

Challenges with international collaboration regarding teaching of mathematical modeling

TSG 21 – ICME 11

Thomas Lingefjärd
University of Gothenburg, Sweden

DQME II

<http://www.dqime.uni-dortmund.de/>

The network "Developing Quality in Mathematics Education II" consist of universities, teacher education institutions and schools in eleven countries. Consequently there is a strong connection between theory and practice and between the research and development of mathematics education. **Cross-cultural cooperation and exchange of ideas, materials, teachers and pupils will be used as a tool for developing quality in mathematics education, especially in the area of mathematical modeling.** The quality and application of the developed learning materials will also be guaranteed by using, comparing and modifying them in eleven different countries.

DQME II

Work tasks for the research group

- To clarify learning objectives for the development of mathematical modeling competences
- To develop quality criteria for learning materials and teaching methods
- To develop and carry out a pilot study for cross-cultural comparisons of an exemplary mathematical modeling project

Example of quality criteria for learning materials

Learning objectives	Descriptors
Motivation	<ul style="list-style-type: none">▪ Engagement (personal and societal)▪ Teaching purpose▪ Authenticity▪ Linking existing math. knowledge▪ Challenging
Systematization & Mathematization	<ul style="list-style-type: none">▪ Is data needed?▪ Abstraction▪ Assigning variables▪ Making assumptions▪ Simplifying▪ Representation(s)

Doing the mathematics

- Formalizing and analyzing the math problem
- Using data
- Approximation and estimation
- Use of ICT (software, GC)
- Use algorithms
- Mathematical common sense
- Proof (validation of the math used)
- Use of math. representation(s)

Interpretation & Validation

- Validation of the solution mathematically
- Validation of the solution in the 'real world'
- Are the results good enough?
Or is another cycle needed?

Communication skills

- **Group discussions**
 - justifying
 - discuss different strategies
- **Presenting the results and process**
 - oral presentation, written presentation, posters, reporting

Critical questions:

What happens when we force the teacher to open up the usual didactical contract?

What can pass as a good mathematical modeling project in four different countries?

How will mathematics teachers in upper secondary schools in different countries actually teach the same mathematical modeling project?

How will different teachers handle the usual constraints in terms of a dense syllabus, national and local tests with higher priorities, student motivation to take on an extra task beside the common daily burden of mathematics, and so on.

What will the students in the different countries learn and how will it be assessed?

The problem

Humans that suffer from Asthma are often treated with the medicine theophylline. Theophylline, also known as dimethylxanthine, is a methylxanthine drug used in therapy for respiratory diseases such as asthma under a variety of brand names. Patients are often treated with an equally large dose, D mg, over equally large time intervals, T hours. A doctor has measured how the concentration of theophylline in the blood of one patient varies after the patient has been injected with a dose of 60 mg. The results from this measurement are the basic data for the project. See table 1.

The problem

Table 1: Accumulation of theophylline in the blood

Time (hours)	Concentration mg/liter (mg/L)
0	10.0
2	7.0
4	5.0
6	3.5
8	2.5
10	1.9
12	1.3
14	0.9
16	0.6
18	0.5

The problem

The students was asked to construct a mathematical model for the whole situation and to write a report to the doctor that addresses the following questions:

How will the concentration of theophylline in the blood decrease over time?

How can we plan a continuously medication schema with a fixed dose D over a fixed time interval T , so that the concentration after a couple of injections is in the interval 5-15 mg/L?

How can we plan a continuously medication schema with a start dose and thereafter a fixed dose D over fixed time interval T , so that the concentration **directly** will be within the interval 5-15 mg/L?

What considerations must be taken into account before one use this medication plan for a patient?

Classroom practice...

So far we have documentation from two Swedish and one Danish classroom, we are waiting for the Romanian documentation.

How did these three teachers handle the teaching challenges that obviously occur when an extensive project like the Asthma problem enters their classroom?

What was different?

Sweden 1: Only the presentation of the solutions on video. One - two weeks of work on “free time”.
“Excluded” from the ordinary teaching.

Sweden 2: The teacher hands out the problem 9.00 and expects the students to present solutions 11.15. The problem is handled in a half day on its own, but included in the course.

Denmark: The project seems to be integrated (included) in the mathematics course and it look as if the teacher actually “teach” the Asthma project.