Translating Problems into Code: What Findings in Decision-Making Suggest About Teaching Computational Problem Solving At the First-Year Level

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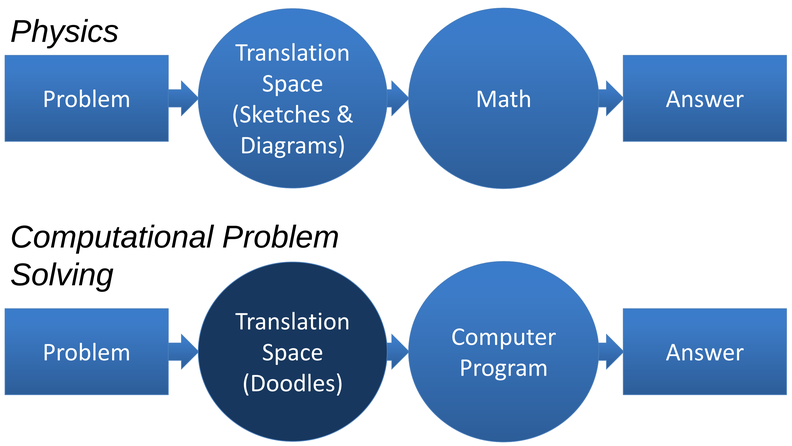
Abstract

This investigation looks at deliberately evoking skills more typically associated with emotions to help first-year engineering students do computational problem solving.

Background

- Decision-making sciences indicate the use of amygdala (emotion), not just prefrontal cortex (logic) (Lehrer, 2009)
- Computational problem solving may be analogous to problem solving in physics
  - In physics, a *translation space* helps to determine the direction math should take (Root-Bernstein, 1991)



- Use of drawing (doodling) has been indicated with use of amygdala (Ablon, *et al*., 1993)

Method

- Incorporate structured doodling into lectures / labs (Winter 2009 ENGR 101, Introduction to Computers and Programming, Section 100) (test)
- Comparison with Fall 2007, ENGR 101, Section 100, which had a similar curriculum (control)

Results: Examples

- Successful doodles do abstract various subtasks that are implicit in an algorithm
- Successful doodles do examine an algorithm from more than one aspect (e.g., sketch, list, table, test case, jot)
- Example: Accumulator

*This **sketch** visualized what the algorithm should be doing*

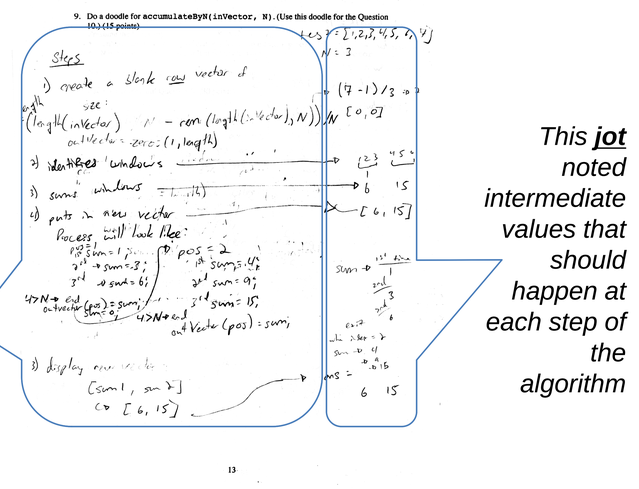
*This **jot** helped to noted the kind of input to be used*

Doodles can accom-modate various learning styles. Not every aspect in doodling needs to be used

*This **table** summarized intermediate values that should happen during looping*

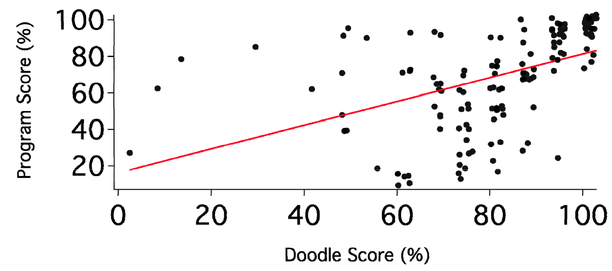
*This **list** abstracted the basic steps of the algorithm*

*This **jot** noted intermediate values that should happen at each step of the algorithm*

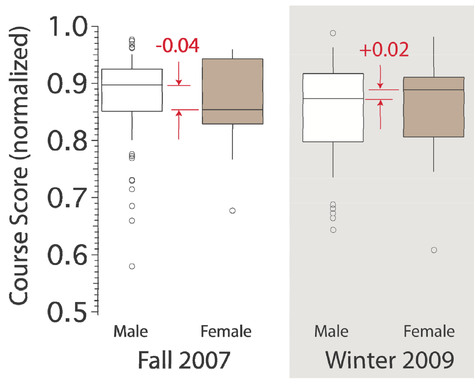


Results

- Proficiency of doodles is positively correlated with a proficiency in programming
  - Q9 (doodle) & Q10 (associated program) on second midterm, W09 (N_{2009} = 131 students)



- Doodling seems to benefit women
  - Median grade gap between men and women narrows considerably (N_{2007} = 146 students)



Gap in F07 about a half grade

No appreciable gap in W09

Absolute score comparison between terms not treated because of other changes to curriculum

Conclusions

- Introduction of structured doodling into curriculum indicated an overall beneficial effect on learning
- Women seem to have benefited significantly
- More study needed to adjust for possible confounds

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