Abstract

The work done in relation to this thesis can be split up into three parts. In the first part, mathematical skills of first year students in the School of Engineering and Natural Sciences, University of Iceland, are investigated. A status exam was administrated to the students in the beginning of their first semester from 2011 to 2014. The results show that a large proportion of students lack basic skills in mathematics. Analysis of variance was used to investigate which background variables are linked to performance on the test. Secondary school, gender, year of diagnostic test, time since last mathematics course in secondary school, number of semesters of mathematics courses in secondary school and the students' perception on how well they did in mathematics in secondary schools and how well they are prepared were all linked to performance on the test. The result on the diagnostic test was also found to be a good predictor of performance in first year calculus courses, specially for students in mathematics, physics and engineering.

In the second part, development of an open learning environment, the tutor-web, is described. The system has been under development in the University of Iceland for the past decade. Educational material within mathematics and statistics is available within the system at no cost for the users, including over 4000 exercises. Novel algorithms for allocating exercises to students as well as grading with the goal of increase learning have been developed.

In the third part, the performance of students working in the open learning environment is compared to the performance of students handing in pen-and-paper homework. A repeated randomized crossover trial was conducted where students were given unexpected tests in class after working in the tutor-web or handing in traditional homework. A significant difference in learning between web-based homework (WBH) and pen-and-paper homework (PPH) was detected, supporting the use of WBH as a learning tool.