

Monday, April 24, 8:45 – 10:15am

Plenary Session #2:

Presenters: Micki Chi and Stella Vosniadou

The theme of the second plenary, *Challenges in Learning Science Concepts*, will be co-presented.

Presenter: Micki Chi

Title: Teaching Emergence: An Attempt at Differentiating Science Concepts of Processes

Michelene (Micki) Chi is the Dorothy Bray Endowed Professor in the Mary Lou Fulton Teachers College at Arizona State University (ASU). Her research focuses on developing theories about learning and pedagogy applicable to all domains of science, then translating them into instructional practice. She currently has three strands of work applicable to both



pre-college and college-level instruction in STEM. The first strand is a theory of active learning or engagement called ICAP. The second strand is a theory about emergence causality that explains the robustness of many science misconceptions across domains. The third strand is her discovery of a new paradigm for learning from online videos that overcomes the limitation of active learning practices in asynchronous online learning contexts. Dr. Chi has published widely, in both cognitive science and learning science journals. Dr. Chi was elected to the National Academy of Education in 2010, and she received the Sylvia Scribner Award from the American Educational Research Association (AERA) in 2013, and the Wickenden Award from the American Society for Engineering Education in 2014 for the best published paper of the year. In 2015, she received the Thorndike Award from the American Psychological Association, and in 2016, the Distinguished Contributions to Research in Education Award from AERA. She was also elected to the oldest and most prestigious honorary societies in 2016 –The American Academy of Arts and Sciences.

Abstract

The robustness of many misconceptions about science concepts has been explained by the ontological commitment in students' thinking to an alternative category of processes. That is, many science concepts of processes require an emergent kind of causal explanation whereas students' misconceptions provide a sequential kind of causal explanation. In order to teach students to be able to give a correct causal explanation, we need to teach students an understanding of emergent processes. We are developing a module that attempts to help students differentiate emergent from sequential processes by contrasting everyday emergent and sequential processes. Students reveal difficulty in understanding the macro-level patterns of processes.

Presenter: Stella Vosniadou

Title: The Co-existence of Intuitive and Scientific Understandings: Implications for the Design of Curricula and Instruction

Stella Vosniadou is Strategic Professor in the School of Education, Flinders University, Australia. In previous academic appointments she served as Professor of Cognitive Psychology, Chair of the Cognitive Science Division, and Chair of the Interdisciplinary Postgraduate Program in Basic and Applied Cognitive Science in the Department of Philosophy and History of Science, at the National and Kapodistrian University of Athens, and as a Senior Research Associate at the Center for the Study of Reading, University of Illinois in Urbana-Champaign.



Professor Vosniadou has more than 150 publications including authored and edited books and articles in refereed journals and edited volumes in the areas of cognitive development, cognitive psychology, conceptual change, and learning science and mathematics. She is well known internationally for her research for which she received the *2011 Distinguished International Contributions to Child Development Award* by the *Society for Research in Child Development*. She is a fellow of the *American Educational Research Association* and of the *International Academy of Education*, and a frequent keynote speaker in International Conferences. Professor Vosniadou is the current editor of the '*Educational Practices Series*' a publication of the International Academy of Education and of the International Bureau of Education of the UNESCO, and serves on the editorial board of five international journals, including the *Educational Psychologist*, *Mathematical Learning and Thinking*, and *Human Development*.

Abstract

The realization that students are not 'tabula rasa' when exposed to science concepts but have alternative conceptions (preconceptions, misconceptions) that may inhibit science learning, was one of the important outcomes of research in the 80's. Since then, cognitive science research has succeeded in describing the many kinds of conceptual changes that are necessary as individuals move from intuitive beliefs to learning science, mathematics, medicine, economics, etc. Throughout these years it has been implicitly assumed that in the process of conceptual change scientific explanations and theories replace intuitive understandings, particularly in the minds of experts. Although some researchers had suggested that this may not be the case some time ago, it is only recently that a body of evidence started to be accumulated demonstrating the co-existence of intuitive conceptions and scientific explanations in a number of different knowledge domains (physics, biology, medicine, psychology, mathematics), different cultures (American, European, African, indigenous populations), and using different methodologies (interviews, questionnaires, reaction time studies, neuroimaging). In this presentation I will discuss some of this evidence and will draw its implications for the design of curricula and instruction.