

Contextual learning of mathematics for engineers

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Keywords: teaching and learning of mathematics for engineers, novel approaches to teaching, contextual learning, mathematics and applications.

INTRODUCTION

I present some preliminary results from a project where mathematics is specially adapted to one particular engineering programme with the aim of making mathematics an active thinking tool when working with engineering problems, and improving the students' perceived relevance of mathematics for their study programme. The project is based on a contextual learning approach.

Several models for teaching mathematics to engineering students can be found, from mathematics as a general foundation subject to mathematics as an integrated part of the students' engineering specialisation. The first model may lead to students having difficulties to apply mathematics when needed in engineering courses (Carvalho & Oliveira, 2018), whereas the second model provides better opportunities for showing the relevance of mathematics for the engineering specialisation, but this model is expensive to implement.

MATHEMATICS AS A THINKING TOOL

At the Norwegian University of Science and Technology mathematics has traditionally been provided almost identically to all five-year Master of Technology (MT) programmes, without links to specific engineering fields. *Mathematics as a Thinking Tool* is a pilot project aiming at strengthening the connection between mathematics and the engineering fields, thereby hoping to increase the students' perceived relevance of mathematics, as well as making mathematics an active thinking tool in their work with engineering problems. There is evidence to show that many engineering programmes do not exploit the potential of mathematics in the early phases (e.g., González-Martín & Hernandes Gomes, 2017), and the project aims to change this situation by making mathematics and engineering courses mutually support each other. A basis for the project can be found in the Conceive, Design, Implement, Operate (CDIO) Initiative, which emphasises both *conceptual understanding* and *contextual learning* (Crawley et al., 2014). Examples of activities in the project are presented in Bolstad et al. (2022). I will present some answers to the question whether the students' perceived relevance of and motivation for mathematics differ for students within the project compared to those not in the project.

So far, the project has included two cohorts of the MT programme *Electronics Systems Design and Innovation* (Elsys) but from 2022 it will be expanded to two other programmes. A survey was distributed in the spring of 2022 to the first-year, second

semester, Elsys students ($n = 45$) and in identical form to all the other first-year MT students ($n = 494$). The number of responses corresponds to a response rate of between 30 and 40%. Below are some of the questions asked in the survey, with answers (%) in brackets. Boldface numbers are for students from Elsys:

How would you characterise your motivation for mathematics now compared to when you started your studies? (larger 22/**31**, about the same 44/**44**, smaller 34/**25**)

I have seen why mathematics will be important for me later in my studies (completely agree 34/**82**, partly agree 38/**18**, partly disagree 21/**0**, completely disagree 7/**0**)

In my work with other courses (i.e., not mathematics courses) I have seen the importance of learning mathematics (completely agree 37/**85**, partly agree 44/**13**, partly disagree 14/**0**, completely disagree 5/**0**)

I don't think the mathematics I have learned is very relevant for my study programme. (completely agree 5/**2**, partly agree 25/**2**, partly disagree 44/**18**, completely disagree 26/**78**)

So far, in my work with other courses (i.e., not mathematics courses), I have managed with the mathematics I learned at school (completely agree 28/**7**, partly agree 32/**11**, partly disagree 24/**49**, completely disagree 16/**33**)

The numbers indicate that the perceived relevance of mathematics is larger for students within the project than for the others. However, the motivation for learning mathematics seems to develop in a similar way in the two groups. The survey will be repeated in 2023 for all first-year students. Then it will be possible to compare the answers from the two new programmes with the results from 2022, when these programmes were not part of the project.

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