New engineering students' learning styles and basic skills in mathematics

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Introduction

- This study is related to a project which aims to increase the number of students passing compulsory engineering mathematics courses.
- Problems are, for example, first year students' varying skills in mathematics and passivity in their studies.
- We would like them to adopt more effective learning strategies.
- Hence is necessary to understand students' learning processes better.
Research questions

What are the fundamentals affecting learning outcomes in mathematics for new students who come to our university?

• What kind of learning styles do new students have?
• What differences, if any, there are between engineering students and, e.g., communication science students?
• What starting skills new students have in mathematics?
• What were the most difficult topics in the high school mathematics for new students?
Basic skill's test

• The test problems were originally created in Tampere University of Technology (TUT).
• In Aalto University the test was implemented by using Automatic assessment system STACK (Sangwin 2003).
• It included 16 randomized questions covering the high school topics considered to be the most crucial.
Distribution of the results

ALL students N=833 mean=9.84 std=3.72

Black=2010
White=2009
Distribution of the points of each exercise in 2010

ALL students N=833 mean=9.84 std=3.72
In autumns 2009 and 2010 we sent a learning styles questionnaire to all students who participated the basic skill test. The number of responses was 222 (26%) in 2009 and 432 (52%) in 2010. The questionnaire was based on R. Felder's Index of Learning Styles Questionnaire (Felder 2001). It included 44 questions about four different learning style dimensions.
Dimensions of the learning styles

- Active/reflective
- Sensing/intuitive
- Visual/verbal
- Sequential/global
- Processing
- Perception
- Input
- Understanding
Results of the learning styles questionnaire in 2009

- We divided the results of each dimension into five categories 1-5. An example from active/reflective scale:
  1: strongly reflective
  2: moderately reflective
  3: balanced
  4: moderately active
  5: strongly active
- We compared the results to the results of the communication science students in University of Tampere (UTA) (Vainionpää, 2006).

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Learning styles questionnaire
Active/reflective scale

- Roughly normally distributed
- Mean 3.13, std=0.79
- UTA: mean 3.25, std=0.74
Learning styles questionnaire

Sensing/intuitive scale

- Negatively skewed
- Mean 3.96, std=0.85
- UTA: mean 3.00, std=0.90

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Learning styles questionnaire

Visual/verbal scale

- Negatively skewed
- Mean 3.79, std=0.95
- UTA: mean 3.51, std=1.00

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Learning styles questionnaire
Sequential/global scale

- Roughly normally distributed
- Mean 3.10, std=0.76
- UTA: mean 2.54, std=0.83
Conclusions

• According to the results of the basic skill's test of mathematics students have many gaps in mathematics.
• Difficult topics are for example symbolic fractions, logarithms and trigonometric expressions
  • More time should be dedicated to these difficult topics in high school and university mathematics.
• No strong correlation was found between the results of the basic skill test and learning styles questionnaire.
Conclusions

• According to earlier studies engineering students tend to be more active, sensing, visual and sequential learners (for example Booth, 2008).
• Our results show that engineering students in Aalto University sensing and visual learners. However in other scales results are normally distributed.
• Mathematics teaching in Aalto University is predominantly verbal or visual presentation of verbal information. Teachers should thus use more visual elements in their teaching.
Thank you!

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