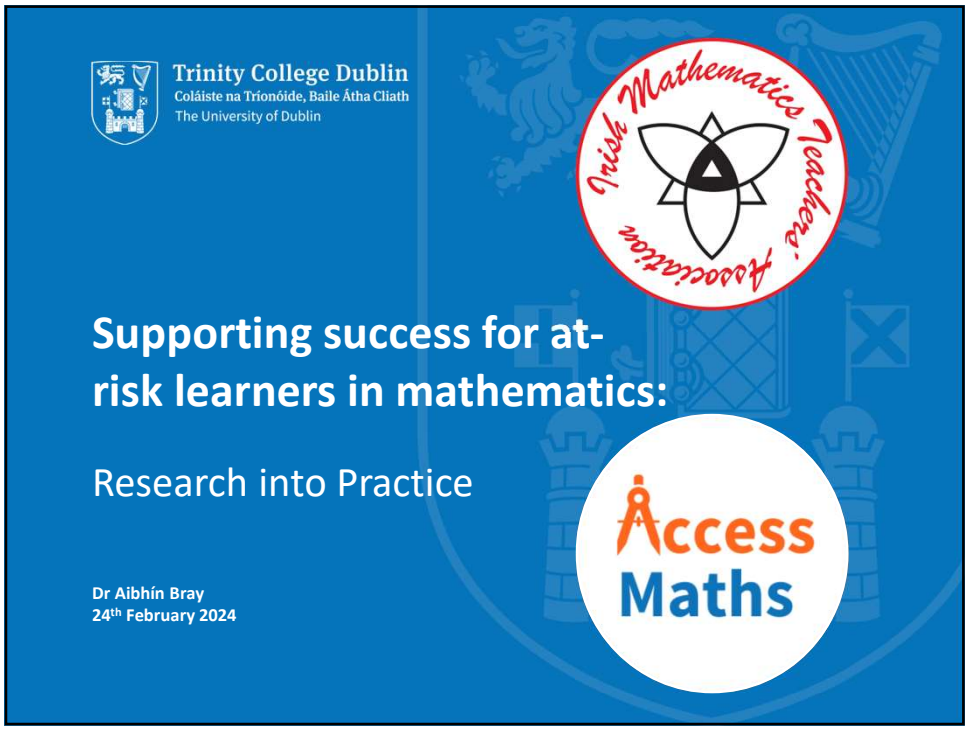

1

Overview

Research into Practice

1. What is the problem?
2. Background: Who am I to talk about this?
3. Context: Junior Cycle Mathematics
4. What does research say we can do about it?
5. How have we been interpreting it?

2

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What is the problem?

3

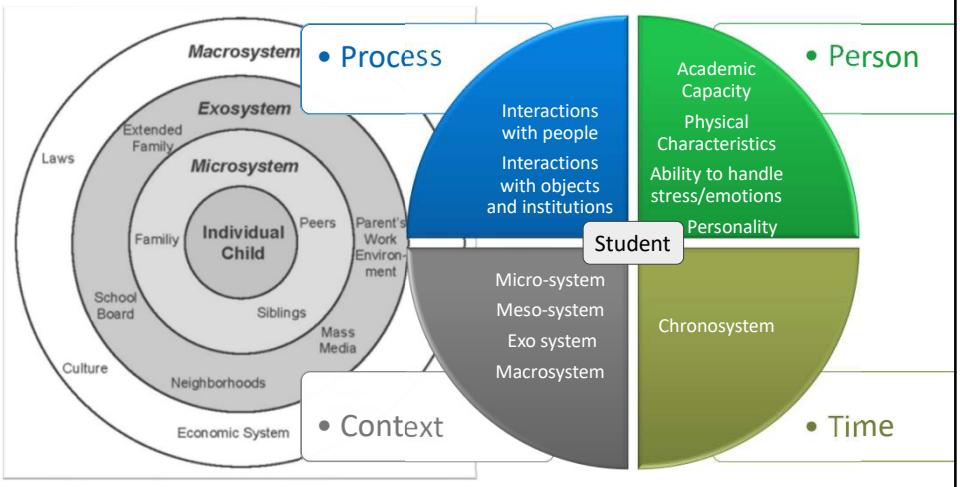
Students in schools in areas of low socio-economic status (SES) are less likely to succeed in mathematics.

But why?

4

Placing the student at the centre

Bronfenbrenner's Process, Person, Context, Time (PPCT) model (2007)



5

Person

The student

Students' attitudes towards mathematics tend to be more negative in schools in areas of low SES (Ní Shuilleabhain, Cronin, and Prendergast, 2020):

- higher levels of mathematical anxiety and
- lower self-concept in mathematics.

6

Context
Neighbourhood and School

Low SES Neighbourhoods 'less conducive' to educational achievement (Dietrichson, Bøg, Filges, & Klint Jørgensen, 2017):

- Less access to social capital via mentors or role models,
- Fewer resources.

Difficult working conditions (Dotson and Foley, 2016):

- Challenges in hiring and retaining well-qualified mathematics teachers.

Climate of low expectations for students (Megowan-Romanowicz et al., 2013)

7

Time
Age and Stage

- Initial years in post-primary are crucial.
- Performance at this stage acts as a gatekeeper to higher-level mathematics courses and beyond.
- Achievement gaps tend to widen for students from lower SES backgrounds at this time

(McKenna, Muething, Flower, Bryant, & Bryant, 2015).

8

Process

What we do

- Students from low SES backgrounds are more likely to "*receive less effective instruction on average compared to their higher income peers*" (Ekmekci, Corkin, and Fan, 2019)
- Pedagogic approaches tend to focus more on controlling behaviours (Megowan-Romanowicz, Middleton, Ganesh, & Joanou, 2013).

9

Who am I?

- Lecturer and researcher in the School of Education, Trinity College Dublin
- Trinity Access Programmes
- Maths Teacher

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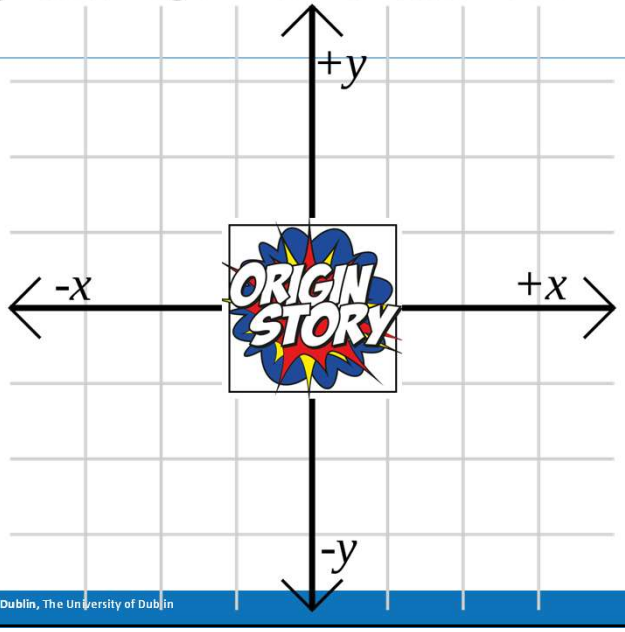
TAP 30
Trinity Access Programmes
Cláir Rochtana Na Tríonóide

Trinity Access Programmes and Access Maths

Access Maths

11

Trinity Access Programmes and Access Maths



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Trinity Access Programmes
What do we do?

- Engage with communities and schools in areas with low progression to post-secondary education
- Support development of positive mindsets as well as offering practical supports towards going to University.
- Programmes range from primary school students through to postgraduates.

Alternative Entry Routes >

Undergraduate Supports >

Supports for Schools >

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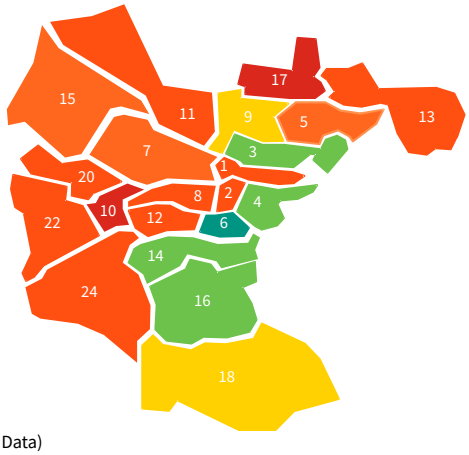
Progression to Higher Education



Dublin 6	99%
Dublin 4	84%
Dublin 16	79%
Dublin 14	76%
Dublin 3	60%
Dublin 18	58%
Dublin 9	55%
Dublin 5	47%
Dublin 15	47%
Dublin 7	41%
Dublin 12	37%
Dublin 13	36%
Dublin 20	32%
Dublin 24	29%
Dublin 8	28%
Dublin 11	28%
Dublin 2	26%
Dublin 22	26%
Dublin 1	22%
Dublin 10	16%
Dublin 17	15%

(2013 Data)
Non fee-paying Schools

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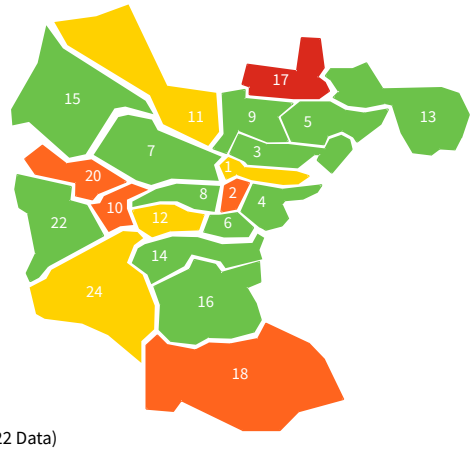
Progression to Higher Education



(2022 Data)
Non fee-paying Schools

Dublin 14	87%
Dublin 4	85%
Dublin 3	82%
Dublin 6	80%
Dublin 16	77%
Dublin 13	73%
Dublin 9	73%
Dublin 7	71%
Dublin 15	71%
Dublin 22	66%
Dublin 5	66%
Dublin 8	60%
Dublin 1	56%
Dublin 12	56%
Dublin 11	54%
Dublin 24	51%
Dublin 10	49%
Dublin 20	46%
Dublin 2	41%
Dublin 18	37%
Dublin 17	*20%

*Latest data point available for Dublin 17 is from 2020.

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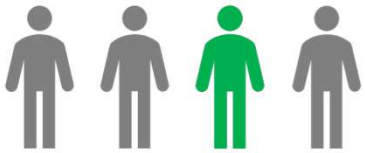
Could we do better in TCD?

2022 data



25% Non-traditional backgrounds

350 HEAR places unfilled since 2019

200 In maths-related courses

Choices at lower secondary are critical

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Access Maths

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Access Maths

TAP
Trinity Access Programmes

What can we do?

- Bremore Educate Together Secondary School
- Cabinteely Community School.
- Coláiste Bríde, Clondalkin
- Coláiste Mhuire, Kilkenny
- Firhouse Community College, Tallaght

Dublin

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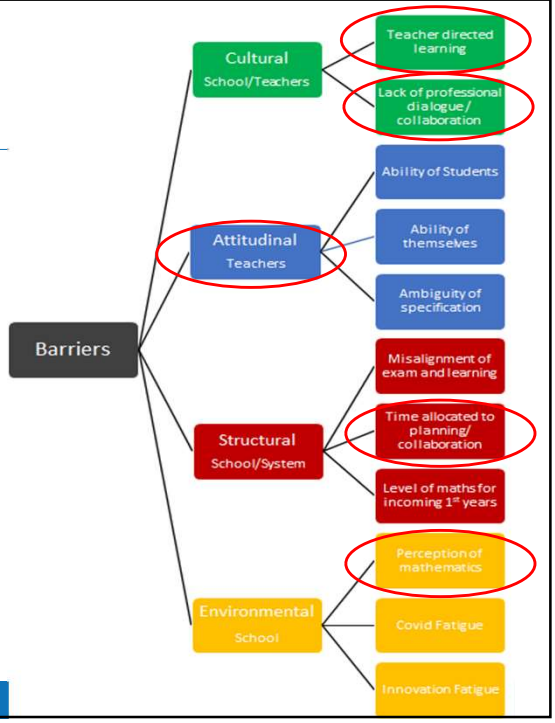
Barriers



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Project Goals

1. Create a Community of Practice to support teachers in addressing the barriers identified.
2. Improve students' enjoyment of, and engagement with, Maths leading to:
   - increased participation and attainment in Junior Cycle
   - increased Maths participation and attainment in Senior Cycle
3. Open up STEM pathways in 3rd level and employment in STEM areas

Trinity Access Programmes
Cláir Rochtana Na Tríonóide

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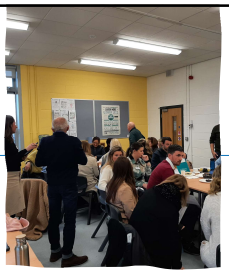
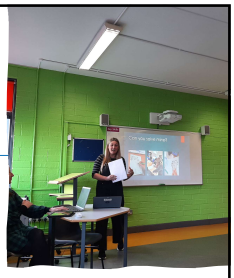
How will (might!) we achieve this?





- In-school support
- Co-Planning
- Co-Teaching
- Observation
- Teachmeets

Co-creation of lessons that (faithfully?) reflect the Junior Cycle Framework (intended curriculum!)

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Junior Cycle Mathematics

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What is the goal/aim of mathematics education

Join at menti.com, using code **8579 7077**

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Mathematics Curriculum (Ireland) - Aims

Mathematical Proficiency

1. **conceptual understanding**—The comprehension of mathematical concepts, operations and relations
2. **procedural fluency**—the ability to use a variety of mathematical procedures in an effective and efficient way
3. **strategic competence**—the skill to devise represent and solve mathematical problems
4. **adaptive reasoning**—the capacity to use logic to understand, explain and justify one's thinking
5. **productive disposition**—the tendency to see mathematics as practical, useful and worthwhile.

(Kilpatrick et al., 2001, p117)

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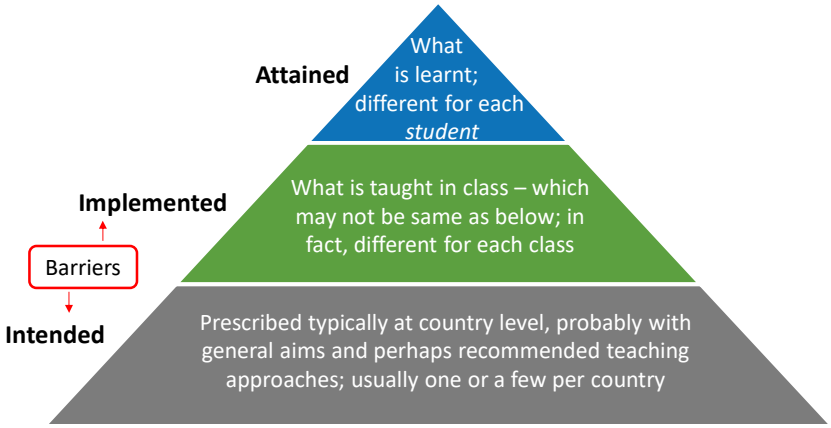
Three "levels" of curriculum

(Howson & Wilson, 1986; Cai & Howson, 2013)



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Intended Curriculum (Ireland)

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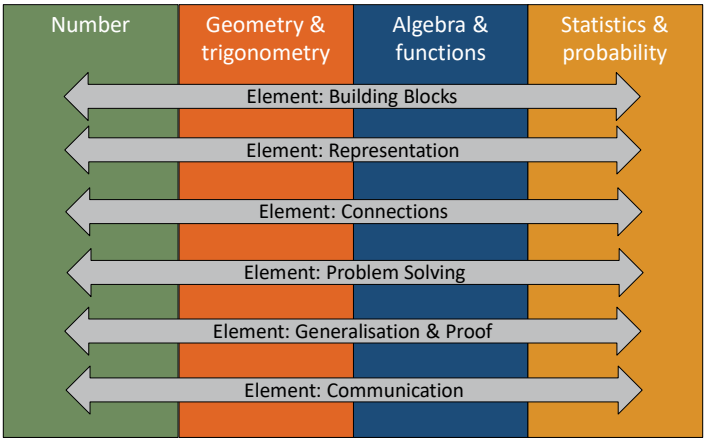
Intended (Mathematics) curriculum

Revised Junior Cycle course, 2018: Content

Few changes of (apparent) consequence. Reconceptualised via the Unifying Strand



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Intended (Mathematics) curriculum

Revised Junior Cycle course, 2018: Key features

- **Mathematics** and **learning mathematics**
  - "… an **interconnected** body of ideas and reasoning processes that students **negotiate collaboratively** with teachers and their peers and as **independent learners**" ("Specification", p. 4)

Increased emphasis on problem solving and problem-based learning

- **Assessment**
  - "There are also new assessments which offers students a chance to demonstrate their achievement as **creators** of mathematical reports"

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Implemented Curriculum: What does Irish data say?

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Study aims (2 studies)

Emma Berry, Aibhín Bray, Elizabeth Oldham and Caitlin Ní Shuilleabháin

Aims of the studies

1. To establish what is "common practice" in terms of pedagogical approaches within (1) *the Leaving Certificate Higher level (LC HL) classroom*, and (2) *in Junior Cycle (JC) DEIS contexts.*
2. To identify the factors that influence the use of those pedagogical approaches

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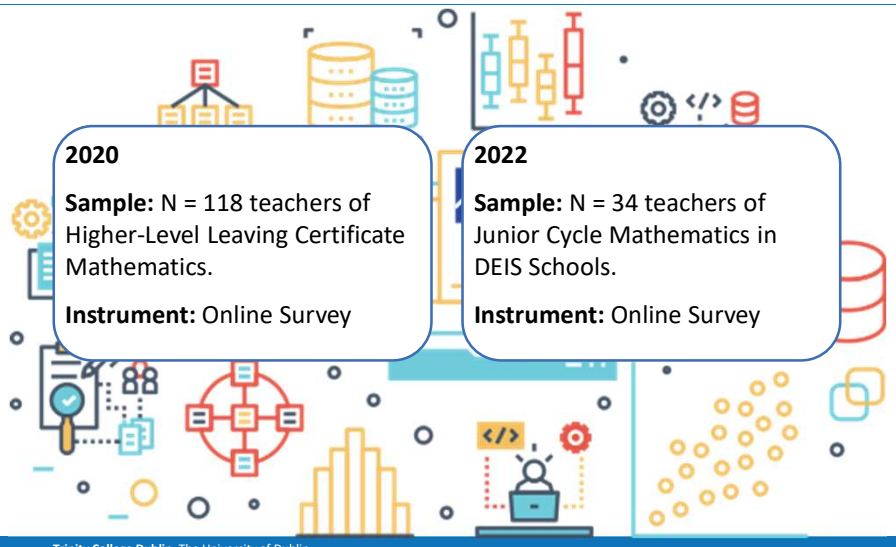
Data sets



2020

Sample: N = 118 teachers of Higher-Level Leaving Certificate Mathematics.

Instrument: Online Survey

2022

Sample: N = 34 teachers of Junior Cycle Mathematics in DEIS Schools.

Instrument: Online Survey

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Results

Descriptive analysis

% of teachers most frequently using, level of comfort with, and perceived effectiveness of, listed pedagogies

Pedagogy	% most frequent		% most comfort		% most effective	
	LC HL	JC	LC HL	JC	LC HL	JC
Direct instruction (chalk and talk)	61	61	72	75	52	57
Open-ended questioning	34	14	6	14	8	0
Discussion and debate	26	14	18	0	11	7
Independent problem solving	24	18	6	4	10	7
Group work	23	18	6	7	6	21
Inquiry-based learning (IBL)	14	4	2	0	15	7
Flipped classroom	7	4	4	0	3	0

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Why do we do what we do?

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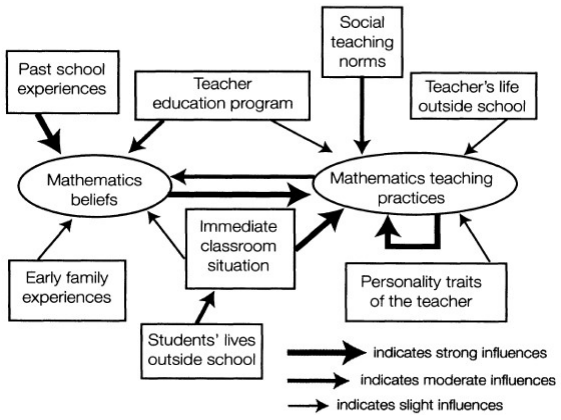
Influences on Teacher Beliefs & Practice

Take a couple of minutes to think about some of the possible influences on the formation of your own beliefs and practice



(Raymond, 1997)

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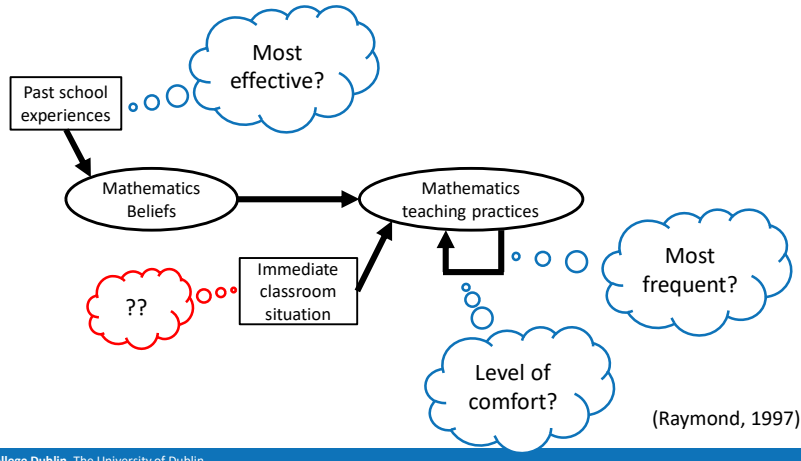
Influences on Teacher Beliefs & Practice

Strongest influences



(Raymond, 1997)

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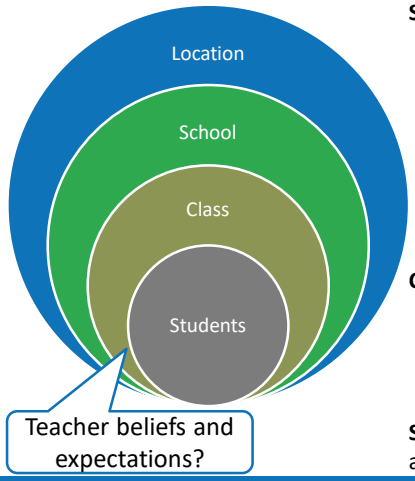
Immediate Classroom Situation

What is the classroom like?



Location: Urban? Rural? Affluent? Impoverished?

School:

- Fee-paying/non-fee-paying?
- Voluntary secondary, community and comprehensive, Vocational/community colleges (ETB)?
- Gaelcoláiste (Irish language)?
- DEIS (socio-economic disadadvantage)
- Denominational or non-denominational
- Mixed or co-educational?

Class:

- Mixed-ability or "streamed"?
- Level of additional/special educational needs? Language competency etc.
- Ethnic make-up

Students: Home situation, peer relationships, academic focus, aspirations and goals,…

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What "should" we do? What does the research tell us?

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Research

What might "best practice" look like?

1. Maintain **high expectations** for your students (Ni Shuilleabhain et al., 2020)
2. **Focus on Mastery** rather than (only) on Performance (Martin et al., 2015; Megowan-Romanovicz. 2013)
   - Take the time to ensure deep understanding
   - Use **"rich" tasks** (Mizra & Hussain, 2014)
   - Use the **intended curriculum** to scaffold your planning
   - Problem-based and project-based learning (Cervantes et al., 2015)
3. Motivation: Use **relevant contexts** to increase **Intrinsic** and **Utility Value** of the subject (Gaspard et al., 2014)
4. **Collaborate** and take an **iterative approach to planning** (Valerio, 2021)

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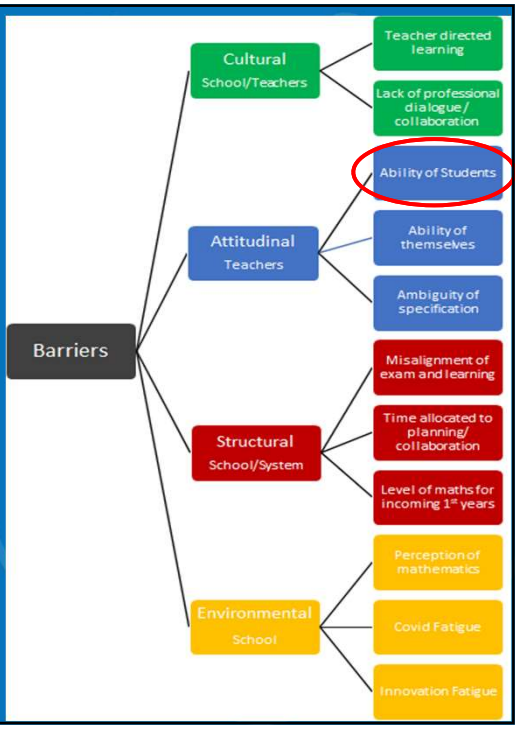
1. Expectations



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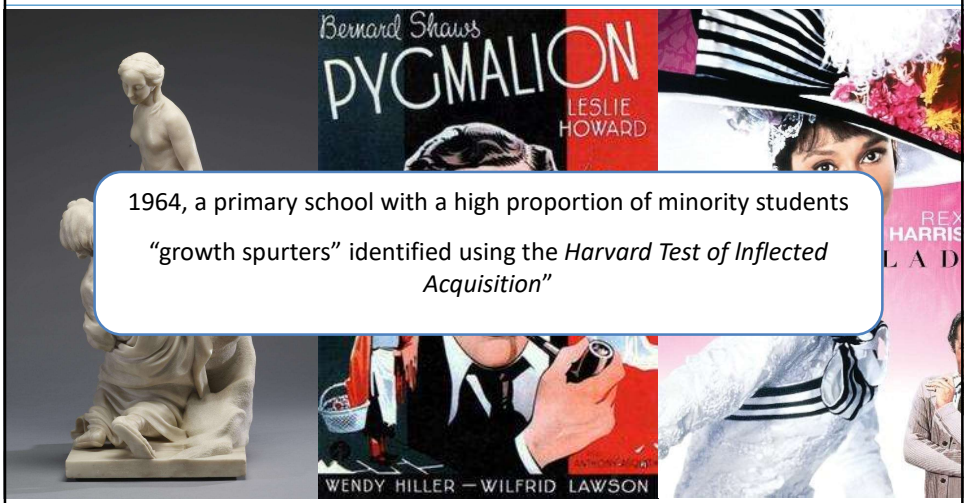
Expectancy advantage

The Pygmalion Effect



1964, a primary school with a high proportion of minority students

"growth spurters" identified using the *Harvard Test of Inflected Acquisition*"

Rosenthal, R., & Jacobson, L. (1968). Pygmalion in the classroom. The urban review, 3(1), 16-20.

40

Expectations count!

"When teachers expected that certain children would show greater intellectual development, those children did show greater intellectual development.

… evidence that one person's expectations of another's behavior may come to serve as a self-fulfilling prophecy." (Rosenthal & Jacobson, 1968, p.20)

Results may be related to level of (dis)advantage, with teachers tending to have to have lower expectations for lower SES students (Ni Shuilleabhain et al., 2020)

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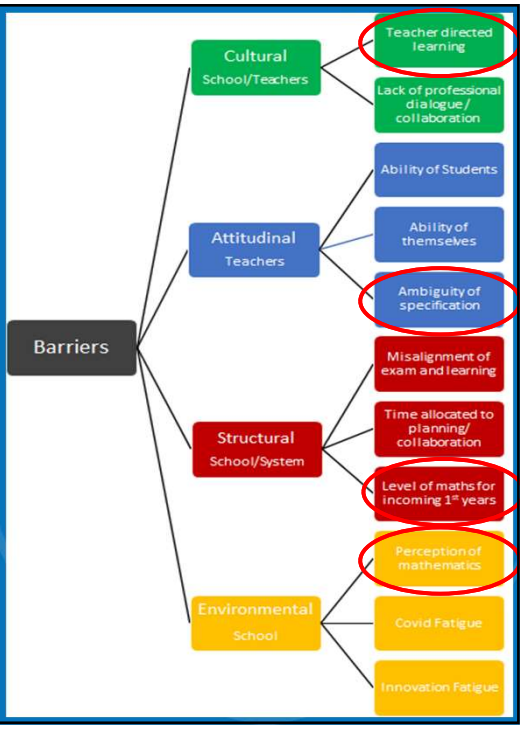
2. Focus on Mastery



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Pedagogy counts!

Focus on Mastery rather than (only) on Performance (Martin et al., 2015; Megowan-Romanovicz. 2013)

- Use the **intended curriculum** to scaffold your planning
  - » Equal importance given to mastery and performance through the integration of the five strands in planning

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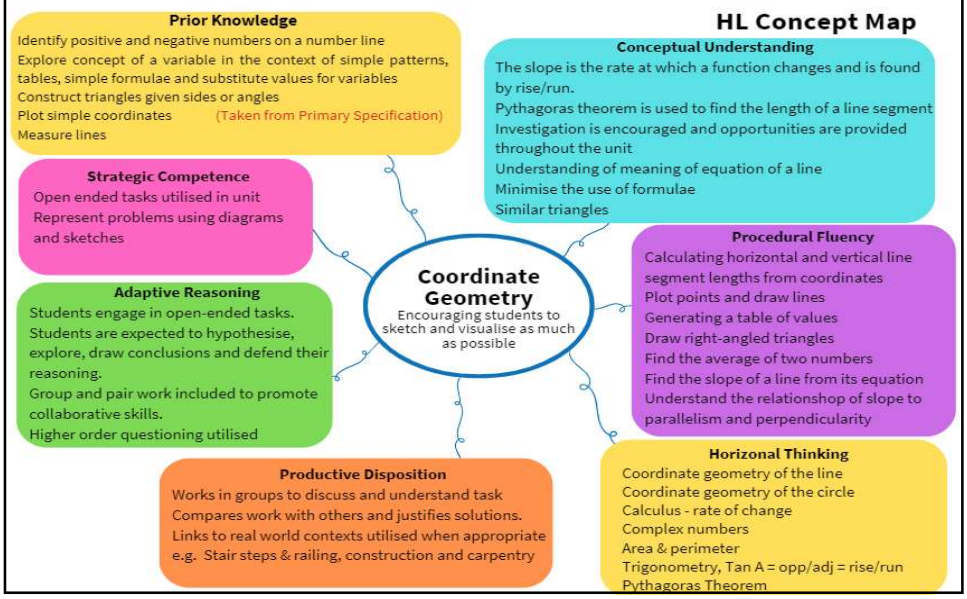
Units of Learning ~ Maths Proficiency

Using the intended curriculum for planning



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Pedagogy counts!

CBA – preparing both teachers and students

Focus on Mastery rather than (only) on Performance (Martin et al., 2015; Megowan-Romanovicz. 2013)

- Use the **intended curriculum** to scaffold your planning
- Take the **time** to ensure deep understanding
- Use **"rich" tasks** (Mizra & Hussain, 2014)

'I did not feel like I was doing Maths- I felt like I was playing a game or completing a puzzle. It was very enjoyable.'

'I feel like I understand what I am doing instead of just learning off a formula. This makes me feel more confident in Maths.'

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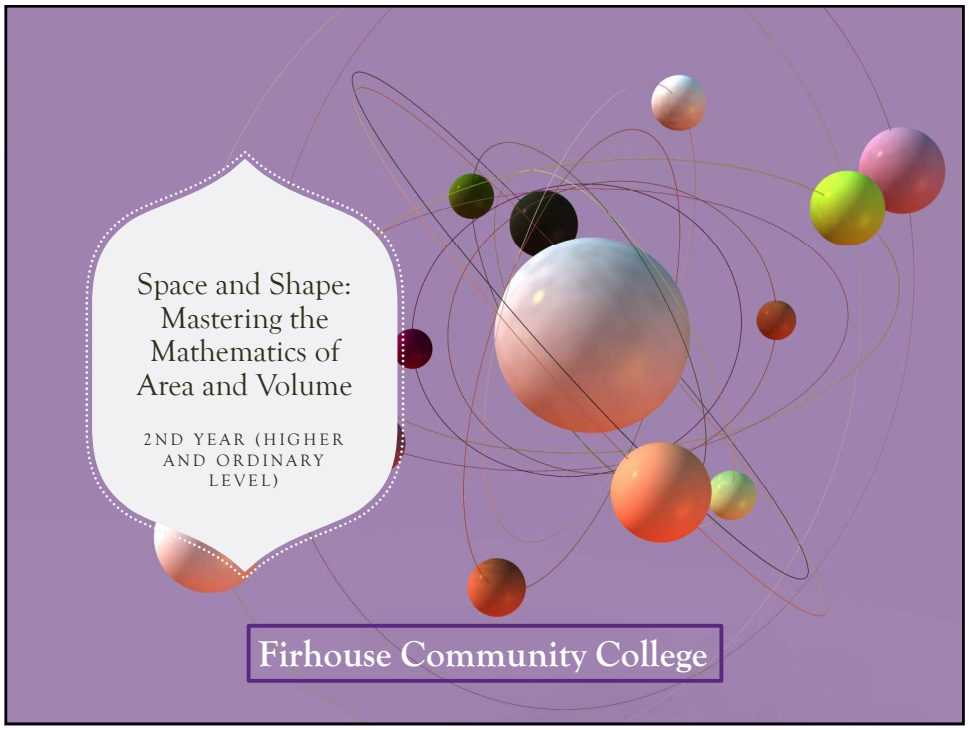

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Purpose of this activity:

1. Promote deep understanding via physical interaction. E.g., OL students count boxes.
2. Investigate changes in area and perimeter of 2D shapes (rectangles, squares, triangles)
3. Encourage classroom discussion amongst students.

"In a mixed ability group the teacher has to *open* the work, making it suitable for students working at different levels and different speeds."
(Boaler, 2015, p.105)

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JCT Task

"If a piece is cut off a two-dimensional shape it reduces both the area and the perimeter"

Investigate this statement.

What conclusions can be drawn?

Justify your reasoning.

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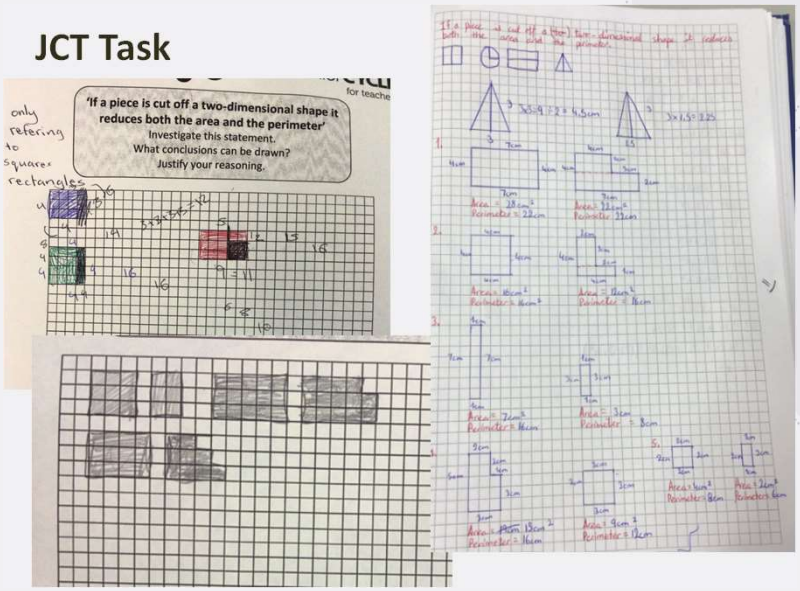
JCT Task



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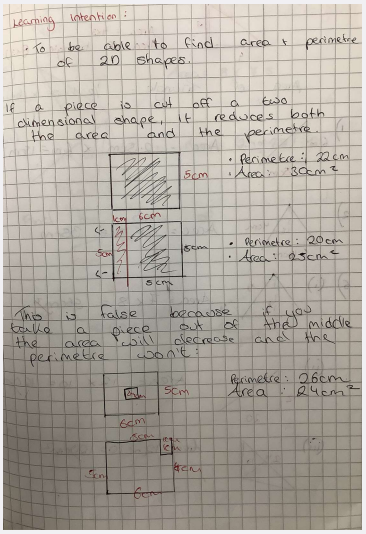
JCT Task



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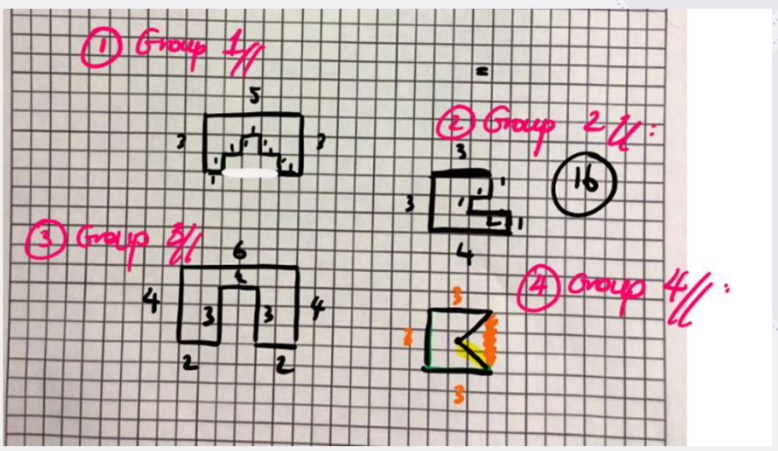
JCT Task:



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What the teachers say

Activities and rich tasks allow the students to take ownership of their own learning which is so refreshing to see, and the students themselves really enjoy it as they are experiencing a sense of achievement throughout the lessons.

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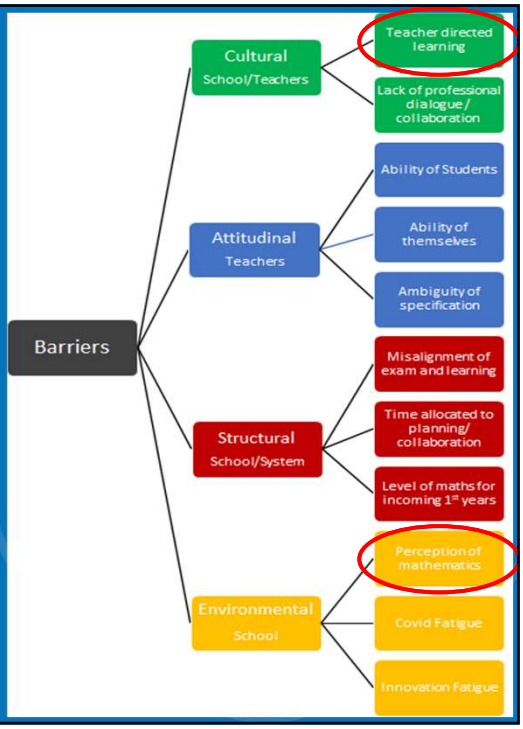
3. Motivation via Intrinsic and Utility Value



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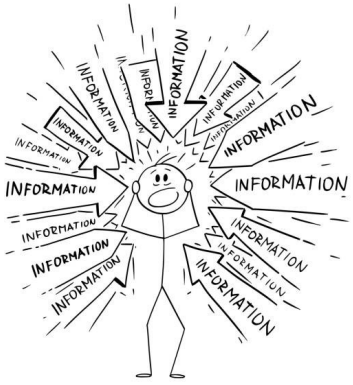
Motivation counts!

Use of meaningful context

- *Intrinsic value* (i.e., personal enjoyment),
- *Utility value* (i.e., perceived usefulness for future goals)



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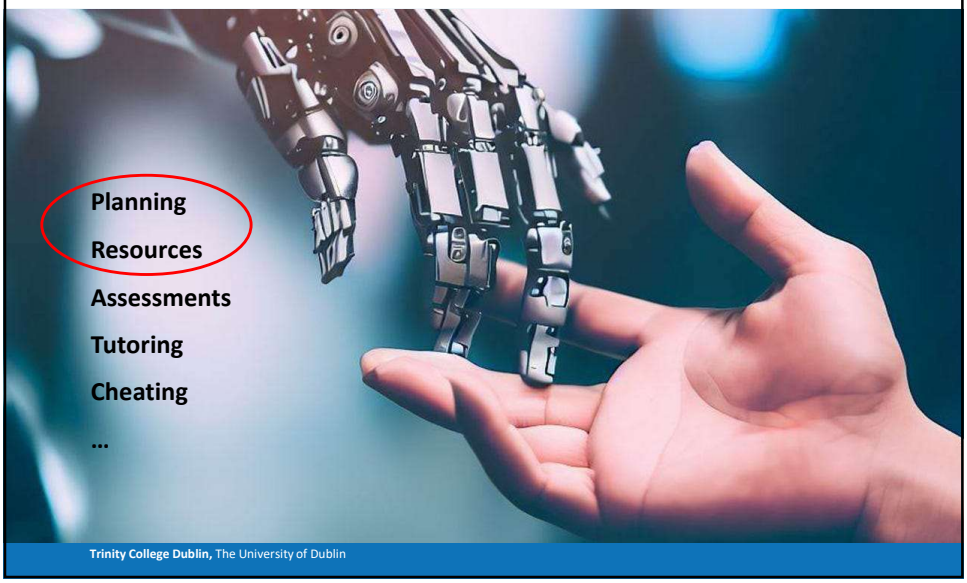
AI in Maths Education?

How might we use AI in teaching and learning?



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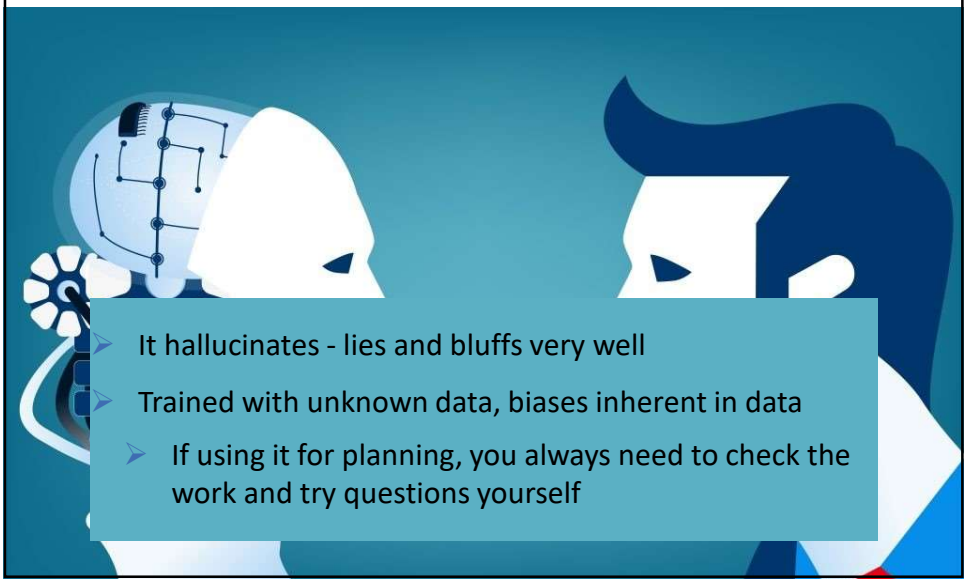
Issues



- It hallucinates - lies and bluffs very well
- Trained with unknown data, biases inherent in data
  - If using it for planning, you always need to check the work and try questions yourself

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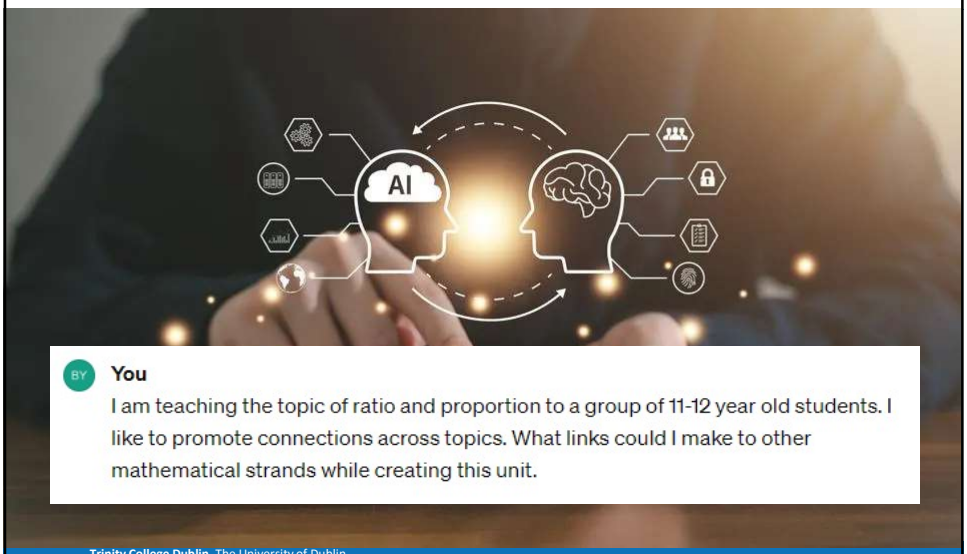
Prompt number 1



You

I am teaching the topic of ratio and proportion to a group of 11-12 year old students. I like to promote connections across topics. What links could I make to other mathematical strands while creating this unit.

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ChatGPT

Teaching ratio and proportion to 11-12 year old students offers a great opportunity to interconnect various mathematical concepts. Here are some links you can make to other mathematical strands:

1. **Fractions:** Ratios are closel expressed as a fraction anc is similar to simplifying rati
2. **Decimals and Percentages** and this conversion is a pra representations of the sam
3. **Multiplication and Divisior** grasp of multiplication and involving proportional reas
4. **Algebra:** Introducing simpl through ratio and proportic y when x is 6?
5. **Geometry:** Ratios are fundi and figures. This can be a b drawings.
6. **Measurement:** Ratios are often used in measurement for converting units (e.g., kilometers to miles, grams to pounds). This can also extend to real-life applications like cooking (recipes scaling) and map reading (scale).
7. **Statistics and Probability:** Ratios are used in statistics to compare data sets and in probability to express the likelihood of an event occurring.
8. **Real-Life Applications:** Emphasize how ratio and proportion are used in everyday life, such as in cooking (recipes), shopping (comparing prices), and even in sports (statistics).
9. **Financial Mathematics:** Ratios are key in understanding concepts like interest rates, exchange rates, and financial ratios used in business.
10. **Problem Solving:** Encourage students to apply their knowledge of ratios and proportions to solve complex, multi-step problems, fostering critical thinking and analytical skills.

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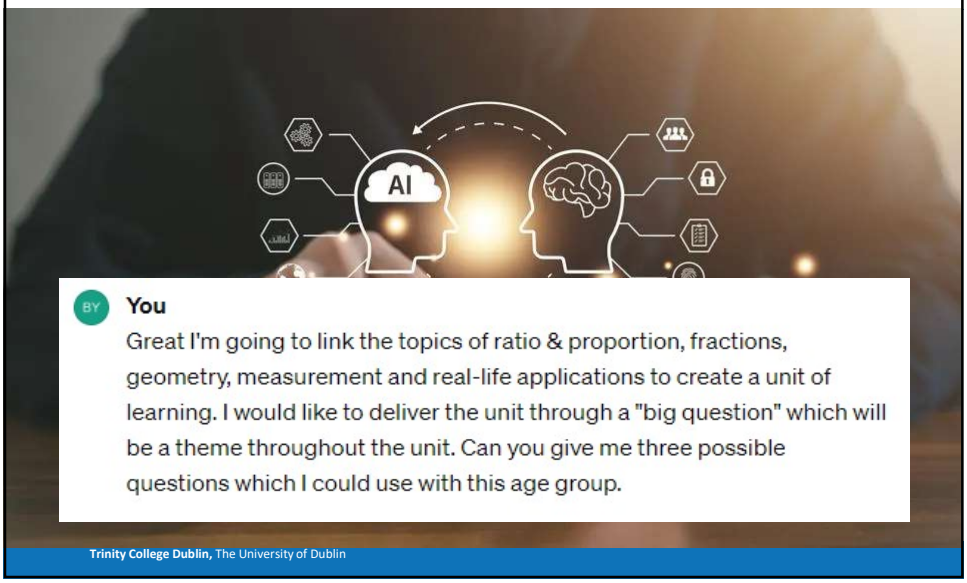
The Big Question: Prompt number 2



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ChatGPT

Creating a unit around a "big question" is a fantastic way to engage students and provide context to the mathematical concepts you're teaching. Here are three big questions that could effectively tie together the topics of ratio & proportion, fractions, geometry, measurement, and real-life applications for your 11-12 year old students:

1. **"How can we use mathematics to design our own dream park?"**
   - This question allows students to explore ratios and proportions in the context of designing a layout (e.g., playground to green space ratios). They can use fractions to allocate different areas of the park and apply geometry for planning paths, playgrounds, and other structures. Measurement is key in scaling their designs accurately. This project can be very hands-on and encourages creativity, planning, and practical application of math in a real-world scenario.
2. **"Can we plan a sustainable community garden using mathematical concepts?"**
   - This question encourages students to apply ratios and proportions to allocate space for c
   garden. They can u
   vegetables, and fru
   Measurement skills
   scale drawings. Thi
   sustainability and e
   multidisciplinary.
3. **"How can we use math to organize a school event or fair?"**
   - This question allows students to apply ratios and proportions to plan various aspects of the event, like the ratio of food stalls to game stalls. They can use fractions to divide tasks and resources, and geometry to layout the event space. Measurement skills come into play when allocating space for different activities and managing resources. This project can also incorporate financial mathematics (budgeting, pricing) and offers a practical insight into event planning.

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Some tips…

- Tell the AI **who** you are, and who you are creating the resource for (e.g., I am a maths teacher working with a class aged 11-12 years old).
- Be specific as to **what** you want, a worksheet, an idea, a table.
  - Be clear on the *topics* you want included in the questions (area & perimeter, ratio, etc.)
  - Insert the *type of question* which you would like to get similar questions back.
- **Critique** the questions and engage with a dialogue to improve questions and ideas.

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Have a go..

https://chat.openai.com/auth/login

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Let's have a play

Use Chat GPT to generate any one of the following:

- An activity that connects two or three areas of mathematics in a meaningful way.
- A big question which you could use to link maths to real life.
- An active learning activity for a class that you are teaching next week.
- An individualised learning activity for a student in your class.

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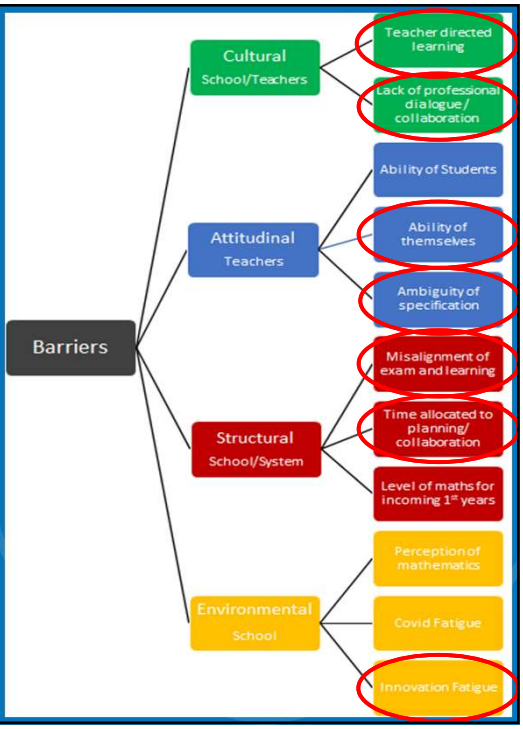
4. Collaborate and iterate



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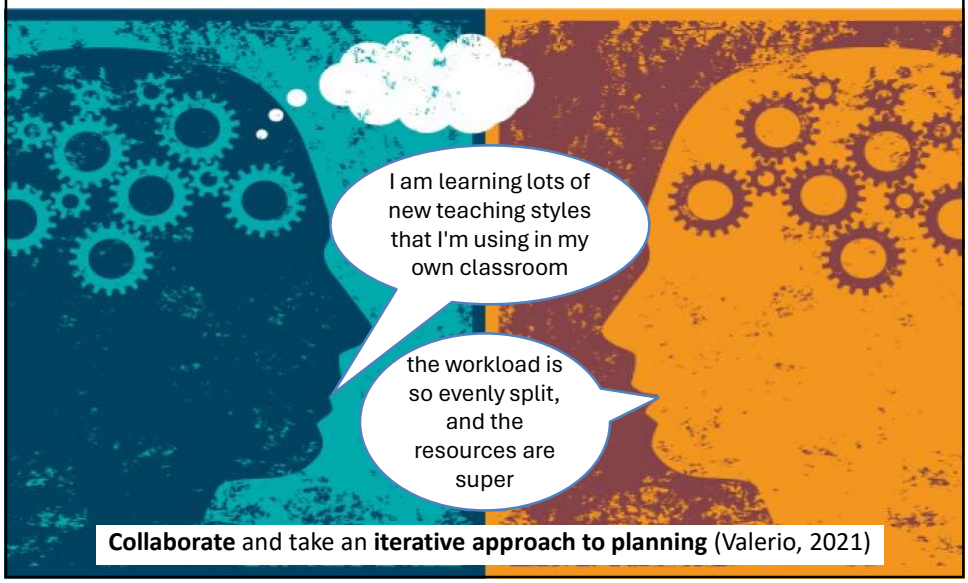
Teachers Matter!



Collaborate and take an **iterative approach to planning** (Valerio, 2021)

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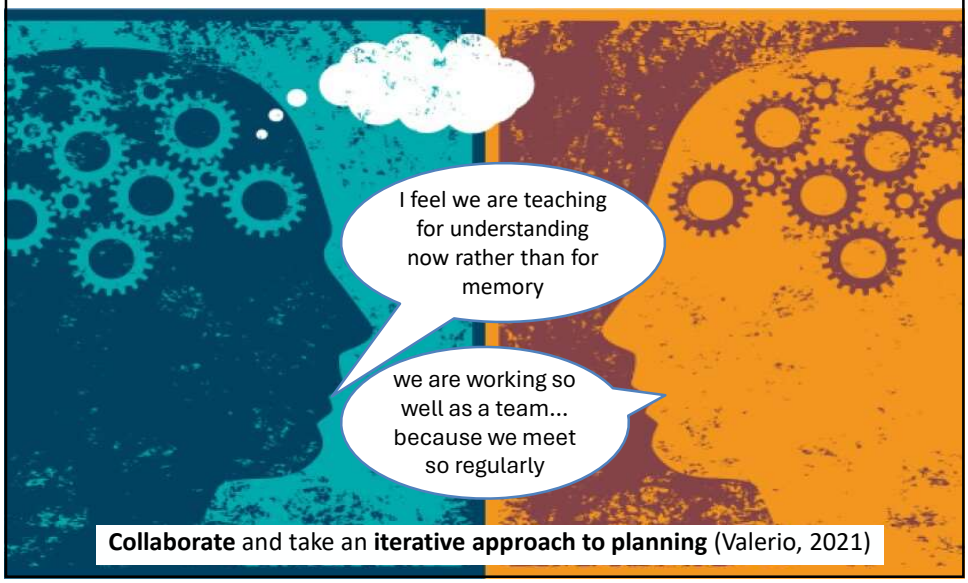
Teachers Matter!



Collaborate and take an **iterative approach to planning** (Valerio, 2021)

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A work in progress

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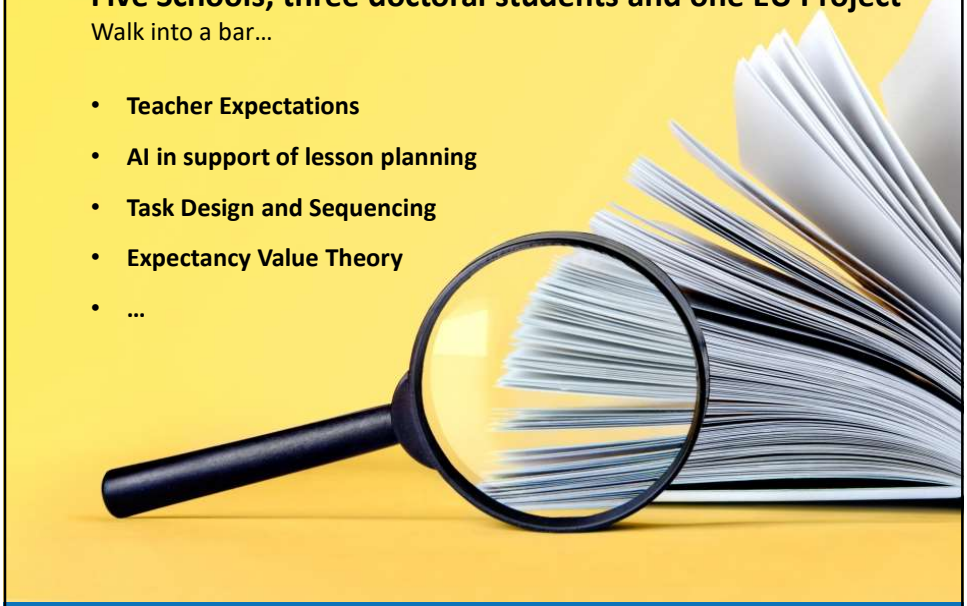
Five Schools, three doctoral students and one EU Project

Walk into a bar…

- **Teacher Expectations**
- **AI in support of lesson planning**
- **Task Design and Sequencing**
- **Expectancy Value Theory**
- **…**



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This is just the beginning!

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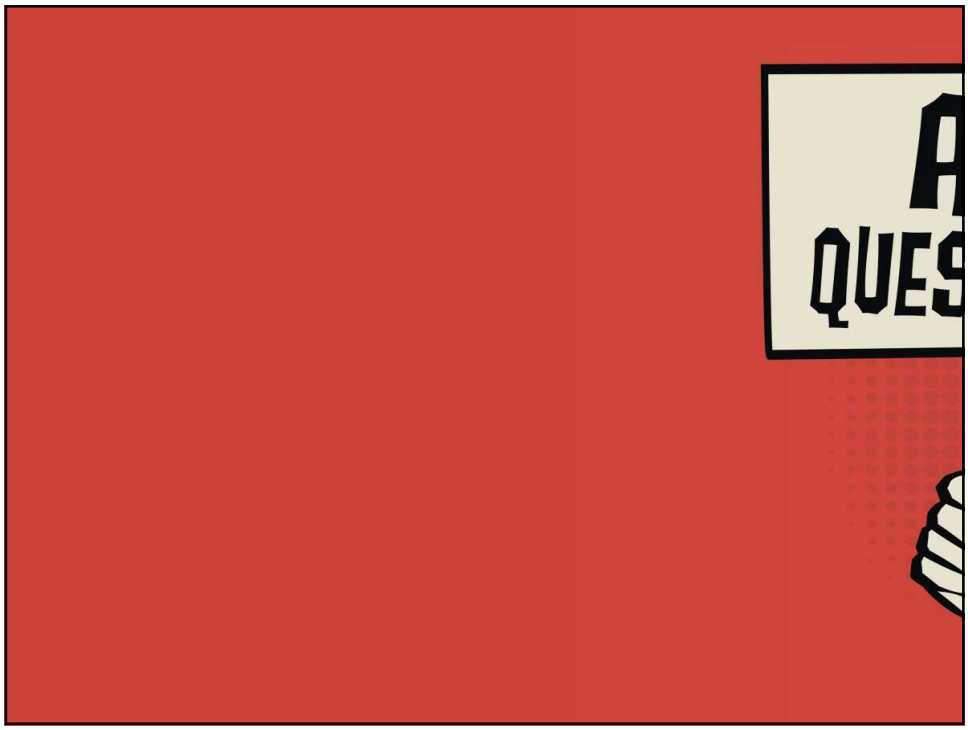

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Thank You

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