It is time to reveal what students with MLD know, rather than what they do not know

Marja van den Heuvel-Panhuizen
Knowing what students know is *the* starting point of good instruction.

Looking for what students know

- implies a change in assessment: Assessing (MLD) students’ mathematical potential

- implies a change in teaching: Building on what (MLD) students already know
Knowing what students know is the starting point of good instruction.

Looking for what students know

• implies a change in assessment: Assessing (MLD) students’ mathematical potential

• implies a change in teaching: Building on what (MLD) students already know
Examples

**IMPULSE project**
1. Offering students problems in which they can show their competence
   1a. Within curriculum: Subtraction problems
   1b. Beyond curriculum: Combinatorial problems

**FaSMEd project**
2. Offering students optional auxiliary tools:
   Percentage problems

**“Going across the grain” study** by Watson (2002)
3. Advanced mathematical thinking by low attaining students
Example 1a
Offering students problems by which they can show their competence
Subtraction problems that elicit strategies
Study with Special Education students

56 students from 14 classes in SE school
8-12 years old, mathematics level Grade 2
15 problems

Example 1a

Students who are weak in mathematics should be taught just one procedure: Subtraction should be solved by Direct Subtraction and not by Indirect Addition

Is there evidence for this?
Example 1a

Taking Away Context

Direct Subtraction DS strategy

62 euro

29 euro discount

answer: 33
space for 51 cards

49 are already included

answer:

Indirect addition
IA strategy

Adding On
Context
Example 1a

IA use and problem format

Adding On Context

Taking Away Context

Bare number
Example 2a

IA use and numbers involved

- 56-52
- 31-29
- 51-39
- 47-15
- 56-28
Conclusions

- SE students can make spontaneous use of IA
  - DS  63%
  - IA  34%
  - Average IA use per student 4.6 (min 0, max 8)

- SE students are rather flexible in applying IA

- SE students are quite successful when applying IA
  - DS  51% correct
  - IA  68% correct
Example 1b
Offering students problems in which they can show their competence:
Combinatorial problems
Research question:
Can special education students solve combinatorial problems?

Participants:
84 students (age $M = 11.1$) from 5 SE schools
76 students (age $M = 9.4$) from 5 RE schools
mathematics levels Grade 2-5

Instrument:
6 combinatorial problems in ICT environment
Example 1b

Correctly solved problems

<table>
<thead>
<tr>
<th></th>
<th>SE students</th>
<th>RE students</th>
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<tr>
<td>56%</td>
<td>57%</td>
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Strategy use:
- systematic
- semi-systematic
- non-systematic
Frequency (%) of strategy use

Example 1b

SE Students

RE Students

- Non-systematic
- Semi-systematic
- Systematic

M2 M3 M4 M5 M2 M3 M4 M5
Example 2
Offering students optional auxiliary tools:
Percentage problems
Example 2

Digital Assessment Environment

- Web-based
- Monitoring function
- Problems based on key competencies
- Auxiliary tools

Six problems on percentage

Grade 6 teacher about his student Ducan:
“He belongs to the low-level stream in my class and now he did three of the six problems correctly!”
Problem 1

When a battery is full, it will work 120 hours. It is still charged for 40%. For how many hours will this battery still work? Answer: \( \ldots \) hours
Problem 1

When a battery is full, it will work 120 hours. It is still charged for 40%. For how many hours will this battery still work?

Answer: ... hours
Problem 1

When a battery is full, it will work 120 hours. It is still charged for 40%. For how many hours will this battery still work? Answer: ... hours
Problem 1

When a battery is full, it will work 120 hours. 
It is still charged for 40%. 
For how many hours will this battery still work? 
Answer: \[ \boxed{...} \] hours
Example 2

Problem 1

When a battery is full, it will work 120 hours. It is still charged for 40%. For how many hours will this battery still work? Answer: ... hours

The answer is filled in
Problem 1

When a battery is full, it will work 120 hours. It is still charged for 40%. For how many hours will this battery still work?

Answer: 48 hours
Problem 2

A cell phone costs 70 euro. You get a discount of 20%. What do you have to pay?
Answer: 66 euro

Wrong answer, but what do the auxiliary tools tell the teacher?
Problem 2

A cell phone costs 70 euro. You get a discount of 20%. What do you have to pay?
Answer: 66 euro
Problem 5
In 24 minutes the battery is charged for 75%.
What is the total charging time?
Answer: 30 minutes

Wrong answer, but what do the auxiliary tools tell the teacher?
Problem 5

In 24 minutes the battery is charged for 75%. What is the total charging time?

Answer: 30 minutes

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<th>scrap paper with grid</th>
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<td>12</td>
<td>6</td>
<td>...</td>
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Example 3
Advanced mathematical thinking by low attaining students
Instances of mathematical thinking among low attaining students in an ordinary secondary classroom

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Abstract

This paper is a report of a classroom research project whose aim was to find out whether low attaining 14-year-old students of mathematics would be able to think mathematically at a level higher than recall and reproduction during their ordinary classroom mathematics activities. Analysis of classroom interactive episodes revealed many instances of mathematical thinking of a kind which was not normally exploited, required or expected in their classes. Five episodes are described, comparing the students’ thinking to that usually described as “advanced.” In particular some episodes suggest the power of a type of prompt which can be generalized as “going across the grain.” © 2002 Elsevier Science Inc. All rights reserved.
“Going across the grain” study by Watson (2002)

“‘Low attaining students’ are generally classified […] on the basis of accumulated incompetence in tests and other written work.”

\[\textit{Deficiency-based approach}\]

\[\textit{Proficiency-based approach}\]
All could do this after some thought

These low attainers showed that they can
- identify and use patterns
- work with abstractions and relations
Research on MLD needs a proficiency-based approach

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