ID708 – How working with a professional model affects **students‘ views on the validity of simulation results**

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Motivation

- Simulation results of mathematical **models are used for political decision making** and in public debates.

- **Assessing** the potential **scope and validity** of these models should therefore be part of mathematical literacy.

“The capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgments […] as a constructive, concerned and reflective citizen.”
(OECD/PISA, 2003)

- Idea: **Using a professional model themselves** for policy making could help students with this assessment.

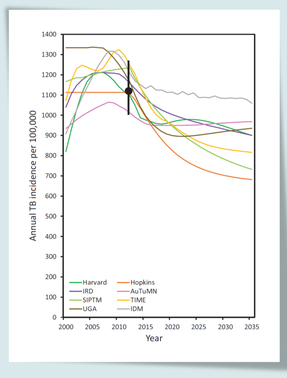


Illustration of model uncertainty by James et al. (2021): Projected tuberculosis incidence rates from 8 independent models

Context

- The Danish KOM project identified **two main components of modeling competency** (Niss & Blum, 2020):
  1. The performative skills to **actively construct** own mathematical models
  2. The ability to **de-construct** given models – to analyse their foundations and evaluate their validity

- A learning environment in which this second competence is particularly important is a so-called

Decision Theatre (DT):

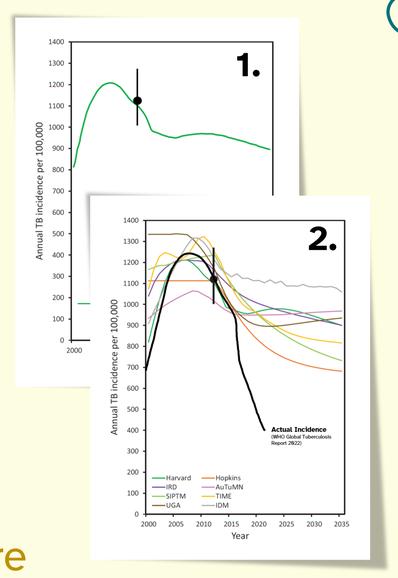
A science communication format in which participants agree (e.g.) on political measures for sustainable mobility in Germany.

Based on their decisions, the agent-based *Mobility Transition Model (MoTMo)* simulates future scenarios that are analysed afterwards – in particular with regard to the plausibility of the simulation results.

cf. Wolf et al. (2023)

Method

- In order to test both the students' pre-theoretical intuition and their theoretical understanding of modeling, a **two-part task** was designed:
  1. *“The figure originally contained the projections of 8 different models of tuberculosis incidence in South Africa. **Draw three curves that could originate from the other models.**”*
  2. *“The actual incidence up to 2021 was significantly lower than predicted by all models. **Give possible reasons for this deviation**.”*

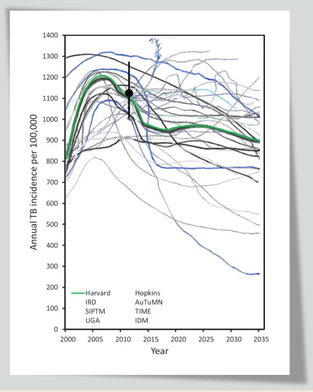


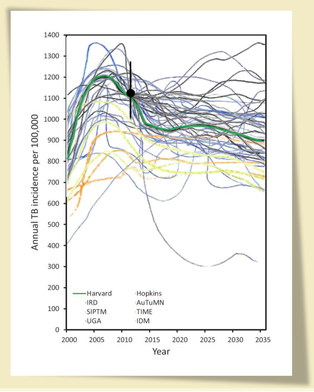
- 23 students completed the two tasks **after**, 33 students **before** participating in a DT.
- The student-curves were plotted in common diagrams.
- The provided reasons were categorised.

Results

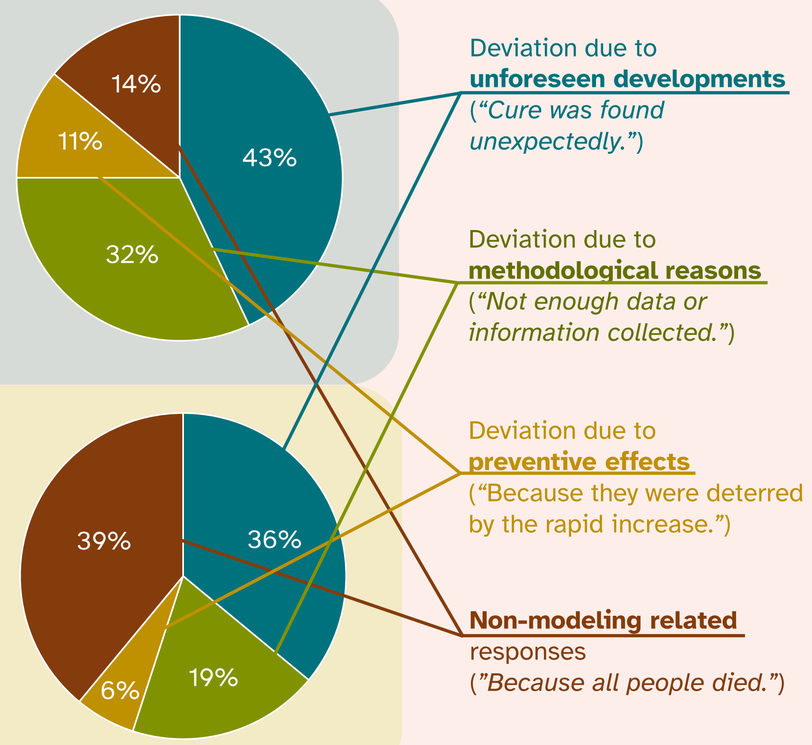
Data

1. Guessed curves:





2. Reasons for deviation



Discussion

Observation:

- The curves of the DT-students show a **greater dispersion** from the reference curve than those of the control group.
- The DT-students attributed the deviation both **more often to methodological issues and to unpredictable developments**.

Interpretation:

- The DT-students seem to assume a **higher model uncertainty**.
- The DT-students show an **increased awareness of the challenges** of building models and interpreting their results.

Illustration: Luisa Lieben

Literature

James, L. P., Salomon, J. A., Buckee, C. O. & Menzies, N. A. (2021). The use and misuse of mathematical modeling for infectious disease policymaking: Lessons for the COVID-19 pandemic. *Medical Decision Making*, *41*(4), 379–385. https://doi.org/10.1177/0272989x21990391

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Wolf, S., Fürst, S., Geiges, A., Laublichler, M., Mielke, J., Steudle, G., Winter, K. & Jaeger, C. (2023). The decision theatre triangle for societal challenges – an example case and research needs. *Journal of Cleaner Production*, 136299. https://doi.org/10.1016/j.jclepro.2023.136299