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The University of Dublin

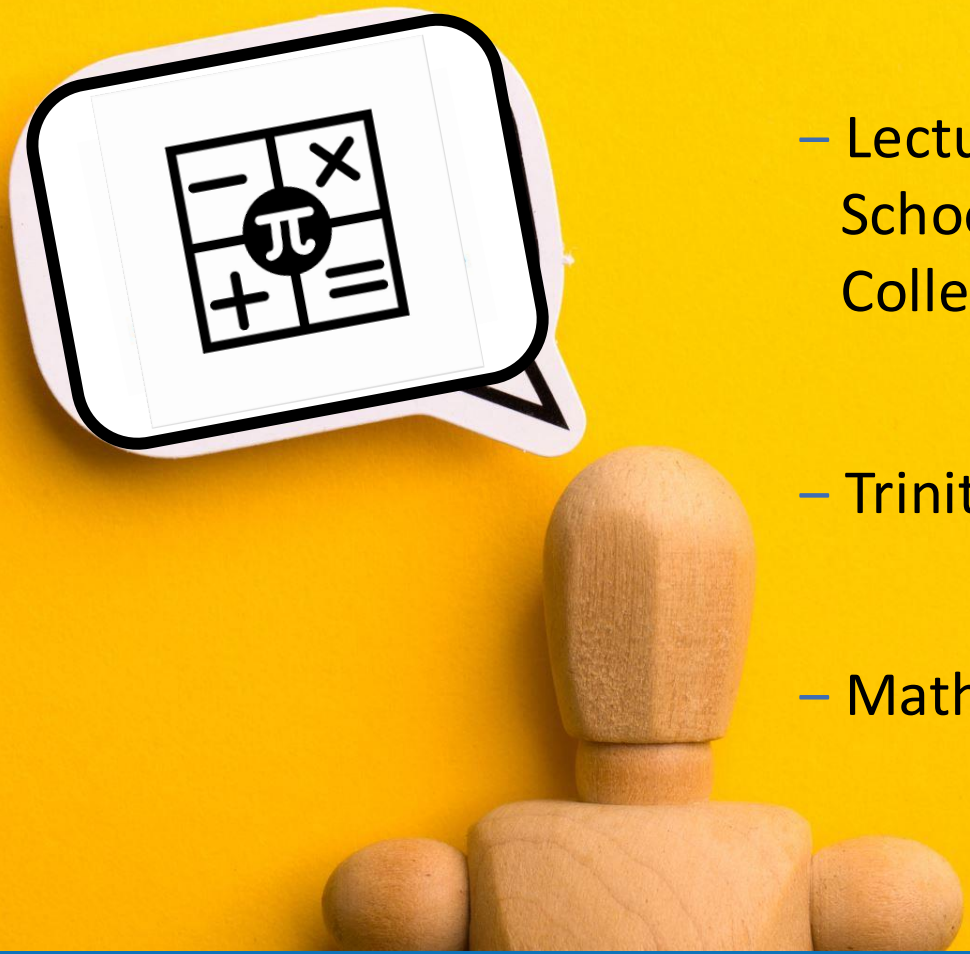
Supporting success for at-risk learners in mathematics: Research into Practice

Aibhín Bray

Trinity College Dublin, the University of Dublin, Ireland

Co-funded by the European Union

Who am I?



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

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Access Maths in STEM (AMiS)

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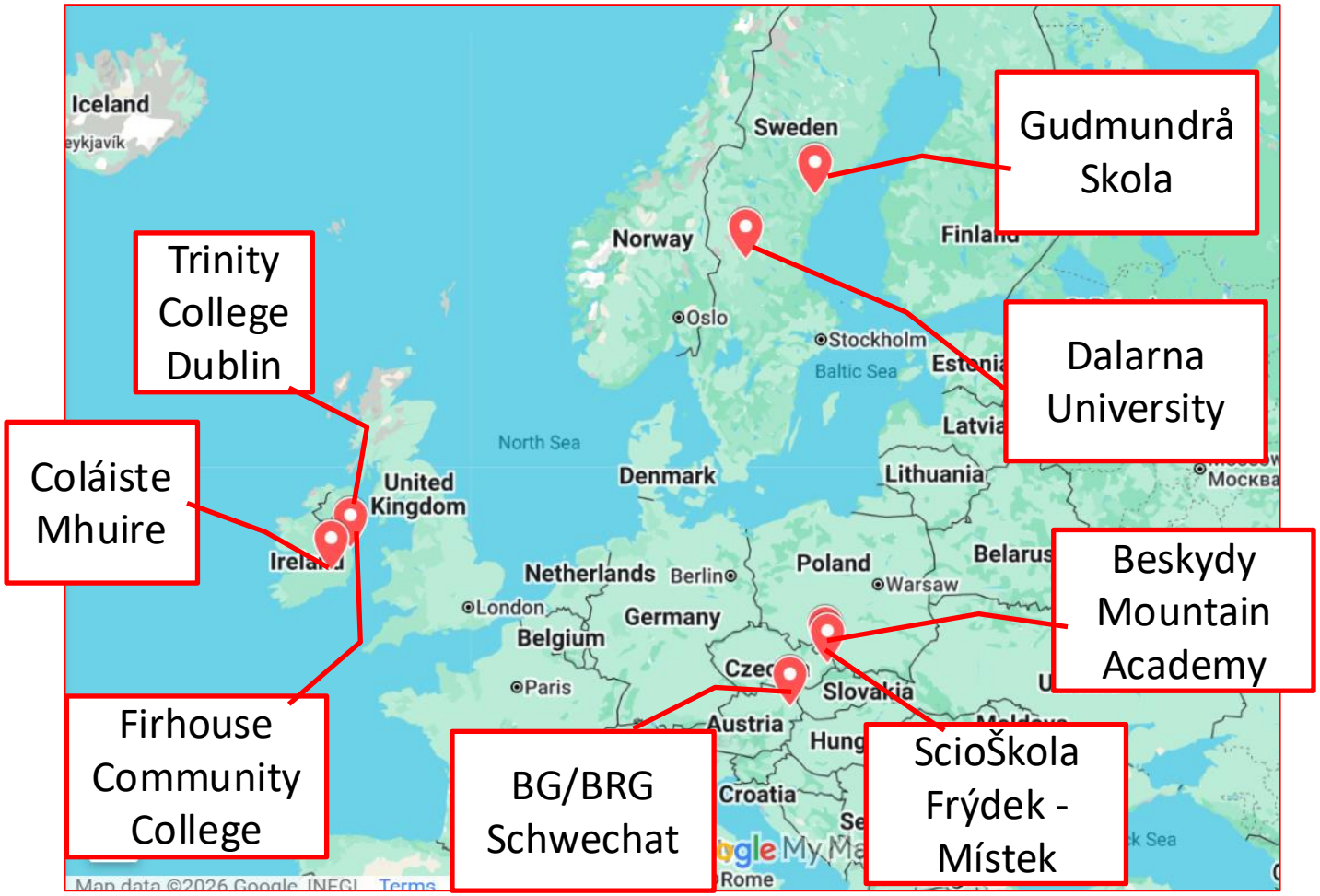
Access Maths in STEM - AMiS

Goal: to improve mathematics teaching, so as to enhance student outcomes in terms of proficiency and enjoyment.

Method: engaging teachers in a Community of Practice to support their co-design of innovative, inclusive, and student-centred mathematics activities and lessons.

AMiS Partners: 2 universities & 6 schools



Overview

Research into Practice

1. **What is the problem?**
2. **What does research say we can do about it?**
3. **How should we interpret it?**
4. **Website and resources.**

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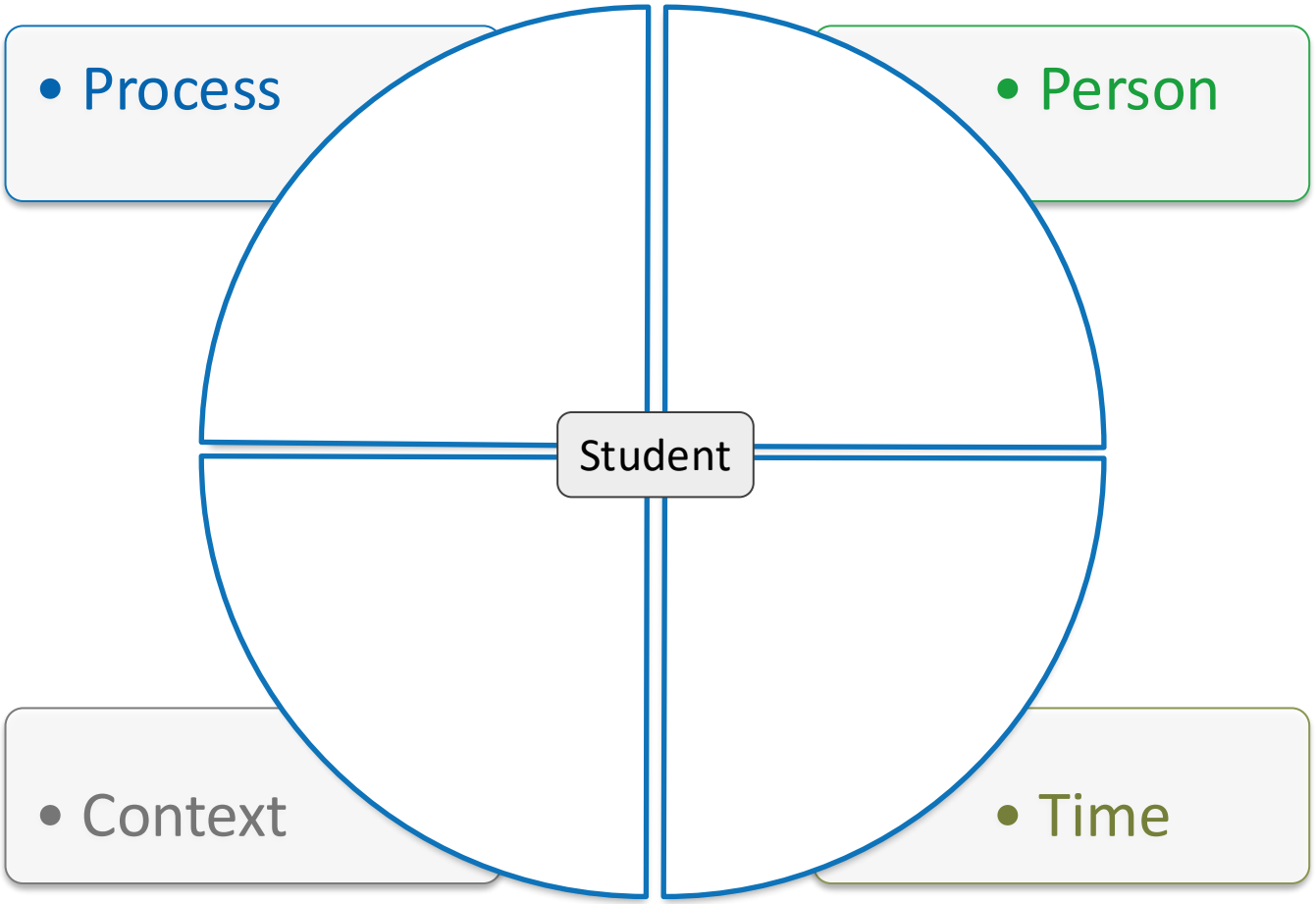
In Ireland, students who attend schools in areas of low socio-economic status (SES) are 60% less likely to take higher-level mathematics by the end of secondary school than their more advantaged peers.

Globally, students in schools in areas of low SES are less likely to succeed in mathematics.

Placing the student at the centre

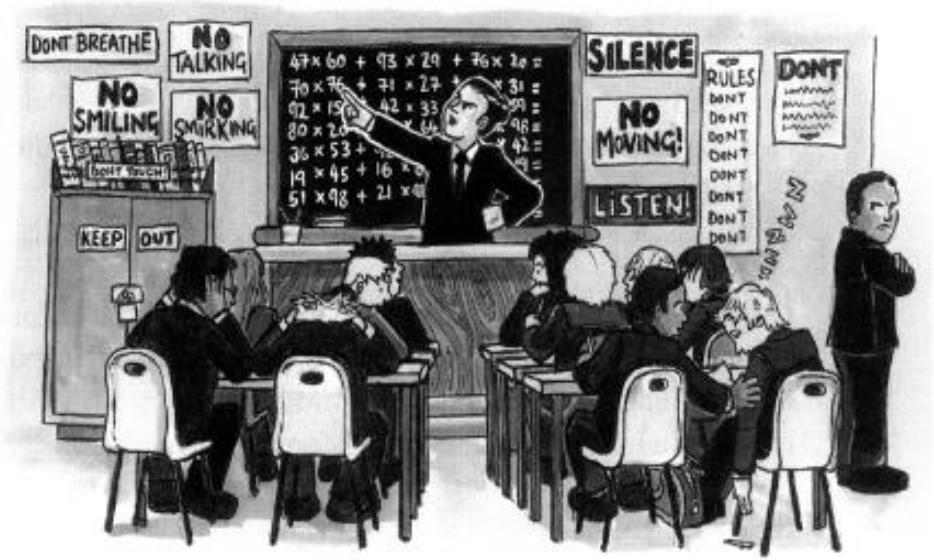
Bronfenbrenner's Process, Person, Context, Time (PPCT) model (2007)



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).



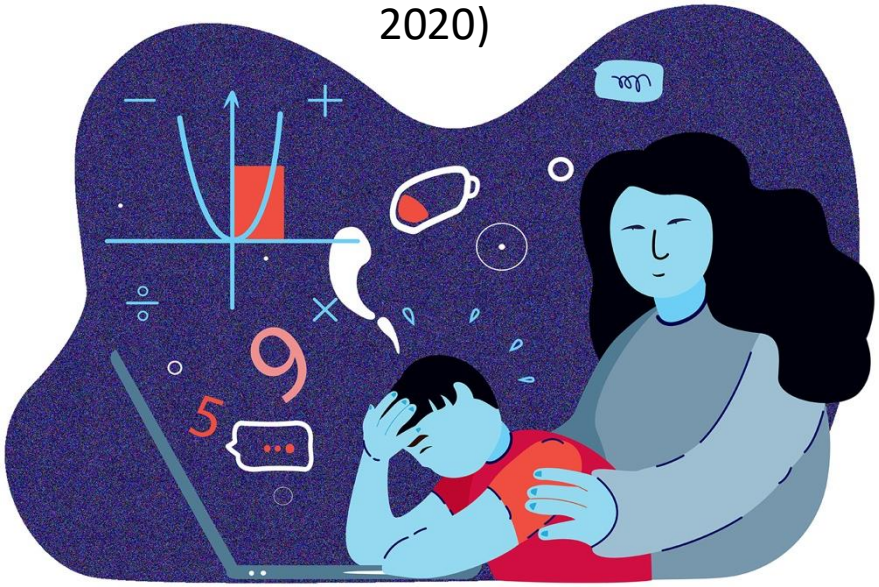
Person

The student

In schools in areas of low SES, students' attitudes towards, and motivation to engage with, mathematics tends to be more negative.

Students tend to experience higher levels of mathematical anxiety and lower self-concept in mathematics.

(Megowan-Romanowicz et al., 2013; Ní Shuilleabhain, Cronin, and Prendergast, 2020)



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.

School/Classroom Climate:

- Climate of low teacher expectations for students (Megowan-Romanowicz et al., 2013)
- Need for open, encouraging environment, in which students feel safe and supported (Cleary and Kitsantis, 2017)

Difficult working conditions (Dotson and Foley, 2016):

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

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).

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

What is being done???

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Curriculum Reform

Goal of the reform: Mathematically Proficient Students

Spurred on by cross-cultural studies such as **PISA** and **TIMSS**, significant efforts have been made across many countries to re-frame **mathematics education as relevant, connected and making sense**.

One way of conceptualising this is through five **intertwined strands of Mathematical Proficiency**.

Mathematical Proficiency

1. **conceptual understanding**—comprehension of mathematical concepts, operations, and relations
2. **procedural fluency**—skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
3. **strategic competence**—ability to formulate, represent, and solve mathematical problems in both familiar and unfamiliar contexts
4. **adaptive reasoning**—capacity for logical thought, reflection, explanation, justification and communication
5. **productive disposition**—habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence, perseverance and one's own efficacy

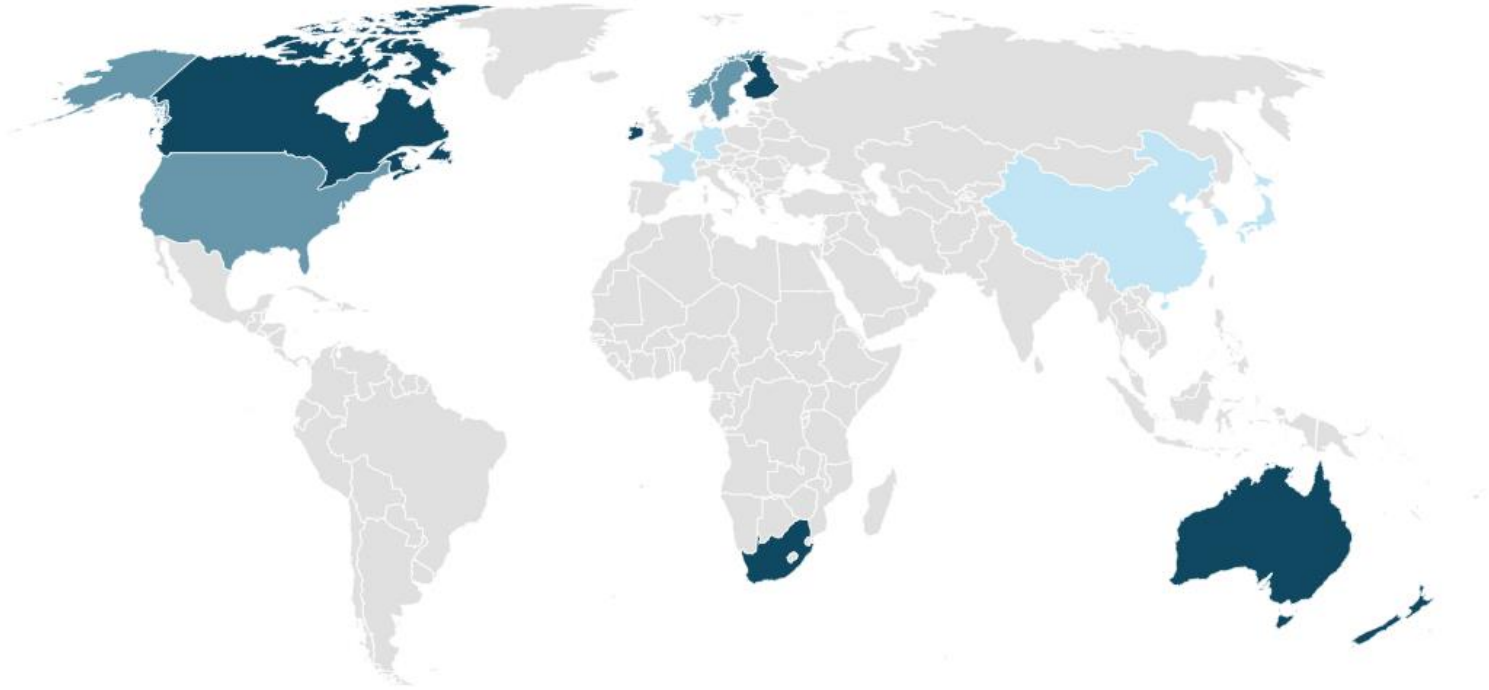
Problem solving

Mathematical thinking and communication

(Kilpatrick et al., 2001, p117)

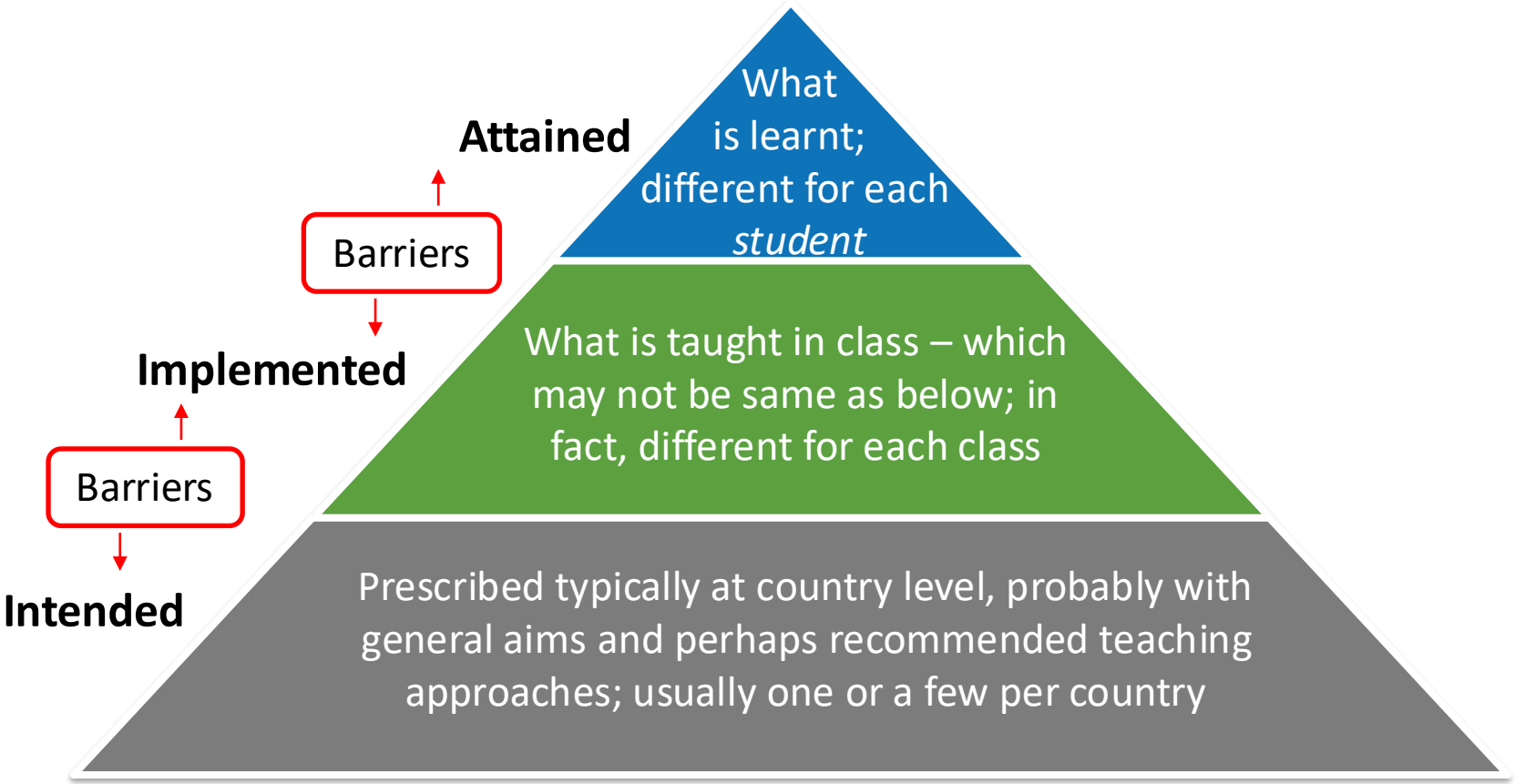
Goal of the reform: Mathematical Proficient Students

This terminology is not globally adopted, but there is strong conceptual alignment in many countries.



Three “levels” of curriculum

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



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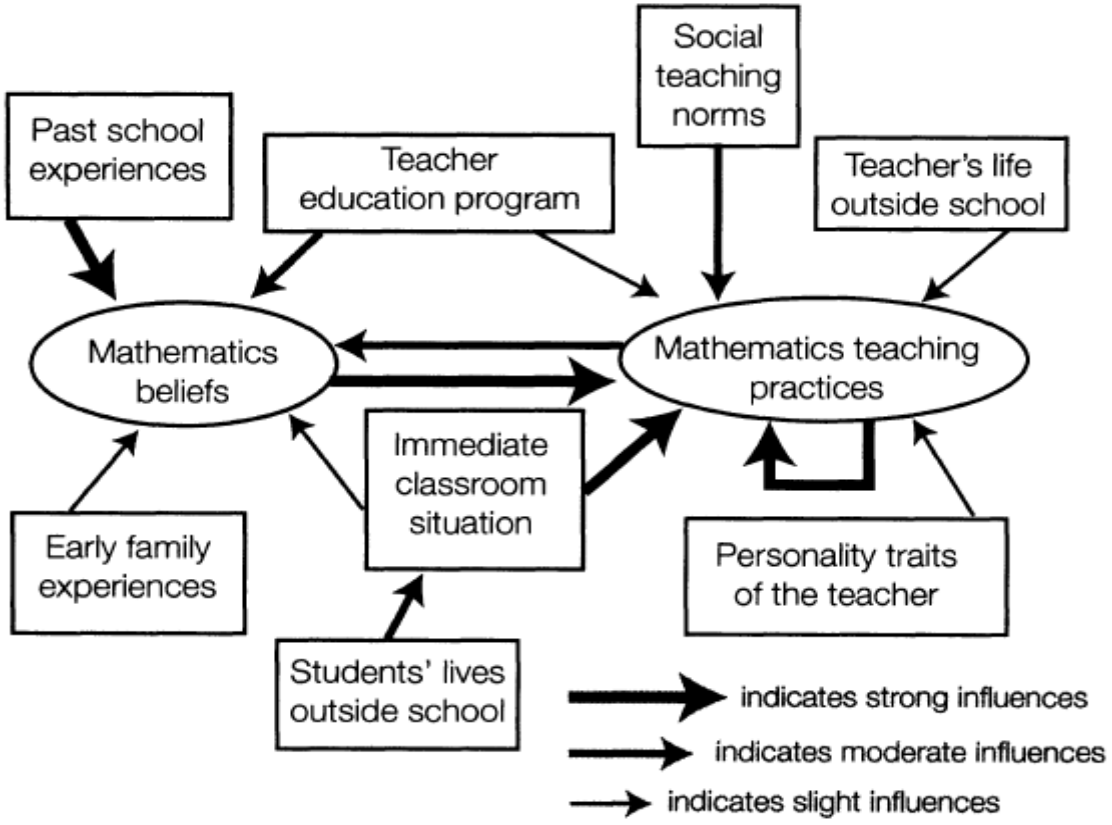
Why do we do what we do?

Influences on Mathematics Teaching Practice

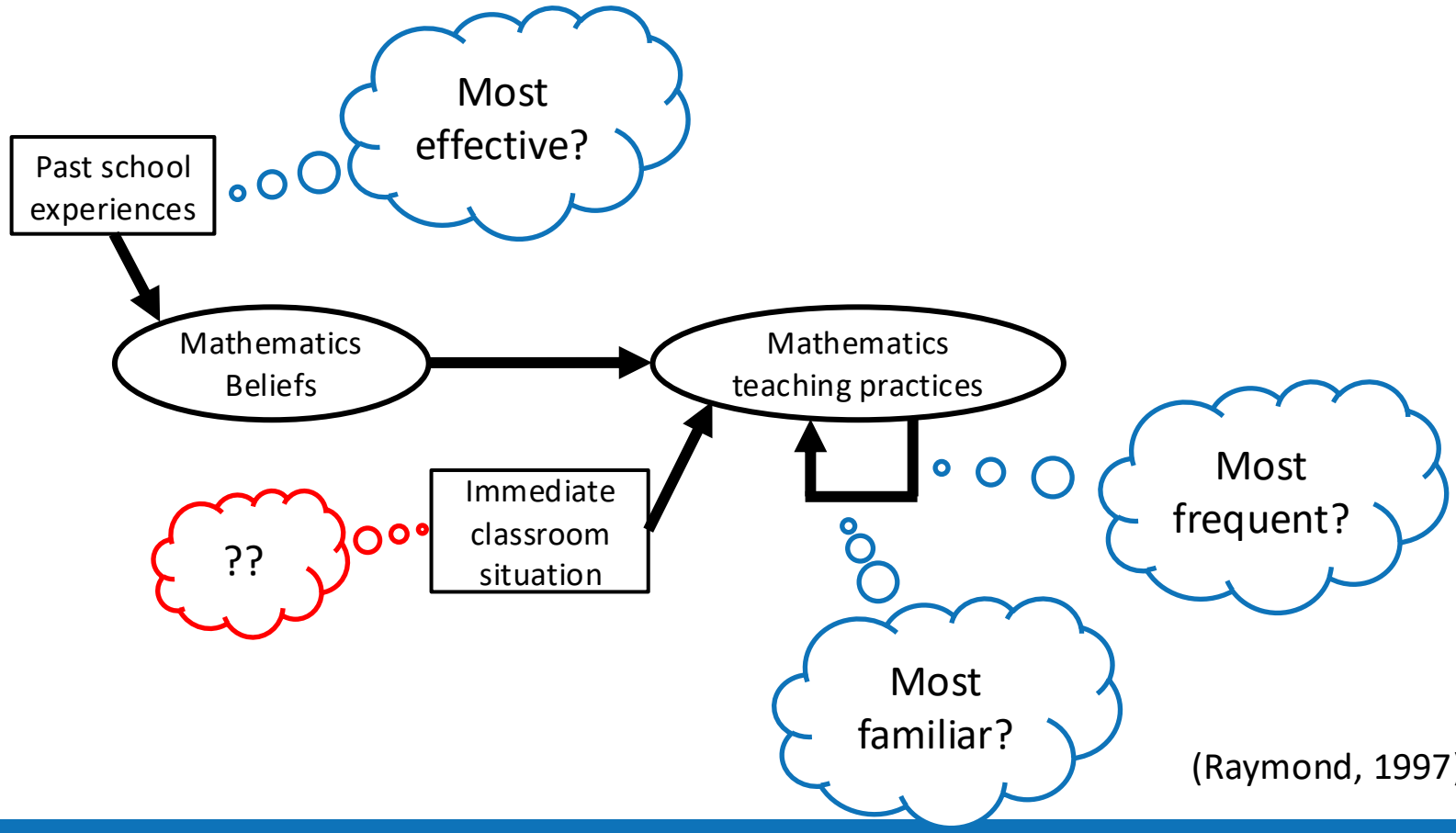
Take one minute to think about some of the possible influences on your own teaching practice – why do you teach the way you do?



(Raymond, 1997)

Influences on Teacher Beliefs & Practice

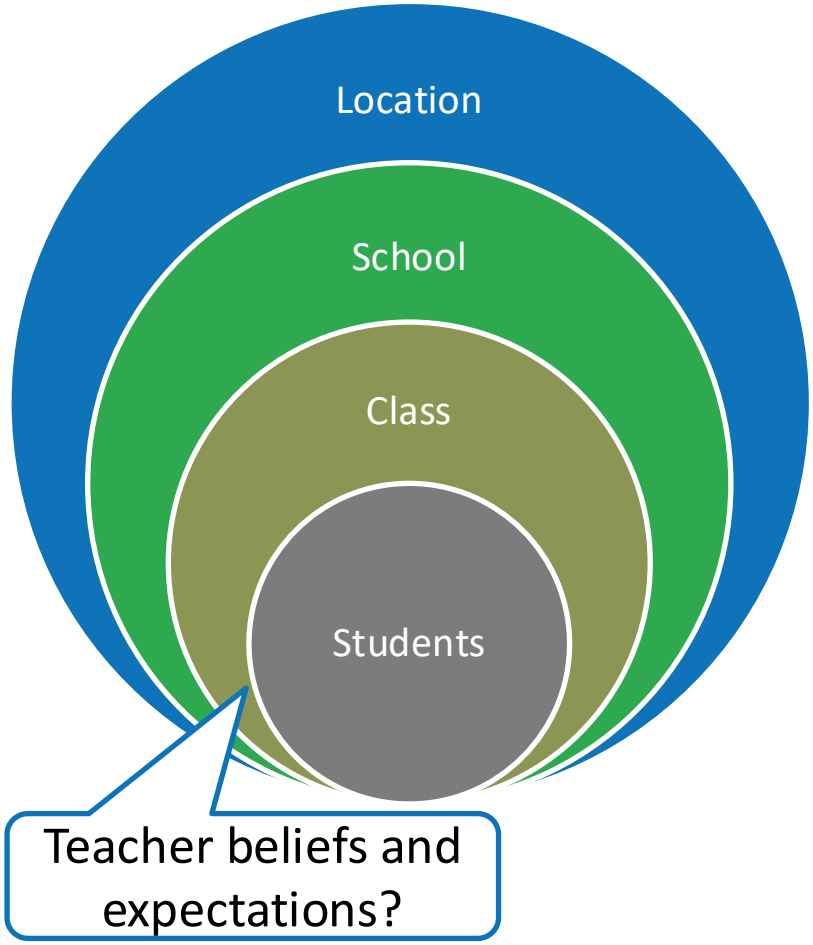
Strongest influences



(Raymond, 1997)

Immediate Classroom Situation

What is the classroom like?



Location: Urban / Rural / Affluent/ Impoverished

School:

- Fee-paying / non-fee-paying
- Socio-economic status
- Denominational / non-denominational
- Co-educational / single sex

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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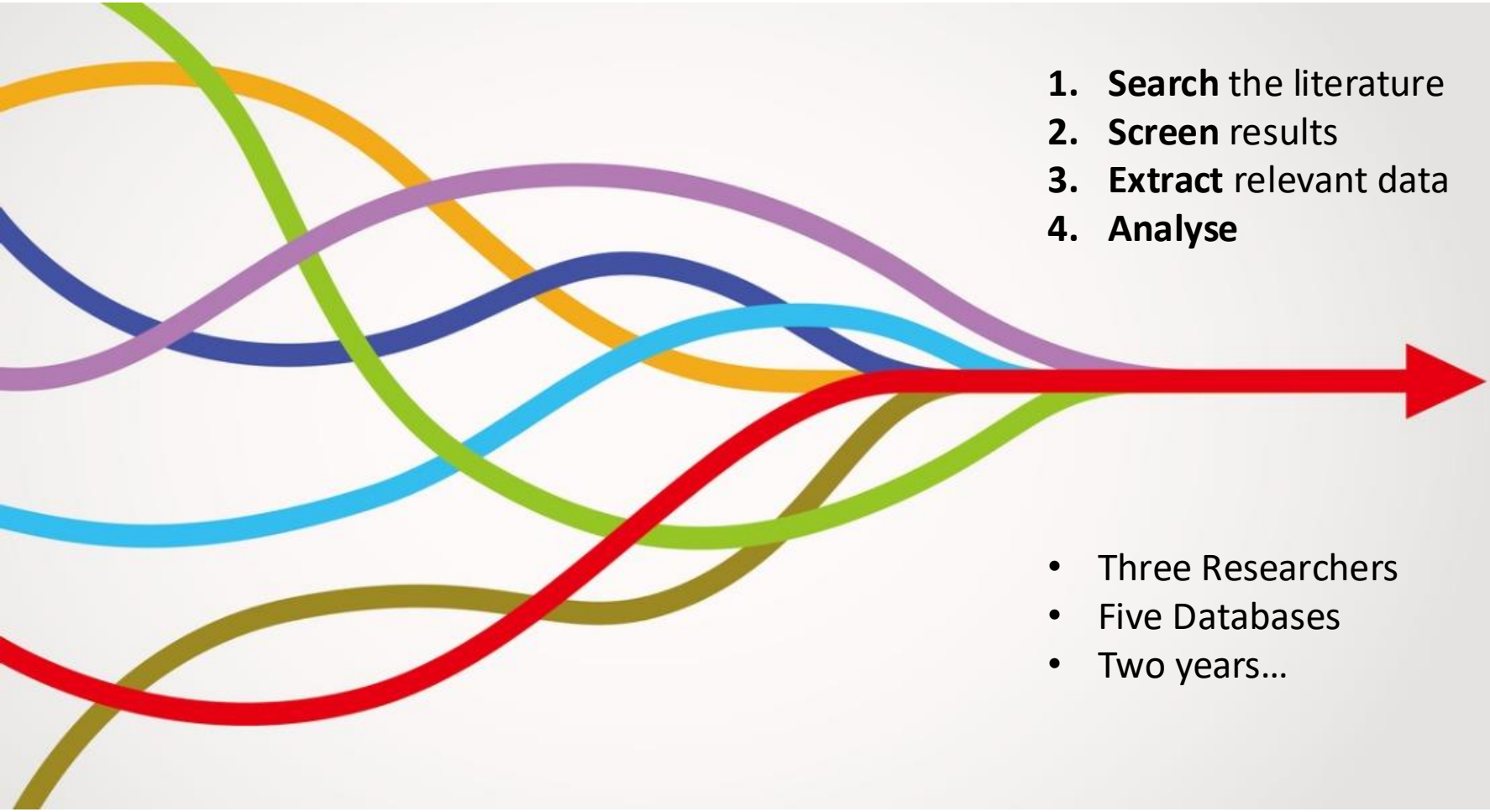
What “should” we do? What does the research tell us?

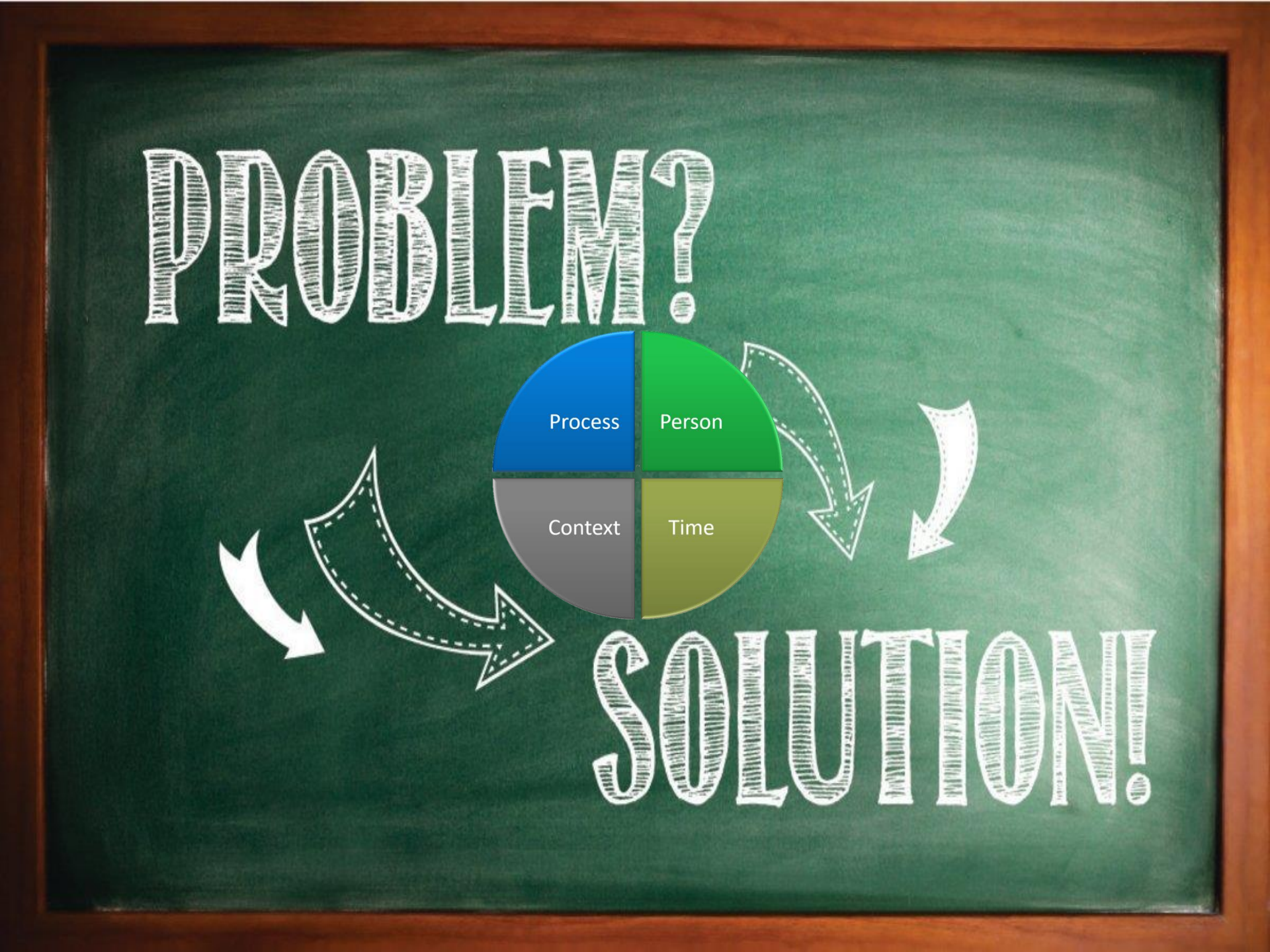
How do we know what is being done?

Systematic Literature Review



1. **Search** the literature
2. **Screen** results
3. **Extract** relevant data
4. **Analyse**

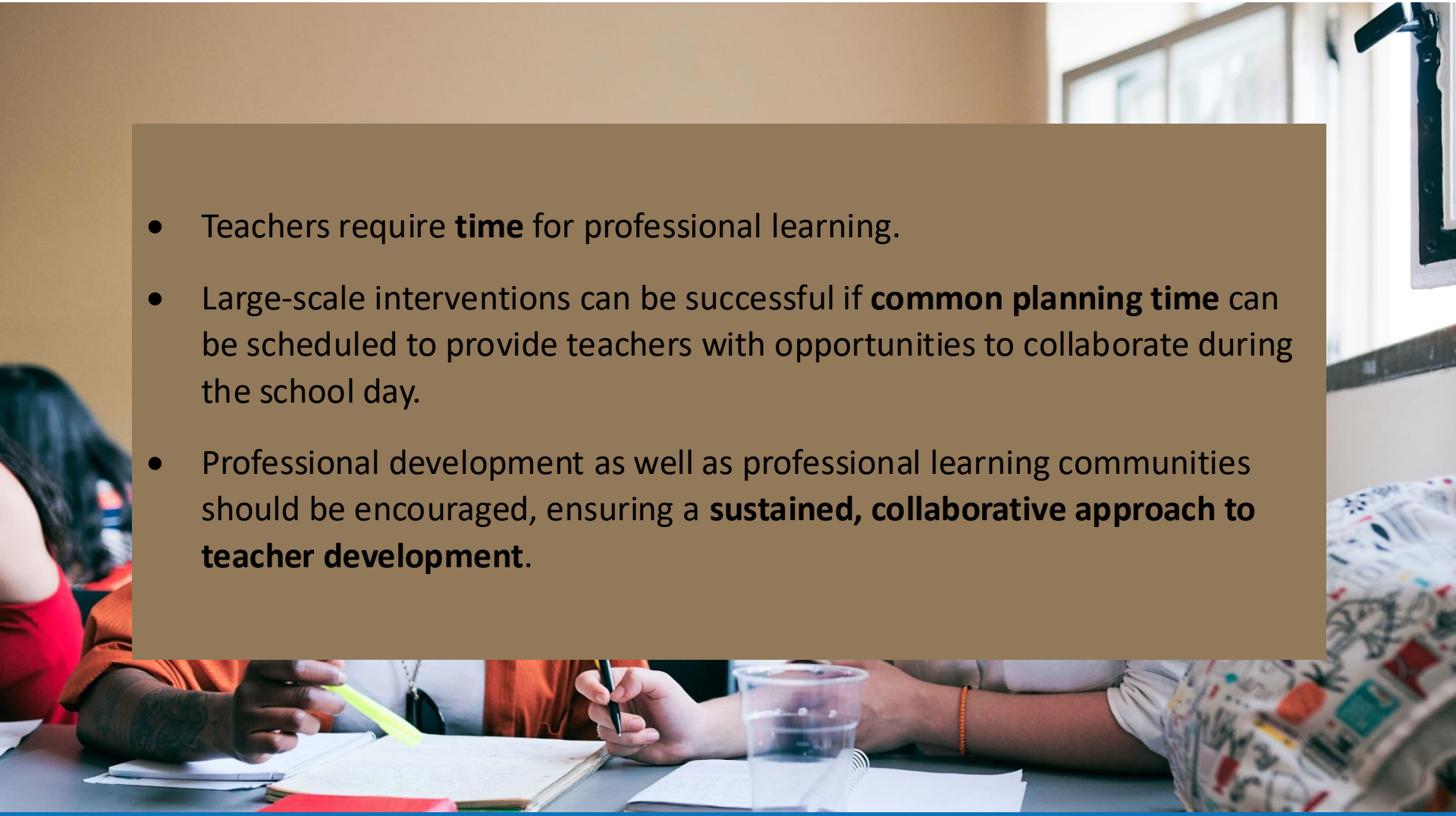
- Three Researchers
- Five Databases
- Two years…


PROBLEM?
Process
Person
Context
Time
SOLUTION!

Recommendations: Schools/Classroom focus

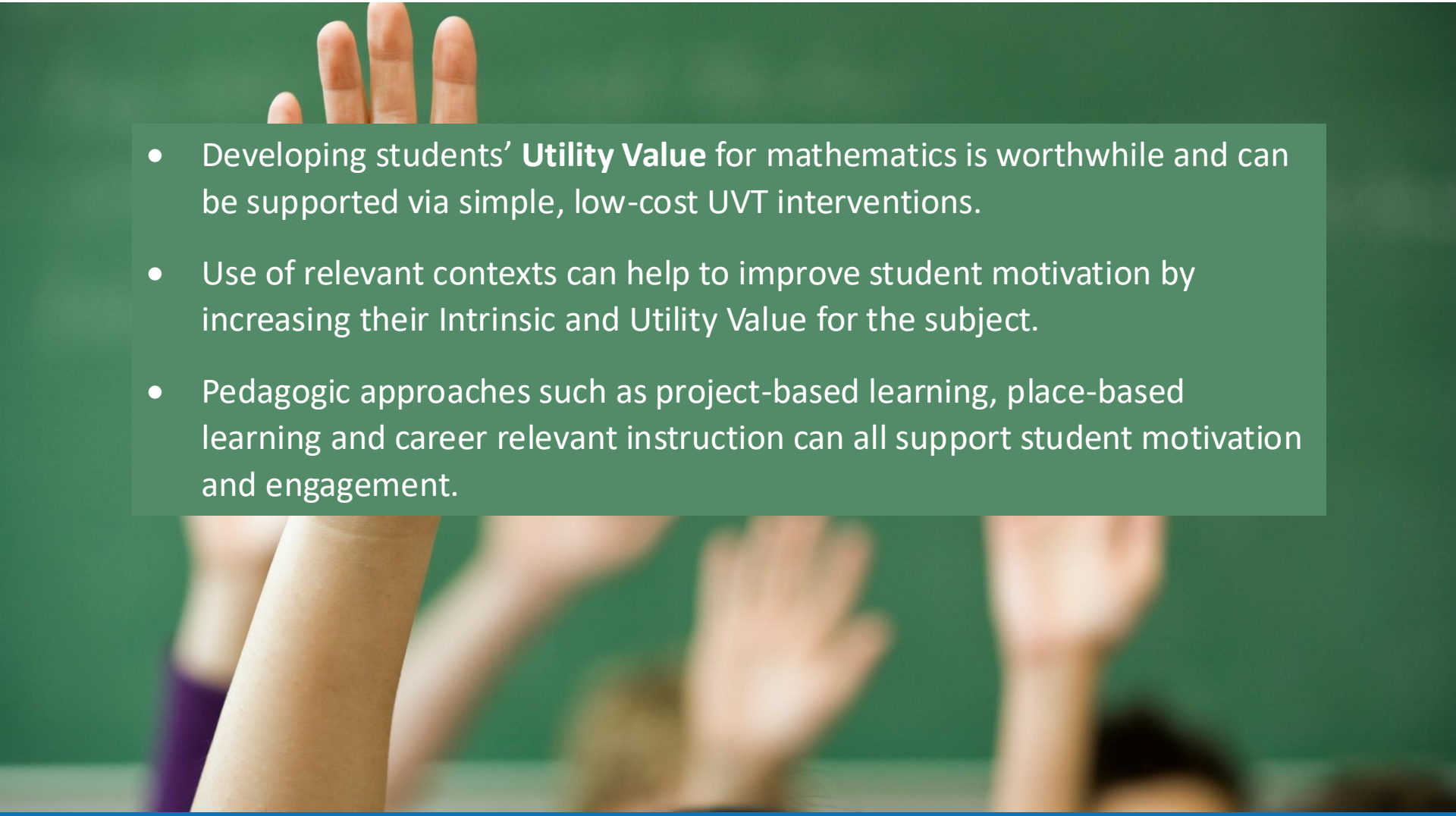
- Create a classroom and school climate in which students feel respected, listened to and safe.
- Where possible:
  - Keep higher level courses open to all learners, maintaining high expectations for students.
  - provide additional instruction to at-risk students.
  - Try to recruit “near peers” to support student learning.
  - Ensure that students have access to the resources that they need.

Recommendations: Teacher focus



- Teachers require **time** for professional learning.
- Large-scale interventions can be successful if **common planning time** can be scheduled to provide teachers with opportunities to collaborate during the school day.
- Professional development as well as professional learning communities should be encouraged, ensuring a **sustained, collaborative approach to teacher development**.

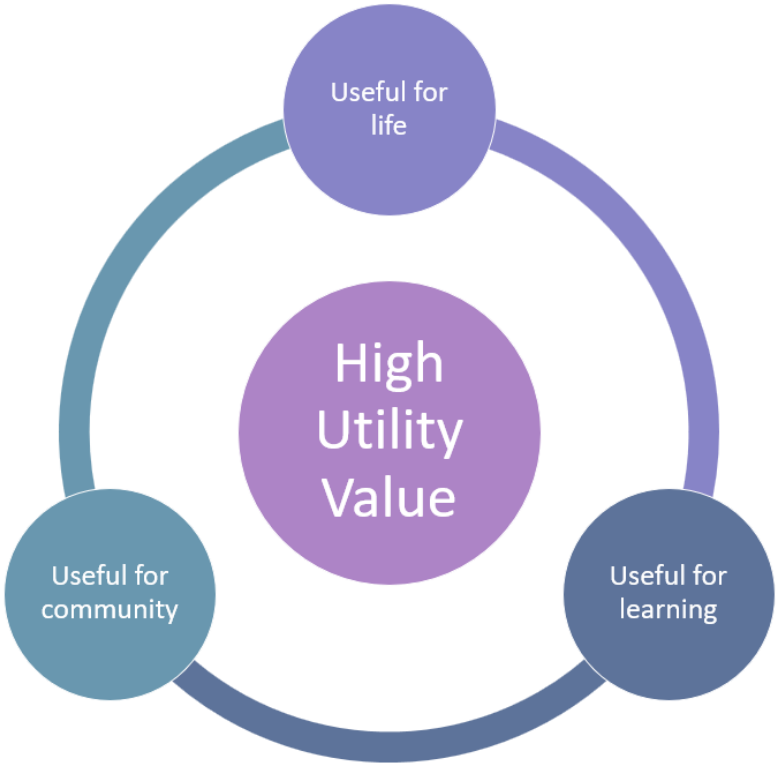
Recommendations: Student focus



- Developing students' **Utility Value** for mathematics is worthwhile and can be supported via simple, low-cost UVT interventions.
- Use of relevant contexts can help to improve student motivation by increasing their Intrinsic and Utility Value for the subject.
- Pedagogic approaches such as project-based learning, place-based learning and career relevant instruction can all support student motivation and engagement.

What is “Utility Value”

- the perceived usefulness of a task in relation to achieving future goals or providing satisfaction
- By increasing the utility task-value we can increase student engagement, interest and achievement
- Utility Value can be effected through discussion and reflection as well as by engaging with meaningful, contextualised mathematics activities .



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How have we implemented this? Access Maths in STEM (AMiS)

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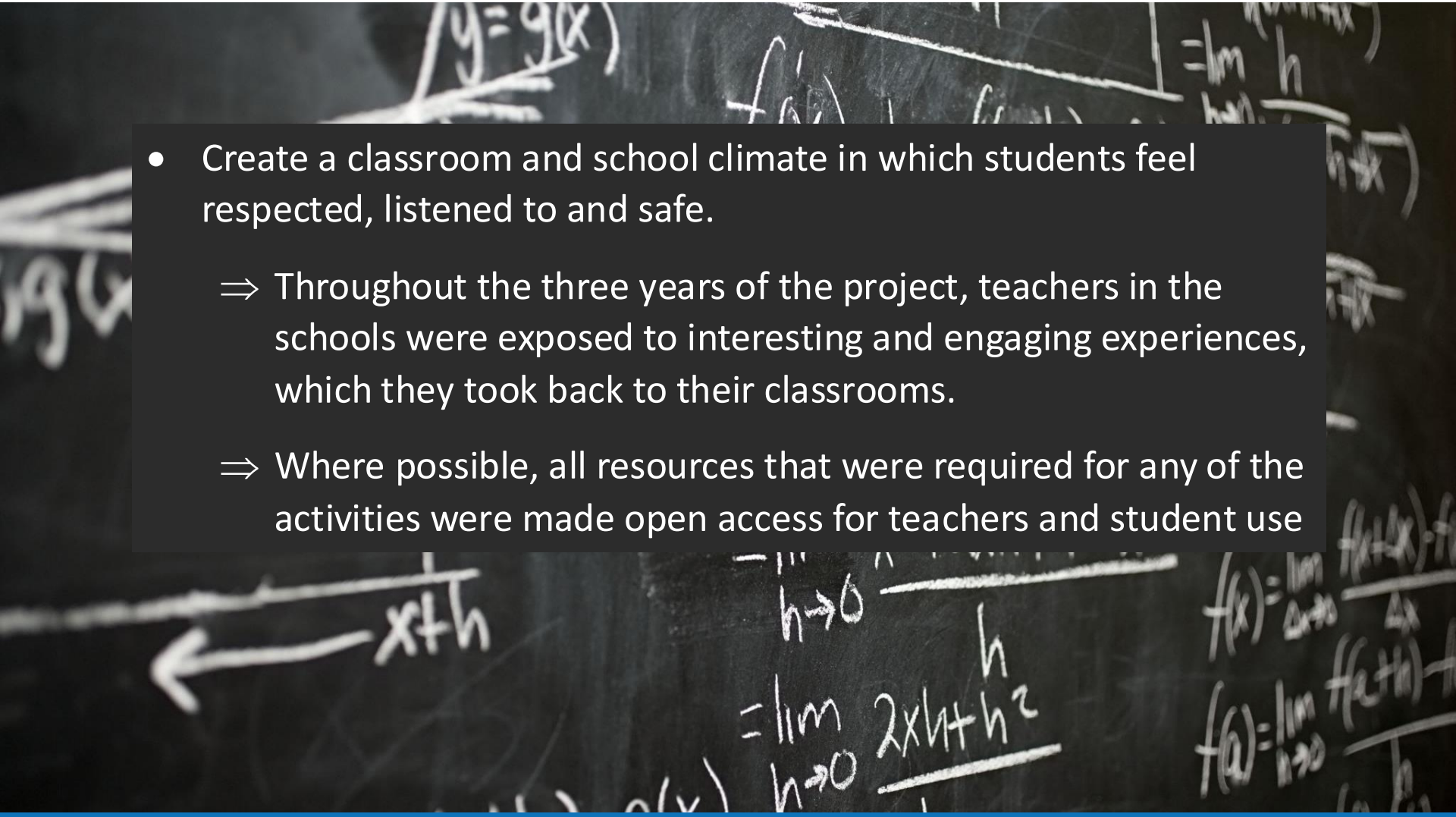
Recommendations: Schools/Classroom focus

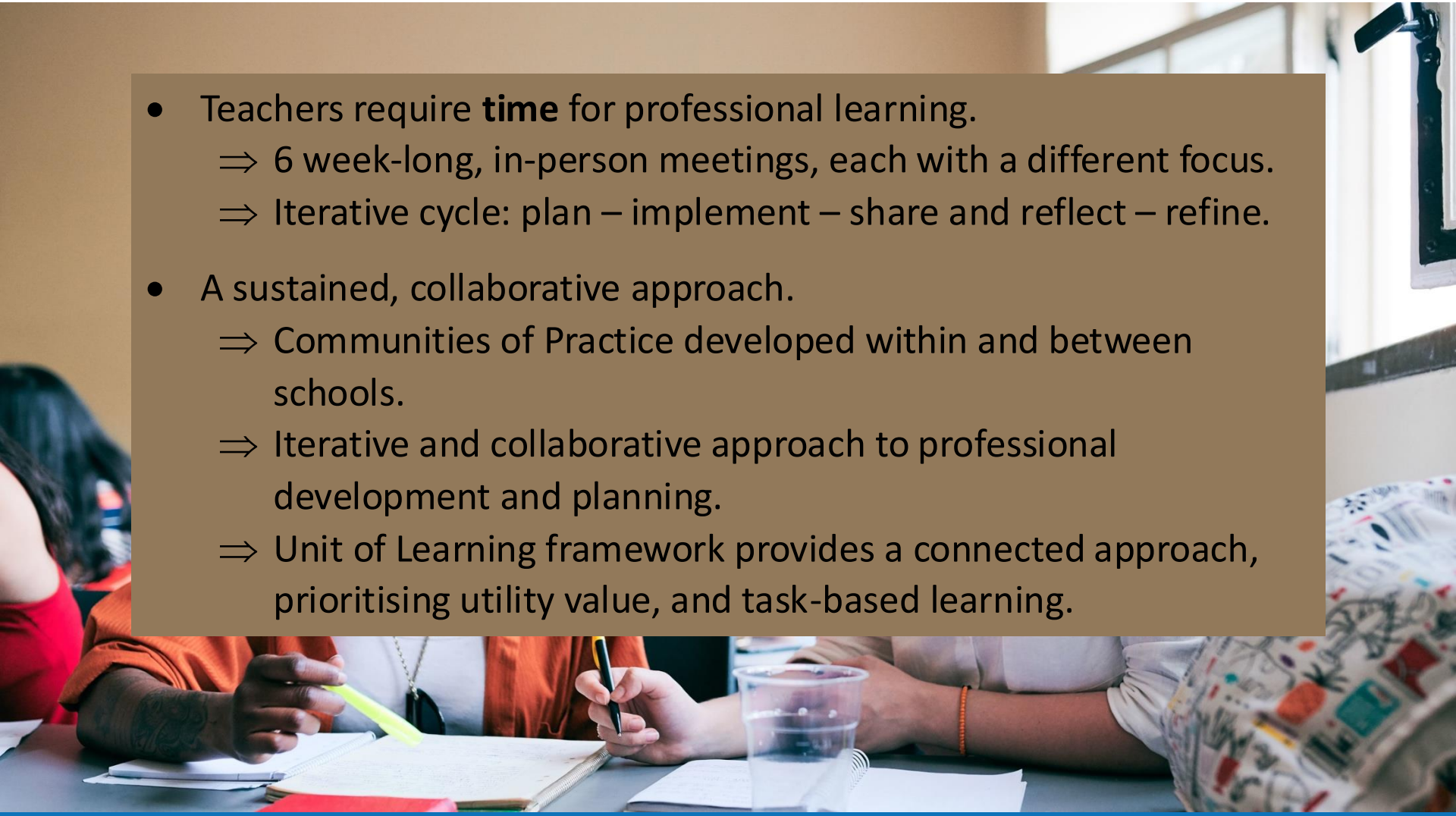


- Create a classroom and school climate in which students feel respected, listened to and safe.

  ⇒ Throughout the three years of the project, teachers in the schools were exposed to interesting and engaging experiences, which they took back to their classrooms.

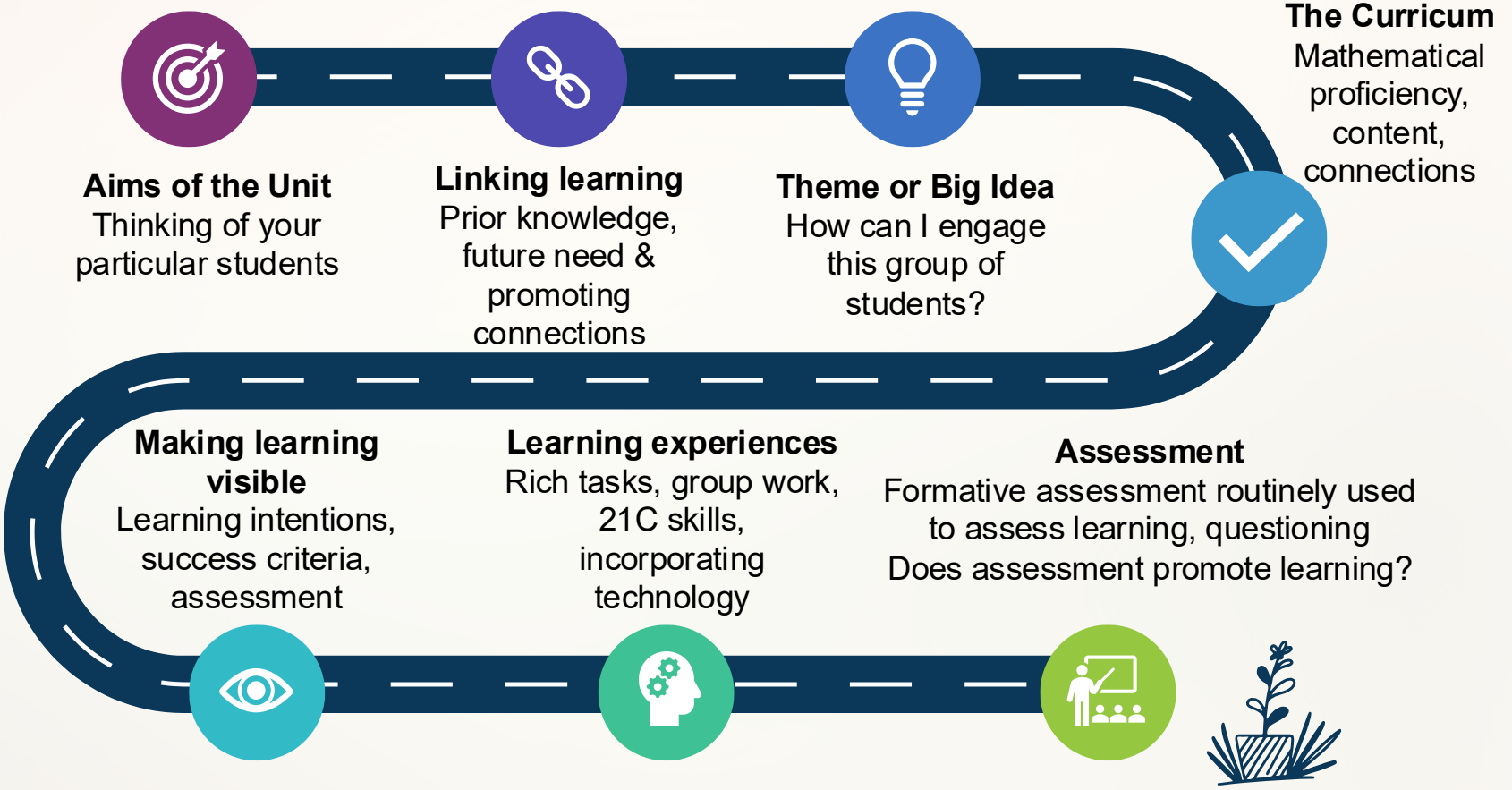
  ⇒ Where possible, all resources that were required for any of the activities were made open access for teachers and student use

Recommendations: Teacher focus

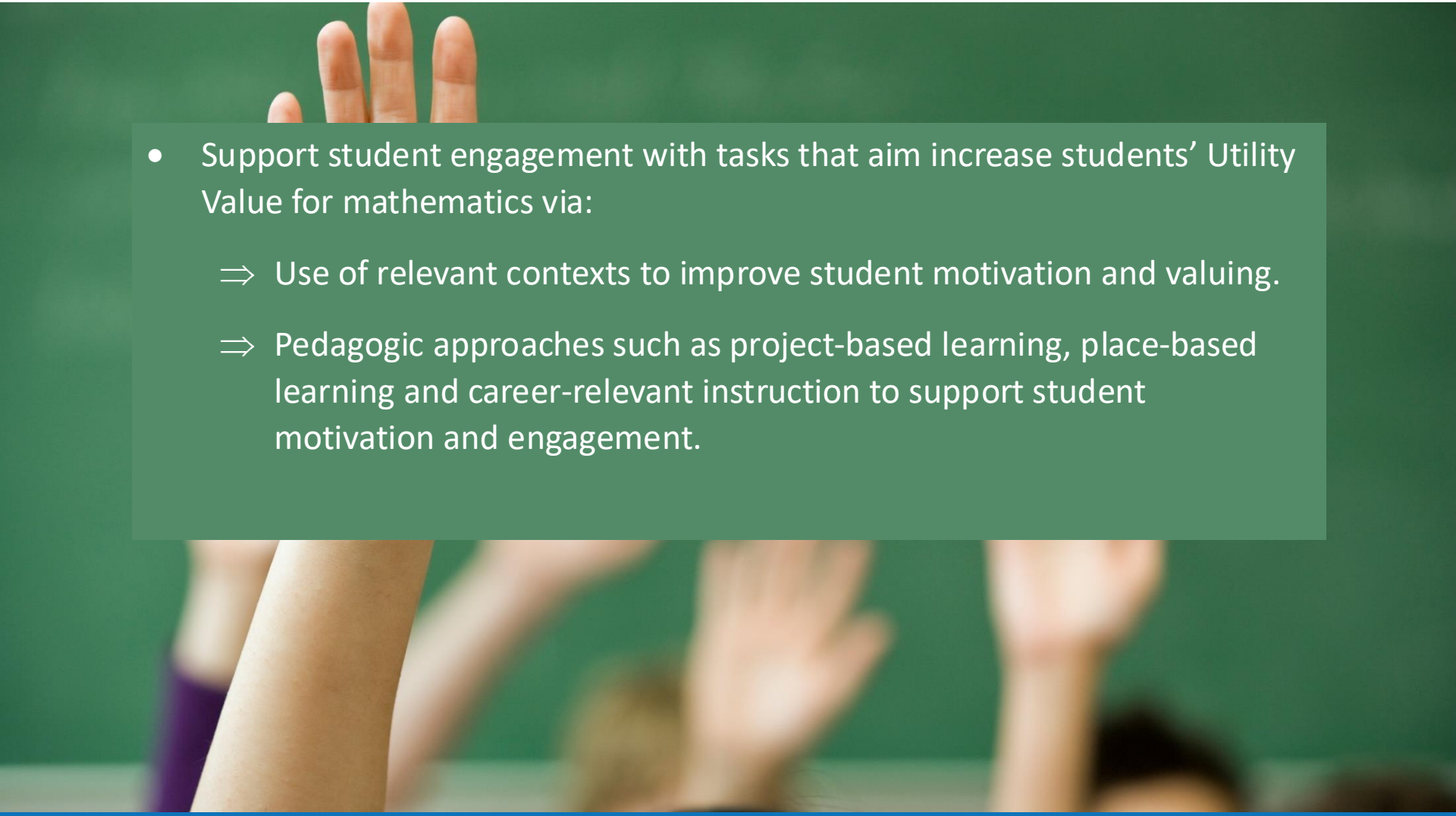


- Teachers require **time** for professional learning.
  - ⇒ 6 week-long, in-person meetings, each with a different focus.
  - ⇒ Iterative cycle: plan – implement – share and reflect – refine.
- A sustained, collaborative approach.
  - ⇒ Communities of Practice developed within and between schools.
  - ⇒ Iterative and collaborative approach to professional development and planning.
  - ⇒ Unit of Learning framework provides a connected approach, prioritising utility value, and task-based learning.

UoL Journey – backwards design approach

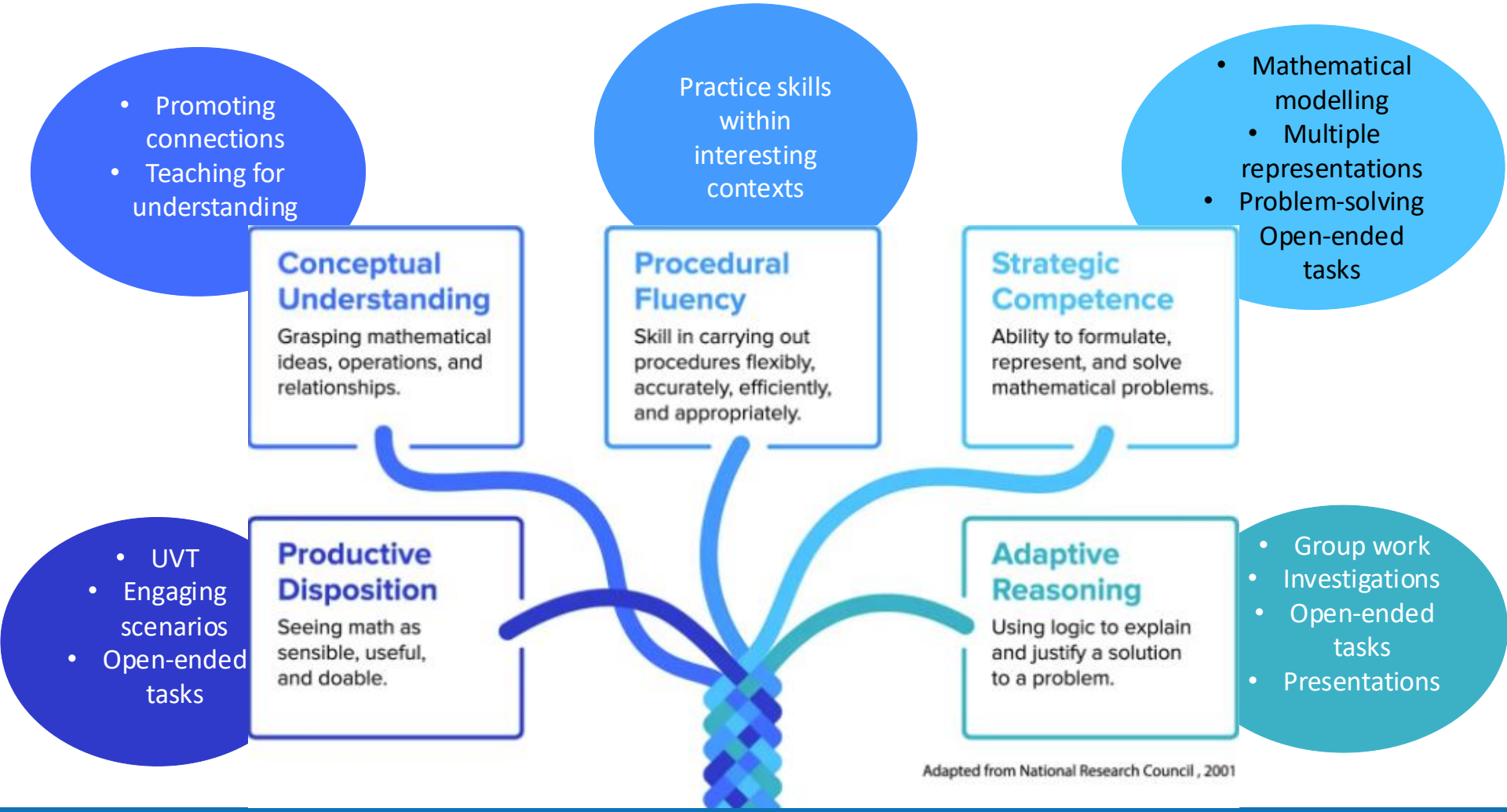


Recommendations: Student focus



- Support student engagement with tasks that aim increase students' Utility Value for mathematics via:
  - ⇒ Use of relevant contexts to improve student motivation and valuing.
  - ⇒ Pedagogic approaches such as project-based learning, place-based learning and career-relevant instruction to support student motivation and engagement.

Mathematical Proficiency



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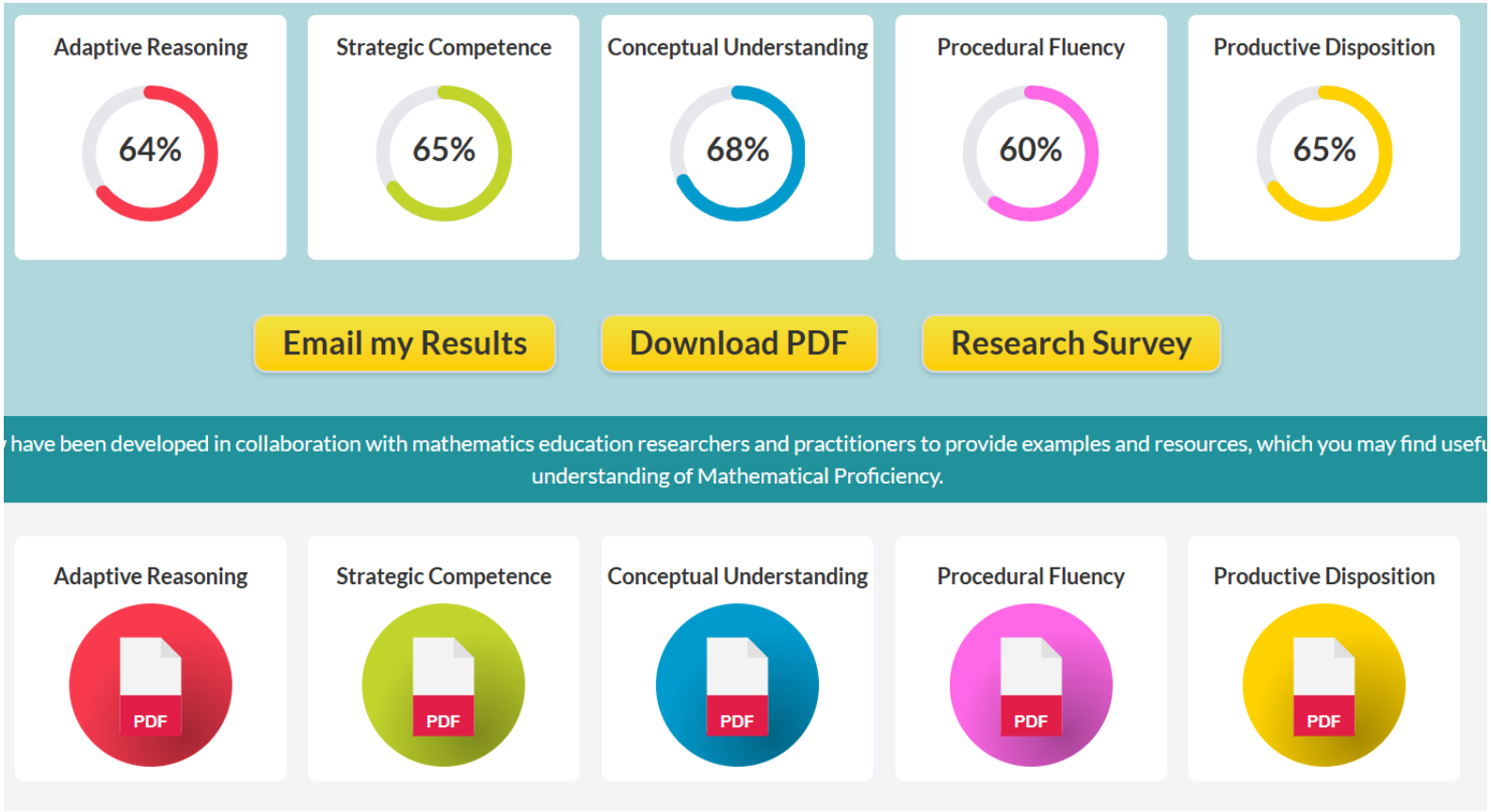
Website and Resources

Mathematical Proficiency Self-evaluation tool

How confident are you?

app.amis-europe.eu


Adaptive Reasoning
64%
Strategic Competence
65%
Conceptual Understanding
68%
Procedural Fluency
60%
Productive Disposition
65%
Email my Results
Download PDF
Research Survey
have been developed in collaboration with mathematics education researchers and practitioners to provide examples and resources, which you may find usefu
understanding of Mathematical Proficiency.
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Thank You