Creative Concepts Conference, Texas A & M University, College Station, Texas, May.

Speaker on "Creating Schools that Develop Expertise in Students." Workshop on The Gifted School. Hosted by OERI and Council for Exceptional Children. Tyson's Corner, Virginia, June.

Keynote speaker: "Revising a mental model as one learns." *The Seventeenth Annual Conference of the Cognitive Science Society*. University of Pittsburgh, Pittsburgh, PA, July.

Keynote speaker: "Self-explaining is the construction of a mental model" at the University of Memphis Conference on Reasoning, Memphis, Tennessee, September.

Invited speaker: "Learning from text by self-explaining." Clarion University, Clarion, PA, Nov.

1996

Workshop participant at Sage Foundation on *Literacy*, New York, April.

1997

Colloquium speaker, "How to Learn More Effectively", presented at Center for Advanced Study in the Behavioral Sciences, February.

Colloquium speaker, "Self-Explaining: A Domain-General Learning Activity". presented to the Education in Math, Science, and Technology group, U.C. Berkeley, March.

Colloquium speaker, "Self-Explaining: A Domain-General Learning Activity". presented to the Center for Research in Mathematics and Science Education, San Diego State University, April.

Colloquium speaker, "Learning Compatible vs Incompatible Concepts: Incrementally versus Conceptual Change", presented to the Department of Psychology, Stanford University, April.

Guest Lecturer, Symbolic Systems, School of Education, Stanford University, June.

Colloquium speaker, "Conceptual Change in Learning Complex Concepts", presented to the Cognitive Science Program, Georgia Tech, November.

1998

Workshop speaker, "Current Research in Medical Education", presented at the Workshop on Formalizing the Informal: A Rationale for the Clinical Teaching of Medical Students and Residents. University of Pittsburgh Medical Center, Center for Continuing Education in the Health Sciences, March.

Presenter, "Learning Concepts of Equilibration Processes", at the Conference on Designing for Science, Learning Research and Development Center, April.

Tutorial speaker: "Discourse in Contexts of Learning ", *Twentieth Annual Conference of the Cognitive Science Society*, Madison, WI, August.

Conference speaker, "Misrepresenting Complex Dynamic Systems as Events: A barrier to Learning Science", EARLI *Second European Symposium on Conceptual Change*. Madrid, Spain, November.

Speaker, "What Makes Human Tutoring Effective?" Circle Seminar Series on Tutoring. Carnegie Mellon University, December.

1999

Speaker, "What makes human tutoring effective?" National Science Foundation, Washington D.C., Jan.

Speaker, "Why are decentralized concepts so hard to learn?" at the UCI Conference on Decentralization. Sponsored by the Institute for Mathematical Behavioral Sciences and the Department of Economics, University of California at Irvine, February.

Speaker, "Assessment of Conceptual Change", presented to the Committee on the Foundation of Assessment, National Academy of Sciences/National Research Council, Board on Testing and Assessment, Irvine, CA, May.

Guest speaker, "Understanding Emergent Versus Causal Mechanisms: Overcoming Obstacles to Learning Science Concepts", along with Jay McClelland, at a Seminar on *How the Brain Learns*, Harrisburg, PA, June.

Keynote speaker: Annual meeting of the American Society for Engineering Education, St. Louis, June.

Colloquium speaker, "Misclassifying Processes as Objects and Emergence as Causality: Why We Misunderstand Many Complex Concepts and Phenomena". NEBARS at University of Connecticut, November.

Workshop speaker on Classroom and Tutorial Discourse. Organizers: Brian MacWhinney, Catherine Snow and Steven Bird. Carnegie Mellon University, Pittsburgh, PA, December.

2000

Speaker, "Emergent versus Causal Schemas", presented at an interactive symposium on Conceptual Change and Complex Causality, organized by David Perkins, American Educational Research Association, New Orleans, April.

Distinguished Lecturer, "Assessment of Learning at Three Different Grain Sizes", presented at the American Society for Engineering Education Conference, St. Louis, June.

Presenter, "How Can We Enhance Students' Learning?" at a workshop of the University of Pittsburgh Medical Complex School of Profusion, Nov. 2000.

2001

"Why do students fail to understand *complex dynamic* type of concepts?" Presented in the symposium *Conceptual change and complex causality: Furthering the conversation*. American Educational Research Association, Seattle, April 2001.

Participant in a Workshop, sponsored by the Russell Sage Foundation, to react to their report on their Literacy Program. New York, NY, June 2001.

2002

Presenter, "Learning through collaborative observation of tutoring" at the CIRCLE Advisory Board Meeting, Pittsburgh, March.

One of the scholars whose work was highlighted at an American Educational Research Association poster session called *Reach for the Stars*. New Orleans, LA, April 2002.

Presenter, "Learning from physics text: Effects of interactive and observed discourse with tutors and peers", at a Symposium on Conceptual Learning from Scientific Text and Discourse, at the Society for Text and Discourse conference. Chicago, IL, June 2002.

Commentary provided for the Graduate Record Exam Symposium, at the Graduate Record Exam Board Meeting, Seattle, June 2002.

Workshop presenter, to help Office of Naval Research shape a new 6.1 ONR program on Cognitive Science and Human Performance. Las Cruces, NM, October 2002.

2003

Distinguished Speaker, “Emergent systems versus Causal Events: Schemas for Overcoming versus Generating Misconceptions in Science”, presented for the Cognitive Science Colloquium Series, Department of Psychology, Georgia Tech, Atlanta, Georgia, March 2003.

Keynote speaker, “Emergent versus Commonsense Causal Processes: How Misconceptions in Science Arise and How They Can Be Overcome,” presented at the 10th European Association for Research on Learning and Instruction, Padova, Italy.

2004

Keynote speaker, “How Students Learn”. Colloquium on Teaching and Learning, Rensselaer Polytechnic Institute, May 2004.

2005

Discussant at the Adaptive Expertise Colloquium, organized by the LIFE Science of Learning Center, VaNTH Engineering Research Centers, and SRI International, Palo Alto, CA, Sept 2005.

2006

Participant at the Santa Fe Institute’s Educational Outreach Workshop on *Complex Dynamic Systems*, Santa Fe, NM, March 2006.

Discussant for the symposium *How to support explanation in the classroom: The role of teachers and tasks*. American Educational Research Association meeting, San Francisco, CA, April 2006.

Lead discussant at the NSF workshop on *Transfer and Expertise*, Arlington, November.

Colloquium speaker, *Learning from Tutoring and Observing Tutoring Collaboratively*, OISE, Toronto, Canada, November 2006.

2007

Participant in the Evolution Challenge Workshop, Las Vegas, NV February.

Lead discussant on *Expertise* at the National Science Foundation meeting, Oct.

A discussant, along with Rich Shavelson, for a Presidential session on “Professional Expertise”, Chicago, IL, April 2007.

2008

“Co-construction from Joint Explaining”. Paper presented at International Conference of the Learning Sciences, Utrecht, Netherlands, June 2008.

Keynote address: “Qualitative misunderstanding of emergent processes.” Presented at the VI European Meeting in Conceptual Change, Turku, Finland, August 16, 2008.

“Qualitative misunderstanding of emergent processes.” Presented to Arts, Media and Entertainment, ASU, Oct 2008.

“Does Qualitative Understanding of Emergent Processes Transfer to Learning Science concepts? A Pilot Intervention.” Presented a colloquium to kick off the colloquium series at Duke University’s Science Center, Nov. 2008.

2009

“What are misconceptions and how might they be overcome?” Brownbag presented to the Applied Psychology Program, Polytechnic Campus, ASU, Feb 2009.

“Ways of optimizing student learning.” Talk presented at K-12, Hendon, VA, May 7, 2009.

“Expert learners.” Talk presented at the 36th Carnegie Cognition Symposium on Expertise June 2, 2009.

“Why are some processes so hard to understand? An instructional module targeted at misconceptions.” Talk presented at the Cognitive Science Symposium on Transfer of Learning.

“Ways to optimize student learning: A learner-centered approach.” Colloquium presented at the Cognitive Science Colloquium Series, Bloomington, Indiana, Oct.

“An instructional module targeted at misconceptions.” Talk presented at the symposium From Child to Scientist: Mechanisms of Learning and Development, Carnegie-Mellon University, Oct

2010

“Using a Cognitive Framework of Differentiated Overt Learning Activities (DOLA) for Designing Effective Classroom Instruction in Materials Science and Nanotechnology,” Michelene T.H. Chi, Stephen Krausse & Muhsin Menekse, a poster presented at the NSF-sponsored Awardee Conference, Reston, Va. Jan.

“Dialogue Analyses for Learning.” Paper presented at the *Communication Analyses Workshop*, Tempe, AZ Feb.

Discussant, for IES symposium *Solving Problems in School: Concepts, Procedures, and Instruction to Support Learning*, at the 2010 APS Annual Convention in Boston, May.

“Intelligent Tutoring Systems and Games for STEM instruction.” Invited participant at an ONR-sponsored workshop, UCLA CRESST, Nov.

2011

“Engaging Students with Differential Effectiveness: The ICAP (Interactive>Constructive>Active>Passive) Hypothesis.” Invited presentation at the *Frontiers in Education Workshop*, Pearson, Boston, Feb.

“Misconceived Causal Explanations for Emergent Science Processes.” Invited talk for the symposium *New Approaches to the Problem of Conceptual Change in the Learning of Science and Math*. Presented at the 33rd Annual Conference of the Cognitive Science Society, Boston, July.

“Students’ Self-explanations.” Invited talk for the symposium *Explanation-based mechanisms for learning: An interdisciplinary approach*. Presented at the 33rd Annual Conference of

the Cognitive Science Society, Boston, July.

Panel member to discuss explanations for the impact of dialog, in *Socializing Intelligence Through Academic Talk and Dialogue*, Talk title was: "What accounts for the benefits of dialoguing or learning collaboratively, for learning?" Pittsburgh, Sept.

Highlighted session speaker, at the International Conference on Computers in Education, for the sub-conference track Computer-supported Collaborative Learning, Chiang-Mai, Thailand, Nov.

2012

Invited participant at a Gates Foundation M.I.T sponsored workshop on *Quality Matters*. Boston, MA: Jan. 24-25.

"ICAP: A Hypothesis Generated from a Framework for Differentiating Levels of Cognitive Engagement in Active Learning." Invited talk for *Pearson's Mastering Leadership Conference*, Scottsdale, AZ: March.

Invited participant in an NSF brainstorming session to discuss the potential synergies of having engineering education researchers' partner with Engineering Research Centers (ERCs), which are ten-year, \$40M projects, Arlington, VA., March 6, 2012.

Invited participant in a workshop on *Optimal Teaching Workshop*, UC San Diego, May.

"Two Approaches to Enhancing Learning: Dialogue Videos and Engagement Activities." Talk presented at the 2012 University/Microsoft Research Summer Institute, titled *Crowdsourcing Personalized Online Education*, Suncadia, WA: July.

"Two Kinds and Four Sub-types of Misconceived Knowledge, Ways to Change it, and the Learning Outcomes." Colloquium to be presented to the Mathematics and Science Education Ph.D. Program, UC San Diego: Oct.

"Two Kinds and Four Sub-types of Misconceived Knowledge, Ways to Change it, and the Learning Outcomes." Colloquium to be presented to the joint Cognitive Science and the Learning Sciences program, Northwestern University, Nov.

2013

"Overcoming misconceptions for conceptual understanding," presented at the *Improving Middle School Science Instruction Using Cognitive Science*, A National Conference, sponsored by IES's National R & D Center for Cognition and Science Instruction Conference, Washington, DC: May 21-22.

"Why are dialogues better instructional materials than monologues?" Paper presented at the symposium *Trends in Support for the Analysis of Collaborative Learning, Part 1: Support*, organized by Nikol Rummel & Tamara Van Gog, Ruhr-Universitat Bochum: Aug. 2013.

2014

"ICAP: Differentiating four levels of engagement for active learning." Presented at *How to Actively Engage Your Students: A Workshop on Active Learning*. Arizona State University: March.

"Generic and Specific Issues in Conceptual Change in Science," Plenary panel presentation at the *Conceptual Change Sig* meeting at Bologna, Italy: August, 2014.

Invited participant at IES annual meeting, Sept. 2014.

Plenary speaker on “Conceptual Change Across Domain: Science,” Conceptual Change Sig meeting of the European Association for Research on Learning and Instruction, Bologna, Italy: August, 2014.

2015

One of 32 outstanding scholars of education selected to participate in the AERA Scholars Retreat. Santa Fe, NM: October 1-4.

“Teaching the crosscutting concept of emergent cause-and-effect to overcome misconceptions.” Paper presented at the Conference on Complex Systems '15. Tempe, AZ: September 29.

“Ways to enhance your understanding while you are learning.” Talk presented at Penn State University to their instructors and professors. State College, PA: October 19.

“Engaging students cognitively in active learning.” Talk presented at the AERA Coordinated Committee Meeting. Washington, DC: October 23.

“Robust misconceptions: What are they and how to overcome them.” Colloquium speaker at the Human Development Department Colloquia at Columbia University. New York, NY: November 3.

2016

Invited speaker: “ICAP: A theoretical framework for active learning.” Presented to the Education Development Center (EDC), Inc. New York, NY. Feb. 24.

Poster presented at the Modeling and Model-Based Reasoning in STEM Conference at Purdue University titled, “Misconceptions in STEM are Misrepresentations of One Kind of Processes as Another Kind”. Lafayette, Indiana. August 26th.

Presented at the EnFUSE Symposium hosted by the NSF’s division of undergraduate education with the talk titled “Learning from Dialog versus Monolog Videos”. April. D.C.

Invited participant on an NSF-funded workshop to promote collaboration between cognitive science and discipline-based education research on STEM learning. Washington D.C. September, 2016.

2017

(For 2017-2021, Students & postdoc names are underlined.)

Chi, M.T.H. *“ICAP: A theoretical framework for how to engage students to promote deeper learning,”* at the Strengthening Institutional Linkages Initiative Faculty Development Seminar, MLFTC, ASU, Jan.

Chi, M.T.H. Brown Bag: *“Translating ICAP on Student Engagement into Practice,”* Presented to the Graduate School of Education, Rutgers, Feb.

Chi, M.T.H. Brown bag presentation at the University of Pittsburgh’s Discipline-Based Science Education Research Center (dB-SERC) on: *“ICAP titled: ICAP: A Theoretical Framework for Active Learning to Promote Deeper Understanding.”* Pittsburgh, March.

Bowers, N., Jordan, M., & Chi, M.T.H. presented a paper at AERA at the *Everyday Science* session titled, "Identifying Ontological Difficulties in Causal Explanation of Everyday Science". May.

Adams, J. & Chi, M.T.H. presented a paper presented at AERA 2017 titled, "How Should Collaborative Pairs Be Grouped?"

Bruchok, C. & Zillmer, N. & Chi, M.T.H. presented a poster titled, "Teaching Teachers to Differentiate Learning Behaviors: Translating Learnings from Interactive>Constructive>Active>Passive Into Professional Development," at AERA .

Stump, G., Li, N. & Chi, M.T.H. presented a poster titled, "Utilization of the Interactive, Constructive, Active, and Passive Framework to Analyze Student Learning," at AERA, May.

2018

Adams, J., & Chi, M. T. H. (2018, February). Fostering Collaboration in Engineering Classrooms. Poster presented at the 2018 ASU Learning Innovation Showcase, Tempe, AZ.

Caplan, M. R., & Chi, M. T. H. (2018, February). Dialogue vs monologue videos in engineering classrooms. Poster presented at the 2018 ASU Learning Innovation Showcase, Tempe, AZ.

Ding, L., & Chi, M. T. H. (2018, February). Using monologue- and dialogue-videos in an authentic flipped college-level biology course: A 2-year study. Poster presented at the 2018 ASU Learning Innovation Showcase, Tempe, AZ.

Lai, P., & Chi, M. T. H. (2018, February). Emergence thinking for understanding science. Poster presented at the 2018 ASU Learning Innovation Showcase, Tempe, AZ.

Morris, J. A., & Chi, M. T. H. (2018, February). Developing and revising instructional activities to optimize cognitive engagement. Poster presented at the 2018 ASU Learning Innovation Showcase, Tempe, AZ.

Chi, M. T. H. (2018, June). *Concrete definition of beneficial collaborative dialogues*. Poster to be presented at the 13th International Conference of the Learning Sciences, London, United Kingdom.

Ding, L., Adams, J., Stephens, M. D., Brownell, S., & Chi, M. T. H. (2018, June). *Failure to replicate using dialogue videos in learning: Lessons learned from an authentic course*. Paper to be presented at the 13th International Conference of the Learning Sciences, London, United Kingdom.

Chi, M. T. H. (2018, July). How students engage to learn. Paper presented at the 40th Annual Meeting of the Cognitive Science Society, Madison, WI.

Chi, M.T.H. Invited paper, "*Learning the underlying structures of causal and acausal processes*" presented at the symposium Learning-to-learn from novice to expertise: New challenges and approaches for one of the oldest topics of cognitive science. Symposium organized by Perez, R., Gray, W. D (2018, July) at the 40th Annual Meeting of the Cognitive Science Society, Madison, WI.

2019

VanBibber, B., Lai, P., Ding, L., Adams, J., & Chi, M. T. H. (2019). *Student learning of emergent science using the PAIR-C framework*. Paper accepted to be presented at NARST, Portland, OR.

2020 (Covid cancelled many pre-scheduled in-person presentations)

Chi, M.T.H. Plenary speaker, “ICAP: How to promote deeper learning by engaging students cognitively” at the 42nd Annual National Institute on the Teaching of Psychology (NITOP) in St. Pete Beach, Florida, January, 2020.

Su, M., Cho, J., Vanbibber, B., Ha, J., & Chi, M. (2020). Diagnosis of Misconceptions with Coherent Underlying Structure in Learning Diffusion. In Gresalfi, M. and Horn, I. S. (Eds.), *The Interdisciplinary of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020*, Volume 4 (pp. 2321-2324). Nashville, Tennessee: International Society of the Learning Sciences.

Cullicott, C., Semken, S., Chi, M., & Boucher, N. (2020). “Compel Them to Engage with the Content:” Upgrading an Undergraduate Geology Course Using ICAP. In Gresalfi, M. and Horn, I. S. (Eds.), *The Interdisciplinary of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020*, Volume 4 (pp. 2361-2362). Nashville, Tennessee: International Society of the Learning Sciences.

Cullicott, C. E., Semken, S., Chi, M., & Boucher, N (2020, December 1-17). Aligning Place-Based Geoscience Teaching with the ICAP Framework of Cognitive Engagement for Enhanced Active Learning [Conference presentation]. American Geophysical Union Fall Meeting, San Francisco, CA, United States.

Ha, J., Su, M., Chi, M., & Cullicott, C. (2020). Misunderstandings of Teachers Applying ICAP Theory into Practice. In Gresalfi, M. and Horn, I. S. (Eds.), *The Interdisciplinary of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020*, Volume 4 (pp. 2407-2408). Nashville, Tennessee: International Society of the Learning Sciences.

2021 (Covid cancelled many in-person conferences)

Su, M., Cho, J. Y., Chi, M. T. H., Boucher, N., VanBibber, B (2021). Designing Simulation Module to Diagnose Misconceptions in Learning Natural Selection. In de Vries, E., Hod, Y., & Ahn J. (Eds.). *Proceedings of the 15th International Conference of the Learning Sciences - ICLS 2021*. Bochum, Germany: International Society of the Learning Sciences.

Cullicott, C., Semken, S., Chi, M. T. H., & Boucher, N. (2021) Enhancing active learning in a place-based geoscience course using the ICAP Theory of Cognitive Engagement [Poster presentation]. *Geological Society of American Abstracts with Programs*, 53(6). Doi: 10.1130/abs/2021AM-367458

2022 (still Covid)

Chi, M.T. H., Hong, Y.C, Qian, Y. Improving online learning with tutorial dialog videos. Poster presented at the NSF-IUSE Summit. Washing D.C., June.

Qian, Y., Hong, Y.C. & Chi, M. Improving student learning from videos in large-scale online STEM courses. Featured Research presented at the annual conference of the Association for Educational Communications and Technology (AECT). Las Vegas. Oct.

2023 (sabbatical year)

Chi, M.T.H. Guest speaker. ASU’s Teaching Community of Practice (TCP). The TCP is a group of about 100 faculty who meet regularly to discuss ideas related to engineering education. Feb.

Chi, M.T.H. Colloquium speaker. ICAP: A theoretical framework that defines active learning and predict learning outcomes. University of California at San Diego, Dept. of Psychology. April 6, 2023.

SERVICES (EXTERNAL)

Advisor or Consultant on Executive Committees, Boards, etc. (listing since 2007 only)

Participated in a panel meeting on 21st Century Skills, Sponsored by the Spencer and Russell Sage Foundations, New York, May, 2007.

A member of a 3-member visiting team to participate in the self-study process at Teachers College, Columbia University, for their Psychology and Education Program, December, 2007.

A member of the Executive Committee of the Pittsburgh Science of Learning Center, 2004-2009.

Consultant: "Adaptive Simple Sequencing Instruction Support Toolkit", SBIR Phase II, Intelligent Automation, Inc. July 2007.

Mentoring Spencer postdoctoral fellows at the National Academy of Education, at the Keck Center, Washington, Feb. 2011.

A member of the Standing Review Committee, National Academy of Education, 2011-2014.

Co-chaired the inaugural conference on Learning@Scale, sponsored by ACM, 2013-2014.

Member of Advisory Boards (since 2008 only)

Advisory board for a grant by Ronald L. Miller P.I. (Professor of Chemical Engineering, Colorado School of Mines) "Developing ontological schema training methods to help students develop scientifically accurate mental models of engineering concepts." NSF Engineering Education Program. 2006-2011.

Advisory board for two grants (IES and NSF), to Wayne Ward and Ron Cole, Boulder Language Technologies, to improve science learning in third, fourth and fifth grades through spoken dialog interaction with a virtual tutor (2008-2011)

Advisory board for the Center for Advanced Technology in the Schools (CATS), Led by Jim Stigler from UCLA Psychology, Greg Chung and Eva Baker of UCLA Center for Research on Evaluation, Standards, and Student Testing (CRESST). The Center will combine research on cognitive psychology, assessment, and games in the area of middle school learning (2008-2011).

Advisory board for an NSF grant on Cumulative Learning using Embedded Assessment Results (CLEAR), Marcia Linn and Chad Dorsey, co-P.I.s, Berkeley, CA. (2009-2012)

Advisory board for a NSF funded project Transfer of Perceptually Grounded Principles, Rob Goldstone and Sam Day, Indiana University (2009-2011).

Advisory board for a CAREER Award, The Role of Conceptual Change in Knowledge Acquisition, Andrew Shtulman, Dept. of Psychology, Occidental College, Awarded 2010-2015.

Advisory board on College Ready Work, for the Bill and Melinda Gates Foundation, (2010-2013).

Advisory board for an NSF grant, An Integrated Model of Cognitive and Affective Scaffolding for Intelligent Tutoring Systems, by Dr. James Lester (Dept. of Computer Science), North Carolina State University, Awarded 2010.

Advisory board for an NSF Career Award, In-class Peer Tutoring, by Dr. Shane Brown, Dept of Civil & Environmental Engineering, Washington State University, 2010-2015.

Advisory board for an NSF Career award, A Cognitive Science of Explanation, Tania Lombrozo, Dept. of Psychology, UC Berkeley. 2011-2016.

Advisory Board for an NSF Career Award, A Rational Analysis of How Teachers' Examples Constrain Learning and Inference. Dr. Patrick Shafto, Dept. of Psychology, University of Louisville, 2012-2017.

Advisory Board for NSF REESE project Digital Games as Analogical Sources for Science Learning, Wendy Martin, Center for Children and Technology/Education Development (2014-2016).

Re-imagining Video-based Online Learning, Dr. Joanne Lobato, Dept. of Mathematics and Statistics, San Diego State University, 2014-2016.

Advisory board for NSF funded project: Learning by Teaching a Synthetic Peer: Investigating the effect of tutor scaffolding for tutor learning. Drs. Noboru Matsuda, Ken Koedinger, William Cohen, Human-computer Interaction Institute, Carnegie-Mellon University, 2013-2016.

Advisory Board for MIT's Online Education Policy Initiative, the initiative is supported by the Carnegie Foundation and the National Science Foundation, Nov. 2014-2016.

Advisory meeting at the meeting on the Science of Learning & Development (SoLD) hosted by the Chan Zuckerberg Initiative, June, 2017.

Advisory board for an IES funded project called CourseMirror (PI: Muhsin Menekse), School of Engineering, Purdue University, 2018.

Advisory board for NSF funded CAREER Award for project on "CS-Climate", Kristy Boyer, Computer Science, University of Florida (2020-2022)

Advisory Board for advising research by ActionLab, EdPlus, ASU's Online School (2020-2022)

Advisory Board for McGraw Hill's panel on the Learning Sciences (2020-2022)

Advisory Board for a collaborative research center on *Explainable AI Systems*, submitted by the Universities Bielefeld and Paderborn, to the German Research Foundation (DFG), Funded (2021-2026).

Advisory Board for a funded NSF HER CORE project on *Computational Modeling for Integrating Science and Engineering Design: Model Construction, Manipulation, and Exploration*, P.I. Satabdi Basu, Center for Education Research and Innovation, SRI Education. (2022 – 2025)

Advisory Board for a project *TEPS: Teaching through Example-based Problem Solving: An intervention to Equip Preservice Elementary Teachers for In-Depth Mathematics Teaching*, submitted to NSF DR-K-12. P.I. Meixia Ding, Temple University. (2022)

Advisory Board for a project *Exploring the Effects of AI-Augmented Support during Collaborative, Co-Creative Computer Science Learning*, submitted to NSF (ECR), Kristy Boyer, P.I. University of Florida, 2022.

Advisory Board for Southern New Hampshire University's online BA Psychology Program (2022-2023). [Nickolas]

National Committees

1979-1981 Elected Secretary of Division C, American Educational Research Association

1980-1984 Cognition, Emotion and Personality Research Review Panel, National Institute of Mental Health

1985-1986 Cognition and Survey Research Committee, Social Sciences Research Council

1989-1990	Publications Committee, Governing Council of the Society for Research in Child Development
1989-1991	Committee on Techniques for Enhancing Human Performance, National Research Council, National Academy of Sciences
1992-1993	GRE External Advisory Committee on Reasoning in Context, Educational Testing Service
1993-1999	Board of Governors, Cognitive Science Society
2001	Review Panel for ROLE (Research On Learning and Education) Proposals
2001	Guest speaker on the GRE Board, Educational Testing Service
2005-2006	Dissertation Selection Committee, the Spencer Foundation
2005-2007	IES Math and Science Review Panel
2007-2009	Fellows Selection Committee, Cognitive Science Society
2007-2008	Reviewer for Fellow Selection, Center for Advanced Study in the Behavioral Sciences
2010-2012	Member of the review panel for Spencer's Small Grant program.
2012	Member of the Selection Committee for this Inaugural Year for the AERA Div. C Early Career Award
2011-2013	Member of the Standing Review Committee of the National Academy of Education
2013-2015	Fellows Selection Committee, Cognitive Science Society
2014-2017	Chair of the Research Advisory Committee, AERA
2017-2018	Participant in the Science of Learning and Development (SoLD) meeting of the Chan-Zuckerberg Initiative
2015-2020	Selection committee, Sylvia Scribner Award

Editorial Boards

1985-1990	Cognitive Development
1987-1992	Human Development
1990-1998	Journal of the Learning Sciences
1993-1995	Cognition and Instruction
1993-1995	Co-Editor of Lawrence Erlbaum Series: Human and Machine Expertise
1993-1996	Behavioral Research in Accounting
1993-1995	Cognitive Science (Senior Editor)
1996-1997	Cognitive Science
2000-2003	Journal of the Learning Sciences
Current:	Routinely review for many journals but not accepting any editorial positions.

National and International: Major Conferences Organized

1982	The Nature of Expertise, Pittsburgh, PA
2008	Talk, Dialogues, and Learning (also included organizing a festschrift for L. Resnick), Pittsburgh, PA
2014	Co-chaired the inaugural conference on Learning@Scale, Atlanta, March, 2014

Respond to ICAP Queries and Requests for More Information about ICAP (examples from 2021 only)

Jan. 2021	Request for more information about ICAP for Intentional Futures, working on project funded by the Bill and Melinda Gates Foundation.
March 2021	MindEdge, a company that develops eLearning materials, wants to use ICAP to guide their materials development.
March 2021	Education Coordinator from Egypt, needing to know more about ICAP for Samsung Innovation Campus.

SERVICE Within ASU (major ones only)

2000-2001	Ad Hoc Tenure Review Committees (at the University Level)
2000-2002	Selection Committee (to select faculty members for the University level Ad Hoc Tenure Review committees)
2004-2007	Member of the Executive Committee of the Pittsburgh Science of Learning Center
2007-2008	Chancellor's Distinguished Research Award Committee
2013-2014	Director of the Arizona State University Learning Sciences Institute
2020	Tenure and promotion committee (5 candidates), MLFTC
2020	President Crow's provost search committee
2020	Created a 32 power point slides that gives a short summary of ICAP--specifically targeted at tips for online learning, given to teachers who attend the Remote Summit. <i>REMOTE: The Connected Faculty Summit</i> is hosted by ASU on July 13 and 14th (2021) and showcased best practices, techniques, and tools to provide actionable insights to Higher Education faculty around the concept of "the best of online education."
2020-2022	Ad Hoc Tenure Review Committee
2021	Regents Professor Selection Committee

TEACHING, MENTORING, and FACULTY DEVELOPMENT WORKSHOPS

Workshops

I started in the fall of 2021 to provide faculty development workshops on how to use ICAP to improve teaching, available and free to all faculty, clinical faculty, graduate students and staff. More specifically, it teaches instructors on how to engage students "Constructively" versus "Actively".

Zoom workshops provided for any interested faculty at ASU:

- August 20, 2021
- October 1, 2021
- December 6, 2021
- February 25, 2022
- April 1, 2022

Zoom workshop provided to MLFTC instructional designers

- April 27, 2022

In person workshop, provided to any interested faculty at ASU:

- August 4, 2022, from 12:30 – 3:30

Mentoring

I frequently mentor external postdocs and graduate students, such to the Spencer postdoctoral and pre-doctoral fellow, sponsored by National Academy; or talk to junior faculty and graduate students about academic careers, organized by conferences, such as for AERA's Division C Faculty Mentorship Program.

External Dissertation committee for non-ASU and international students

I often serve on the dissertation committee for non-ASU students. Three recent examples are:

- Toi Sin Arvidsson, a Ph.D. student at Teachers' College, Columbia University, 2018;

- Christina Augsburg, Visiting student from University of Augsburg, 2017
- Imogen Henrich, a Ph.D. student at School of Education, University of Southern California, 2021

Teaching at ASU

2017 DC1791: Proposal Writing Seminar, MLFTC, ASU.
 2018 DCI 790: Reading and Conference, DCI 792: Research, MLFTC, ASU.
 2020 DCI 691: Improving Teaching and Learning, MLFTC, ASU

Postdocs Mentored and their current position

Paul Feltovich (1978-80), Senior Research Scientist, Florida Institute for Human and Machine Cognition
 Mitch Rabinowitz (1980-82), Professor, Dept. of Psychology, Fordham University
 Camilla Gobbo (1983-84), Professor emeritus, Dept. of Psychology, Padova University, Italy
 Matthew Lewis (1984-85), Executive Vice President, Interactive Video Technologies
 Miriam Bassok (1985-87), Prof., Dept. of Psychology, Univ. of Washington
 Peter Reimann (1984-88), Professor, University of Sydney, Australia
 Jean Hutchinson (1986-88) Professor, Department of Geological Sciences and Geological Engineering, Queen's University
 Miriam Reiner (1988-89) Head of the Virtual Reality and NeuroCognition lab at the Technion-Israel Institute of Technology.
 Joanne Striley (1988-89) Professor, Department of Teacher Education, Michigan State University
 Mei-Hung Chiu (1990-91), Professor and chair, Graduate Institute of Science Education, National Taiwan Normal University.
 Takeshi Okada (1994-95), Professor, Graduate School of Education and Interfaculty Initiative in Information Studies, The University of Tokyo, Japan
 Michel Ferrari (1996-1998), Associate Professor, Ontario Institute for Studies in Education, Toronto
 Cindy E. Hmelo (1996-1998), Professor & Director of Institute, School of Education, Indiana University
 Judith McQuaide (1998-1999), Senior Researcher Manager, National Education Association
 Takeshi Yamauchi (1998-2000), Associate Professor, Dept. of Psychology, Texas A&M
 Heisawn Jeong (1998-2000) Professor in Cognitive Science and Learning Sciences, Hallym University, Korea
 Randy Engle (2001-2003), Assistant Professor, Berkeley School of Education (deceased)
 Marguerite Roy (2001-2003), Research Analyst, Medical Council of Canada
 Agnieszka Kosminska Kristensen (2003-2005).
 Scotty Craig (2005-2007). Associate Professor, Arizona State University
 Kirsten Butcher (2005-2007). Associate Professor, University of Utah
 Jing-Wen Lin (2007). Faculty, Department of Science Education, National Taipei University of Education, Taiwan
 Paul E. Hand (2009-2010)
 Kasia Muldner (July 1, 2010-2012), Associate Professor, Carleton University
 Glenda Stump (June 1, 2010-2012; 2014-15). Education Research Scientist, Open Learning, MIT
 Ruth Wylie (Dec. 1, 2011), Associate Director, Science of the Imagination Institute, ASU.
 Seokmin Kang (July 16, 2012-2015), Teaching faculty, Hallym University, Korea
 Kathleen McElDoon (2013-2015), Deputy Director of Research, Tennessee State Board of Education
 Matt Lancaster (2012-2014), Assistant Professor, Department of Psychology, Lourdes University
 Susan Trickett (2013-2014), Knowledge Management Specialist, Denver Public Schools

Na Li (2013-2016), Assistant Professor, Shenzhen Institute of Advanced Technology (SIAT), Chinese Academy of Sciences (CAS), visiting scholar at University of Southern California
 Emily Bogusch (2014-2015), Mathematics Teacher (11th /12th grade), Phoenix Coding Academy, Phoenix, Arizona.
 Nicole Zillmer (2016), Director of Research, Authentic Connections, Arizona State University
 Elon Langbeheim (2016), Assistant Professor, Ben Gurion University
 Polly Lai (2017-2020), Lecturer, Learning and Teacher Development, Queensland Institute of Technology, Australia
 Joshua Morris (2017-2019), Assistant Professor, College of Education and Human Services, University of Illinois
 Lu Ding (2017-2019) Instructional Designer, Assistant Professor, University of Alabama
 Soojeong Jeong (2019-2020), Instructor, Utah State University
 John Cho (2019-2021)
 Yingxiao Qian (2019-current)

Graduate Students (including students from 1992 onwards only)

Rebecca Leas (Ph.D., 1992; Department of Physical Education). Professor at Clarion University of Pennsylvania.
 Jeffrey Sampler (Ph.D., 1992; Katz Graduate School of Business)
 James Slotta (Ph.D., 1997), Endowed Chair, Professor, Ontario Institute of Education.
 Heisawn Jeong (Ph.D., 1998), Professor, Department of Education, Hallym University, Korea.
 Christine Carlock (M.S. 1999; Ph.D. Katz Graduate School of Business), Assoc. Professor, Univ. of Connecticut
 Ahmad Hashem (Ph.D., Psychology and Informatics, 2000), Global Healthcare Industry Manager, Microsoft
 Nick de Leeuw (M.S. 2000), Adjunct Professor of Psychology, Vassar College
 Stephanie Siler (M.S., 1998). Research Associate, Dept. of Psychology, at Carnegie-Mellon University.
 Roger Taylor (M.S., 2002). Assistant Professor, CUNY.
 Bob Hausmann (M.S., 2001; Ph.D. 2005, Psychology). Research Associate, Carnegie-Learning.
 Rod Roscoe (M.S. 2004, Ph.D. 2007, Dept. of Psychology), Associate Professor, Human Systems Engineering, Polytechnic School, Arizona State University.
 Soniya Gadgil (Masters, 2009, Dept. of Psychology, University of Pittsburgh)
 Stephanie Touchman (Science Education, College of Education, ASU), 2009-11
 Cheryl Berg (Science Education, College of Education, ASU) – graduated 2011
 Brenda Fonseca (Psychology in Education, College of Education, ASU)
 Muhsin Menekse (Science Education, College of Education, ASU), Ph.D. 2012, Assistant Professor at the School of Engineering, Purdue University.
 Floris Blankenstein—A visiting student from Maastricht University, Holland
 Rachel Lam (Education), Ph.D. 2012
 Dongchen Xu (Psychology), M.S. 2015
 Christi Bruchok (Education), 2015-2016
 Joshua Adams (Education), 2014-2019
 Catherine Cullicott (Education), current
 Man Su (Education), current
 Jesse Ha (Education), current
 Ratrapee Techawitthayachinda, (Education), current
 Jongchan Park (Education), current