

Education

## Inquiry in Mathematics: What is it really?

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### Starting with a problem

- Change between addition and subtraction to make 27
- Change between addition and subtraction to make 17
- Change between addition and subtraction to make 12

## What is inquiry?



## What is INQUIRY?

Inquiry as a pedagogical approach



Pedagogy that enables inquiry

#### **TEACHER**

#### **STUDENT**

#### What is the purpose of school mathematics?

Mathematics instruction should provide students with a *sense of the discipline* ... a sense of what mathematics is and how it is done

(Schoenfeld 1992, p.12)

What is mathematics and how is it done?

Math is the science of patterns and the art of engaging the meaning of these patterns.

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Exploration and understanding are at the heart of what it means to do mathematics. MATHEMATICS FOR HUMAR FLOURISHING

FRANCIS SU WITH REFLECTIONS BY CHRISTOPHER JACHSON Perhaps I could best describe my experience of doing mathematics in terms of entering a dark mansion. You go into the first room and it's dark, completely dark. You stumble around, bumping into the furniture. Gradually, you learn where each piece of furniture is. And finally, after six months or so, you find the light switch and turn it on. Suddenly, it's all illuminated and you can see exactly where you were. Then you enter the next dark room...

— Andrew Wiles



- What exactly are you doing? (Can you describe it precisely?)
- Why are you doing it? (How does it fit into the solution?)
- How does it help you? (What will you do with the outcome when you obtain it?)

Schoenfeld, 1992



#### NOTICING

CONJECTURING

#### GENERALISING

#### JUSTIFYING

REPRESENTING

- Exploring specific examples of mathematical ideas to see what we noticed
- Asking questions and making conjectures about what is noticed, and then testing these conjectures
- Forming generalisations based on mathematical patterns and relationships noticed
- Justifying conjectures and generalisations that are made using convincing arguments and proofs
- Representing mathematical thinking and concepts in multiple forms

- Change between addition and subtraction to make 27
- Change between addition and subtraction to make 17
- Change between addition and subtraction to make 12

## What did you notice?



## What did you notice?

Creating the desired sum with a few tiles The effect of "flipping" a tile on the final sum is twice the value of that tile means the other tiles need to add to 0 10 + 9 + 8 - 7 + 6 + 5 - 4 - 3 - 2 + 1 = 2310 + 9 + 8 - 7 + 6 + 5 - 4 - 3 + 2 + 1 = 2710 + 9 + 8 - 7 + 6 + 5 + 4 - 3 - 2 + 1 = 3127 You cannot make 12!

- Change between addition and subtraction to make 27
- Change between addition and subtraction to make 17
- Change between addition and subtraction to make 12
- Why can you not make 12?

10	+	9	+	8	—	7	+	6	+	5	—	4	—	3	+	2	+	1	=	27	
10	+	9	+	8	_	7	+	6	_	5	_	4	_	3	+	2	+	1	=	17	
10	+	9	+	8	_	7	+	6	_	5	+	4	_	3	+	2	+	1	=	25	
10	+	9	_	8	_	7	+	6	_	5	+	4	_	3	+	2	+	1	=	9	
10	+	9	_	8	+	7	+	6	_	5	+	4	_	3	+	2	+	1	=	23	
10	+	9	_	8	+	7	+	6	_	5	+	4	+	3	+	2	+	1	=	29	

What do you notice?

#### 10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 55

8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 36

8 + 7 - 6 + 5 + 4 + 3 + 2 + 1 = 24

10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 = 52

9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 45

#### 10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 55

5 evens and 5 odds given an odd

#### 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 36

4 evens and 4 odds give an even

9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 45

4 evens and 5 odds give an odd









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## Noticing

Noticing in learning mathematics is the active process of attending to the mathematical structure... For students to be successful in mathematical inquiry, they should be proficient in noticing. What students notice guides their next move in their learning or inquiry. In general, failure to notice leads to failure to learn, particularly with understanding.

(Chapman 2024, p.1)

#### 748 + 369 - 769 - 348 =

#### 748 + 369 + 251 - 761 - 358 - 249 =

Mason, 2022



# Conjecture Convince

Mason, J., Burton, L., & Stacey, K. (2010). Thinking mathematically (2nd ed.). Pearson.



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## Pedagogical toolbox













1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	66	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

	45	

	45	

	45	

	45	

	45	





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## **Taxicab Geometry**







For this exercise A = (-2, -1). Mark A on a sheet of graph paper. For each point P below calculate  $d_T(P, A)$  and mark P on the graph paper.

a) P = (1, -1)b) P = (-2, -4)c) P = (-1, -3)*d*) P = (0, -2)*e)*  $P = (\frac{1}{2}, -1\frac{1}{2})$ **f)**  $P = (-1\frac{1}{2}, -3\frac{1}{2})$ g) P = (0, 0)h) P = (-2, 2)





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