Why inquiry? Teaching for Learning: three layers of collaborative inquiry
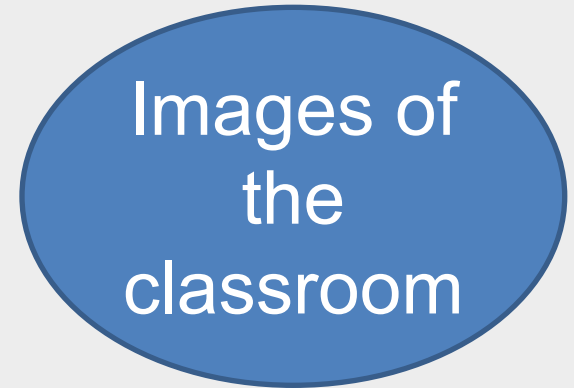
Barbara Jaworski

What is this talk about?

Teaching

- What is teaching?
- What does it mean to teach mathematics?

Learning

- What does it mean to learn mathematics?

How are teaching and learning related to each other?

Images of the classroom

What is teaching?

An action might be described as 'teaching' if, first, it aims to bring about learning, second, it takes account of where the learner is at, and, third it has regard for the nature of what has to be learnt.
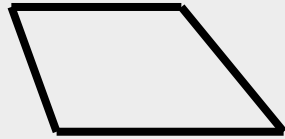
(Pring, 2000, p. 23)

'Is' versus 'seeing as'

Look at the figure here.

What is it?

What shape is it?

The teacher said, 'If you think it's not a trapezium then what *is* it?'

Michael said, tentatively, 'It's a square …'

A class of 12 year olds had been asked by their teacher to name this shape, which he had drawn on the board. Someone said that it was a trapezium. Some students agreed with this, but not all.

There were murmurings, giggles, 'a square'?! …
But Michael went on '… sort of flat.'

The teacher looked puzzled, as if he could not see a square either. He invited Michael to come out to the board and explain his square. Michael did.

'Oh' said the teacher. 'Oh, I think I see what you mean … does anyone else see what he means?'

There were more murmurings, puzzled looks, tentative nods.

Michael indicated that you had to be looking down on the square – as if it were on your book, only tilted. He moved his hand to illustrate.
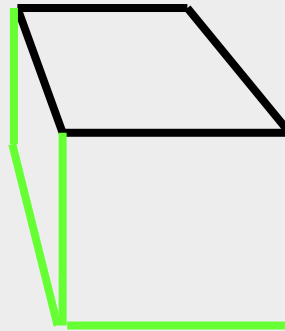
Then the teacher drew

Oooooh yes (!) said the students and there were nods around the class.

(Jaworski, 1987)

… a moral practice

Teaching … is more than a set of specific actions
in which a particular person is helped to learn this or that.
It is an activity in which the teacher is sharing in a moral
enterprise, namely the initiation of young people into a
worthwhile way of seeing the world …
There can be no avoidance … of that essentially moral
judgement of the teacher over what is worth learning

and what are the worthwhile ways of pursuing it.
(Pring, 2004, p. 18)

An exercise culture

This implies that the activities engaged in the classroom to a large extent involve struggling with pre-formulated exercises that get their meaning through what the teacher has just lectured about. An exercise traditionally has one, and only one, correct answer, and finding this answer will steer the whole cycle of classroom activities and the obligations of the partners involved: The teacher has to explain how to solve a particular type of exercise; the students have to try to do so; the teacher must check the students' solutions, as mistakes have to be eliminated from the mathematics classroom; a student could sometimes be asked to present a solution to the whole class, and so the cycle continues.
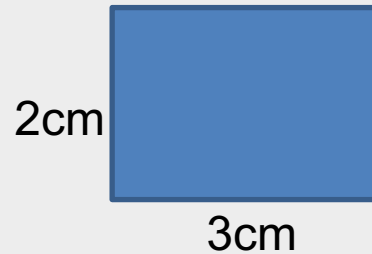
Skovsmose & Saljo, 2008

Tasks in an exercise

Number

- 2+3+4+5 = ☐

- 2+ ☐ = 3+4

- ☐ . 3 = 12/4

Area

Find the area of the rectangle:

2cm

3cm

Probability

In a bag there are 5 blue balls and 7 red balls. If one ball is taken from the bag, what is the probability that it is blue?

Some inquiry-based tasks

A. Take any natural number and express it as a sum in as many ways as possible
(e.g. 10 = 2+8 = 3+2+2+2+1
                  = 1+1+1+1+6)
Multiply the numbers of any sum and find the largest product. **Explore & Generalise**?

B. You have a number of balls in a bag, some red and some white. What is the least number of red balls for which the probability of drawing two red balls in succession (without replacement) is more than 1/3? **Explore & Generalise**?

C. Can you find any plane shape for which the area is numerically equal to its perimeter?   Use Cabri?   **Explore & Generalise**?

Further tasks

Given the function
f(x) = x² − 3x + 4,
sketch the function on a pair of axes in GeoGebra.

a) Find the equation of a line that crosses this curve where x=1 and x=2
b) Find the equation of a line of gradient 3 that crosses the curve twice
c) Find the equation of a line of gradient -3 that does not cross the curve **DISCUSS**

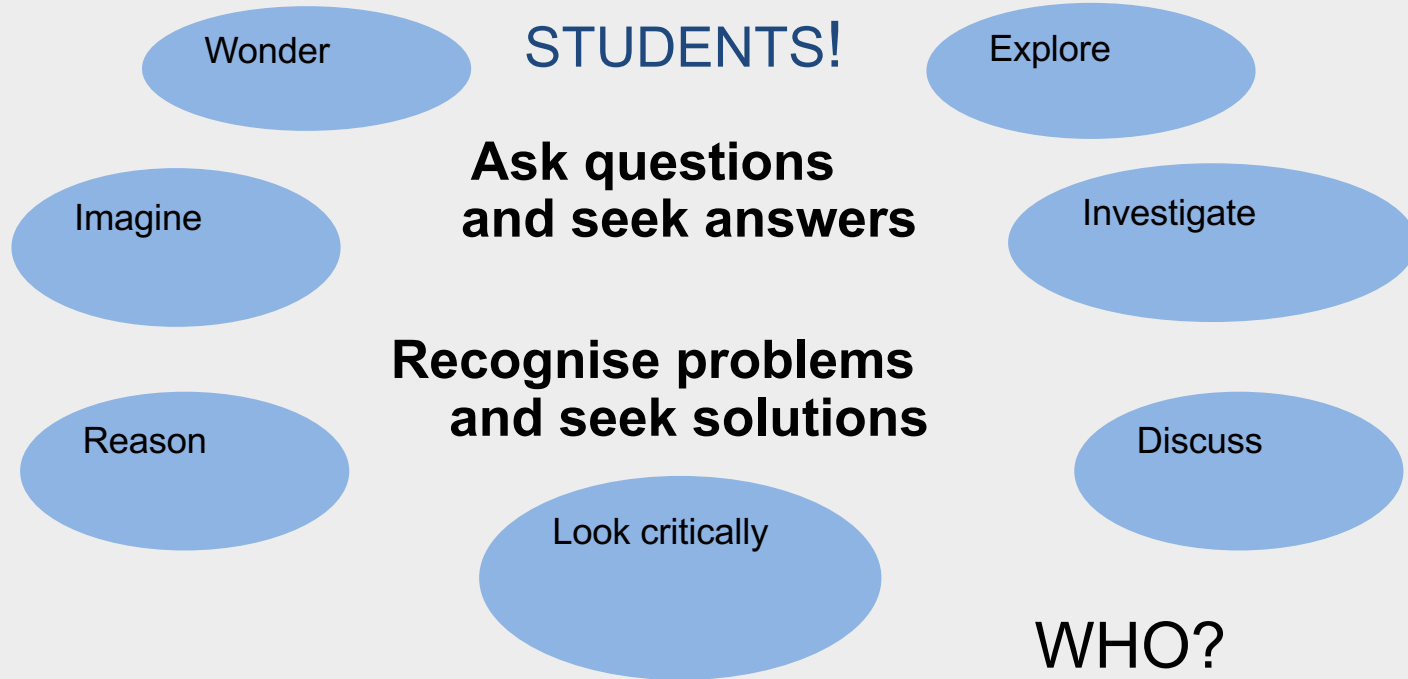Use sliders in GeoGebra to determine which of the graphs below could represent the function y=ax⁴+bx³+cx²+dx+e
Here a, b, c, d and e are real numbers, and a≠0.   Explain
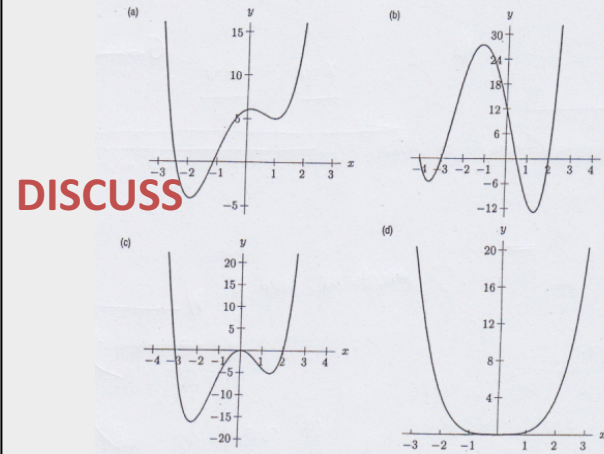
DISCUSS

An inquiry culture

- Offering open-ended questions
- Engaging students in exploration and investigation
- Encouraging discussion and questioning
- Looking critically at methods and answers
- Finding new ways of looking and seeing

Inquiry in the classroom

Wonder

STUDENTS!

Explore

**Ask questions
and seek answers**

Imagine

Investigate

**Recognise problems
and seek solutions**

Reason

Discuss

Look critically

WHO?

Inquiry-based tasks

- Provide easy access to mathematical ideas

- Enable everyone to make a start

- Provide opportunity to ask questions, solve problems, imagine, explore, investigate …

- Encourage discussion and reasoning, diverse directions and levels of thinking, fluidity and flexibilility

- Encourage student centrality/ownership in/of the mathematics

- Promote serious mathematical thinking

Creativity

Inquiry enables

- Students to be creative with mathematics

- Teachers to be creative with teaching mathematics

What is the teacher doing …

… when students work on inquiry-based tasks?

What is the teacher's role?

- Circulating and listening
- Asking, and encouraging students to ask questions
- Encouraging dialogue and/or debate
- Fostering reasoning
- Prompting and challenging

- Deciding what will be needed in the next lesson
- Gaining new ideas for further inquiry

Inquiry in mathematics teaching

Involves *teachers-as-inquirers* exploring

- the kinds of tasks that engage students and promote mathematical inquiry

- ways of organising the classroom that enable inquiry activity with all its attributes

- The many issues and tensions that arise related to the classroom, school, parents, educational system, society and politics.

and reflecting on what occurs in the classroom with feedback to future action

An inquiry cycle

Plan for teaching

Act and observe

Reflect and analyse

Feedback to future planning

Iterative and systematic ➡ Action research

Design research

e.g.,

Design a particular classroom task

Use the task in the classroom and observe what happens -- gather data

Reflect on what occurred -- analyse the data

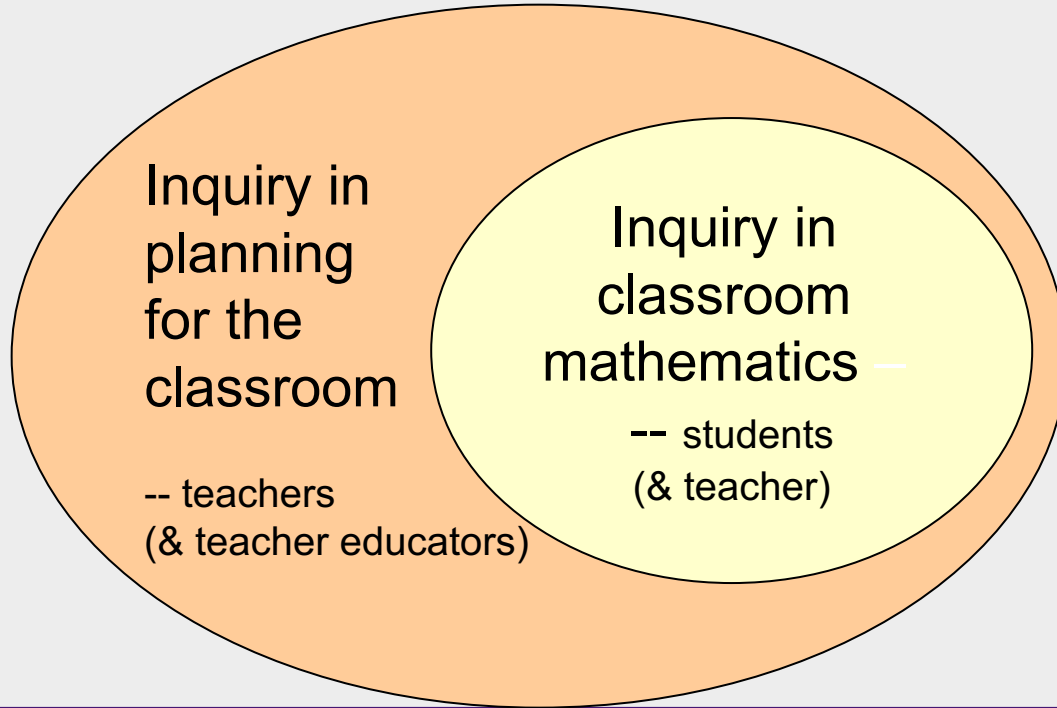Use what has been learned through observation and analysis to redesign the task

Inquiry in two layers

Inquiry in students' mathematical activity in the classroom

Inquiry in teachers' exploration of classroom approaches
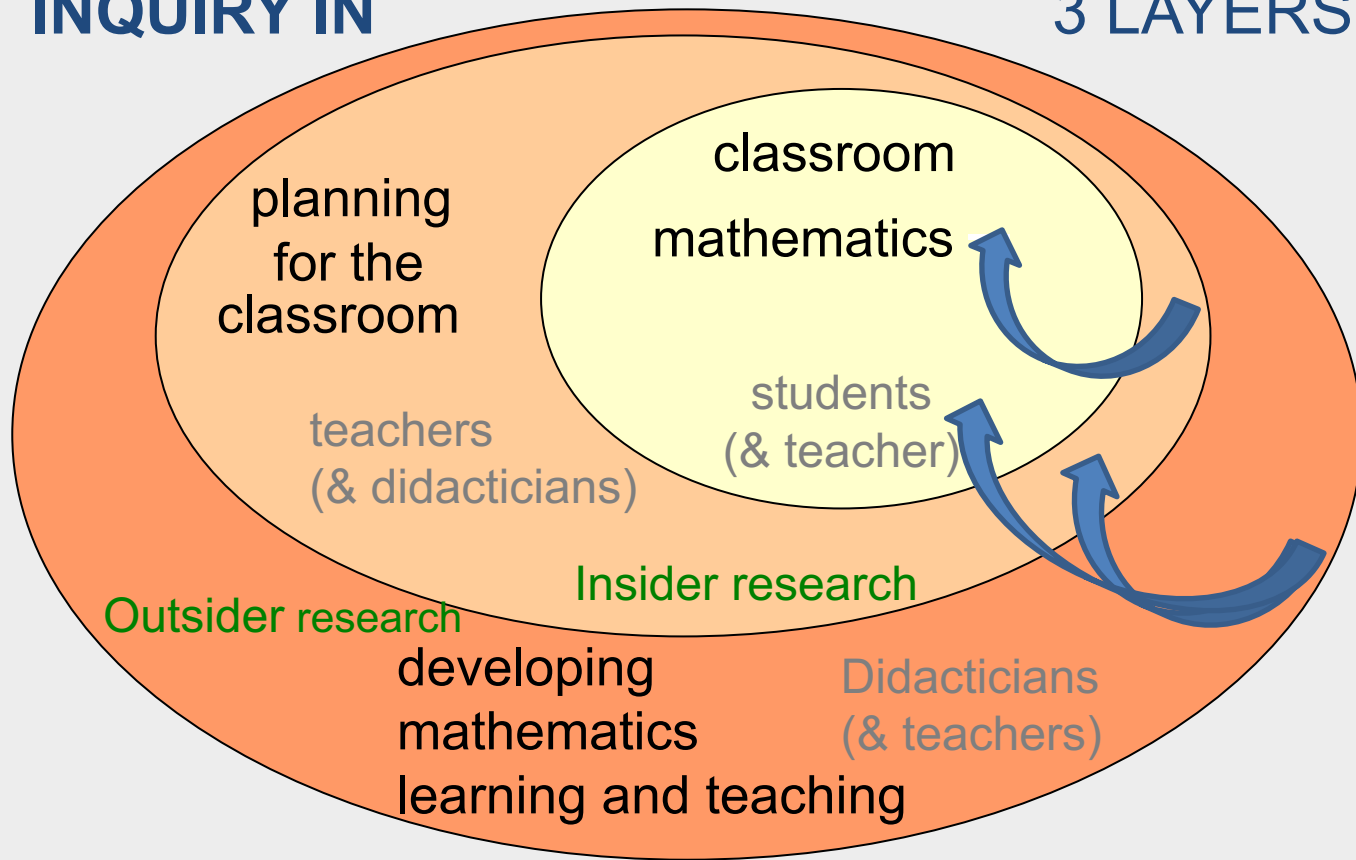
Loughborough University

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Two *communities* of inquiry

Inquiry in planning for the classroom

-- teachers
(& teacher educators)

Inquiry in classroom mathematics --

-- students
(& teacher)

INQUIRY IN   3 LAYERS

classroom

mathematics

planning
for the
classroom

teachers
(& didacticians)

students
(& teacher)

Insider research

Outsider research

developing
mathematics
learning and teaching

Didacticians
(& teachers)

Loughborough
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For further writing on inquiry in mathematics classrooms and associated developmental research, see:

Jaworski B. (2006) Theory and Practice in Mathematics Teaching Development: critical inquiry as a mode of learning in teaching. *Journal of Mathematics Teacher Education.* Special Issue: Relations between theory and practice in mathematics teacher Education. Vol. 9 number 2, pp. 187-211

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Jaworski, B. (2015). Unifying complexity in mathematics teaching-learning development – a theory-practice dialectic In Y. Li, E. A. Silver, & S. Li (Eds.) (2014). *Transforming mathematics instruction: Multiple approaches and practices.* Cham, Switzerland: Springer.

Thank you for listening!

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