DIGITIZATION AND HOPEFULLY DIGITALIZATION OF THE SWEDISH NATIONAL TESTS IN MATHEMATICS

A status update and thoughts for the future

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OUTLINE

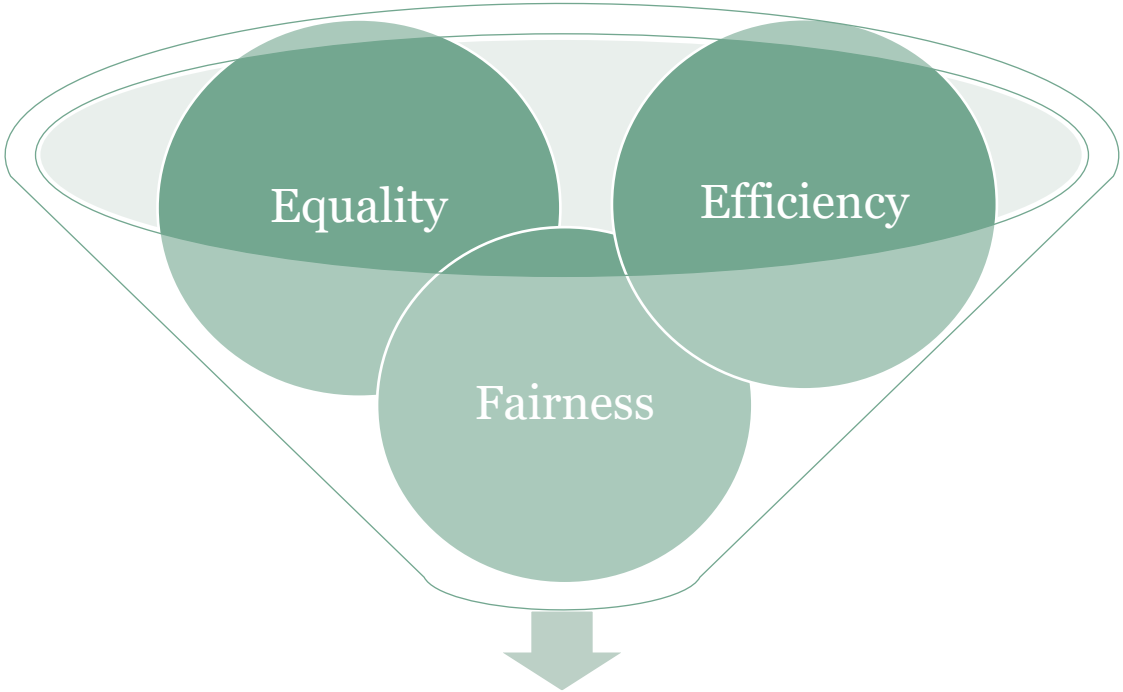
- Short introduction to the Swedish school system and national tests.
- Background on the digitalization.
- Thoughts about future digital tests in mathematics.
- Digital tools and testing.
- Comparison paper based and computer based testing.

SWEDISH SCHOOL SYSTEM AND NATIONAL TESTS

- Curriculum goals focusing compentencies
- Criterion-referenced grading
- Grading criteria with focus on the process
- Teachers are assessing and grading their own students.
  - The grades are used for selection.
- National tests in Swedish, English and mathematics to support fair and equal grading.

DIGITALIZATION OF THE NATIONAL TESTS

- It has taken some time…
- Decision taken 2017.
- Initially math was planned to 2023, now autumn 2025.
- Covid 19, Schrems II and GDPR have delayed the work.
- Development of a functional digital assessment platform.
  - A platform that will only be used for national tests.
- Still, the schools are not ready technically to handle the digital tests.



Aim with the digitalisation

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EQUALITY, EFFICIENCY AND FAIRNESS

- No papers to distribute
- Automatic scoring
  - Increase items that can be automatically scored.
- Training and monitoring of raters
- Digital tools
- Possibilities to make adaptations for students with disabilities.

NATIONAL TESTS IN MATHEMATICS COURSE 2-4 TODAY

- Paperbased, 2h+2h
- Part B – short answer, without calculator.
- Part C – complete solutions, without calculator.
- Part D1- short answer, graphical tools required.
- Part D2 – complete solutions, calculators allowed, graphical tools required for Ma2-4.
- Example of a national test in course 3

CHARACTERISTICS TODAY

- Few multiple-choice, mainly short answer items
  - Problematic to automatically score digitally
- Include all competencies
  - Appriciated and quite exemplary
- Advanced digital tools are problematic
  - All kinds of tools are allowed, only graphical tools are required.
  - A major shift from hand held graphical tools to GeoGebra.

FORTHCOMING DIGITAL TESTS

- Reliability is prioritized
  - Automatic scoring as much as possible
  - De-identification when scoring esseys and complete solutions.
- Technical issues
  - Short answers cannot include mathematical notation.
  - Complete solutions will remain on paper.
- Possibility to choose digital tools
  - Include a part with only a scientific calculator available.

FORTHCOMING DIGITAL TESTS
CONT.

- How tasks and scoring guides can be designed is to some extent limited by the technology and demands of accessibility
  - Types of items possible to include
  - How the scoring guides can be arranged
  - For mathematics (and physics), complete solutions on paper
  - Functionality of the digital tools
  - Security during field trials
  - Possibility to give feedback from field trials.
- Introduces threats to validity, both CIV and CUR

WHAT IS THE PLAN FOR THE DIGITAL TESTS IN MATH?

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DISCUSSED TEST MODELS

	As the paper based tests	”The three parts testlet model” Version A	”The three parts testlet model” Version B
Part 1	Short answers and complete solutions. No calculator	Short answers. No calculator	Short answers and complete solutions. No calculator.
Part 2	Short answers and complete solutions. All calculators allowed.	Short answers. Graphical calculators needed.	Short answers and complete solutions. Graphical calculators needed.
Part 3		Complete solutions. Scientific calculator.	Complete solutions. Scientific calculator.

DIGITAL TOOLS IN THE ASSESSMENT PLATFORM

- Separate parts of GeoGebra classic
  - The scientific calculator
  - The graphing calculator
  - The probability calculator
  - The CAS calculator
  - The geometry calculator (*is not planned to be used*)
  - The 3D-calculator (*is not planned to be used*)
  - but not the spread sheet
- However, some functionality restrictions in these tools.

DIGITAL TOOLS IN THE ASSESSMENT PLATFORM

- An old version of GeoGebra Suite
  - Several functions are hidden in the graphical calculator.
  - The spread sheet is hidden.
  - However, this tool is embedded in the test item and the student work is saved and can be scored.
- It is also possible to embed a prepared GeoGebra asset which can work as an interactive simulation.
- Finally, an Excel-type component exsists.

DIGITAL TOOLS IN THE ASSESSMENT PLATFORM

- The question is how many different tools can be included in an assessment situation?

WHY SOLUTIONS ON PAPER?

- All students in upper secondary school takes a national test in mathematics.
- An equation editor that students are not used to.
- No possibility to draw figures or change given pictures
  - And graphs in parts without digital tools.

A SNEAK PEAK INTO THE FUTURE

- Some examples of possible items in the assessment platform.

STUDY COMPARING PAPER BASED AND COMPUTER BASED TESTS

- Does the digital format introduce cognitive load?
- Investigate if there are any differences between a paper-based and a digital implementation of mathematics test items.
- Differences with respect to:
  - difficulty
  - use of scratch paper
  - amount of time needed

THE TESTS

- Test items from the second course in upper secondary school mathematics.
- Two testlets with equal difficulty.
  - Nine items per testlet.
  - Mainly short answer and MC-questions but also two items demanding complete solutions.

THE PARTICIPANTS AND STUDY DESIGN

- Two study groups at the same school.
- Each student took one paper and pencil testlet and one digital testlet.

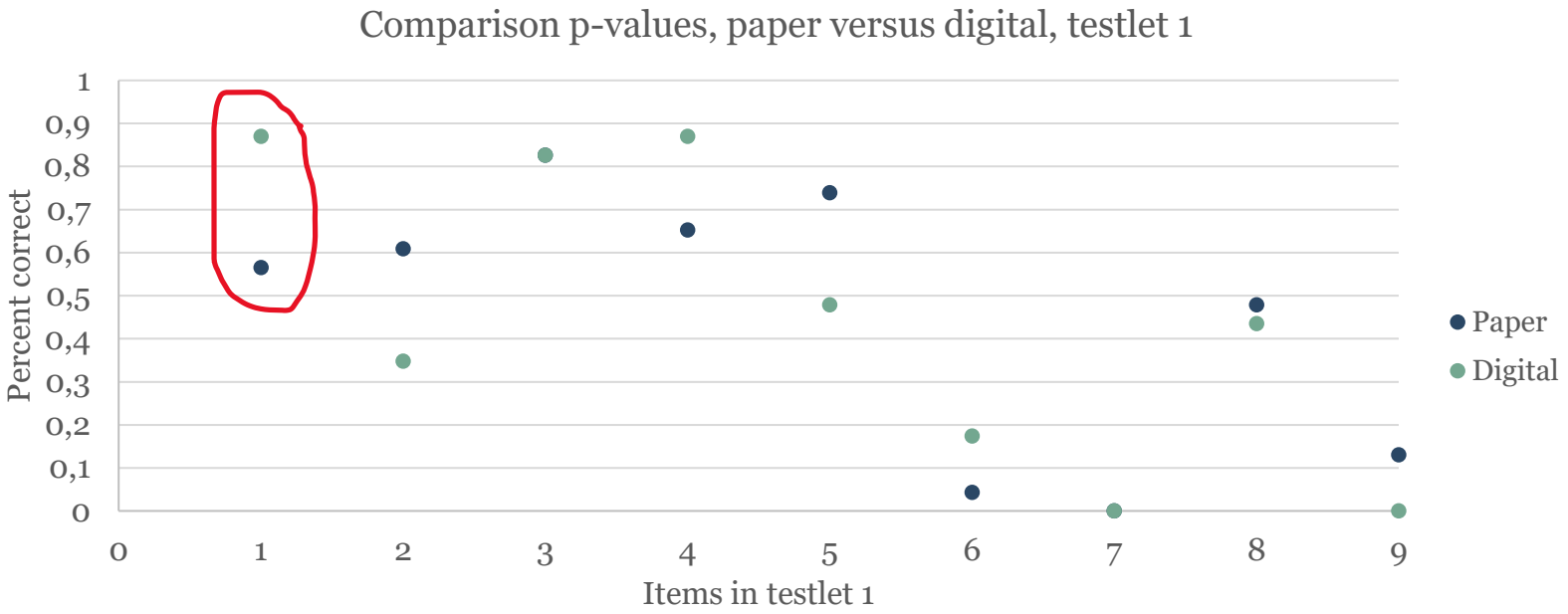
Group 1:

- 23 students
- Testlet 1 digitally and Testlet 2 paper and pencil.

Group 2:

- 22 students
- Testlet 1 paper and pencil and Testlet 2 digitally.

PROPORTION CORRECT, TESTLET 1



TESTLET 1 U1

Solve the equation $\sqrt{x+1} = 5$

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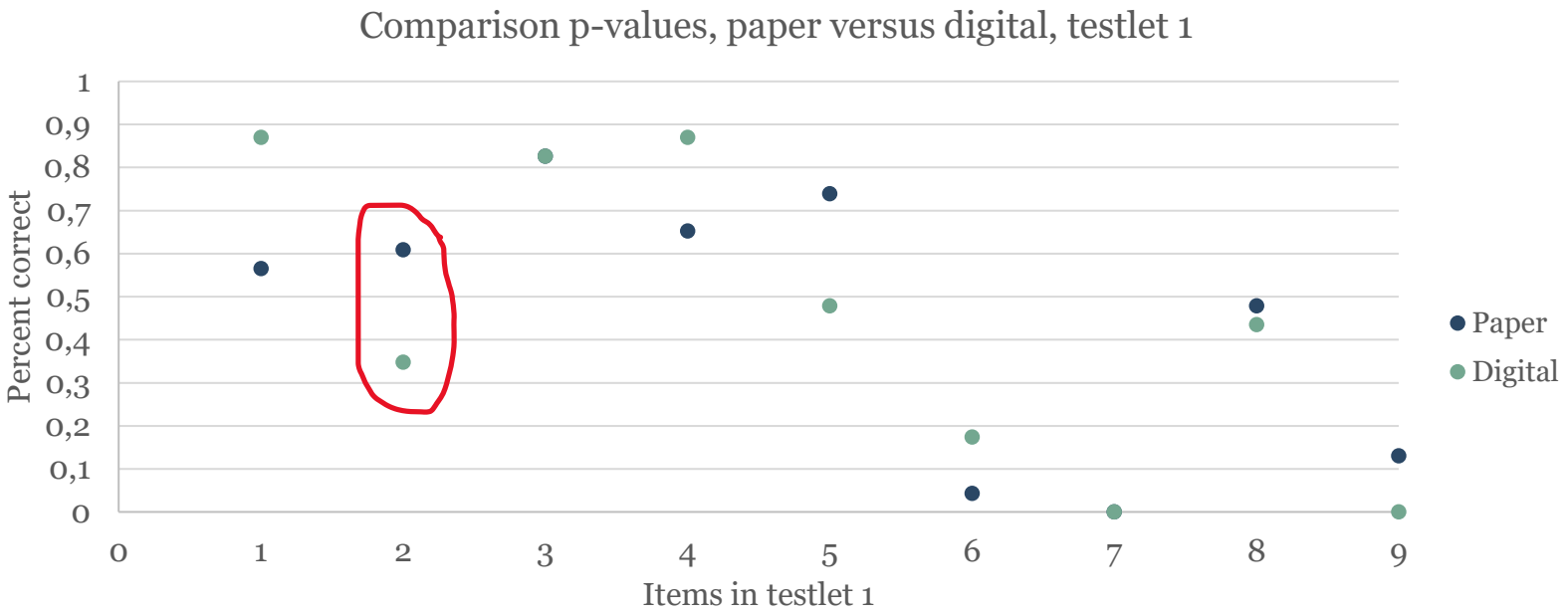
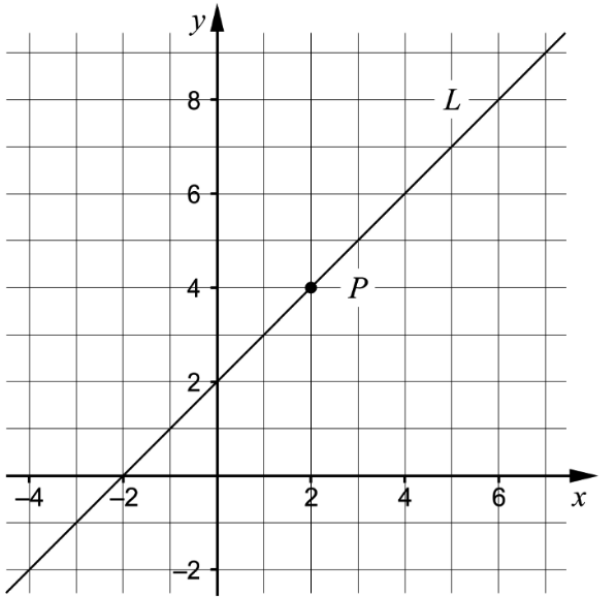
PROPORTION CORRECT, TESTLET 1



TESTLET 1, ITEM 2

The coordinate system shows a straight line L and a point P on the line.



Write down the equation for another straight line which together with the line L forms a linear system with solution at point P.

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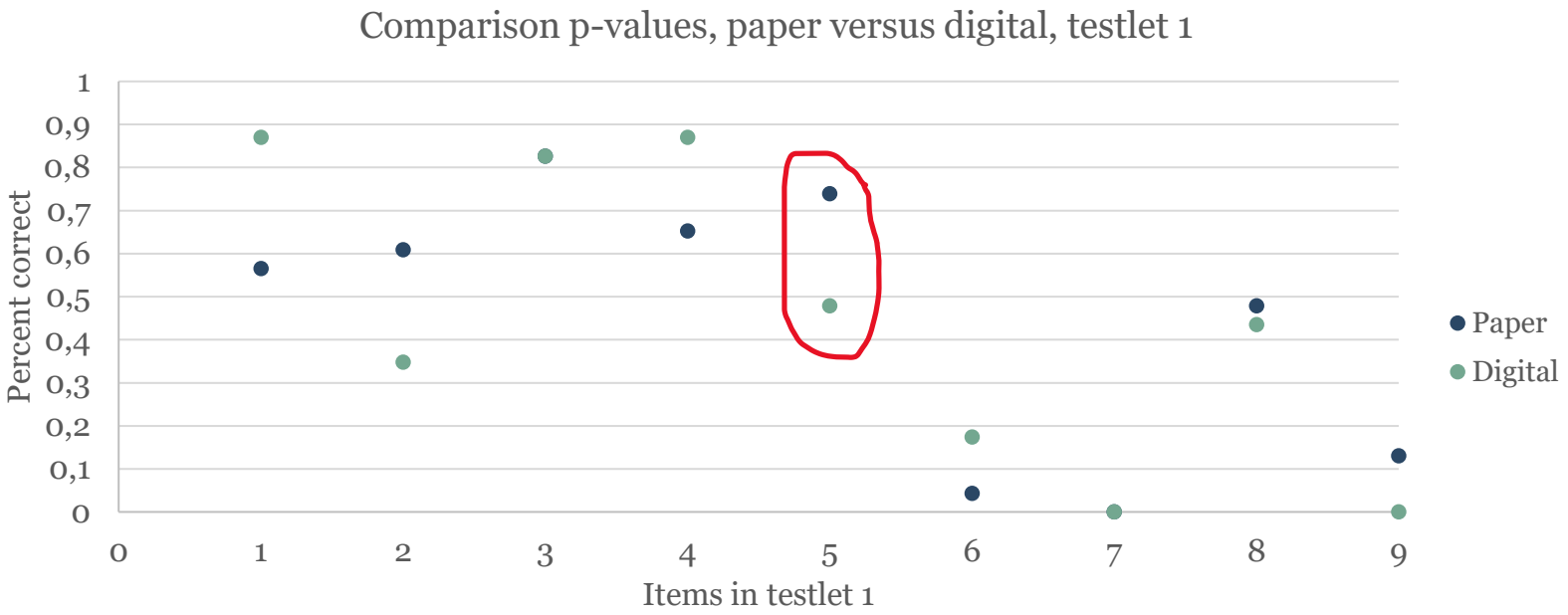
PROPORTION CORRECT, TESTLET 1



TESTLET 1, ITEM 5

Simplify the expression as far as possible $\dfrac{(\sqrt{x}+\sqrt{3})^2-(x+3)}{2}$

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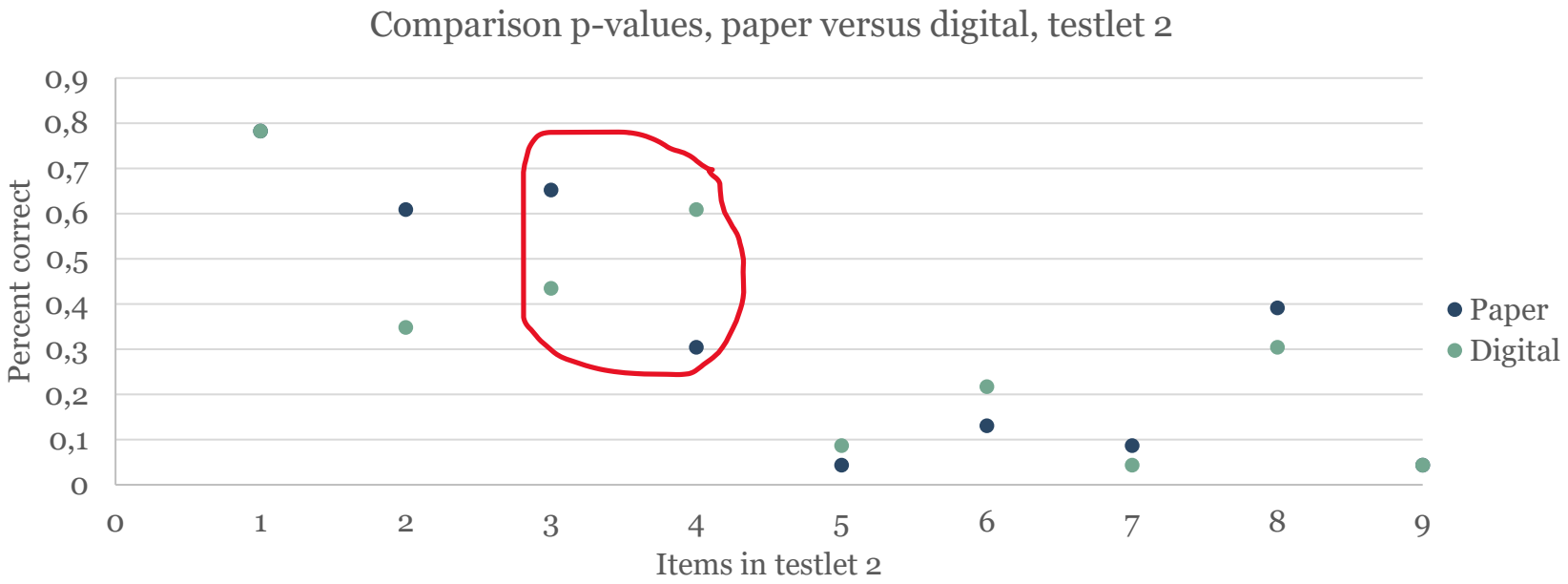
USE OF SCRATCH PAPER, TESTLET 1

	Paper	Digital
1	8	1
2	10	
3a		
3b		
4	16	10
5	13	5
6	5	2
7	Full solution	8
8	Full solution	2

PROPORTION CORRECT, TESTLET 2

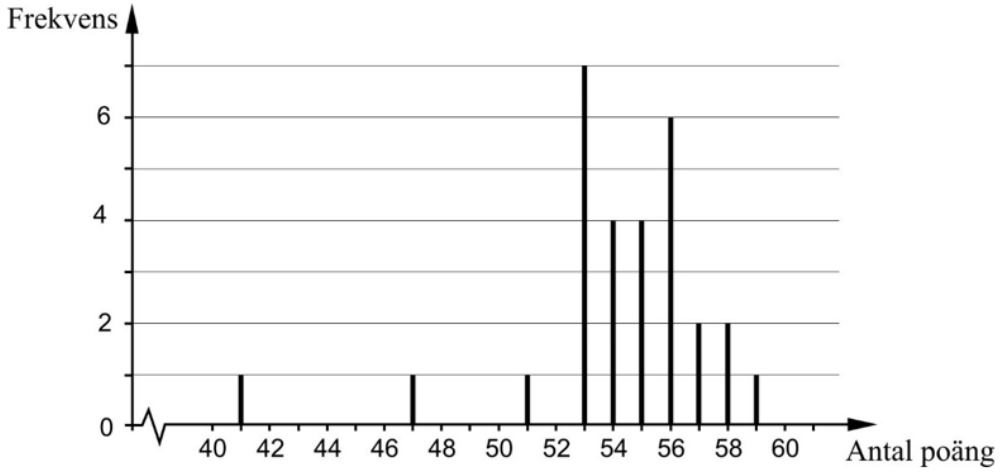


USE OF SCRATCH PAPER, TESTLET 2

	Paper	Digital
1	5	2
2	1	
3	12	4
4	11	5
5	1	
6		
7		
8	Full solution	5
9	Full solution	4

TESTLET 2, ITEM 3 AND 4

The diagram shows the results from a test in mathematics for 29 students.

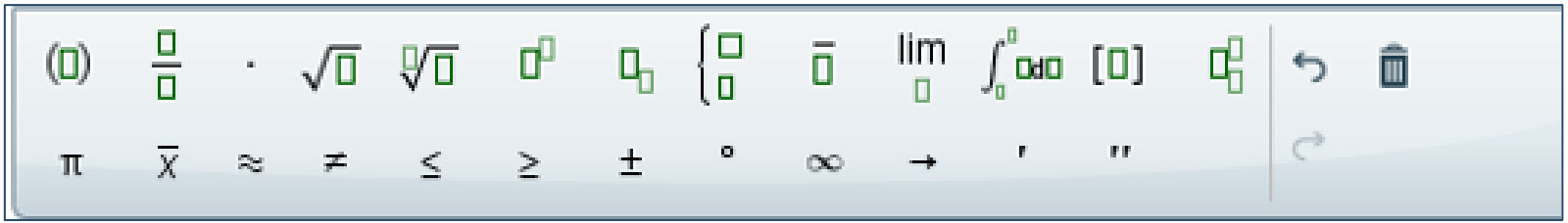


3. Determine the range.

4. Determine the median.

ITEMS WITH COMPLETE SOLUTIONS

Solve the equation $x^2 - 6x + 5 = 0$ algebraically.



ITEMS WITH SOLUTIONS CONT.

$x^2 - 6x + 5 = 0$

$x = -\frac{-6}{2} \pm \sqrt{(\frac{-6}{2})^2 - 5}$

$x = 3 \pm \sqrt{9-5}$

$x = 3 \pm \sqrt{4}$

$x = 3 \pm 2$

$x_1 = 5$

$x_2 = 1$

x^2 − 6x − 5 = 0

x = − (−6)/2 + / − (−6^2/2−5

x = 3 + / − roten ur 4

x = 3 + / −2

x1 = 3 + 2 = 1

x2 = 3 + 2 = 5

$x) - \frac{-6}{2} \sqrt{\square} (\frac{-6}{2})^2 - 5$

$x = 3\sqrt{4}$

$x = 3 \pm 2$

ISSUES TO HANDLE

- The functionality of the digital tools.
- Automatic scoring of mathematical expressions.
- Accessibility for students with disabilities.
- Complete solutions on paper.
- The formula sheet.
- The use of scribbling/scratch paper.

QUESTIONS?

Thank you for listening

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