

Mathematical modeling in physics teaching

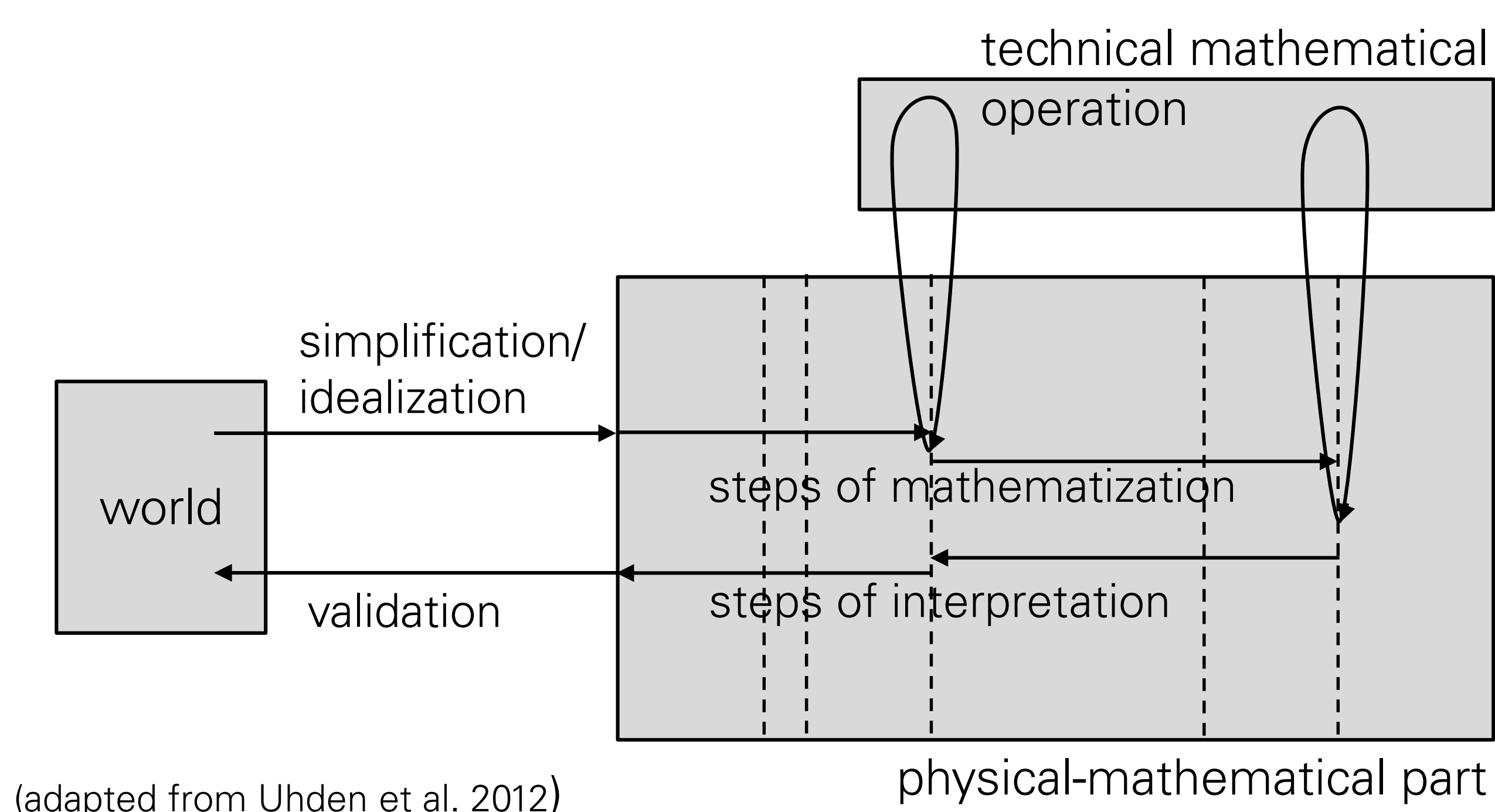
Interplay of mathematics and physics

Physics and mathematics are intimately related as physical phenomena may incite development in mathematics and mathematical methods help in describing physical problems. The common ground is the identification of structures e.g. by finding laws and analogies. Because of this strong relation the use of mathematical models is also important for teaching the nature of physics. Herewith the structural role mathematics plays for physics has to be stressed (Pietrocola, 2006). Mathematical modeling

is a central feature of this process. However, it is in the nature of physics that nearly all physical processes are described by mathematical elements. Therefore a wide definition seems appropriate:

When a physical phenomenon or process is described by numeric, algebraic or geometrical structures we call this a mathematical model.

Model of mathematical modeling in physics



The starting point of our model of mathematical modeling is the modeling cycle of Blum&Leiß (2005) which was adapted in order to analyze in detail the steps during modeling. The main goal was to distinguish structural and technical skills in order to analyze in detail the strategies and difficulties of students in solving specific tasks requiring the connection of mathematical elements and physics concepts.

Utilization

- analyze students' approach to tasks
- investigate students' strategies and difficulties during mathematical modeling
- design new teaching situations regarding mathematical modeling

Physics education

Students

Students' views on the use of mathematics in physics strongly is determined by the appearance of equations and formula.

There are only few detailed studies on their views:

- Krey (2012) found that students have a quite sophisticated view and distinguish different roles of mathematics in physics. Especially they prefer diagrams before formula, which was confirmed for students of grade 8 by Pospiech&Oese (2013).
- Uhden (2012) identified specific problems and strategies of students in grade 9 and 10 in solving specially designed tasks, stimulating non routine strategies.

Current projects

Marie-Annette Geyer: Change of representations of functional dependencies in lower secondary physics education

- How do students solve physical-mathematical problems which include or require changes of representations?
- Which difficulties do students experience during their approach?

Teachers

Concerning physics teachers there are only very few studies on their view on the role mathematics should play in physics lessons and what are their aims in teaching mathematical elements in physics lessons. Lehavi, Pospiech et al. (2015) conducted an explorative study about the view of experienced or master teachers on this subject. They derived a model on the pedagogical content knowledge specific for teaching the interplay of mathematics and physics. Interviews with teachers showed characteristic patterns of teaching, addressing different aspects of the interplay. In addition it arose that teachers often (have to) concentrate on the technical role of mathematics.

Wiebke Janßen: Verbalizations of formulae in lower secondary physics education

- How do teachers verbalize formulae to explain their physical meaning?
- Are there typical patterns of different kinds of verbalizations for the explaining of formulae?