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Teaching and Learning about Complex Phenomena

Our world entails many complex phenomena, from the outbreak of the COVID-19 pandemic via human-induced climate change to stock market fluctuations. To make sense of and solve problems related to these complex systems, students are expected to develop their systems thinking and modeling competence. This requires teachers and students to understand system characteristics and to use models as epistemic tools to explain and predict phenomena.

My research focuses on how pre-service teachers and secondary school students develop their systems thinking and modeling competence. Using a mixed methods approach, I explore teachers' and students' conceptual understanding, metamodeling knowledge, and engagement with the modeling practices. I use digital computational modeling tools, such as [SageModeler](#), to investigate their modeling knowledge, process, and product and to explore the connection between the different modeling competence dimensions.

In this workshop, I will present some of my research findings and the methods used to obtain them. We will discuss how to investigate teachers' and students' knowledge, skills, and practices, and we will practice several research methods that can be used to study teaching and learning in the context of systems thinking and modeling competence.

Relevant publications

- Engelschalt P., Bielik T., Krell M., Upmeier zu Belzen A., & Krüger D. (2024). Investigating pre-service science teachers' metaknowledge about the modelling process and its relation to metaknowledge about models. *International Journal of Science Education*.
- Eidin E., Bielik T., Touitou I., Bowers J., McIntyre C., Damelin D., & Krajcik J. (2024) Thinking in Terms of Change over Time: Opportunities and Challenges. *Journal of Science Education and Technology*. 33(1), 1-28.
- Bielik T., Jagemann J., Krell M., Krüger D., & Ben Zvi Assaraf O. (2023). Using Concept Maps to Evaluate Preservice Biology Teachers' Conceptualization of Covid-19 as a Complex Phenomenon. *Frontiers in Education*. Vol. 8.
- Bielik T., Fonio E., Feinerman, O., Golan R. T., & Levy S. T. (2021). Working Together: Integrating Computational Modeling Approaches to Investigate Complex Systems. *Journal of Science Education and Technology*, 30, pp. 40-57.