Plenary talks

Plenary 1

Speaker: **Michèle Artigue**

📅 Date: 16/06/25

⏰ Time: 14:15-15:45

📍 Room: V2

Laboratoire de didactique André Revuz (University of Paris Diderot, France)

Interdisciplinarity in the teaching and learning of Calculus and Analysis: reflection on a long term experience

Abstract

My first experience with interdisciplinarity teaching of calculus dates back to the early 1980s, as part of an innovative coordinated mathematics and physics course for first-year students at Paris 7 University. This course sparked joint research between mathematics and physics didacticians on differential and integral processes, and to theoretical reflection on epistemological obstacles in mathematics and physics. I continued to have interdisciplinary experiences then in other contexts, such as the professional development of teachers and teacher educators and with Avenilde Romo Vazquez's doctoral thesis, the training of engineers. With these new experiences, interdisciplinarity also extended to other disciplines, including life sciences, earth sciences and engineering. In this lecture, I will take a retrospective look at these diverse experiences, examining their rationale, their epistemological and didactic foundations, and clarifying what I learned from them.

Plenary 2

Speaker: **Felix Ho**

UPPSALA UNIVERSITET

📅 Date: 17/06/25

⏰ Time: 09:00-10:30

📍 Room: V2

Department of Chemistry - Ångström Laboratory (Uppsala University, Sweden)

Where mathematics and chemistry meet: problem solving at the disciplinary interface, and searching for synergy in students' conceptual understanding of calculus and chemistry

Abstract

The relationship between mathematics and disciplines such as science and engineering—particularly the application of mathematics in these fields—has received growing attention in recent decades. This includes research on mathematical modelling processes and factors, including our own work at the interface of mathematics and chemistry. Beyond algorithmic procedures, meaningful conceptual integration of mathematical and chemical knowledge is essential for building models and theories that explain and predict physical and chemical behavior. In Calculus education, the literature highlights both opportunities and challenges, particularly the tendency for its application in science and engineering to be reduced to a procedural tool, often lacking conceptual depth. Our recent research investigates how university chemistry students solve physical chemistry tasks requiring various degrees of integration between chemical and mathematical knowledge. The extended mathematical modelling cycle we developed provides a detailed account of the cognitive and knowledge-based resources students engage, including disciplinary (chemical) and situational knowledge. It also sheds light on difficulties students face with epistemic framing at the chemistry-mathematics interface. The second part of the presentation explores ways to create synergy across disciplinary boundaries, focusing on contexts involving single and multivariable calculus in physical chemistry. Drawing from topics such as thermodynamics, statistical mechanics, and kinetics, we identify opportunities to enhance conceptual understanding in both chemistry and calculus. We also raise questions about the pedagogical content knowledge required of instructors to support this interdisciplinary teaching effectively.

Plenary 3

Speaker: **Shulamit Kapon**

📅 Date: 18/06/25

⏰ Time: 09:00-10:30

📍 Room: V2

Faculty of Education in Science and Technology - Technion (Haifa, Israel)

Reasoning in secondary school physics with and through mathematics: Cultivating an intuitive foundation for mathematical formalism

Abstract

Studies that examined students' reasoning in calculus often argue that students do not use, and are not prepared conceptually to use, derivatives and integrals meaningfully. In this talk I will argue for the affordances of physics as "a mathematically native speaking country" to tackle some of these challenges at the secondary school level. I will present findings from studies of authentic sensemaking with and through mathematical representations in physics inquiry in secondary school and in teacher education. I will then discuss examples of instructional design that explicitly aims to cultivate an intuitive foundation for some of the mathematical formalism students learn in calculus. The goal is to illustrate how instructional design and teachers' pedagogical and discursive moves can facilitate students' use of mathematical representations not just as tools for computation, but as phenomenological and mechanistic representations of the physical world.

Plenary 4

Speaker: **Steven Jones**

📅 Date: 19/06/25

⏰ Time: 09:00-10:30

📍 Room: V2

Department of Computational, Mathematical and Physical sciences

(Brigham Young University, US)

First-year calculus as a shared STEM space: Prioritizing STEM-coherent meanings within calculus instruction

Abstract

It is clear there are major disconnects between how students learn calculus in math classes versus how those same ideas are used in other STEM disciplines. Even students who get high grades in calculus can struggle to know how to use those same concepts in their STEM coursework. A significant factor is the differences in meanings for calculus concepts that have evolved within the mathematics community over time versus those that have evolved distinctly in STEM disciplines. To address this issue, it may be productive to conceptualize first-year calculus as a "STEM-shared" content area that is not the sole domain of mathematics (prioritizing mostly mathematical concerns), but where the various STEM stakeholders can help shape it. To this end, I examine meanings for concepts that would cohere widely across STEM disciplines, and would allow students to more flexibly use their calculus understandings and knowledge outside of the confines of the mathematics classroom.