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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.

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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?

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Basic skill's test

- All new students (N=704 in 2008, N=843 in 2009 and N=833 in 2010) made the basic skill test in the autumns 2008, 2009 and 2010.
- 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.

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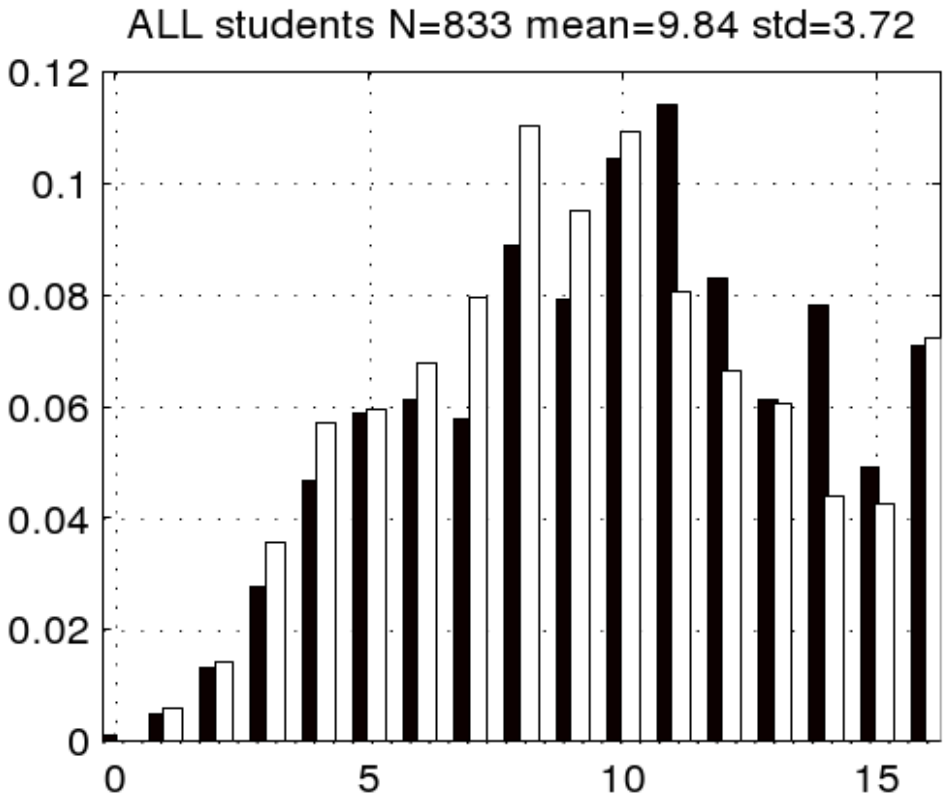
Distribution of the results



Black=2010
White=2009

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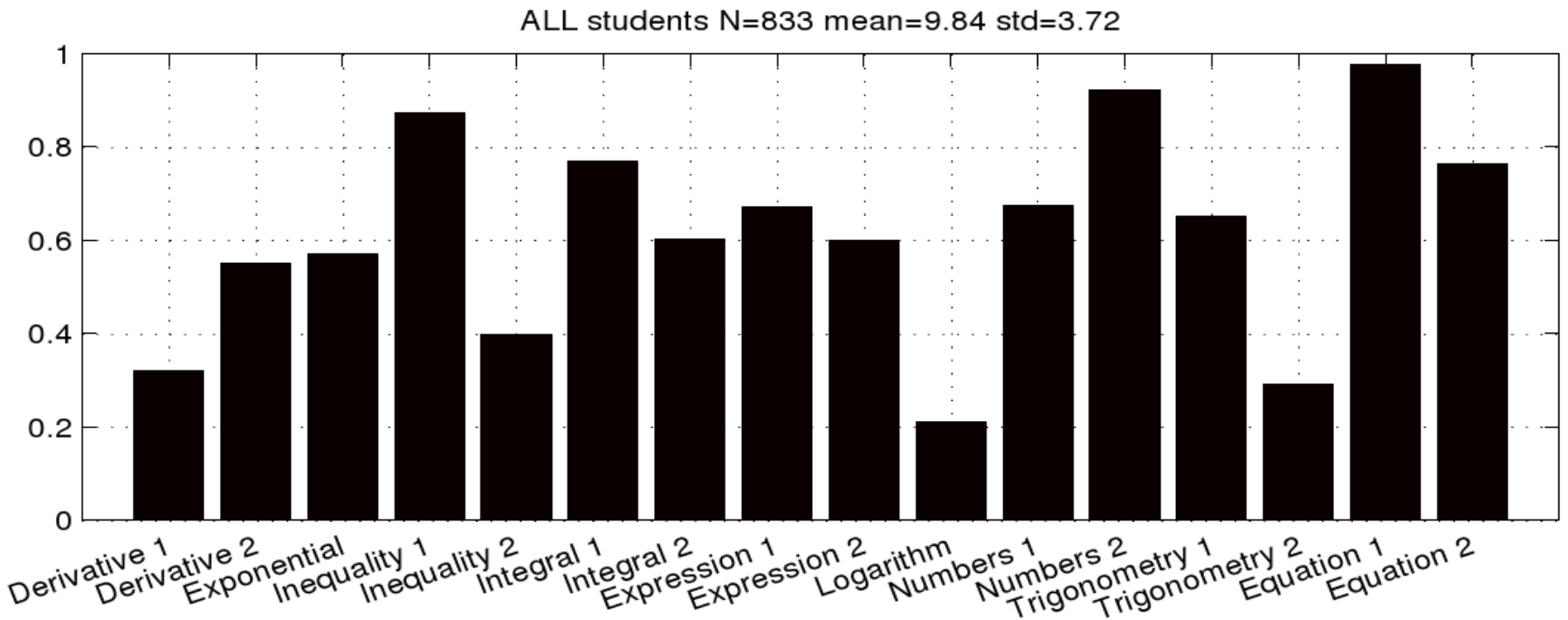
Distribution of the points of each exercise in 2010



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Learning styles questionnaire

- 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.

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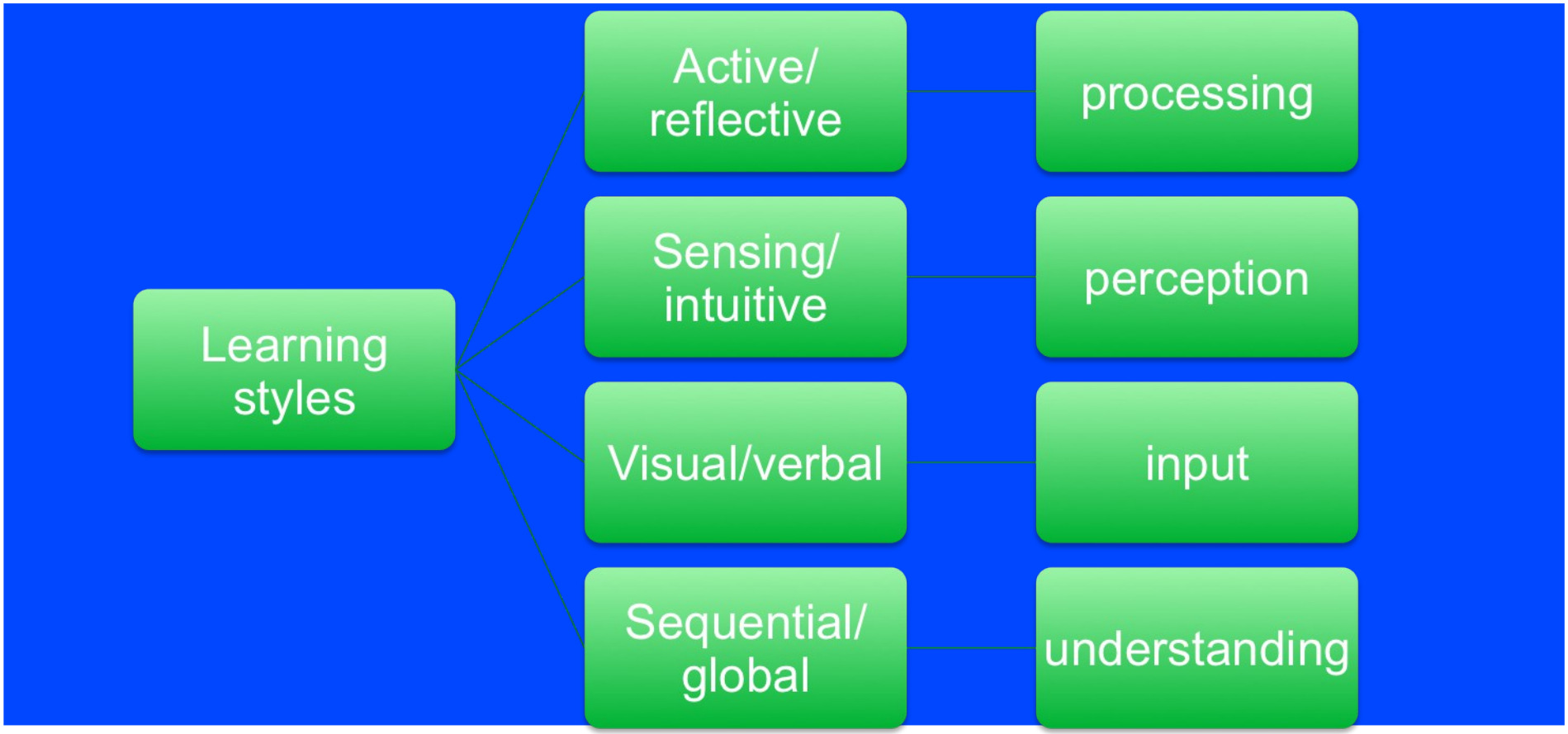
Dimensions of the learning styles



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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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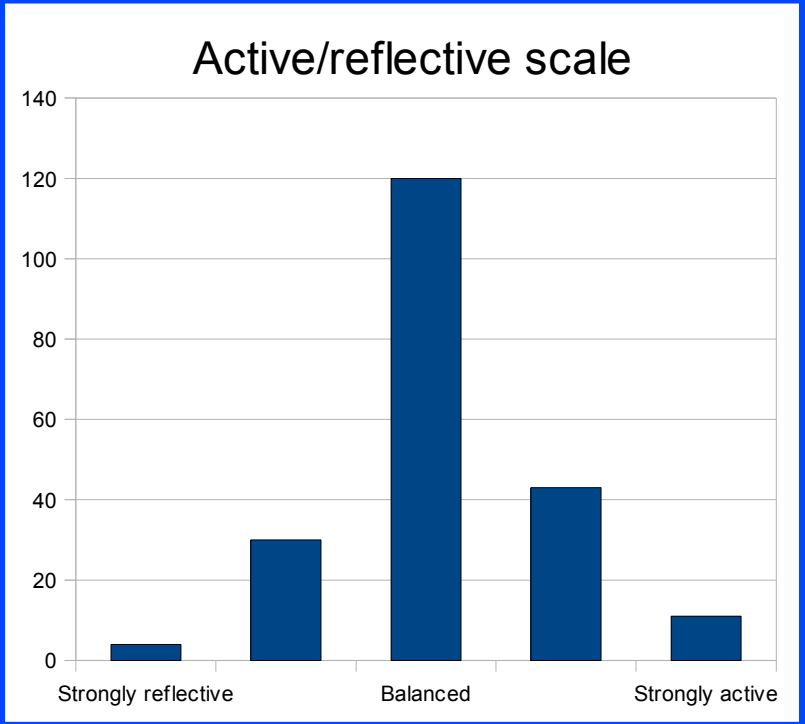
Learning styles questionnaire
Active/reflective scale



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

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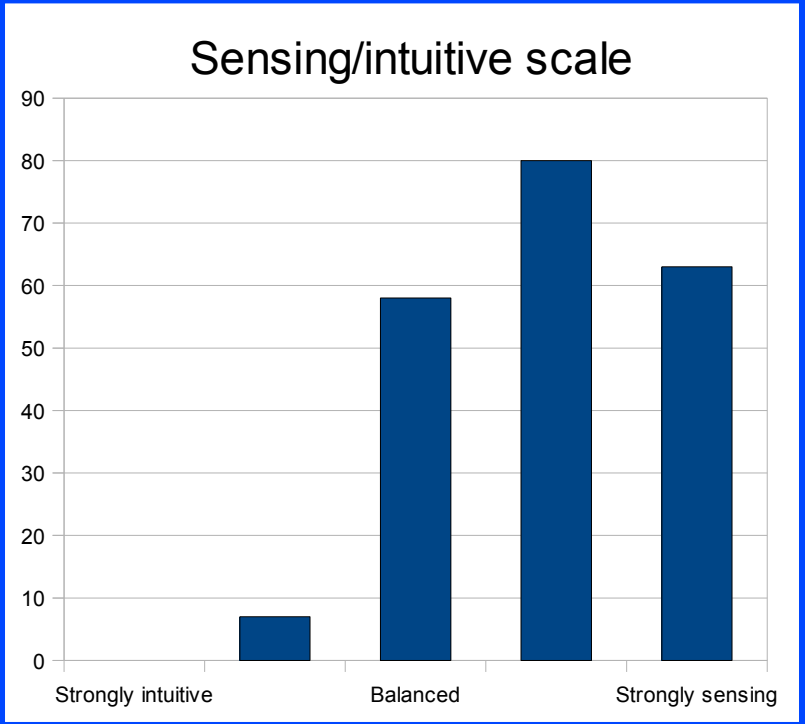
Learning styles questionnaire Sensing/intuitive scale



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

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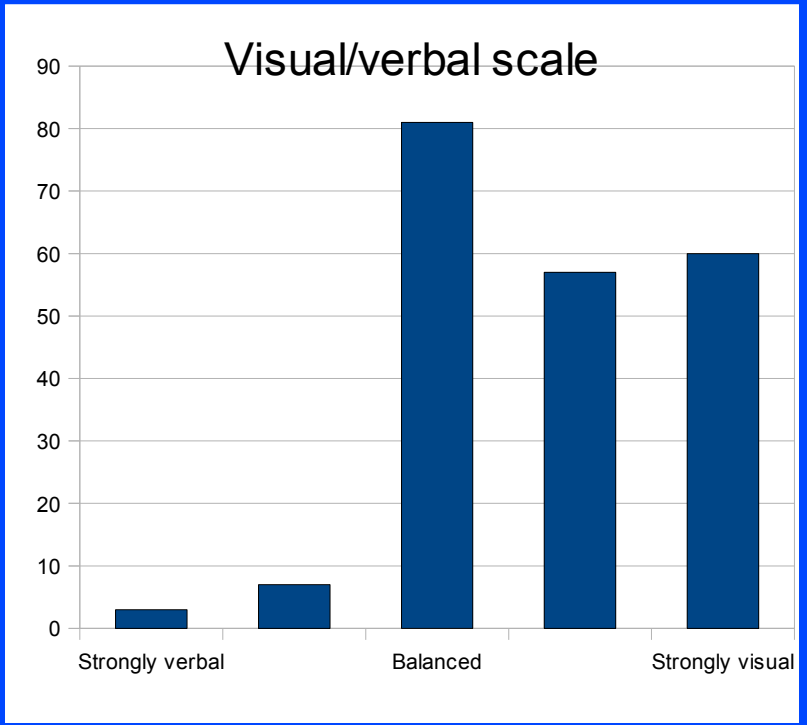
Learning styles questionnaire
Visual/verbal scale



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

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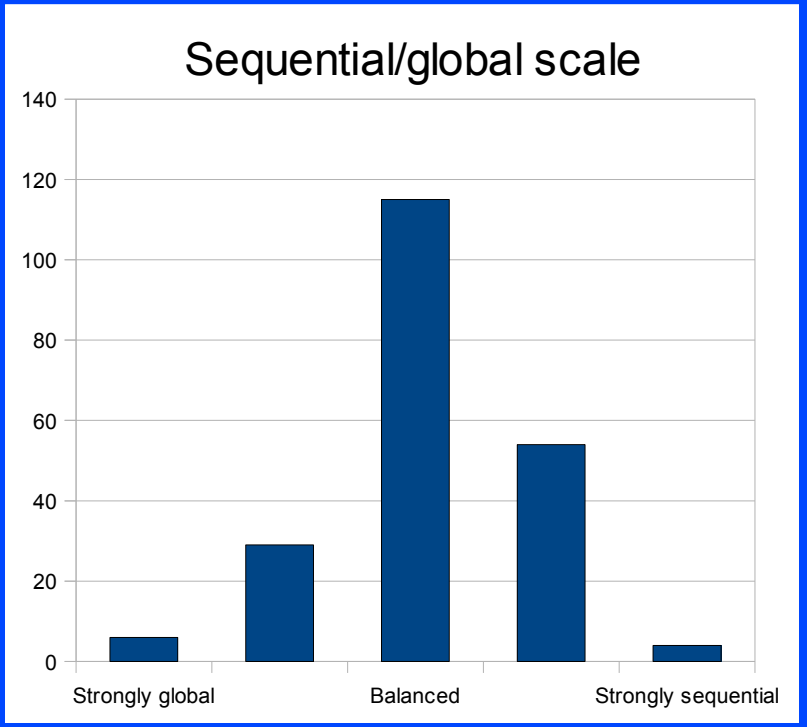
Learning styles questionnaire Sequential/global scale



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

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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.

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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.

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Thank you!

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