ESoE
Eindhoven School of Education

Towards Teaching the Concept of Compound Variable Quantities in Primary Education

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Background

- We live in a highly technological society / There is almost no science & technology education in primary education
- Computer technology is ubiquitous in our society / Computer technology enables new ways of learning

Subject: Compound Variable Quantities

- Change is everywhere; to understand our world is to understand change
- Dynamic system: quantities change over time; they are variable quantities
- Two *covarying* quantities form a new **compound variable quantity**: change of one quantity depends on change of another quantity
- Overall research problem:

How can we teach the concept of compound variable quantities in 5th grade?

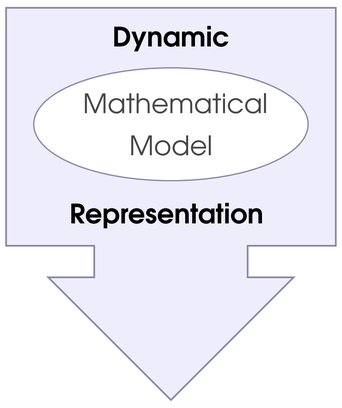
Design Research

What Do 5th Graders Already Understand of a Compound Variable Quantity?

Covariation Framework

(Carlson, Jacobs, Coe, Larsen, & Hsu, 2002): a framework to analyse **students'** reasoning on covarying variables consisting of five developmental levels.

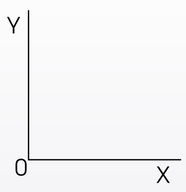
Adapted for Primary Education



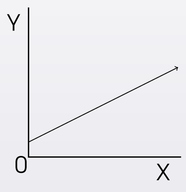
Every next level has an extra corresponding step in student's thinking

Student's thinking appear as various behavior

1. **Coordination level**

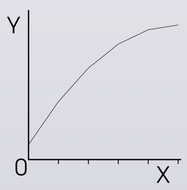


2. **Direction level**

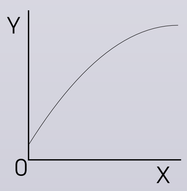


3. **Quantitative coordination level**

4. **Average speed level**

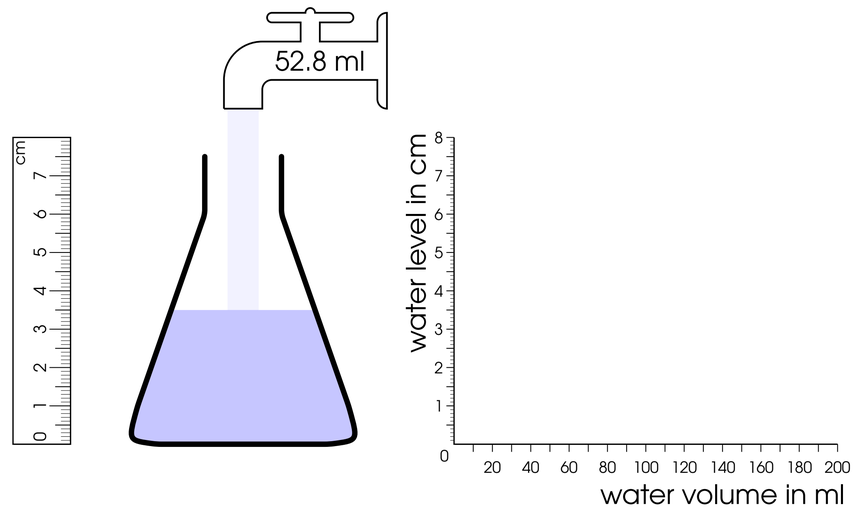


5. **Instantaneous speed level**



1-on-1 Teaching Experiment
Filling a Bottle / Make a Measuring Cup

Figure 1: Dynamic representation of the situation "filling an Erlenmeyer" (snapshot). Pupils are asked to draw a graph describing this situation to reveal their level of *covariational thinking*. Can *you* draw the graph?



Research questions

- How can we use the covariation framework to evaluate 5th graders' reasoning about compound variable quantities?
- At what developmental level in de covariation framework do 5th graders reason?

Set up of the experiment

- Respondents: 10 – 15 fifth graders
- One-on-one teaching experiment between the researcher and one pupil
- Solving three increasingly more difficult problems. In each the respondents are asked:
  - to create a measuring cup from a flask and to draw a graph using a static representation
  - and to improve their measuring cup and graph using a dynamic representation (see Figure 1),
  - all the while explaining, talking, gesturing, drawing.
- Analyses of video recordings using the *covariation framework*

References

Carlson, M., Jacobs, S., Coe, E., Larsen, S., & Hsu, E. (2002). Applying covariational reasoning while modeling dynamic events: a framework and a study. *Journal for Research in Mathematics Education*, *33*(5), 352–378.