

## New diagnostic tests of mathematics in Norway

### Aims and test design

Bjørnar Alseth & Are Turmo

University of Oslo  
Department of Teacher Education and School Development

## National assessment system

<b>Diagnostic tests</b> -Literacy and numeracy -Year 2 (8 year olds)	Identify need for individual follow-up and arrangements on an individual and school level
<b>Learning supportive tests</b> -Mathematics, english (more to come) -Year 8 and 10	Examine each students knowledge within the main areas in each subject
<b>National tests</b> -Reading, numeracy, english -Year 5 and 8	Assess students' skills to inform students, teachers and parents; school, regional and state authorities
<b>Terminal exam</b> -Year 10: English, norwegian, math -Year 11, 12, 13: All subjects	Inform society (higher ed., work life) about each student's competence
<b>International studies</b> - TIMSS, PISA	Assess norwegian students' competence in relation to other countries.

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## Stated aim

"The aim with the diagnostic tests is to identify need for individual follow-up and arrangements on an individual and school level.

The tests define a critical limit for the students' skills, and students with results below this limit do need a special follow-up."

[www.udir.no](http://www.udir.no)

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## Background

- Norwegian students scored below average in math in TIMSS, and worse in 2003 than in 1995. The main reason for this is supposed to be a lack of focus on important learning targets.
- International research shows
  - Great variety in students knowledge in mathematics when entering school
  - The gap between those with highest and lowest test results is stable and partly increasing as students grow older.

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## From the national curriculum

*The aims for the education are that the pupil shall be able to*

- count to 100, divide and compose amounts up to 10, put together and divide groups of ten
- use the number line for calculations and demonstrate the magnitude of numbers
- make estimates of amounts, count, compare numbers and express number magnitudes in varied ways
- develop and use various arithmetic strategies for addition and subtraction of double digit numbers
- double and halve
- recognise, talk about and further develop structures in simple number patterns

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## Background theory

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## Framework

- Counting and number relations
- Grouping and de-grouping
- Problem structures in addition and subtraction

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## Counting and number relations

Competences specified	Potential test items
Count to 20, up and down	Can you count starting with 8? Which number proceeds 17?
Count to 100, up and down	Can you count starting with 45? Which number proceeds 30?
Count with 2, 5 or 10 at a time	Continue the sequences: <ul style="list-style-type: none"> <li>• 2-4-6- ...</li> <li>• 11-16-21- ...</li> <li>• 100-90-80- ...</li> </ul>
Range numbers	Write the numbers in an increasing sequence <ul style="list-style-type: none"> <li>• 25 – 61 – 37 – 19 – 42</li> </ul>
Order numbers on the number line	Draw a line from each number to the right place on the number line

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## Item development

The difficulty of an item is influenced by three factors:

- The competence involved
  - To compare two-digit numbers is easier than to count with five at a time
- The number range
  - 1-9, 1-20, 1-100
- The item format
  - Multiple choice vs. extended answer
  - The use of illustrations (drawings, icons, symbols ...)
  - Response format (draw, mark, write number symbols ...)

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## Carrying out the test

- A guide with instructions for how to prepare and carrying out the test
  - Students work individually, no communication with others
  - Use pencil, no other help material
  - Work with one page at a time, for a certain time limit (1-2 min)
  - The teacher reads instructions to the students for each page
  - The teacher must not give additional information
- A guide with teacher instructions

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## How many?

	3 10 13 31
	30 34 40 43
	5 6 7 8
	17 23 27 32

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## Draw a circle around half

14	46
4 7 8 12	5 20 23 26

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## Write the missing number

$$5 = 10 - \underline{\quad}$$

$$9 - \underline{\quad} = 3$$

$$4 = \underline{\quad} - 8$$

$$\underline{\quad} - 10 = 13$$

$$13 = \underline{\quad} + 6$$

$$\underline{\quad} + 10 = 26$$

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## Piloting of the test

- Two stage pilot design
1. Items piloted at few selected schools: Revisions of items based on feedback.
  2. Main pilot study (N=922).

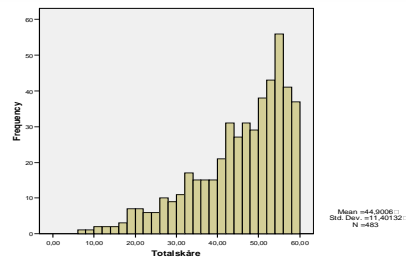
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## Main pilot study

- Double aim: 1) Procedures and 2) Psychometric properties of items.
- 25 randomly selected schools, stratified by county.
- Two booklets; one booklet per school.
- N=483 (booklet 1), and N=439 (booklet 2).

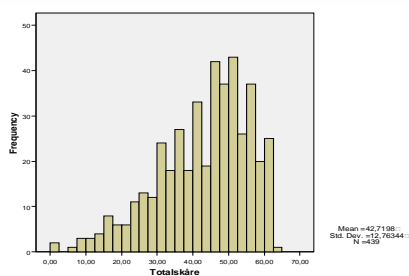
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## Booklet 1: Score distribution



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## Booklet 2: Score distribution



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## Gender differences?

- Booklet 1: No gender difference in mean score; standard deviation larger for boys (SD=11.6 and SD=11.2).
- Booklet 2: Boys slightly higher score than girls (effect size=0.12); standard deviation larger for boys (SD=12.8 and SD=11.9).

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## Dependent on socio-economic background?

- Students asked to indicate the number of books in their home (based on illustrations).
- Reasonable distribution, but reliable?
- Correlations with score: 0.06 (booklet 1) and 0.05 (booklet 2), correlations not significant.

## Psychometric properties

	Cronbach's alpha	Number of items
Test 1	0.94	60
Test 2	0.95	64

## How to define the "critical level"?

- How many students?
- Based on analysis of item content?
- Based on a statistical definition?
- Not only students who need extraordinary help (f. ex. 1-2 %).
- Not too many students (not manageable for the teacher in the classroom).
- Tradition from other diagnostic tests i Norway: 20 %.

## The 20 percent criteria

	Total number of score points	20 % lowest scoring students	Less than half of the score point
Booklet 1	60	35 points or below	12.4 %
Booklet 2	64	31 points or below	21.2 %

## "Less than half of the score points"

- Teacher conducts a diagnostic interview with the individual student.
- Important to validate the quantitative diagnosis.
- Final diagnosis made based on both the quantitative and qualitative information.
- Follow-up material will be developed.

## Contact

[bjornar.alth@ils.uio.no](mailto:bjornar.alth@ils.uio.no)  
[are.turmo@ils.uio.no](mailto:are.turmo@ils.uio.no)