

FED-CSAE Seminar: “Reasoning Through Applying: Intellectual Resources Bridging Mathematics and Science”

Centre for STEM and AI Education, Faculty of Education

Date & Time: 5 December 2025 (Friday); 10:00-11:30

Venue: E32-G002, Faculty of Law

Language: English

Registration: Online Registration (<https://go.um.edu.mo/h3hkp791> or )

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Speaker:

Prof. Kyong Mi CHOI is an Associate Professor of Mathematics Education in the Department of Curriculum, Instruction, and Special Education at the School of Education and Human Development, University of Virginia (UVA), where she has served since 2017. Before joining UVA, she was a faculty member at the University of Iowa from 2009 to 2017. She earned her B.A. from Seoul National University and her M.A. and Ph.D. from Teachers College, Columbia University. Prior to pursuing her doctoral studies, she taught high school mathematics in New Jersey, USA. Prof. Choi’s research focuses on student learning and teacher education in mathematics, with particular emphasis on reasoning, applying, and cognitive development across mathematics and science. She has published more than 50 scholarly works on topics including mathematically gifted students, students’ cognitive practices and learning outcomes, and in-service teacher professional development. Employing both qualitative and quantitative methodologies such as confirmatory factor analysis (CFA), structural equation modeling (SEM), and cognitive diagnostic modeling (CDM), her research seeks to advance understanding of how learners construct and apply mathematical knowledge. As principal investigator, she has led several teacher-training projects designed to strengthen teachers’ content and pedagogical knowledge in mathematics, particularly in underserved and high-need educational contexts.

Abstract:

This series of research studies investigates how reasoning and applying function as interdependent components of intellectual resources that support interdisciplinary learning across mathematics and science. Drawing on a decade of theoretical, empirical, and classroom-based research, the work integrates analyses of national curricula, large-scale assessment data (TIMSS), and intervention studies with teachers and students. The findings demonstrate that applying—the procedural and operational dimension of knowledge—serves as a cognitive bridge that mediates reasoning across disciplinary contexts. Structural and cognitive modeling analyses reveal that students’ engagement in applying-oriented, generative tasks enhances their reasoning, cognitive flexibility, and capacity for transfer between mathematics and science. Classroom interventions

further show that when procedural engagement is positioned as an epistemic and sense-making activity, it fosters student authority, ownership, and intellectual empowerment. Framed within the concept of intellectual resources, this research reconceptualizes procedural learning as a generative foundation for reasoning, emphasizing the need for instructional designs and teacher education that cultivate students' ability to use, adapt, and extend intellectual resources across domains.

Future studies and classroom practices should work in tandem to deepen understanding of how intellectual resources—particularly reasoning and applying—develop, interact, and can be intentionally cultivated across disciplines. Longitudinal and cross-cultural research should examine how students' procedural engagement and epistemic agency evolve over time and how different instructional designs, such as generative learning and argument-based inquiry, foster the co-development of reasoning and applying. Mixed-method approaches integrating cognitive diagnostic modeling, discourse analysis, and classroom observation could reveal how learners activate and reorganize intellectual resources during authentic problem-solving. In practice, classrooms that position procedural engagement as an epistemic and generative activity—where students justify strategies, make decisions, and reflect on reasoning—can transform applying into a foundation for intellectual empowerment. Teachers play a pivotal role in this process by shifting from procedural correctness to procedural authorship, designing tasks that promote inquiry, argumentation, and cross-disciplinary reasoning. Together, these research and pedagogical efforts can refine the intellectual resource framework and cultivate globally responsive learning environments that foster reasoning, agency, and cognitive flexibility.