FaSMEd Vision

The abstract states:

The project aims to research the use of technology in formative assessment classroom practices in ways that allow teachers to respond to the emerging needs of low achieving learners in mathematics and science so that they are better motivated in their learning of these important subjects.
This international project will adapt and develop existing research-informed pedagogical interventions (developed by the partners), suited to implementation at scale, for working with low attaining pupils and transforming teaching.
The project will seek to: *report the differences in the way that systemic structures influence the trajectories of lower achieving students within the participating countries; identify their typical pathways through the school system and reveal the educational opportunities that are open to these students. It will report on the varying assessment tools that are used to identify lower achieving students and may determine these pathways, with attention paid to the different interpretations of low achievement in each country.*
This project aims to:
• foster high quality interactions in international classrooms that are instrumental in raising achievement for low achievers;
• expand our knowledge of technologically enhanced teaching and assessment methods addressing low achievement in mathematics and science
Major objectives for the project are to:
• offer approaches for the use of new technologies to support the formative assessment of lower achieving students.
• develop sustainable teaching practices that improve attainment in M&S for the targeted students.
• produce a toolkit for teachers to support the development of practice and a professional development resource to support it
• disseminate the outcomes

Over the conference the following points were discussed as particularly important:

- Emphasis on high quality interactions between teachers and students and between peers for better learning.
- Emphasis on re-engaging students in learning rather than re-teaching materials.
- Desire to avoid explicit labelling of individuals as 'low achievers' and to challenge possible low expectations and labels.

- Essential for 'low achievers' to receive a full, exciting and engaging curriculum – not a watered down version.
- Emphasis on pupil understanding of the core concepts of maths and science – this will then impact on achievement.
- Dialogue as a means of achieving a progressive understanding of maths and science.
- Focus on making connections visible, learning is situated within context.
- Formative assessment to include self and peer assessment in addition to teacher feedback.
- Introducing problem solving tasks where the problem is the focus rather than a specific mathematical/scientific topic.
- Where the cognitive load of some approaches may be high, collaborative learning may be usefully employed so that individuals do not become overwhelmed by a task.
- Emphasis on non-biased gender teaching practices.
- Technology is the method of supporting the teacher-student and peer interaction, not the focus.
- Using technology in a way that pupils are better motivated in learning.
- Technology demands should not be onerous on teachers or students.
- Emphasis on easily accessible and sustainable teaching practices.
- Need to use pre-existing materials that have been shown to be effective and then research how technology can be used to further enhance these practices. Sources for these resources are likely to include:
    - Those produced by the Shell Center at the University of Nottingham for maths: http://map.mathshell.org/static/draft/pd/modules/1_Formative_Assessment/html/index.htm
    - EpiSTEMe science resources: http://www.educ.cam.ac.uk/research/projects/episteme/
    - Possibility of using SAILS materials – not currently publically available but could get access.
- Iterative process of producing the toolkit – cycles of experimentation, collection of evidence, analysis and reflection, followed by further experimentation.

Questions arising:

1. What is our research approach?

Response – the scientific strategy for the project is design study. As stated in the Description of Work (DOW) B1.3 S/T Methodology and associated work plan, B1.3.1 Overall strategy and general description:

> *Shavelson et al(2003, p. 26) suggest that the key principles of design studies are that they are: a) iterative; b) process focused; c) interventionist; d) collaborative; e) multileveled; f) utility oriented and g) theory driven. Hence the design of the project will lead to an iterative, collaborative, process-focused approach to the development of the toolkit for teachers, evaluation of technologies and professional development and build on research evidence for approaches which have the greatest impact. However, we recognise that pedagogical improvement at scale must take account of the existing state of the system and the resources and practices already in place. These constraints imply the adoption of a 'redesign' stance (see Ruthven et al (2010)), building on existing practices and research.*
> *Evaluation is a constant theme in design study and this is aimed to be a 'learning project' where design does not cease with WP1 but is carried through by formative evaluation of the process of the project through reflection and evaluation by the WP leaders and participants.*

2. What is our research question and possible sub-questions?

Response - As stated in DOW 1.1.3 Research questions, research questions to be addressed as a theme across the project and answered in a summary in WP6 are:

> • *How can research-informed approaches help to understand and address key challenges in enhancing participation, engagement and achievement in science / mathematics [in particular to address differences linked to socio-economic status, gender, and ethnicity which appear to be linked to low achievement]?*
> • *What specific new interventions, or changes in policy or practice, offer the greatest potential to improve engagement and learning in science / mathematics and how could their potential effectiveness and feasibility be assessed more fully?*

It is likely that we would want to break these down further in our research with teachers but across the project these are the two questions that we want to address.

3. What is our approach to professional learning – how do we work with teachers?

Response – there was some discussion about how much focus should be given to professional learning but also the recognition that teachers will come to the project with a wide range of experiences, expertise and beliefs and that therefore there is a need to work from where individual teachers are at, this may vary considerably throughout the project.

Overall there is a commitment to working with teachers in the design study approach to the project ('*the approach of the intervention in WP4 will be to engage teachers as practitioner researchers using a 'lesson study' method for professional development (Lewis, Perry, & Murata,*

2006)' DOW 1.2.2. Reflective practice) and to producing a professional development resource that will exemplify use of the toolkit. It is stated in the DOW, *'that evidence shows that such innovation is difficult to implement at scale in order to spread and sustain beyond the initial input and there is a need to know which practices can be introduced where access to more sophisticated tools is limited and low attainment is widespread (for example in South Africa). Hence the project will also seek to build on what is known about the most effective professional development practices (Timperley et al., 2007) to provide approaches which will sustain and enhance innovation in a wide range of EU and international contexts'* (1.2.2 Progress on state of the art). Generally it was discussed that our approach to working with teachers should seek to establish or support features such as: a supportive culture, trust, good dialogic conditions and good discourse practices.

4. What are our criteria for selecting schools, teachers and pupils - will we only work with schools that fulfil certain criteria (e.g. have existing communities of practice, have little/great experience of using technology for learning) or will we recruit a variety of schools and teachers? How many schools will be involved?

Response – this is to be decided in WP1 Project Design, however, given the varying contexts that partners will be working in a more inclusive policy seems sensible. It also seems appropriate that since the toolkit will be designed for use in a variety of contexts, that the participating schools also reflect this.

It is a requirement that we work with low achievers in science and maths but this does not exclude research within mixed ability classes. As stated in the DOW B1.1 Concept and project objective(s) *'In this project, low achievement refers to student performance that is below the expected level of attainment. Under-performance occurs for a wide variety of reasons. However, this project focuses on school-related factors and does not address those linked to specific learning disabilities such as dyscalculia and does not address the provision of support exclusively related to special needs education.'*

It is suggested that an ideal model for each partner country would be three schools with three teachers in each school participating, however, this will depend on local context and possibilities. In addition partners that are investigating both science and maths may have this model replicated in each subject.

5. How will we identify low achievers/assess achievement/students' motivation?

Response – this will also be decided as part of WP1 1.3 Develop a set of research protocols to support the collection of data at each stage. In the DOW there is a commitment that *'Students'*

initial achievement and final achievement will be measured drawing on internationally recognised assessment protocols' (B1.3 S/T Methodology and associated work plan)

6. How is the technology used as a learning tool?
    - giving teacher data from students
    - Individual interacting with technology
    - Students using technology to collaborate and share data

Response – It is intended that '*a variety of technologies will be used, providing opportunities for comparison of their effectiveness and allowing teachers working with technology with their pupils to become better informed in terms of their students' developing understanding using a range of technologies*' (DOW 1.2.2 Progress on state of the art). This may include some or all of the above, as well as additional options. Overall, '*The main locus of progress in this project will exploit the synergy between the most promising current practice in teaching and assessment in mathematics and science with the latest technological developments to create a new pedagogical approach called 'the Connected Classroom'(Shirley et al., 2011) drawing on mobile technology and wireless networking*' (DOW 1.2.2 Progress on state of the art).

7. What are the case studies for? What are their purposes?

Response – as stated in the DOW 1.1.3:

> *Case studies from WP4 and analysed in WP5 will report on:*
> *• How do teachers process formative assessment data from students using a range of technologies?*
> *• How do teachers inform their future teaching using such data?*
> *• How is formative assessment data used by students to inform their learning trajectories?*
> *• When technology is positioned as a learning tool rather than a data logger for the teacher, what issues does this pose for the teacher in terms of their being able become more informed about student understanding?*

8. At the end of the project who do we expect to use the toolkit and how? What do we expect the toolkit to do? What will a tool look like? (Video/resources/list of principles/practical suggestions for the classroom/hints and tips) Is the toolkit an output of the research, part of the research or both? Must we work within the scope of intersection between maths and science or can we work on topic/subject areas that are 'only maths' or 'only science'?

Response – the toolkit will be primarily designed for teachers to support the development of practice and will have an accompanying professional development resource that will exemplify use of the toolkit. *'The expression 'toolkit' refers to a set of curriculum materials and methods for*

pedagogical intervention' (DOW 1.1.2 Objectives) – this will allow for a wide variety of tools according to what is deemed to be most appropriate by the partners. The tools will reflect what has been shown to enhance practice in raising achievement for 'low achievers' in the research. The toolkit will be designed for use in a wide range of European and international contexts.

The precise topic areas to be researched within science and maths are yet to be decided. There was some discussion about focusing on graphs and diagrams, data handling, modelling or a focus on students' conceptual understanding of science/maths. Given the scope of the project it is important to focus on a relatively small number of activities but whether these activities should have similar topic areas is still under discussion. It was proposed that the science and maths groups should each look at a number of agreed materials and then organise a conference/video call for further discussion.