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Reflections on Modeling From an Unlikely Modeler

Commentary to Alan Schoenfeld's Plenary lecture

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Thank you very much for your comprehensive and insightful talk being indeed quite provocative and stimulating.

Let‘s start with your slides on what is done in Polya‘s name.

Indeed, a far too strong simplification of an open approach intending to support **productive thinking** as we call this in the German community.

The proposals are **recipes**, too strongly simplified.

But: They try to develop scaffolds for complex thinking processes, so not the approach in itself is to criticise, but **the way how it is done.**

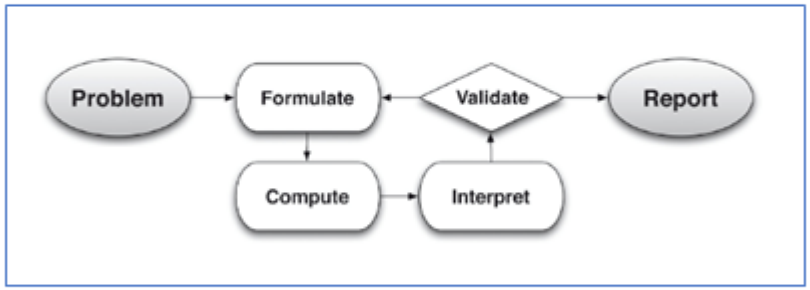
Modelling cycles as heart of mathematical modelling

I strongly appreciate this position from an American researcher

The point is that *this* is the kind of thinking we need to teach students to engage in,

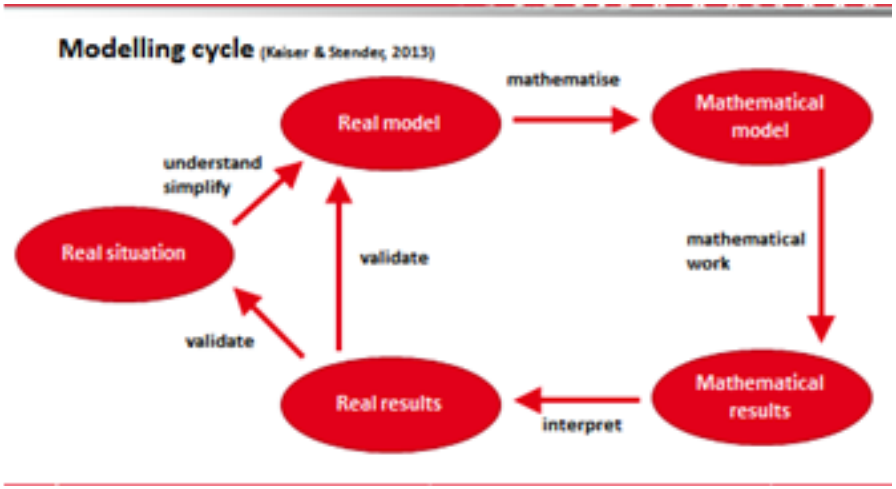
not

This

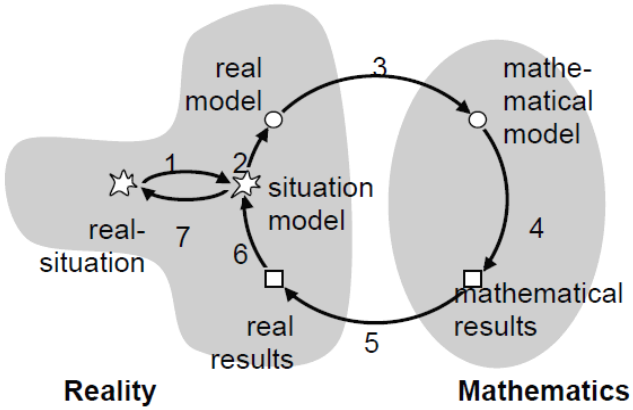


Variety of modelling cycles within the modelling discussion

Kaiser & Stender (2013)



Blum & Leiß (2007)

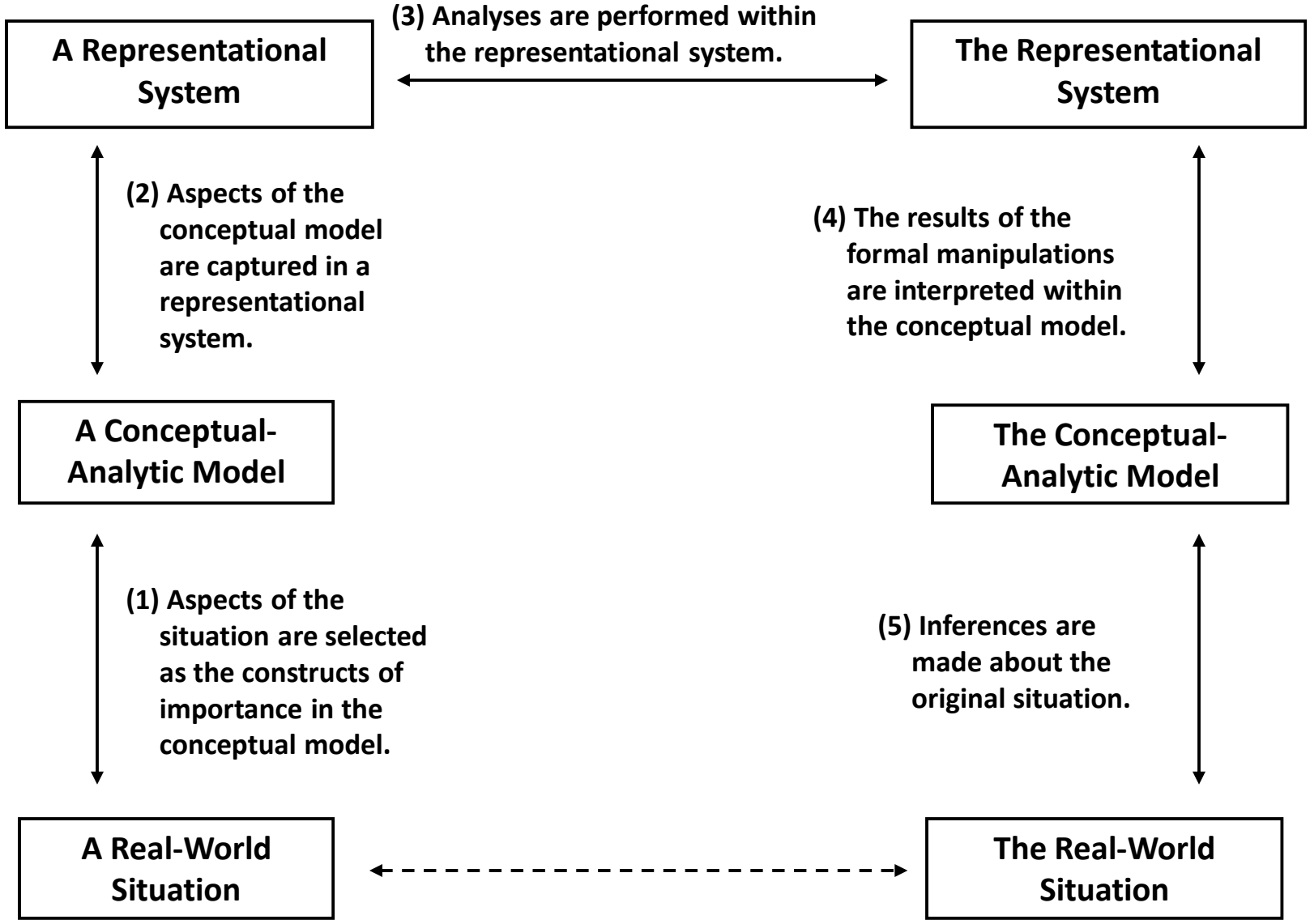


1 understanding the task
2 simplifiying/ structuring
3 mathematizing
4 working mathematically
5 interpretation
6 validation
7 presenting

Or even more advanced the one by Alan Schoenfeld

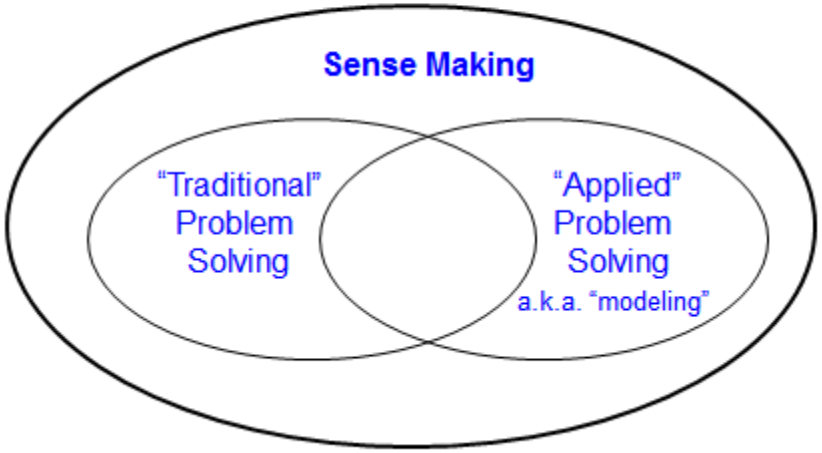
Differentiating **various kinds of models** and **less differentiation of the process**.

Convincing distinctions close to the descriptions developed by Hugh Burkhardt.


A Representational System
(3) Analyses are performed within the representational system.
The Representational System
(2) Aspects of the conceptual model are captured in a representational system.
(4) The results of the formal manipulations are interpreted within the conceptual model.
A Conceptual-Analytic Model
The Conceptual-Analytic Model
(1) Aspects of the situation are selected as the constructs of importance in the conceptual model.
(5) Inferences are made about the original situation.
A Real-World Situation
The Real-World Situation

Distinctions between modelling and problem solving

Whether what you're doing is pure or applied, what matters is thinking things through with the help of the appropriate mathematical tools.



Necessity of own independent modelling work as common departure point of modelling and problem solving

„The basic philosophy behind the approach … of the modelling workshop for higher education is that to become proficient in modelling, you must fully experience it – it is no good just watching somebody else do it, or repeat what somebody else has done – you must experience it yourself. I would liken it to the activity of swimming. You can watch others swim, you can practice exercises, but to swim, you must be in the water doing it yourself.“

(Prologue by David Burghes Proceedings ICTMA 1, 1983, Exeter)

Helmut Neunzert at ICTMA-14, 2009 in Hamburg: Modelling is not a **spectator sport**, **in order to learn modelling, you have to model**.

Same position concerning **problem solving** by **Alan Schoenfeld**.

Consequences still common between mathematical modelling and problem solving

Mathematics to be used in modelling examples should **not be learned recently**. Recommendation in the early ICTMA years by Berry & Huntley and others to refer to mathematics learnt at least 2 years ago.

Teacher independent work on modelling examples **by students necessary.**

No fast intervention by the teacher, only **scaffolding** support in case mathematical means are missing or if the students are in a cul-de-sac regarding the content.

Group work seems to be the most adequate way of dealing with these kinds of problems.

Important distinction: kinds of problems used – request of authenticity or relation to the real world

Usage of authentic examples or real world examples:

- authentic examples (in the sense of Niss, 1998) are recognised by practitioners working in this field as examples they could meet.
- often only problematic situation should be described, students have to determine or develop a question, which can be solved (Pollak, 1969: “here is a situation, think about it”);
- various problem definitions and solutions possible dependent on norms of the modellers;
- solution of the problem needs to convince the students and needs to be anticipated by practitioners.

Role of the context of the problem as important distinction to problem solving

PhD-study by Andreas Busse (ICTMA-10 in Beijing): Qualitatively oriented study on the **influence** of the **context** and **how students understood it**.

Study with 17 year old students based on modelling problems and interviews.

Subjective-bound understanding of the **context**, strong influence of it.

Important example:

A dog's first year is equivalent to 15 human years. The second year of a dog is equivalent to 6 human years. Each of the following years of a dog is equivalent to 5 human years.

After this introductory text some calculation-tasks were given.

Continued …

After solving the task correctly the girl wrote:

I have a dog named Nadja. She was born in 1986 and her age is 13 dogyears, which is approximately 76 human years. Anyway, when I was approximately 2 years old I was sitting on the baby's changing unit. I could not feel my legs from the first day on. But somehow, nobody knows how, I tried to crawl. Nadja heard that and came running into the living room. I fell down. Fortunately Nadja was there and I fell on Nadja's back and then onto the floor. Up to the age of 3 I could not feel my legs! All that is true!!!

Independent from the truth of the story this is an impressive and touching example what can be on a student's mind when confronted to a task.

Further results

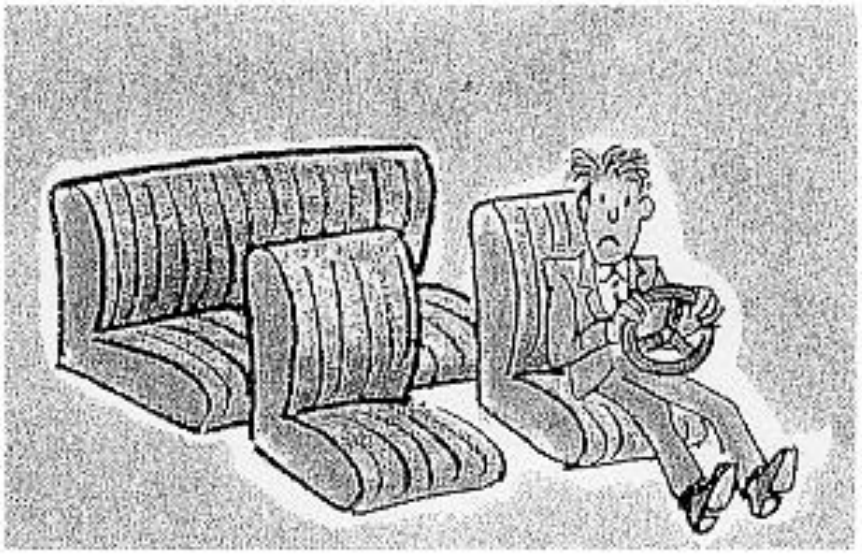
Different students interpreted the **subjective context** offered in the task in very different ways:

- **Individual** differences concerning the **associated aspects** of **reality** and **emotional aspects**.
- Partly **distraction** from the task
- A rich subjective figurative context may be a **disturbing** factor when working on the task.

Finally: The subjective context can cause **motivation**, but **must not**.

Probably **high influence** of the **personal sense or meaningfulness** assigned to the **context** by the individual student.

So, even such an easy diagram can cause meaningful discussions



Did you know that during rush hour only 1.2 people per average are sitting in a car?

Thank you very much Alan for your inspiring talk.