# 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*

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# 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

# 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.

(Swan, 2014)

# 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.

# The challenge of boundary crossing: opportunities for learning through dialogue

Our boundaries:

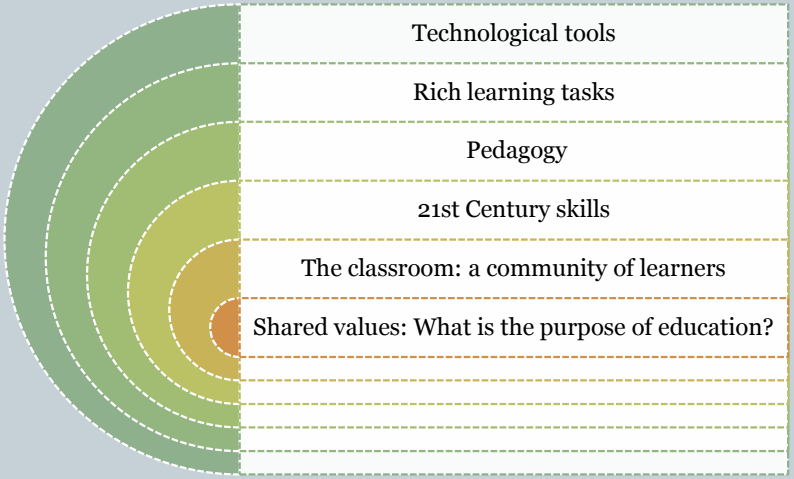
- Geographical/cultural - Science/Mathematics - Cognitive/affective - Researcher/teacher- School/home

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

- Identity
- Coordination
- Reflection
- Transformation

(Akkerman & Bakker (2011))

# The context for technology in education

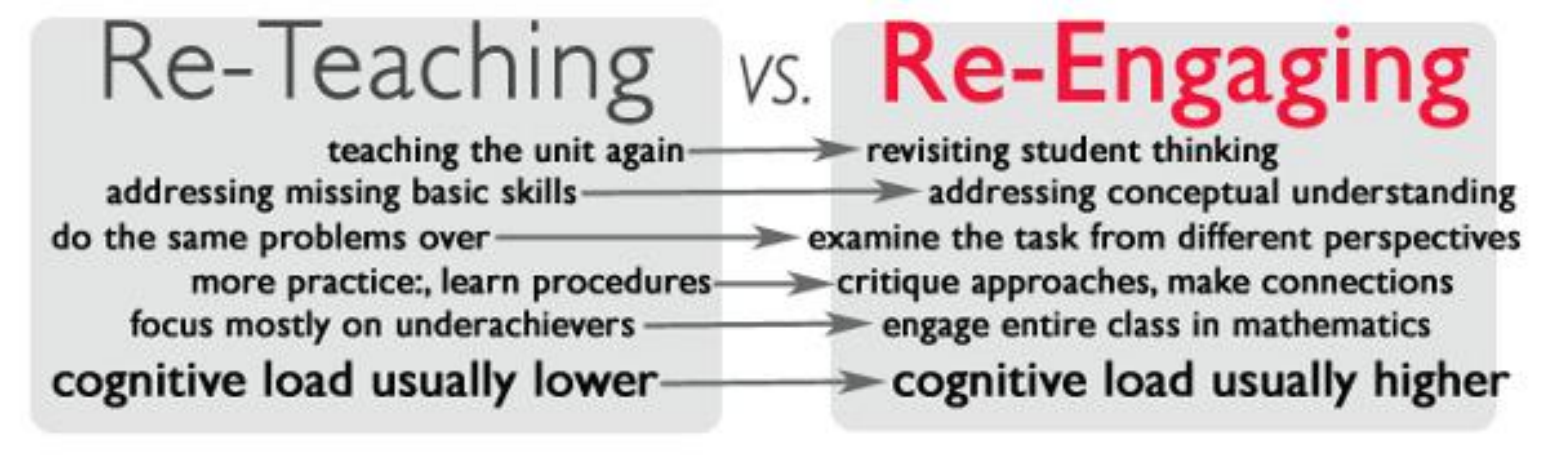



Fullan (2013)

# The purpose of education: what are our values?

- The project is embedded in a context with a clear political dimension of Social renewal and Social Justice:
- International statistics (PISA, TIMSS etc) demonstrate that across many (most) education systems, the membership of certain groups eg: Gender, class or ethnicity implies differential educational outcomes in science and mathematics.
- It is not just a technical issue of finding better ways of teaching and learning science and mathematics – it is about empowering our students.
- Mathematical and scientific literacy: 'Reading and writing the world with science and mathematics' (Freire (1970), Gutstein (2006) )
- 'Reading the world' = Using science and mathematics to understand society and the world.
- 'Writing the world' = Developing a sense of individual and social agency through science and mathematics.

# Pedagogy: Re-Engaging learners.




[Inside mathematics, Re-engaging learners]

# How do we make learning/reasoning/knowledge visible?

Activities:

- Groups – formative assessment lesson (assessment AS learning)
- Individuals – Diagnostic activities

Strategies – planning for:

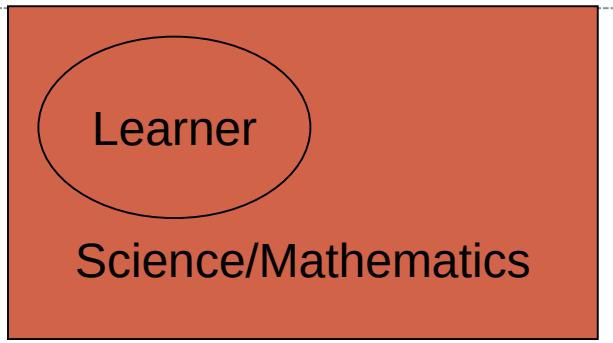
- Questions/prompts
- Feedback
- Activating peer assessment/learning

Tools:

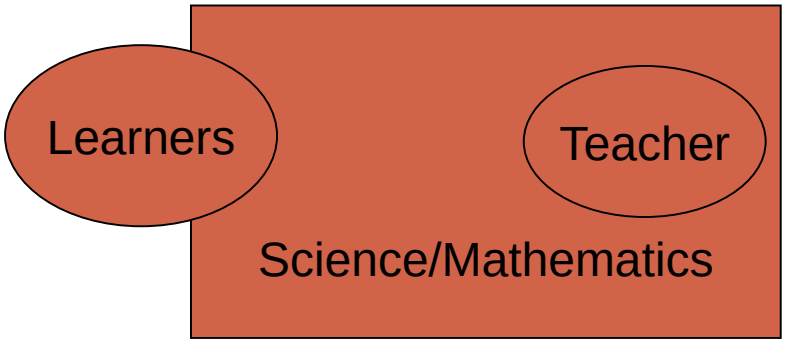
Classroom response systems (simple – sophisticated)

# Evolution of information technology in education

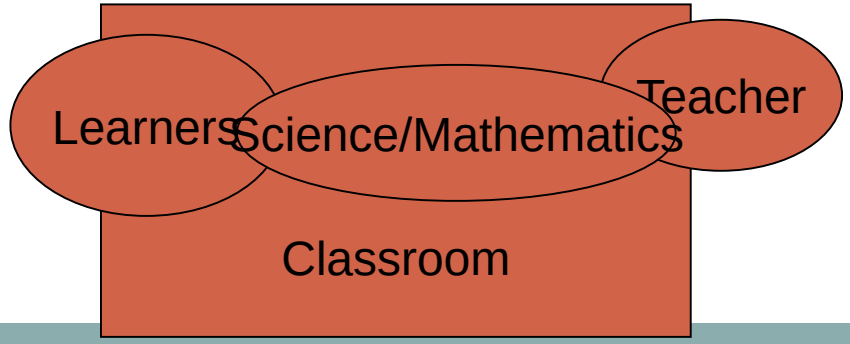
- Type 1 The learner and the computer




- Type 2 The learner, the teacher and the computer




- Type 3 (The connected classroom)



# Professional development (Wiliam, 2011)

Looking at the wrong knowledge…

- The most powerful teacher knowledge is not explicit
- – That's why telling teachers what to do doesn't work
- – What we know is more than we can say
- – And that is why most professional development has been relatively ineffective

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

- – If it did, the most experienced teachers would be the most productive, and that's not true (Hanushek, 2005)

# Teacher learning communities

- Teacher as local expert
- Sustained over time
- Supportive forum for learning
- Embedded in day-to-day reality
- Domain-specific

(Wiliam, 2005)

DZLM Deutsches Zentrum für Lehrerbildung Mathematik

1. Competence orientation

2. Individual preconditions

6. (Self-) Reflection

**Design principles for effective CPD**

3. Sustainable collaborations

5. Versatile design

4. Case orientation

Desimone et al., 2002;
Yoon et al., 2007;
Garet et al., 2008;
Lipowsky, 2011

# Principles for adopting new tools

1. Fits into existing practice
2. Requires minimal training
3. Delivers ‘quick wins’
4. Initial support available in class.
5. A community of supportive colleagues.
6. A ‘champion’ available who can prompt developing practice.

# The toolkit

- https://toolkitfasmed.wordpress.com/
- https://classflow.com/student/

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# Key questions

- How can innovative pedagogies/tools/technologies become embedded in practice?
- What are the key barriers?
  - In the classroom
  - In the school
  - In the educational system?
- How can successful innovations be scaled up?