# Hands-on in computer programming education: educational effects and brain processes (HOPE)

## Project founded by Swedish Research Council (Vetenskapsrådet)
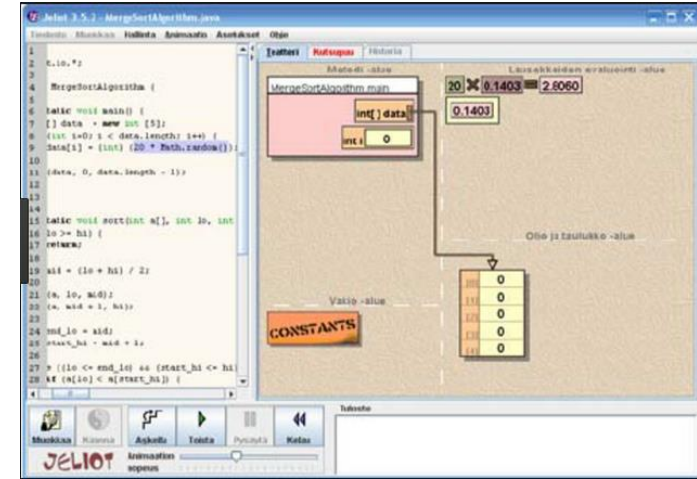
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# Active learning of programming

# Active learning of programming

"Active learning increases student performance in science, engineering, and mathematics" [1]

"both theory and practice can and should be present simultaneously. Theory and practice are not mutually exclusive; they are intimately connected. They live together and support each other." [2]

"When it comes to retention [of programming knowledge], hands-on and interactive tend to produce better results." [3]

**HOPE: basic research to understand How and Why hands-on is beneficial for learning programming, both skills and concepts.**

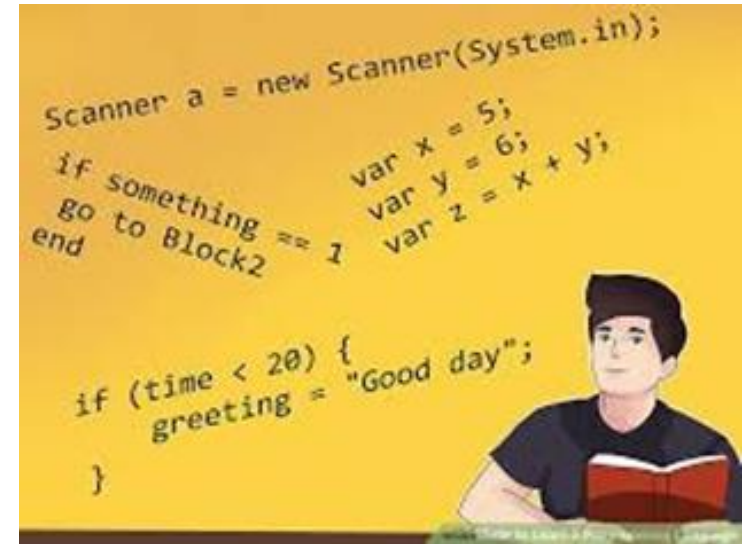# Active learning: how and why does hands-on benefit learning?



Long-term memory?

Motivation?

Motor movements?

Stress?

Interaction in the lab?

Perception of own ability?

Engagement?

Different brain activities?

# Two overarching research questions

- RQ1: How does hands-on influence students' learning of computer programming with regard to some aspects of relevance for learning outcome?

- RQ2: How do students experience hands-on learning and its impact on their practical knowledge and conceptual understanding?
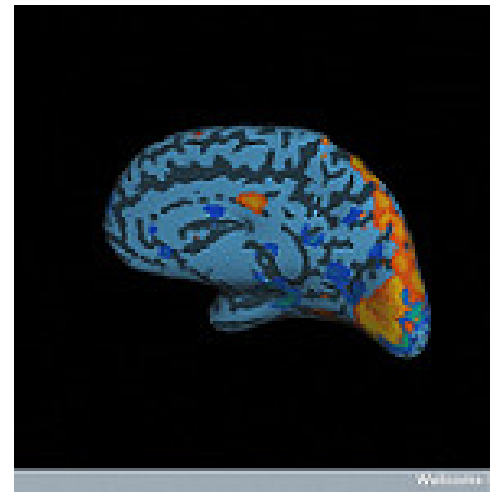
# The research design

### Context A



Experiment, upper secondary level. Mostly quantitative methods

### Context B



fMRI camera image analysis. Upper secondary level.

### Context C



Observation in the CS classroom, qualitative methods. University level.

# Context A

4 hours Java course:

- Pretest (no prior programming knowledge requirement)
- Teaching and exercises. Students work in pairs.
- Knowledge test
- Questionnaires

A week later: longterm memory knowledge test

# HOPE: So far Context A

- Developed teaching material and valid knowledge test
- Pilot study with 60 students: teaching session and knowledge test
- Preliminary results:
  - Verifies that hands-on is beneficial for learning programming
  - No differences between gender
  - It seems as hands-on and hands-off leads to slightly different learning outcomes

# Thank you!

If you are interested please come and talk to us!
Or email us:
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[1] Freeman et al., 2014
[2] Knuth, 1991
[3] https://blog.ndepend.com/learning-programming-hands-on/