FaSMEd

RAISING ACHIEVEMENT THROUGH FORMATIVE ASSESSMENT IN SCIENCE AND MATHEMATICS EDUCATION

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FP7 research project

Action: Science in Society (Research in the role of teaching methods and assessment methods in addressing low achievement in the field of Mathematics, Science and Technology) Collaborative Project

Purpose: To research the use of technology in formative assessment classroom practices that allow teachers to respond to the emerging needs of learners in mathematics and science.

Timescale *3 years*

The project FaSMEd has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 612337

Partners

University of Newcastle upon Tyne, UK (Coordinator)

The University of Nottingham, UK

Ecole Normale Superieure De Lyon, France

National University Of Ireland Maynooth

University Of Duisburg-Essen, Germany

University Of Turin, Italy

Freudenthal Institute, University Of Utrecht, The Netherlands

African Institute For Mathematical Sciences Schools Enrichment Centre , South Africa (Stellenbosch)

University College Of Trondheim, Norway

Objectives:

A *design research* project

To adapt and develop existing research-informed pedagogical interventions (developed by the partners), suited to implementation at scale, through:

- fostering high quality interactions in classrooms that are instrumental in raising achievement;
- Expanding our knowledge of technologically enhanced teaching and assessment methods addressing achievement in mathematics and science

Deliverables:

1. Offer approaches for the use of new technologies to support formative assessment.
2. Develop sustainable teaching practices that improve achievement in Mathematics and Science.
3. Produce a toolkit for teachers to support the development of practice and a professional development resource to support it.
4. Disseminate the outcomes.

Design or “Engineering” Research

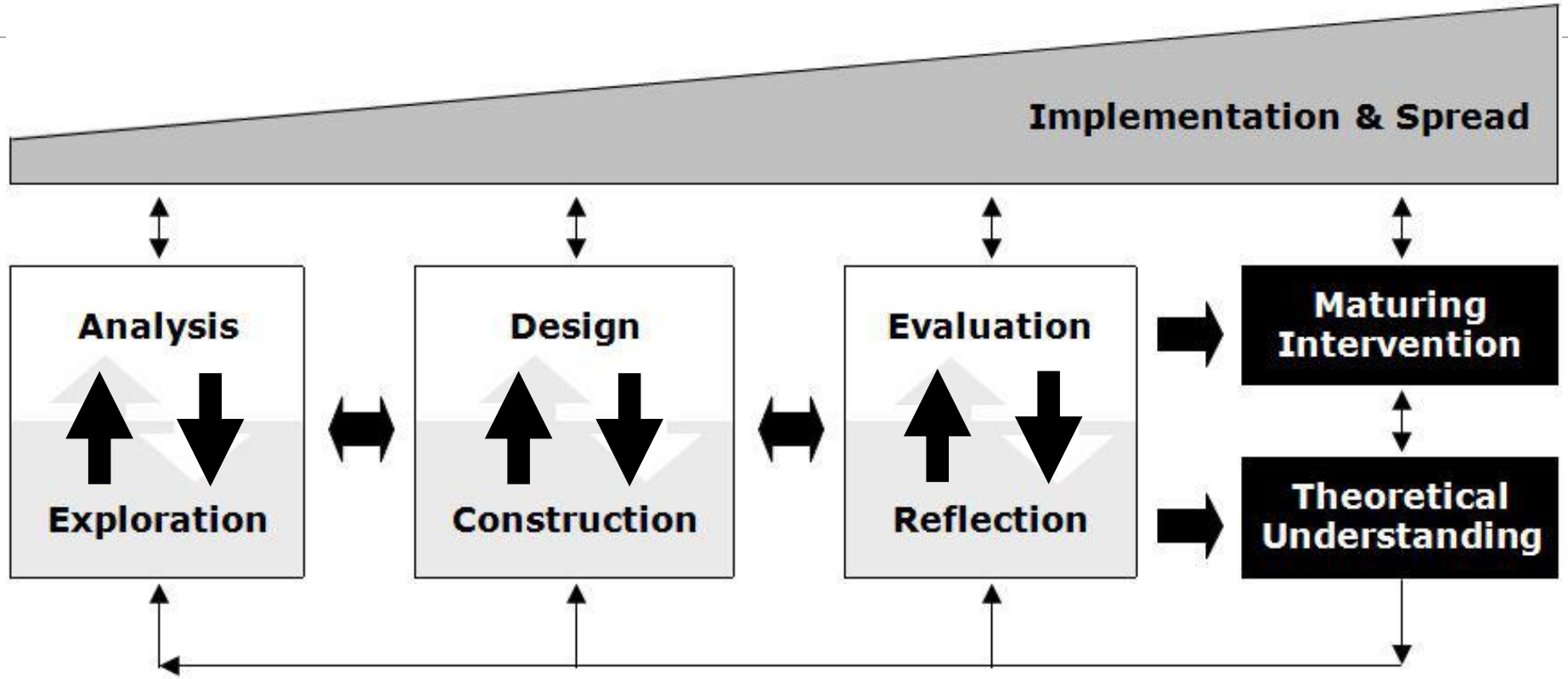
Design-based research **is a formative approach** in which a product or process (or ‘tool’) is envisaged, designed, developed and refined through cycles of enactment, observation, analysis and redesign, with systematic feedback from end-users.

Educational theory is used to inform the design and refinement of the tools, and is itself refined during the research process.

Its goals are to create **innovative tools for others to use**, to describe and explain how these tools function, account for the range of implementations that occur and develop principles and theories that may guide future designs.

Ultimately, **the goal is transformative**; we seek to create new teaching and learning possibilities and study their impact on end-users.

The generic process



McKenney and Reeves (2012)

Issues and challenges

The status of theory.

- What works? How does it function?

The importance of context.

- Social and cultural context. E.g. pressures, constraints.

The role of the researcher.

- From interventionist to ‘hands off’.

Design mutation

- Explain how and why things evolve.

Grain size and selection of teachers

- Small, close observations *moving towards*
  Larger more representative trials

The richness of the data

- range and evolution of implementation; learning gains, attitude changes

The challenge of boundary crossing: opportunities for learning through dialogue

Our boundaries:

- Geographical/cultural - Science/Mathematics - Researcher/teacher

Boundary crossing offers opportunities for learning through dialogue in relation to issues of:

- Identity
- Coordination
- Reflection
- Transformation

(Akkerman & Bakker (2011))

Creating ‘boundary objects’

The toolkit

"The expression 'toolkit' refers to a set of curriculum materials and methods for pedagogical intervention" (proposal)

Curriculum materials:

- Assessment tasks that make teachers more aware of learning obstacles.
- 'Diagnostic' tasks that make students more aware of learning obstacles
- Sample lesson plans that show how FA may be embedded to help overcome these obstacles.
- Examples of how technology can support these.

Processes for pedagogical intervention:

- Professional Development modules
- Ways of using the PD modules

Formative assessment - a process not a product – 'Making learning visible'

"Students and teachers using evidence of learning to **adapt teaching and learning** to meet immediate needs minute-to-minute and day-by-day".

(Thompson and Wiliam, 2007)

"… all those activities undertaken by teachers, and by their students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged. **Such assessment becomes 'formative assessment' when the evidence is actually used to adapt the teaching work to meet the needs**."

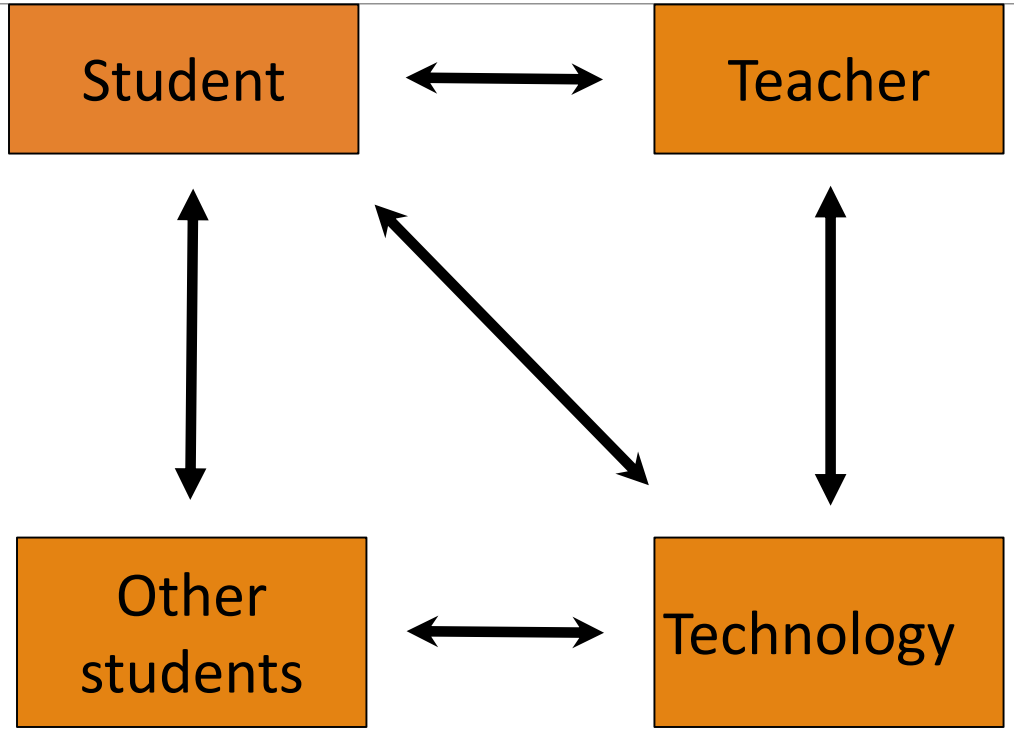
(Black & Wiliam, 1998, para, 91)

Key strategies for formative assessment – the framework for the toolkit

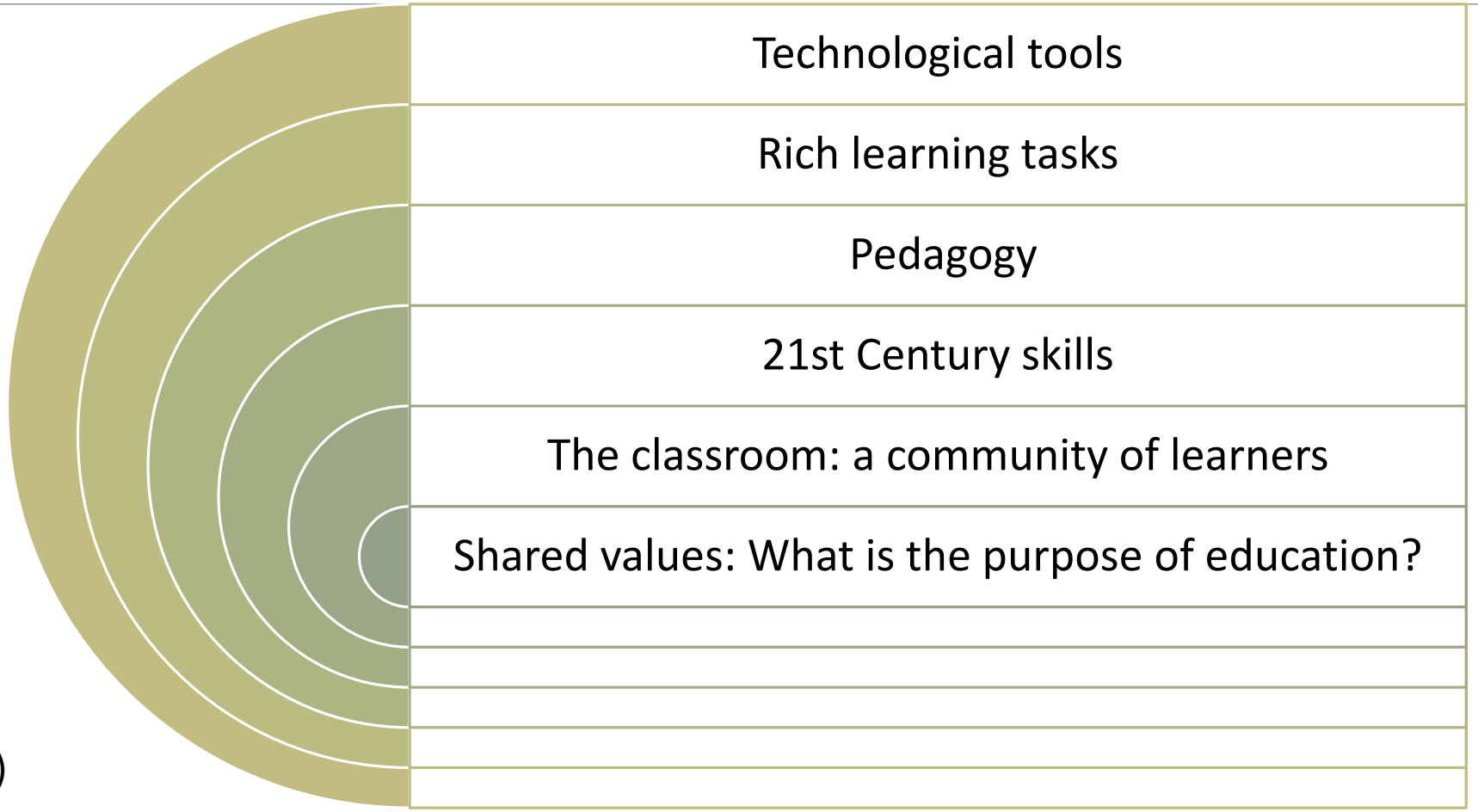
	Where the learner is going	**Where the learner is right now**	**How to get there**
Teacher	Clarifying learning intentions and sharing and criteria for success (1)	Engineering effective classroom discussions, activities and tasks that elicit evidence of learning (2)	Providing feedback that moves learners forward (3)
Peer	Understanding and sharing learning intentions and criteria for success (1)	Activating students as instructional resources for one another (4)	
Learner	Understanding learning intentions and criteria for success (1)	Activating students as the owners of their own learning (5)	

Wiliam & Thompson, 2007

Improving the flow (and quality) of information



The context for technology in education



Fullan (2013)

Professional development and researching the toolkit

A three part “sandwich”:

- **Introductory session:**
  Teachers work on problems, discuss pedagogical challenges they present and plan lessons.
- **Into the classroom:**
  Teacher teach the planned lessons.
- **Follow-up session:**
  Teachers describe and reflect on what happened and plan strategies for future lessons.

Why professional development is hard

Improving practice involves changing habits, not adding knowledge

– That's why it's hard

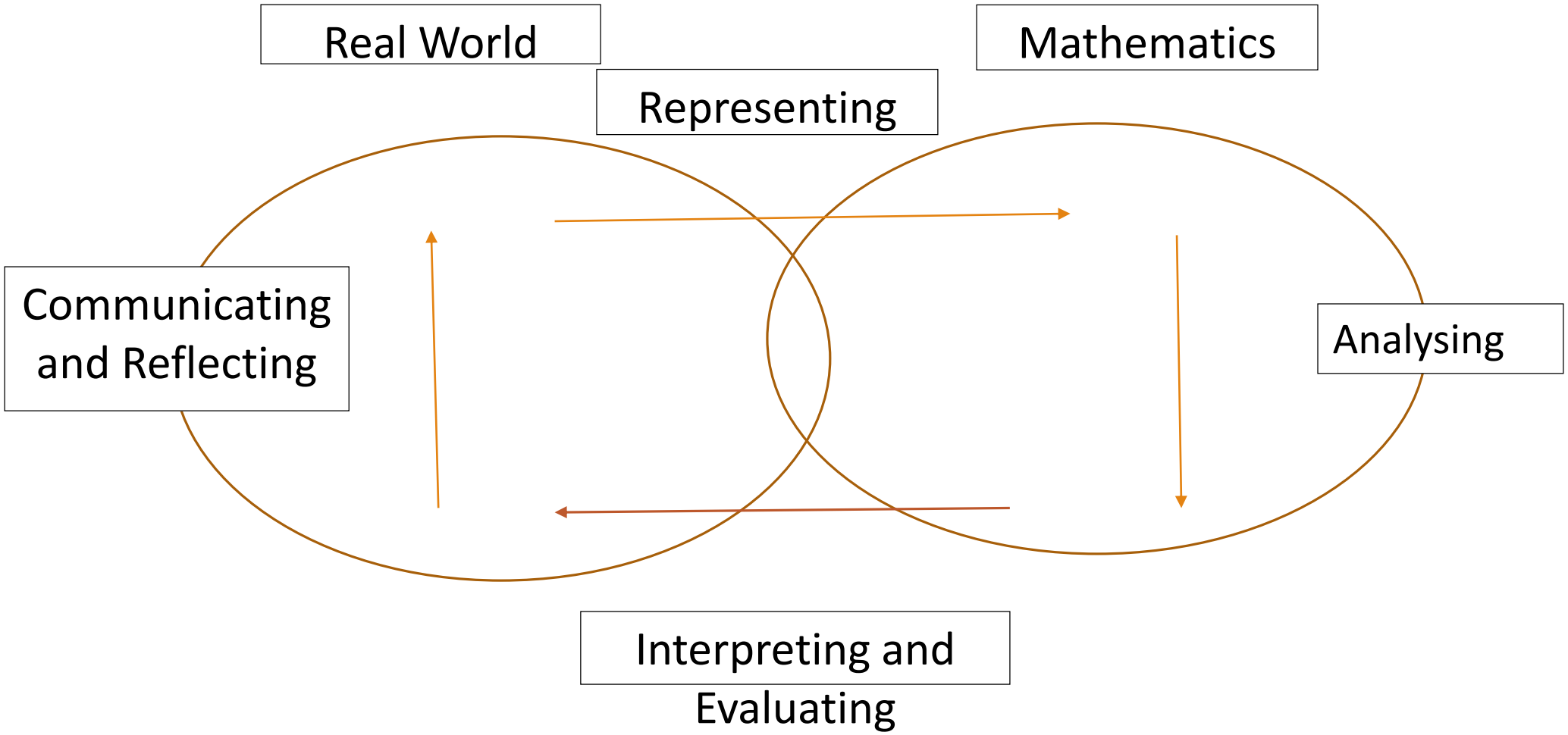
And the hardest bit is not getting new ideas into people's heads

It's getting the old ones out

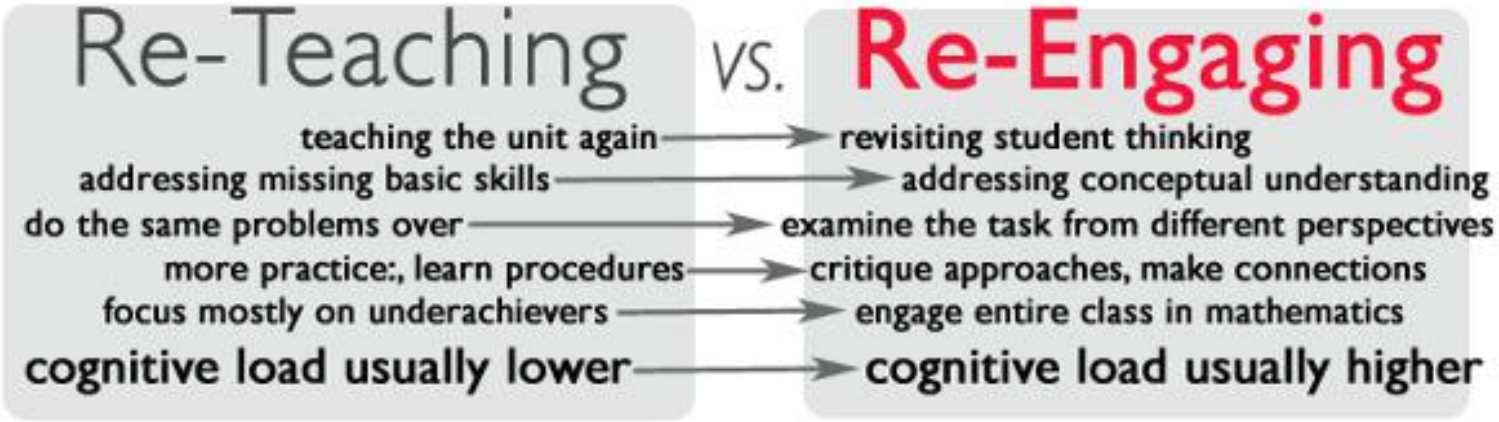
– That's why it takes time

But it doesn't happen naturally

Key processes in Mathematics

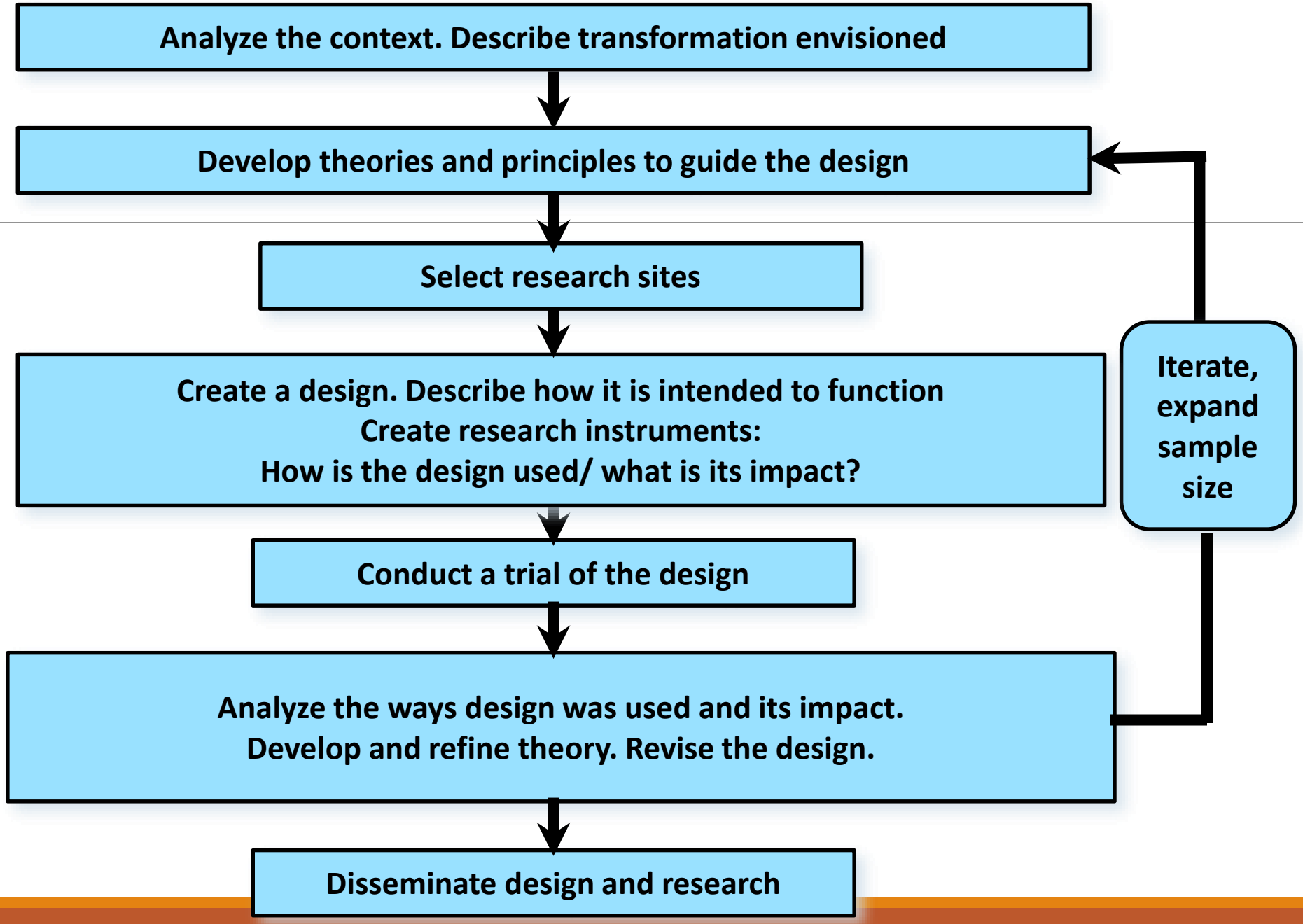


Pedagogy: Re-Engaging learners.



http://www.insidemathematics.org

A collection
of features and elements


Analyze the context. Describe transformation envisioned
Develop theories and principles to guide the design
Select research sites
Create a design. Describe how it is intended to function
Create research instruments:
How is the design used/ what is its impact?
Conduct a trial of the design
Analyze the ways design was used and its impact.
Develop and refine theory. Revise the design.
Disseminate design and research
Iterate, expand sample size

Proposal implies two iterations: Prototype & Final

By Month 10:

- **3.1 Develop a prototype toolkit for teachers to support their use of formative assessment in the classroom including advice and support in using technology**
- **3.4 Develop prototype PD package for teachers**

By Month 25

- **3.2 Evaluation of toolkit**
- **3.5 Evaluation of PD package**

By Month 36

- **3.3 Develop final toolkit**
- **3.6 Develop final PD package**

Websites

http://research.ncl.ac.uk/fasmed/

https://toolkitfasmed.wordpress.com/

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www.insidemathematics.org/classroom-videos/formative-re-engaging-lessons