The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Professional Development and Cambridge Maths

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Some Questions

"To support an infrastructure to enhance the quality of teacher education and continuing professional development." (Cambridge Maths Manifesto)

What are the purposes / content of the professional development?

What forms of CPD are most effective?

What support resources are necessary?

How can it become scalable and sustainable?

Purpose and Content of PD

Mathematical Knowledge

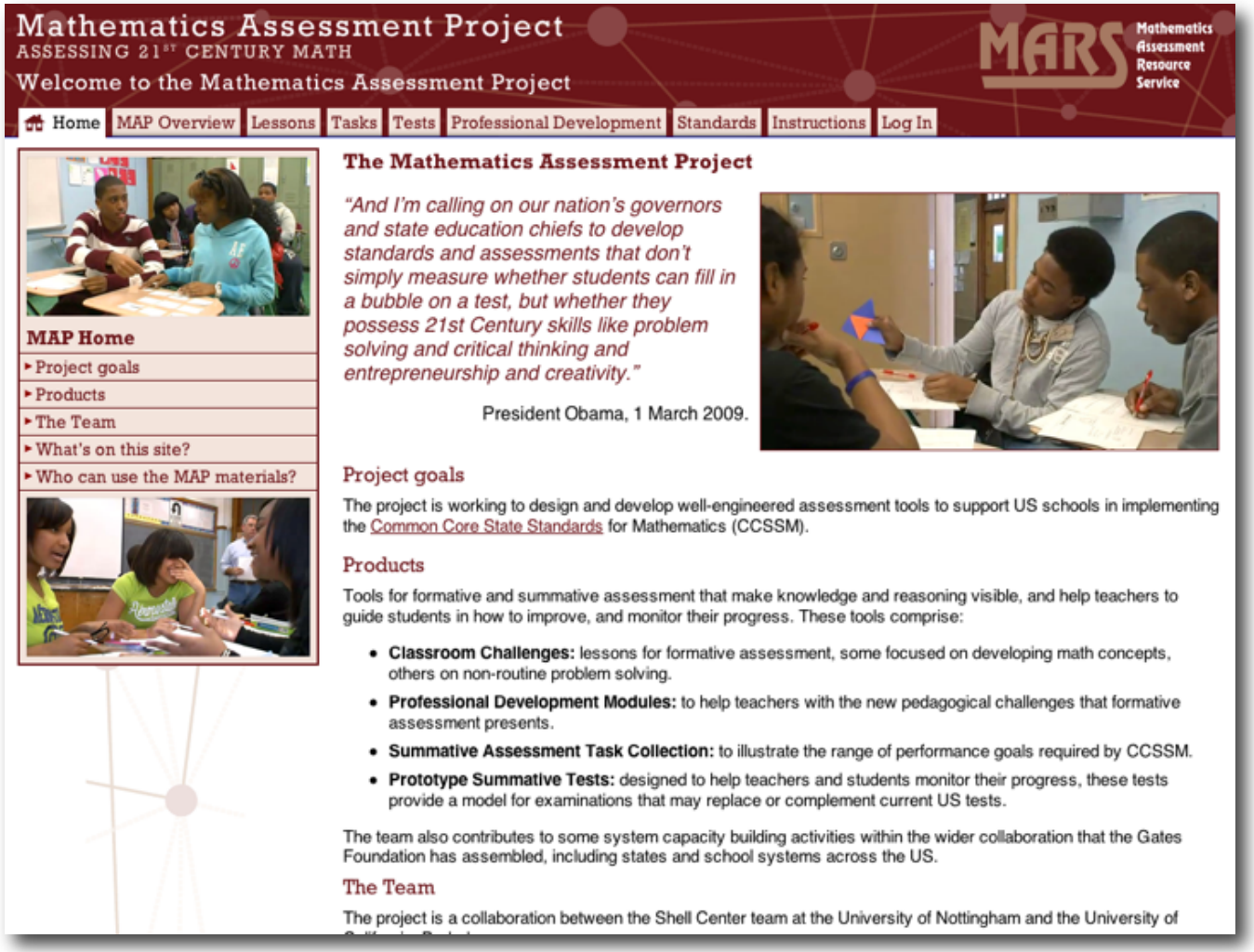
- Proficiency and understanding of the subject; the “big ideas”.
- Awareness of power of maths and how it is used to model the world and solve problems.

Pedagogical Content Knowledge

- *Curriculum:* Identifying multidimensional goals for learning; organising schemes of work; making connections; recognising progress across each dimension.
- *Students*: How students learn Mathematics and common obstacles to learning (e.g. ’misconceptions’).
- *Teaching*: Recognising what powerful teaching looks like. Designing, selecting and sequencing tasks and activities that further the content and process goals *together*.

Mathematics Assessment Project (MAP)

http://map.mathshell.org/materials/



The Five Dimensions of Mathematically Powerful Classrooms:

The Mathematics	Cognitive Demand	Access to Mathematical Content	Agency, Authority, and Identity	Uses of Assessment
The extent to which the mathematics discussed is focused and coherent, and to which connections between procedures, concepts and contexts (where appropriate) are addressed and explained. Students should have opportunities to learn important mathematical content and practices, and to develop productive mathematical habits of mind.	*The extent to which classroom interactions create and maintain an environment of productive intellectual challenge that is conducive to students' mathematical development. There is a happy medium between spoon-feeding mathematics in bite-sized pieces and having the challenges so large that students are lost at sea.*	*The extent to which classroom activity structures invite and support the active engagement of all of the students in the classroom with the core mathematics being addressed by the class. No matter how rich the mathematics being discussed, a classroom in which a small number of students get most of the "air time" is not equitable.*	*The extent to which students have opportunities to conjecture, explain, make mathematical arguments, and build on one another's ideas, in ways that contribute to their development of agency (the capacity and willingness to engage mathematically) and authority (recognition for being mathematically solid), resulting in positive identities as doers of mathematics.*	*The extent to which the teacher solicits student thinking and subsequent instruction responds to those ideas, by building on productive beginnings or addressing emerging misunderstandings. Powerful instruction "meets students where they are" and gives them opportunities to move forward.*

Framework for selecting tasks and activities		
Goal	**Student Product**	**Task and Activity "Genres"**
Factual recall Procedural fluency	• Performance	• Memorise and rehearse through "études" that practice specific skills
Conceptual understanding	• Classification	• Sort, classify, define and deduce
	• Representation	• Describe, interpret and translate
Reasoning and communicating	• Analysis	• Explore structure, variation, connections
	• Argument	• Test, justify and prove conjectures
Solving problems	• Model	• Formulate models and problems
	• Solution	• Employ strategies
(Mathematical literacy)	• Critique	• Interpret & evaluate solutions, strategies, models

Zooming in ….

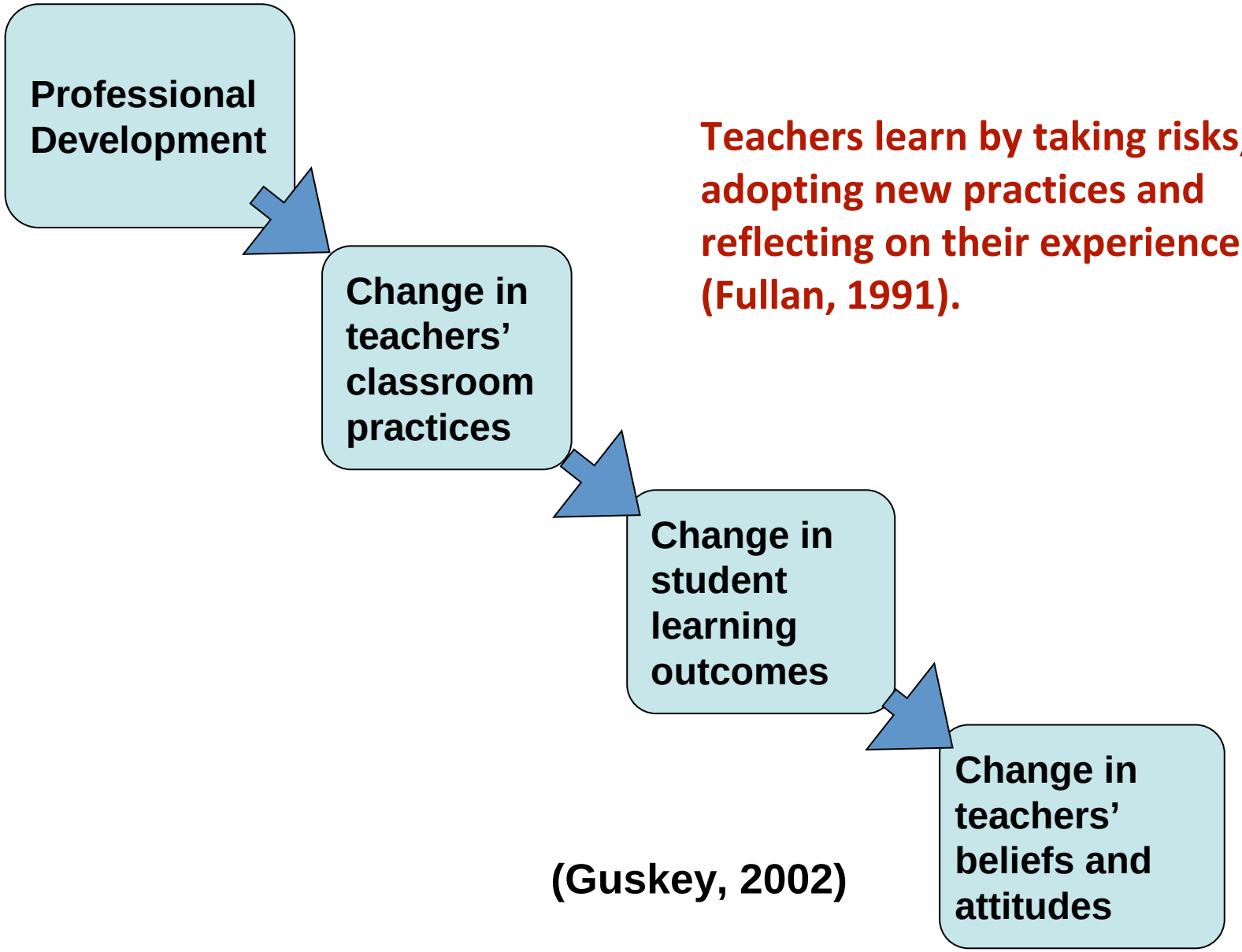
Framework for selecting tasks and activities		
Student Product	**Task and Activity "Genres"**	
• Model	• Formulate models and problems	Identifying accessible questions that may be tackled within a situation. Making suitable assumptions to simplify a situation. Representing a situation mathematically. Identifying significant variables in situations. Generating relationships between variables.

Characteristics of effective PD

- **Experiential** - stimulating and drawing on teachers' own experiences as reflective practitioners.
- **Sustained** - involving cycles of planning, predicting, enactment and reflection.
- **Grounded -** practical, well-resourced; related to particular contexts and cultures.
- **Safe -** teachers able to speak their minds, permission to take risks.
- **Collaborative -** involving networks of teachers and administrators.
- **Informed -** by outside expertise and research.
- **Provocative -** involving both pressure and support.
- **Focused -** attentive to the development of the mathematics itself.

(Guskey, 2002; Joubert and Sutherland, 2009; Villegas-Reimers, 2003; and many others…)

Practices, Learning outcomes, Beliefs



Teachers learn by taking risks, adopting new practices and reflecting on their experiences (Fullan, 1991).

(Guskey, 2002)

Examples of different *forms* of PD

"Training" models

- Transmission of information by an 'expert'.
  Useful mainly for raising awareness of an initiative, but may feel alien to teachers.

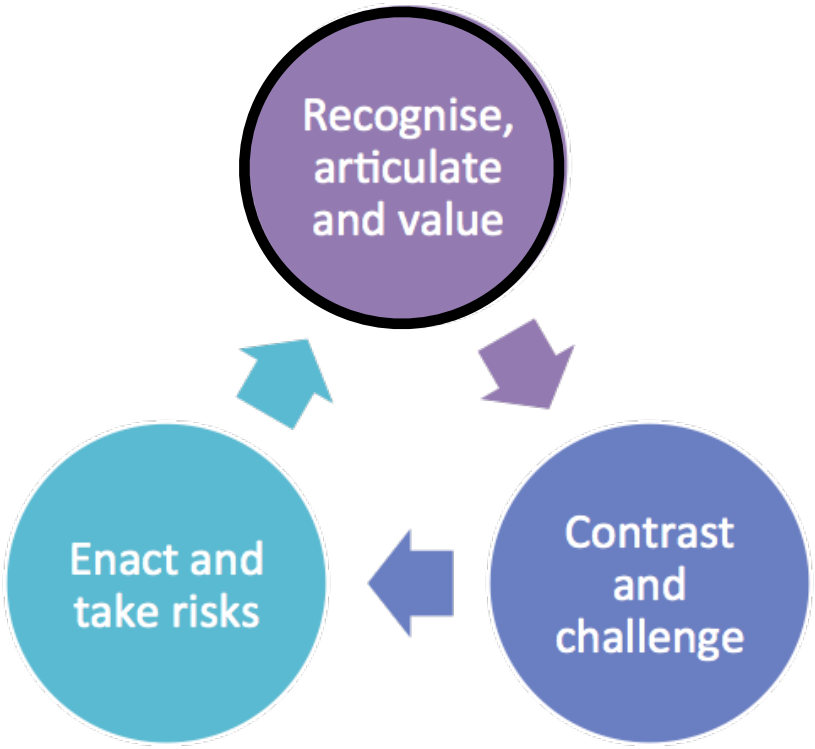
"Experiential course" models

- Courses mediated by a provider, that offer teachers opportunities to explore ideas in their own classrooms and report back. May be accredited.

"Embedded" professional development communities

- Teachers take over responsibility for setting their own research goals and collaboratively and systematically study them in their own classrooms. This may be informed by outside support from materials and/or invited 'experts'.

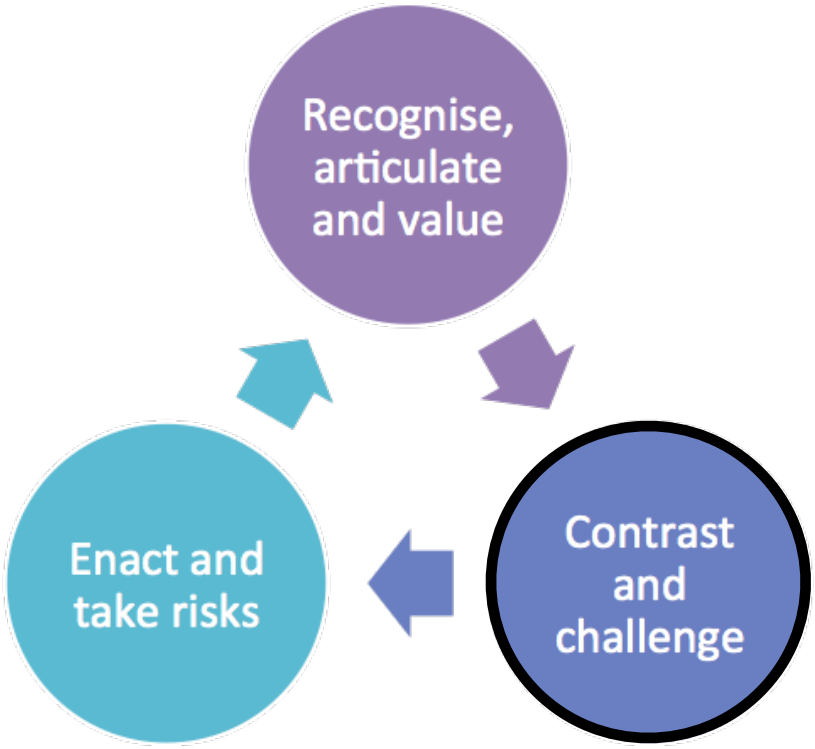
Courses: Cycles of Professional Development



Recognise, articulate and value

Reflect on the contexts in which teachers work and make explicit existing values, beliefs and practices.

Courses: Cycles of Professional Development



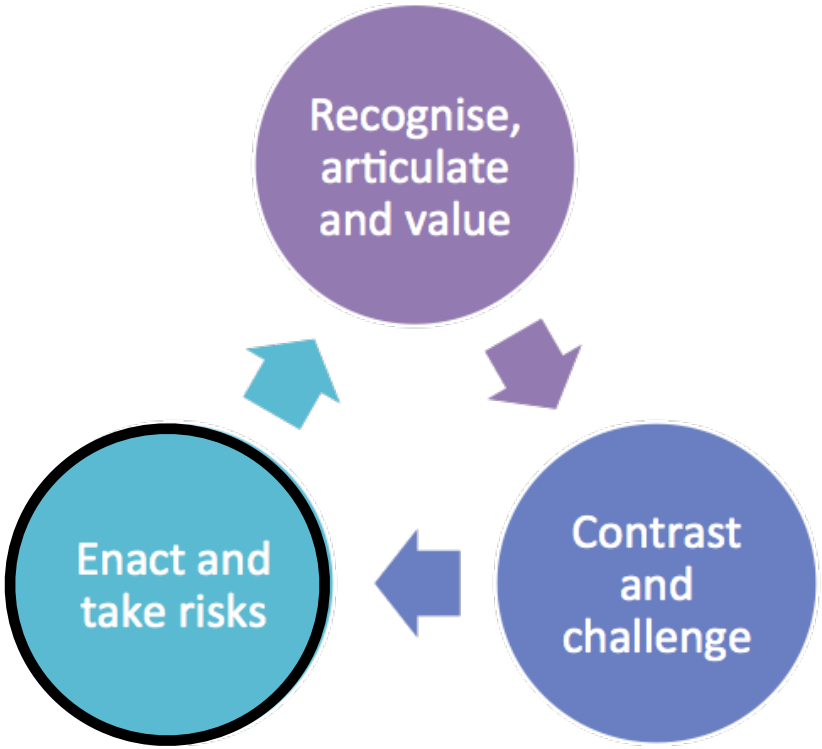
Contrast and challenge

Illustrate vivid, contrasting practices.

Work on task genres. Analyse videos. Discuss theories, pedagogies, and context.

This provides ‘challenge’ or ‘conflict’.

Courses: Cycles of Professional Development

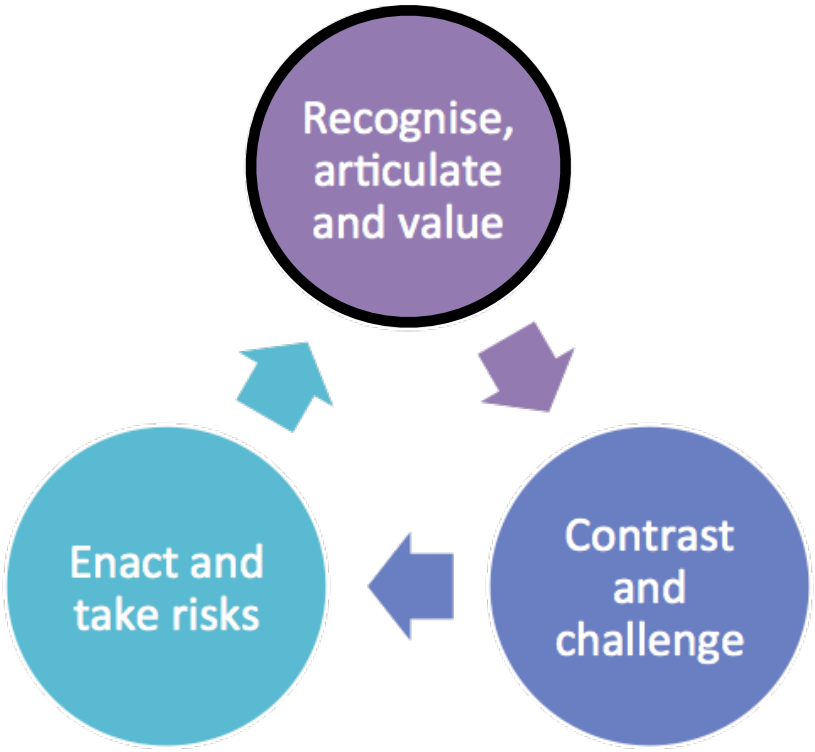


Enact and take risks

Challenge teachers to 'suspend' disbelief and act in new ways, 'as if they believed differently'.

Offer mentor and a network of support as they do this.

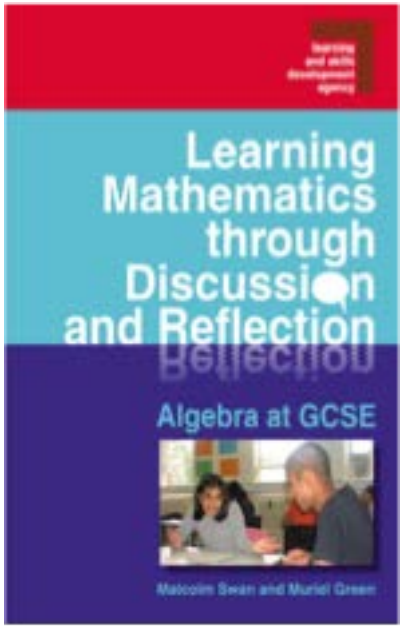
Courses: Cycles of Professional Development

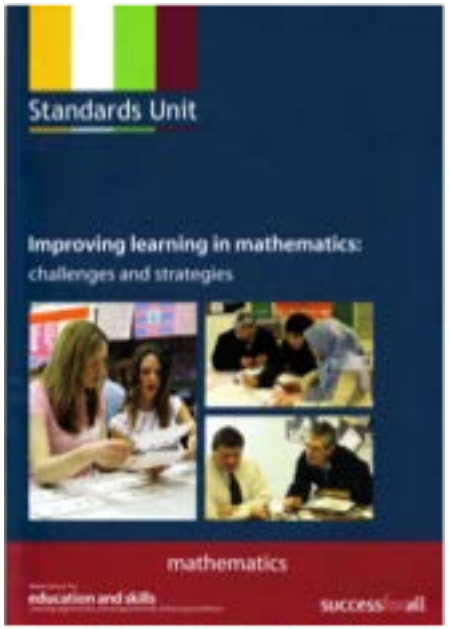


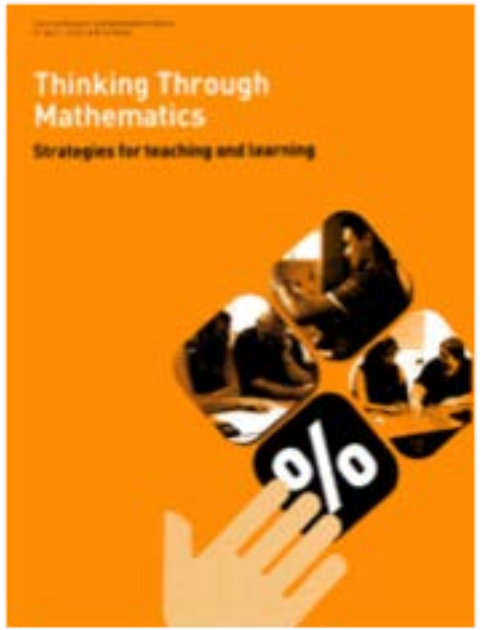
Recognise, articulate and value

Encourage teachers to meet together and reflect on their new experiences and the implications that these offer. Ask teachers to reflect on and recognise the growth of new knowledge, beliefs and practices.

Resources for PD



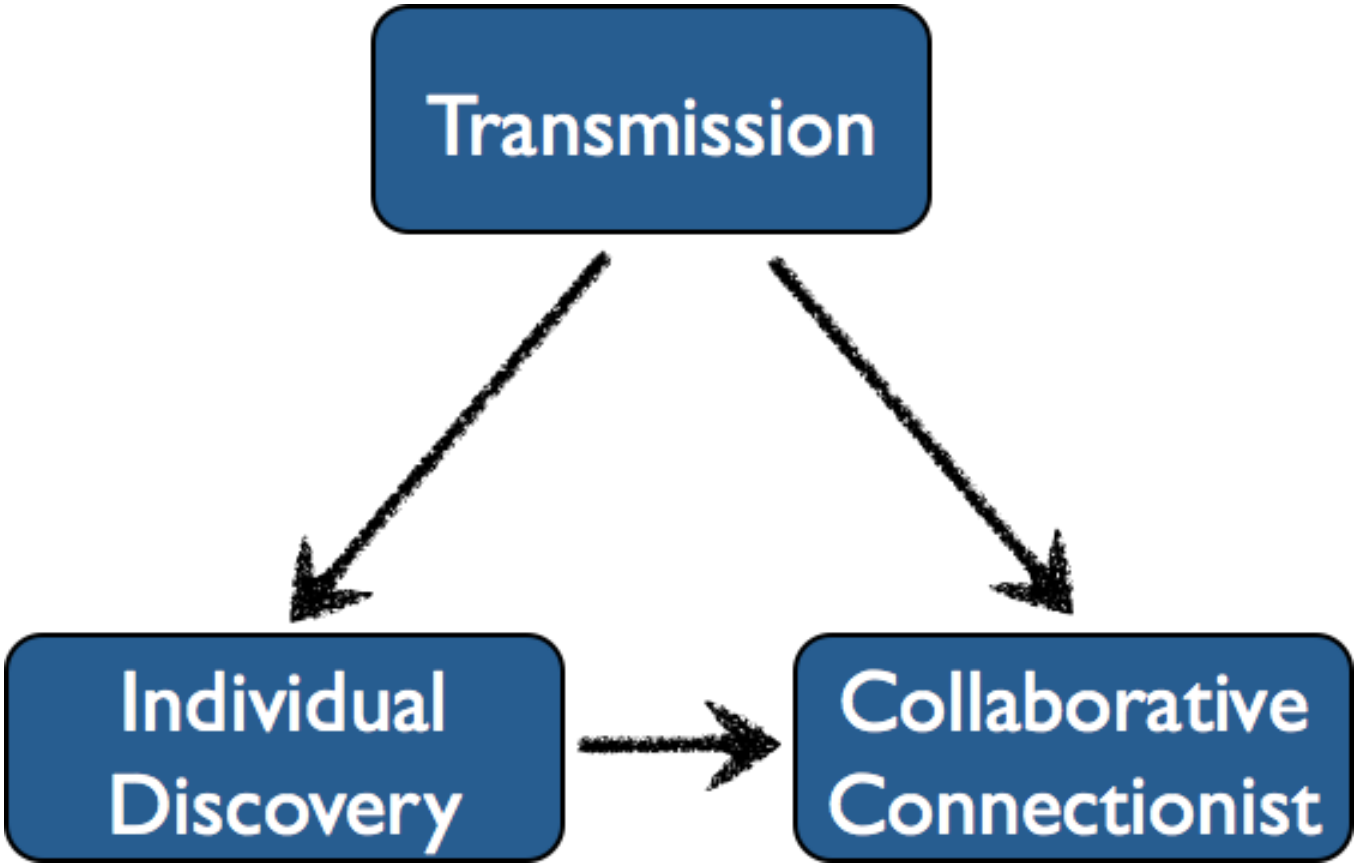




Typical 6-day course

October workshop (2 days)	Reflect on existing practices and beliefs. Mathematical discussion
Teachers use lessons and work with colleagues	
December workshop (1 day)	Sharing outcomes / Conceptual understanding
Teachers use lessons and work with colleagues	
January workshop (1 day)	Sharing outcomes/ Problem solving processes
Teachers use lessons and work with colleagues	
March workshop (1 day)	Sharing outcomes/ Adaptive teaching
Teachers use lessons and work with colleagues	
July workshop (1 day)	Sharing outcomes/ Reflection and review

Teachers' beliefs and practices evolved.



Swedish model: large scale PD

- 2012-16 All teachers in Sweden received government-initiated PD: ***Boost for Mathematics***
- Run by: Swedish National Agency for Education;
  National Centre for Mathematics Education at Univ. of Gothenburg.
- 40,000 teachers across 6,000 schools.
- One meeting per week for one year.
- €75,000,000 for 4-year programme (€1,875 per teacher)
- Over 20 different universities involved.

The state cannot force schools to take part, but the goal is to reach all teachers in Sweden. It seems likely that this goal will be met or nearly met.

Swedish model: Structure

- Teacher collaboration supported by web-based materials.
- Teachers meet almost every week.
- Groups of universities produce the content.
- Teachers work on 2 modules over one year.
- Each module involves 8 cycles of:
    1. **Teachers individually study text, video and recall experiences. (1h)**
    2. **Groups meet to discuss (1), then plan a lesson (2h).**
    3. **Carry out the lesson. In some cases with peer observation.**
    4. **Groups meet to discuss the outcomes.(1h)**
- Groups have access to an advisor.
  Advisors training = 7 days per year.
- Principals trained to be responsible for planning and scheduling (4 meetings).

Embedded Professional Learning Communities

- Collaborative learning by teachers in a more systemic way.
- May be based in individual schools or clusters of schools.
- Self- run by groups of teachers.
- Supported by well-designed resources/ “toolkits” and occasional input from outside ‘experts’.

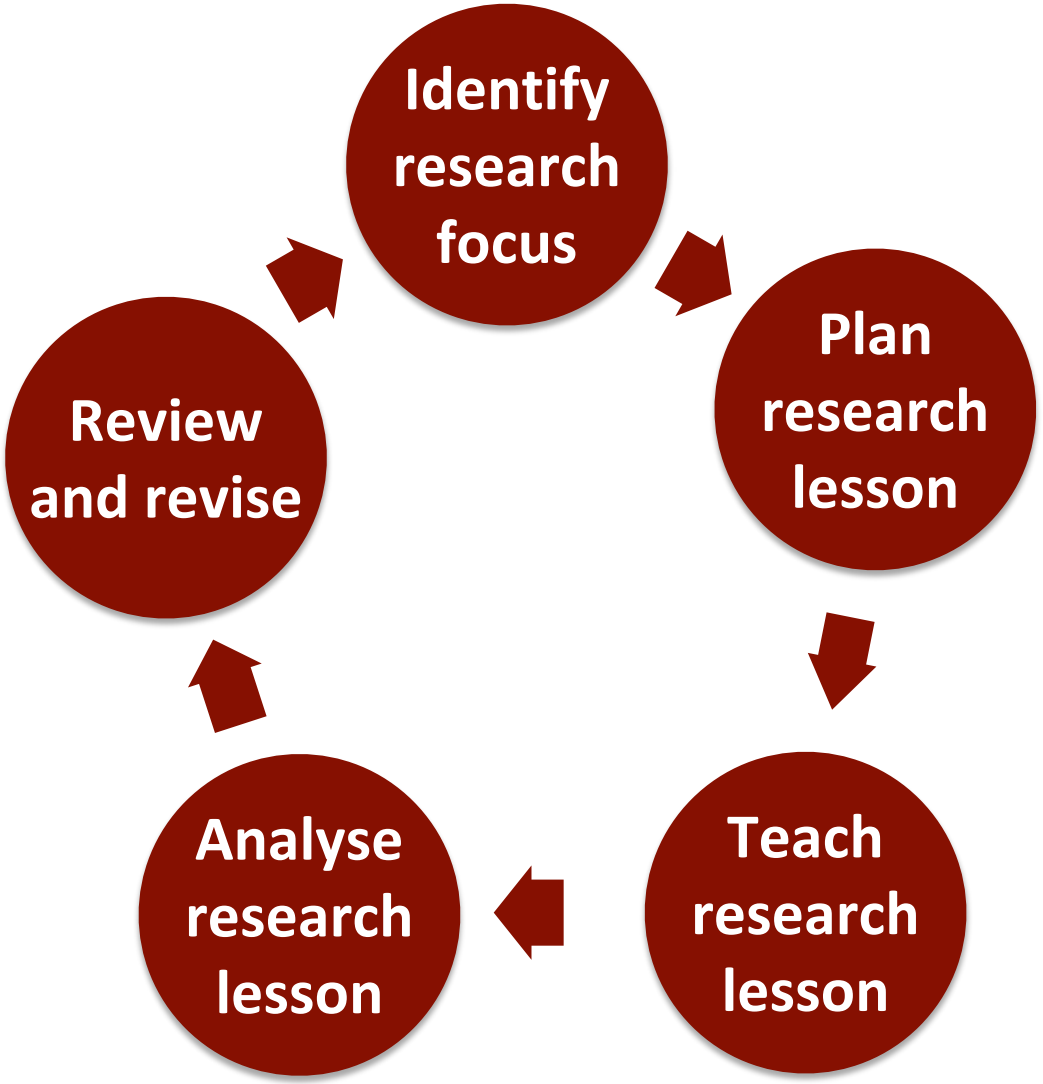
Japanese Lesson Study Model

Intense planning and analysis of lessons designed to focus on specific learning goals.

Community involves cluster of schools working together with HE ‘koshi’.

LS may be public.

Currently exploring how these may work in the UK, in the context of problem solving, funded by Nuffield.



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