U N I V E R S I T Y O F B E R G E N

Modelling MatRich Andresen

’Modelling in and for mathematical teaching and learning’

Presentation of the course MAT647

Content

- Introduction
- Background for the design of the course MAT647
- Mathematical content
- Mathematics education content
- The students' two compulsory projects
- Examination and evaluation MAT 647
- Results and conclusion

Introduction

- This is not a description of best teaching practice, neither in the course nor in school!
- I will discuss potentials for teachers' learning in the course, part of our masters' programme
- The students are secondary school mathematics teachers who take a(n additional) master in mathematics education
- Linking between teachers' visions about eligible teaching on the one hand, and teachers' learning as professionals on the other hand, was taken as the starting point
  - *Teachers' visions about eligible learning* encompass specific pedagogical content knowledge and beliefs, as well as reflections upon professional experiences
  - *Teachers' learning as professionals* is to be understood as cognitive development, hand in hand with development of their professionalism

Hypotheses about the link

- The individual teacher's visions about eligible teaching is a most important factor of influence on his or her learning as a professional.
- The teachers' learning as professionals informs and enriches their visions about eligible teaching
- There must be coherence between goals and means for the teachers' learning as professionals, and their visions about eligible teaching
- The individual teacher's visions about eligible teaching a specific mathematical content strongly depends on his or her own:
  i. mathematical knowledge about the content
  ii. experiences from learning about the same content
  iii. prior experiences with teaching the same content

Background for the design of the course MAT647

These hypotheses formed the basis for my design of the course, which was merged from:

- A 10 ects course, *Differential equations (II)* containing:
  - Existence and uniqueness theorem for non-linear equations
  - Laplace transformations
  - Sturm – Liouville theory
  - Numerical solutions, etc.
- A 5 ects course on *Mathematical problem solving and presentation* which aimed at mastering:
  - To plan and complete a project involving applied mathematics
  - Editing mathematical text using specific software
  - To complete simple calculations numerically
  - Formulate and present a mathematical problem

Design

MAT647 encompass lectures and tasks on:

- Differential equations (II):
  - Linear differential equation systems of 1st and 2nd order, non-linear systems, analytical, qualitative and numerical solutions and Lapace transformations
- Project work, problem solving and mathematical modelling from a teaching and learning perspective

And, besides, students' work in pairs on two projects:

1. To formulate, complete and present a project which encompass work on a simple differential equation model
2. Based on experiences from 1., and on relevant mathemtics education theory, to create and present materials and time schdule for a teaching sequence which encourage and support the pupils to do an inquiry in mathematics as a group work

Course literature. Excerpts of:

- Blanchard, P., Devaney, R.L. and Hall, G. R. (2002 or later). *Differential equations*. Brooks/Cole, USA ISBN 0-534-38514-1
- Gravemeijer, K. et al. (eds.) (2002). *Symbolizing, modeling and tool use in mathematics education*. Kluwer Academic Publishers. Netherlands. ISBN 1-4020-1032-X
- Schoenfeld, A. H. (ed.) (1994). *Mathematical thinking and problem solving*. Routledge. New York. ISBN 0-8058-0989-9
- Sriraman, B. et al. (eds.) (2010). *The First Sourcebook on Nordic Research in Mathematics Education*. Inf. Age Publ. USA. ISBN 978-1-61735-098-6

Mathematical content

- A ‘light version’ of the earlier course, presented in accordance with the view of Blanchard, Devaney, and Hall’s textbook which highlight qualitative, quantitative and numerical methods and the interplay between them
- The mathematical content was taught partly in a traditional lecture – and – task style, but partly also as students’ work in pairs with their own modelling projects
- The students were not quite familiar with the course Differential equations (I) so we spent time on refreshing the prerequisites during the course
- The content of Differential equations (I) would have covered almost all students’ projects 2014 and 2015

Mathematics education content

- From Gravemeijer et al.: Emergent modelling. Modelling is not only a branch of mathematics. Mathematics is a human activity, concept formation may not be clearly discerned from modelling. Horizontal and vertical mathematising. Mathematics learning as guided reinvention
- From Schoenfeld: Problem solving methods based on Polya, what is needed to succeed. Modelling and problemsolving intertwined
- From Sriraman: Mathematics modelling for learning mathematics and or for learning about modelling. Modelling, problem solving and mathematics learning in project work
- Others: Mathematical modelling seen from different theoretical viewpoints (RME and emergent modelling, applied mathematics, mathematical modelling competence etc.)

The students' two compulsory projects

- Part 1.: The one goal of this project was for the students to learn about differential equations by doing a modelling project. They were given an open task, meaning that they had to decide on their own what problem and what differential equation model they wanted to work with in the project. The second goal was for the students to get experiences with learning mathematics from doing a modelling project. So, part one aimed at teachers' learning as professionals

- Part 2.: The one goal of this project was for the students to use, refine and reflect on their experiences from Part 1. The second goal was for the students to create concrete teaching materials for use in their own classes, as a means for them to clarify their visions about eligible teaching

Experiences from running and evaluating MAT 647

- Each of the two compulsory project works counted for 25% of the course's resulting grade
- The oral examination consisted of two parts: one part was a mathematical content question in a traditional style, the other part was one question out of the three:
  - Presentation and reflections upon the mathematical project (Part 1)
  - Presentation and reflections upon the teaching sequence project (Part 2)
  - Desrcribe and reflect upon the correlations between and your experiences with the two projects

Results and conclusion

- The students' results in the form of reports and final grades were surprisingly good, taken into account that the course was heavily loaded with content, and it had a complex structure
- At the oral examination the students revealed mature and rich reflections about their own learning as professionals and about their visions about eligible teaching
- In general, the students were less familiar with the content of Differential equations (I) than expected. Therefore, it might have been appripriate to spend more time on the mathematics content of the course
- On the other hand, all students found it very fruitfull to have the opportunity to choose the mathematical modelling in the first project (Part 1) within that course, to become familiar with the basic concepts, the qualitative methods etc.

UNIVERSITY OF BERGEN

Modelling MatRich Andresen