Learning from variation in teaching. An example from a Learning study in pre-algebra

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What can teachers possibly learn from a Learning study that can enhance student learning?

What is a Learning study?

- Focus on the object of learning: What is critical for learning?
- Theoretically based. Variation theory as a guiding principle for planning and evaluation
- Student understanding the point of departure
- Systematic planning, evaluation and feedback

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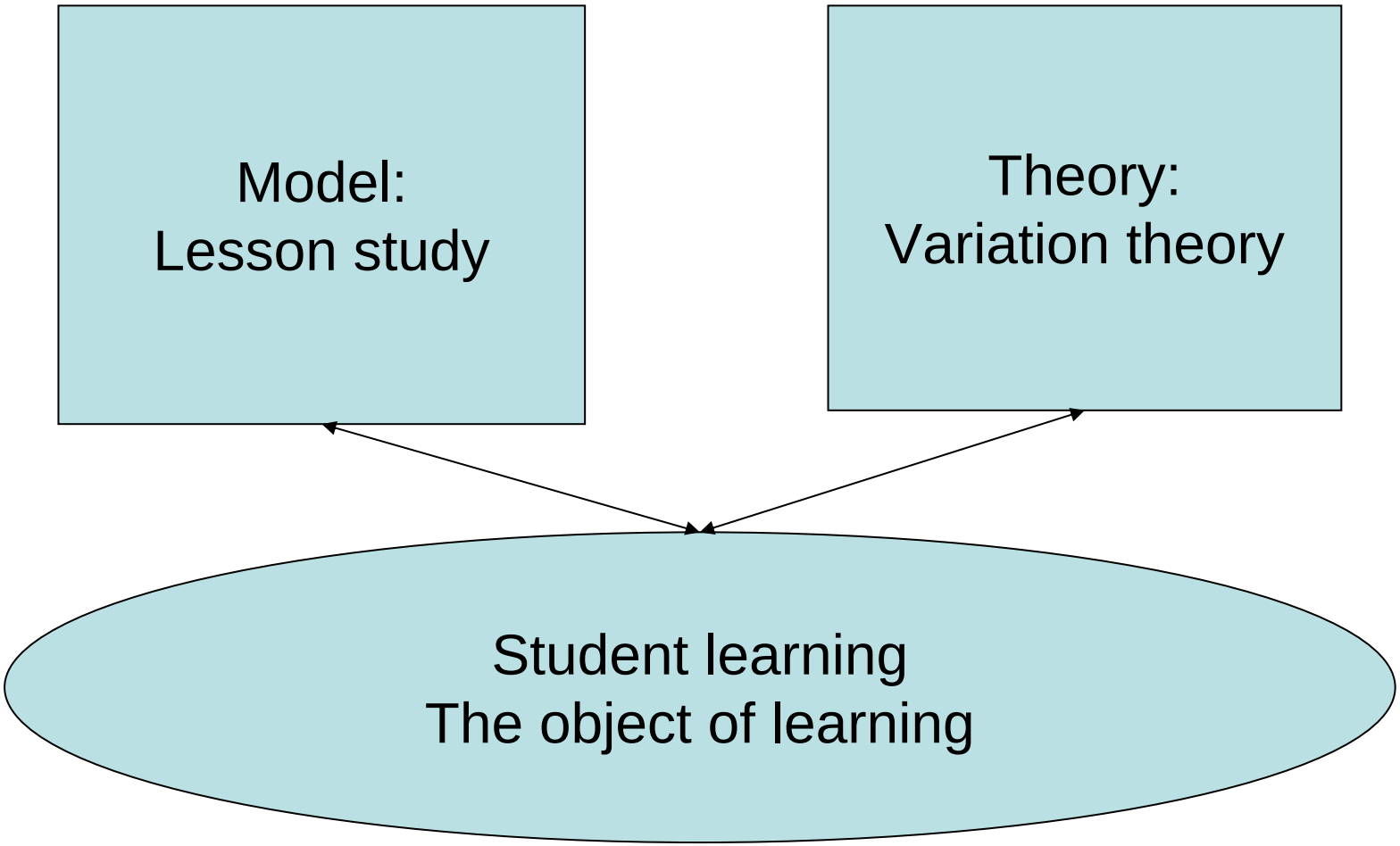

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What can teachers possibly learn from a Learning study that can enhance student learning?

- An example:

Teaching pre-algebra in grade 5 and 6 (students 11-12 years old) (Kullberg & Runesson, 2006)

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The Learning study group

- Three teachers (two females, one male)
- Experience from two LS before
- Informed about variation theory

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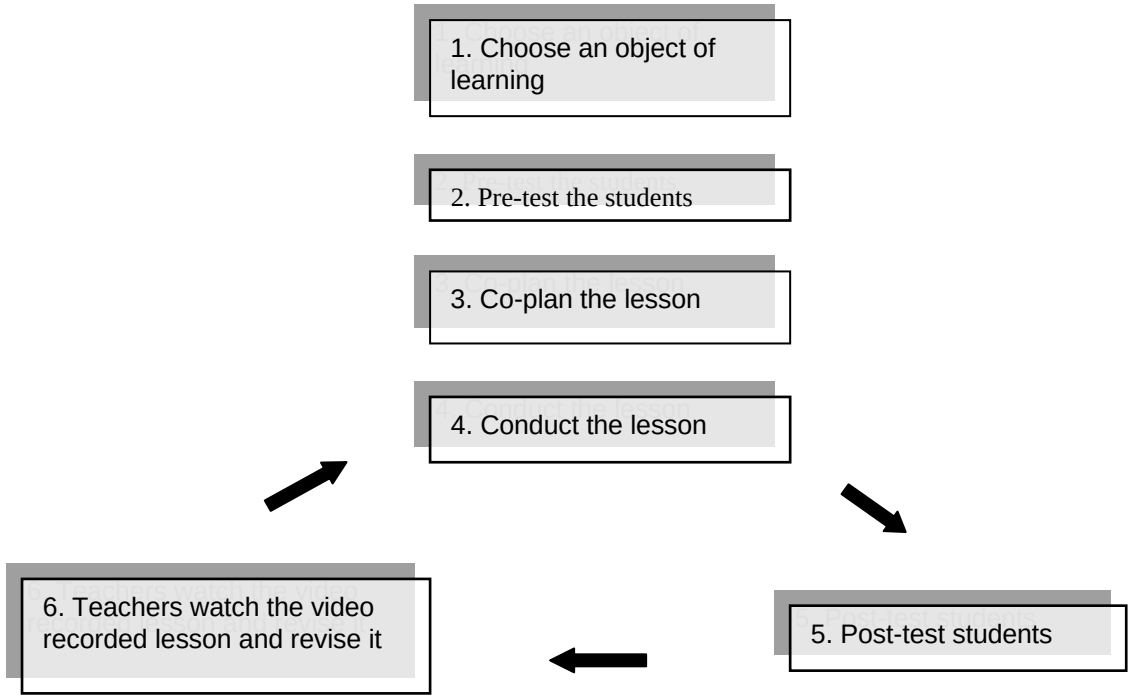

Figure 1. The learning study cycle.

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1. Chose an object of learning

- To be able to write an algebraic expression to a given example
- E.g. “A banana costs 5 kronor more than an orange”

2. Pre-test the students

- Example:

A + 2 = B. A and B are different numbers
Which is the biggest number?

Three bananas and a Mars cost as much as 5 bananas. Which one/-s of the following represents this?

3B+S=5B B+S=5B 5B=3B+S 3B=5B-S

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- The first lesson in the cycle is planned from the results of the pre-test
- The post-test is designed

Lesson 1 Activities

- Students writing expressions to examples
- Teacher asks “Is it correct?”

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Lesson 1

Example: “A chocolate bar costs 5 kronor more than a toffee.”

T + 5 = C
C – T = 5
C – 5 = T
C = T + 5
T = C – 5
C – 5 = T
5 + T = C

- Permutations of T+5=C,
- Variation of the symbols
- Variation of the operation
- Letters constant. The initials for (the price of) a chocolate bar (C) and toffee (T) (range of change)

In all the examples taken in the lesson, no other letters but the above initials were used (c.f. pre-tests)

The teachers watch the video recorded lesson and revise it

- T1: Here [in this situation] I could have given an example that was incorrect. Yes, I could have come up with that, one that was wrong.
- Tutor: Yes, writing an incorrect one!
- T1 Yes, I could. They should have had [an incorrect] one. That's why they failed on that [test-] item [in the post-test]. That's why they haven't got any further.
- T2: Yes, when going through the first example you could have chosen…
- T1 …I could had given the example 'I+7=9. Is that correct'?

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Discovering

How students' learning outcomes on the post–test can be related to the lesson

The question in the lesson was rhetorical: all expressions were correct.

An incorrect expression opens up for alternative learning possibilities: to see how the example could *not* be represented

Lesson 2

I (Henry) am 10 years older than my cousin John

Permutaions of J+10=H

Presenting incorrect example: H+10=J

The students suggest other letters e.g. X and Y, A and B

This was not approved by the teacher

The teachers watch the video recorded lesson and revise it

- Tutor: Nice comments from your students! It doesn't necessarily have to be H and J.
- T2: That I should have been taken up!
- ---
- T1: Did you write X and Y there?
- T2: No, I didn't. I wanted to get to the abbreviations H and J. Therefore I didn't want to confuse them with X and Y. I didn't want to use that.

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Discovering

- Other symbols than the initial letters (shorthand for the variable) must be used
- Using correct/incorrect more systematically. New assignment: Matching correct and incorrect expressions to **the same** example.

Lesson 3

Initially two examples were taken (“My friend Anna is 5 years older than me, Joan” and “A chocolate bar costs five crowns more than a toffee”). Besides varying the positions of the variables (and thus the operation), for instance, T+5=C, they also varied the symbols used. So the letters T and C (shorthand for toffee and chocolate) as variables in the expression were written on the board *simultaneously* with expressions with X and Y *and* other symbols (e.g. w and x).

Lektion 3

“Martha has five more marbles than Colin has”. Match expressions to the example. Some of them corresponded to the example, others did not.

T: Is M=C-8 correct?

W: It could correspond, if C were Martha and M were Colin.

Possible conclusions 1

The teachers realized what they had taken for granted:

The symbols chosen

The necessity of contrasting correct and incorrect representations

They identified the critical aspects

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Possible conclusion 2

- The opening of variation in the lesson (mainly by the students) made them to discern that which was taken for granted.
- E.g. students suggesting alternative symbols and the symbol representing the variable is arbitrary, thus it must med be defined

Possible conclusions 3

- The space of dimensions of variation expanded from L1 to
- The opening of dimensions of variation seems to have afforded the students to open up for dimensions of variation
- The test results became better later in the cycle. An indication of teachers' learning?

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Runesson (in progress)

Table 2. Results of the post-test. Number and percentage of students in each class who changed the positions of the symbols and symbols, respectively, when writing two different algebraic expressions for the example, “An apple and a cucumber cost 15 kronor”.

	The same letters, varying position	Varying letters, the same position	No or incorrect answer
Lesson/class 1 n = 23	87% (20)	0% (0)	13%(3)
Lesson/class 2 n = 26	73% (19)	19% (5)	8% (2)
Lesson/class 3 **n = 27**	59% (16)	30% (8)	11% (3)

Thanks for your attention!

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