

ENHANCING BASIC SKILLS IN MODERN INTRODUCTORY ENGINEERING MATHEMATICS WITH HIGH IT INTEGRATION

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The introductory mathematics course at the Technical University of Denmark is a modern course with a very high degree of ICT integration. Recently, it has been redesigned in a way that could seem methodically retrospective, but serves several purposes. The course now opens with a four-week paper and pencil course in complex numbers, a topic which is necessary for the students' possibilities to construct a clear insight into the theoretical frame of the whole semester course. But as a hidden agenda the work with complex numbers intends to strengthen basic high school mathematical skills in a positive way that looks forward. We show that the intentions are fulfilled to some extent.

INTRODUCTION

The introductory two-semester course in mathematics (Math1) at the Technical University of Denmark (DTU) is with 20 ECTS points and a yearly enrolment of 900 students one of the largest university courses in Denmark. To maintain the course in the frontline of the pedagogical-didactical development within teaching and learning mathematics at university level, it has been re-formed several times regarding the integration of ICT (Markvorsen and Schmidt, 2012). Most relevant for this paper is that the advanced CAS-software program Maple has been a fully integrated part of the course for more than 10 years. As a response to the well-known worry of *the black box effect*, the Math1 course managers introduced rules for a more cautious CAS use in 2007-2010 (Schmidt, Rattleff and Hussmann, 2010). Recently, the CAS debate has been replicated at DTU, but now also as a high school-to-university-transition problem. It has been claimed that the widespread use of CAS in Danish high schools has caused a lack of basic mathematical skills, and that consequently many students are unable to follow the reasoning behind introductory technical textbooks (internal DTU paper, 2011). To counter this new challenge the Math1 course managers have redesigned the first semester of the two-semester course.

CURRICULUM REDESIGN AND INQUIRY DESIGN

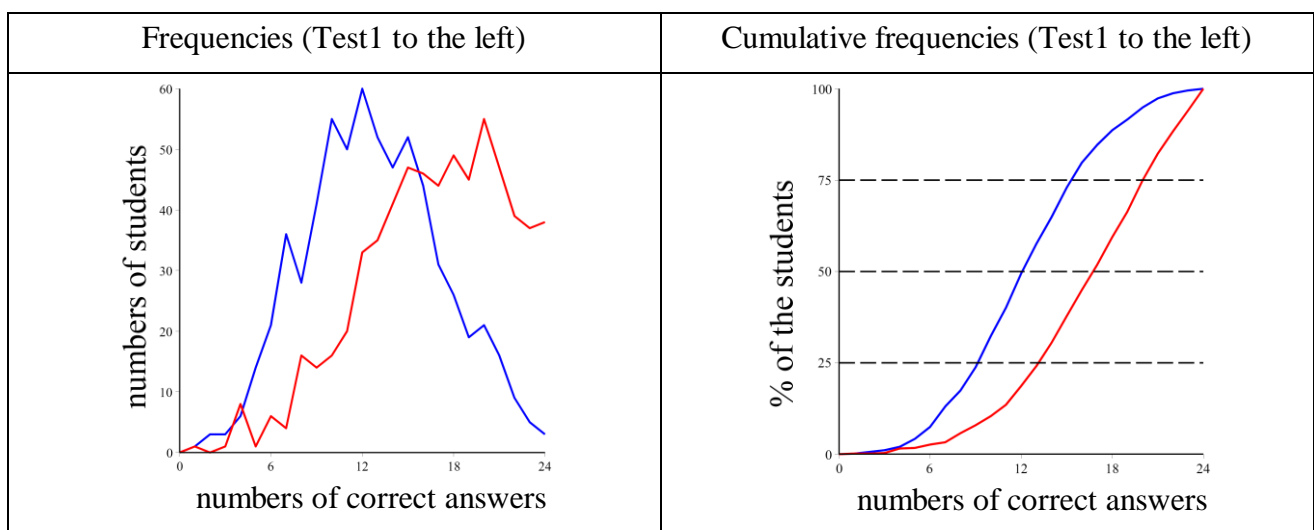
In 2012 the first semester of Math1 was redesigned, so that it opened with a four-week paper and pencil sub-course in complex numbers and simple complex functions. The sub-course includes what is needed for the introduction of linear algebra and for the presentation of linear (systems of) differential equations in a frame of linear transformations between spaces of functions. But to be able to cope with complex numbers and functions the students need to deepen their understanding of (or learn for

the first time!) a big range of pre-university topics from parenthesis, fractions and equations to elementary real functions and differentiation rules.

The **inquiry data** consists of the following components: 1) At the very first day of the math course the students were assigned a 30 minute test in real numbers and elementary real functions (Test1). 2) After the end of the four-week sub-course the students received the same 30 minute test with small parameter-changes (Test2). 3) One week after Test2 the students were asked to answer an electronic questionnaire (EQ) about their experiences of the four-week complex number course.

SOME RESULTS AND CONCLUSIONS

In Test1 the students had in average 12.7 correct answers out of 24 (simple) questions. This indicates a lack of basic skills. As a majority of the students were unsatisfied with their performance and at the same time a vast majority found it highly relevant for “a new-coming engineering student” to be able to answer the questions (EQ), we conclude that the new course design is a motivating factor. The figure below shows that there in general was a significant progress from Test1 to Test2. We underline that the students’ individual progress was very different.



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