



Deliverable D3.2 Evaluation of toolkit

The FaSMEd project aims to introduce and investigate the use of technology in formative assessment classroom practices in order to support and collaborate with teachers as well as raise student achievements in mathematics and science. Therefore, one of the project's major objectives is the production of a toolkit including "activities for teachers and students, together with guidance on approaches to teaching and assessment and the use of technology" (FaSMEd DOW, 2013, p.8). The prototype of this toolkit, as described in "Deliverable D3.1 Prototype Toolkit: A prototype toolkit for teachers to support their use of formative assessment in the classroom including advice and support in using technology", includes materials developed in the project and is being published as a public website (<http://toolkitfasmed.wordpress.com/>).

1. Implementation of prototype toolkit

The prototype toolkit is organised in five sections: *home*, *theory*, *classroom activities*, *professional development* and *research* (see D3.1 for a detailed description of these sections). While the sections *home* and *theory* inform about the project and lay a theoretical foundation for teachers and teacher trainers about formative assessment, the use of technology and professional development, the section *classroom activities* composes the centre of the toolkit (The evaluation of the section *professional development* is addressed in deliverables D3.4 and D3.5 and the section *research* will not be inserted until the final toolkit as it will consist of results from the projects' Case Studies, Intervention Cases and Cross-country analysis). The following classroom activities are integrated in the prototype toolkit:

Activities for mathematics:

- Interpreting Time-distance graphs
- Real-life equations
- Properties of exponents
- Can I sketch a graph based on a given situation?

Activities for science:

- Blood donation
- Evaporating & cooling
- Pressure in a liquid
- Heart rate
- Insulation

- Who has the juiciest apple?

These classroom activities have been implemented by different FaSMEd partners with different technologies throughout the project:

For the mathematics activities, “Real-life equations” and “Properties of exponents” were used by AIMSSEC using small card sets, *PowerPoint* and mini white boards. The activity “Can I sketch a graph based on a given situation?” was developed and implemented in a pen-and-paper as well as digital version by DUE. For the digital version of this formative self-assessment tool, the software *TI-Nspire Navigator* was used on *iPads*. The activity “Interpreting time-distance graphs” was implemented in mathematics classrooms by almost all partners. These implementations involved various different technologies ranging from card sets, different tablet applications like *Socrative*, *Classflow* or *Showbie* over connected classroom technologies (e.g. *IWB (Interactive White Board)* with the software *NetSupportSchool* or *ISM-TClass*) to motion sensor technologies (*echo sound logger* and *TI-84* with *CBR motion sensor*), graph plotters (e.g. *Desmos*, *GeoGebra*, *Pasco software*) and online platforms (e.g. *Schoology* or *Google documents*).

Even though the range of technologies was very wide, mostly it was used to send tasks and questions to the students, receive and project the students’ responses and share ideas with peers, the teacher or the whole class. It is interesting that all partners modified the implemented materials throughout the project in order to adjust the classroom activities to their individual contexts and the needs of their teachers and students. For activities adopted from the MAP project (Mathematics Assessment Project, <http://map.mathshell.org/>), modifications reached from integrating technology into the lesson plans in order to stimulate classroom discussions, adding a recording sheets for the student’s work or changing the methods described in the lesson plans to adjust to organisational issues or the age of students, adding questions or reducing the material as well as using a physical context in order to apply a mathematics activity in a science classroom (e.g. in the case of “Interpreting time-distance graphs” implemented by ENS de Lyon).

For the science activities, NUIM implemented the activity “Heart Rate” by using the technologies *Educreations* and *Explain Everything* and modifying it by implementing a digital pre-assessment task on which students work collaboratively. This was added in order to give the teacher the opportunity to review the students’ work and give feedback. NUIM also implemented the activity “Insulation” by using *iPads*, *LoggerPro* and *Schoology*. This lesson plan was adjusted, so that the tasks was easier to understand and students could give feedback to each other. DUE implemented the activity “Who has the juiciest apple?” by using *PowerPoint* on *iPads*. The definitions and texts were simplified in this activity after receiving feedback from teachers on this lesson.

Regarding further implementations of classroom activities of the existing prototype toolkit, all FaSMEd partners state that they do not wish to implement any other activities, which they

have not yet implemented in schools, but concentrate on refining the already tested activities and tools.

2. Additional classroom activities

When reviewing the FaSMEd partners' development and implementation of classroom activities throughout the project, it becomes clear that the existing prototype toolkit only includes some examples of activities that were developed and investigated. Nevertheless, many other activities have been designed and implemented in classrooms that should be included in the final FaSMEd toolkit:

UNEW:

- Based on MAP resources (Candy cartons, Security Cameras, Selling Soup, Travelling to school, Developing a Sense of Scale), teachers developed activities with problem-solving tasks with the use of *iPads* with *Socrative* and/or *Classflow*, *Google documents*, *Show-Me software*, *Ti-84 with CBR motion sensor* and *Airserver/Reflector and Airplay* technologies.

UNOTT:

- “The Meatball Problem” (adopted from <http://blog.mrmeyer.com/2013/makeover-meatballs/>) for grade 9 students in mathematics using videos, *Google forms* and *IWB* technologies.
- “Algebraic Equations” for grade students in mathematics using the electronic learning environment *Mathspace* (<https://mathspace.co>), *iPads* and *IWB* technologies.
- “Algebraic Expressions” for grade 7 students in mathematics adopted from the MAP project using *iPads* with the software *NearPod* and *IWB* technologies.
- “Directed numbers” for grade 7 students in mathematics adopted from the MAP project using the web-based application *diagnosticquestions.com*, *iPads*, *IWB* technologies and card sets.
- “Magic V” for grade 7 students in mathematics adopted from the NRICH website (<http://nrich.maths.org/6274>) using *iPads*, *IWB* and *NearPod* technologies.
- “Tessellations” for grade 4, 5 and 6 students in mathematics using *IWB*, the web-based application *Tessellation Creator* and mini white boards.
- “Areas and perimeters” for grade 4, 5 and 6 students in mathematics using *iPads*, *NearPod* and *IWB* technologies.

ENS de Lyon:

- “Fractions” for grade 4 students in mathematics using *IWB* and student response system technologies.
- “Equivalence of fractions” for grade 4 students in mathematics using *IWB* and student response system as well as *TI-Primaire calculator* technologies.

- “Improper fractions” for grade 4-5 students in mathematics using *IWB* and student response system as well as *TI-Primaire calculator* technologies.
- “Scales” for grade 6 students in mathematics and science using a beamer and student response system technologies.
- “Real and apparent size of objects seen through a microscope” for grade 8 students in science using a beamer, the software *Optikos (simulation of the light path through a lens)* and student response system technologies.
- “Electricity: measurements of voltage and intensity” for grade 8 students in science using *iPads* and the application *Socrative*.
- “Introduction of probability” for grade 9 students in mathematics using *IWB* and tablets with *NetSupport School* and *Maple TA* technologies.
- “Linear functions” for grade 9 students in mathematics using *IWB* and tablets with *NetSupport School* and *Maple TA* technologies.

NUIM:

- A lesson was designed to promote students as assessors. It makes use of graphic organisers as revision for the students’ summer examinations using peer-assessment as well as self-assessment by filling out reflection sheets. This lesson uses the network *Schoology*, and either a pen-and-paper work or the application *Popplet*.

DUE:

- The self-assessment mathematics activity “Can I sketch a graph based on a given situation?” was modified and a new pen-and-paper version as well as a digital version in the software *TI-Nspire Navigator* used on *iPads* have been developed.
- The self-assessment science activity “Who has the juiciest apple?” was digitally implemented into *PowerPoint* used on *iPads*.
- A new self-assessment biology activity “Sweet or sour – our teeth like neither” was developed using cards.

UNITO:

- Materials from the ArAl project on understanding early algebra (Cusi et al., 2011; <http://www.aralweb.unimore.it/site/home/aral-project.html>) were adopted. These materials involve activities on relations and functions as well as their different representations. They were implemented using the software *IDM-TClass*.

UU:

- Assessment materials for four mathematical content domains for upper primary school students (age of 10-12 years) were developed for the *DAE (Digital Assessment Environment)*: percentage, fractions, metric system and graphs. These materials were implemented in two pilot studies and adopted according to the findings.

AIMSSEC:

- A number of lessons by the MAP project (partly adopted) were implemented using small and big cards and mini white boards: Properties of quadrilaterals, Directed numbers, Triangle construction, Identities and equations, Measurement, Comparing Investments, Increasing and Decreasing Percentages, Defining linear equations, Designing a garden and Baseball jerseys.
- Five new lessons were developed based on the MAP approaches using the same technologies as in the MAP lessons: Early algebra, Trig graphs, Mean Median, Reading functions and Multiple representations of algebraic relationships.

HIST:

- Several technologies graph drawing technologies were tried: *Desmos*, *GeoGebra* and *Pasco data logger* (echo sound logger).
- In addition, student response systems were used, including *Kahoot*, *Socrative*, *Verso App* and *Classflow*.
- In two schools the topic of graphs was connected to statistical experiment concerning how to prevent spreading microorganisms. In one of these schools, graphical representations were sketched by hand, while in the other school, *Excel* was used.

3. Considerations for the final toolkit

This elaboration of classroom activities used in the FaSMEd project to investigate technology enhanced teaching and assessment methods shows that while there is a wide variety of assessment methods and technologies explored in the project. Thus, revealing that the consortium has considered the advice given in previous evaluations. As suggested in deliverable D9.1 “FaSMEd Project Evaluation Report Month 12” by Dr. Alf Coles, Prof. Justin Dillon and Prof. Ken Ruthven, the project should take into account a range of technologies but focus on new digital resources. While this has been achieved in the consortium’s work, it is not yet transparent in the toolkit. Therefore, the FaSMEd partners will need to concentrate on adapting the existing classroom activities and including the additional classroom activities in the final toolkit. These modifications should “highlight the value added by this project, particularly in relation to the role of technology and tools”, where FaSMEd has adapted materials from other projects, as suggested to the consortium by Dr. Alf Coles, Prof. Justin Dillon and Prof. Ken Ruthven in deliverable D9.1 “FaSMEd Project Evaluation Report Month 12” (p.3). In addition, the role of technology should be emphasised by including “a paragraph highlighting this in relation to each activity in the website” (D9.1, p.4). What is more, the “Technical Review Report” by Dr. Josette Farrugia, Dr. Peter Gray and Dr. Eleni A. Kyza states that, the project needs to “focus on digital technologies in relation to formative assessment” because it is the distinguishing characteristic of FaSMEd (Technical Review Report, p.4). This needs to be stressed in the final toolkit by ensuring that the materials provided describe in

more detail “which digital technologies and formative assessment strategies are used and how” (Technical Review Report, p.6).

The consortium has planned to achieve this by not only adapting the classroom activities, but also by structuring the final toolkit according to the developed theoretical FaSMEd framework. This three-dimensional framework was initially developed during a meeting that was held in July 2015 in Essen by Annalisa Cusi, Francesca Morselli and Christina Sabena (University of Torino); Jill Clark, Lucy Tiplady and David Wright (University of Newcastle); Diane Dalby (University of Nottingham); Bärbel Barzel and Hana Ruchniewicz (University of Duisburg-Essen). It takes into account three main dimensions that enable to characterise technology enhanced formative assessment processes: (1) the five key strategies of formative assessment introduced by Wiliam and Thompson (2007); (2) the three agents that intervene in the formative assessment processes and that could activate these strategies, namely the teacher, the student and the peers; (3) the functionalities of technology (see figure 1).

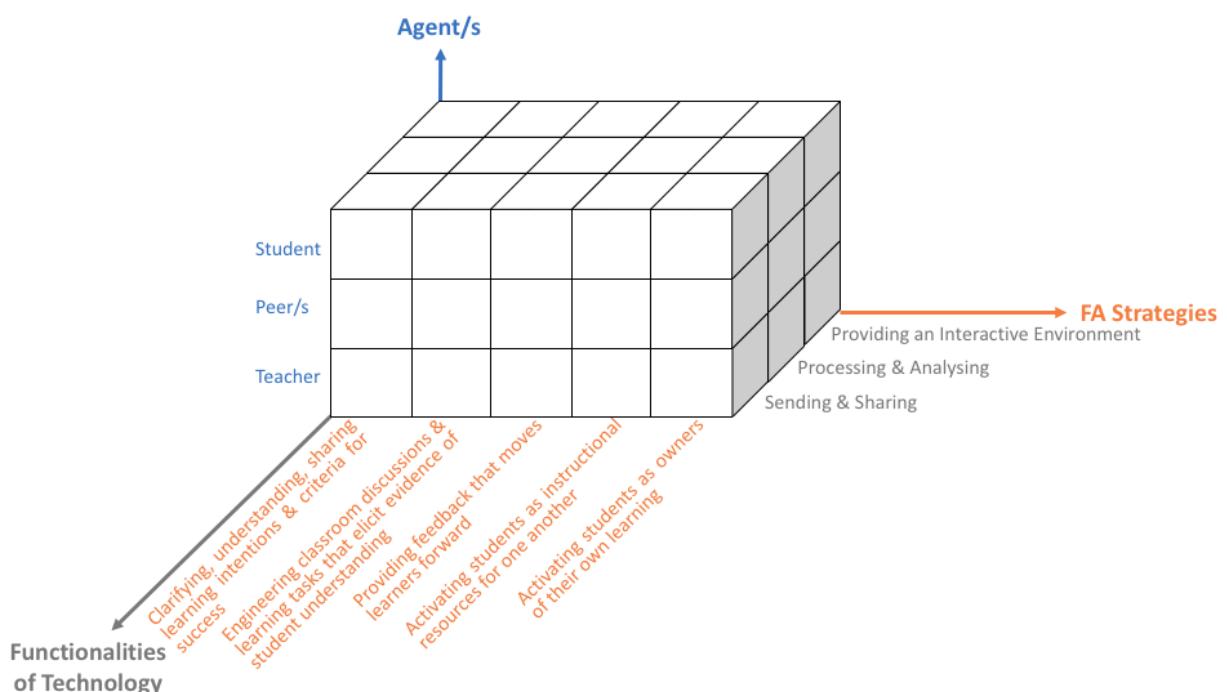


Figure 1: Overview of the FaSMEd framework

The overview of the FaSMEd framework highlights how the subdivision of each dimension into different sub-categories enables to identify small cuboids within the diagram. Each cuboid helps to locate specific formative assessment practices, highlighting the agents involved in this practice, the main formative assessment strategies that are activated and the functionalities of the technology that is involved. The classroom activities integrated in the toolkit, will be located within this framework to stress the connections between formative assessment strategies and functionalities of the technology.

Moreover, the “Technical Review Report” of the project states that “the question of what, and how, materials and outputs should be presented on the website must be addressed” as well as that “the toolkit website should be linked to, or integrated into, the main project website” (Technical Review Report, p.6). While the issues of presentation and structure will be

addressed in the upcoming consortium meeting (February 9th-11th 2016), it has been clarified that the final toolkit will be hosted by Newcastle University on their Wordpress server. Therefore, a connection to the main homepage should not be difficult to achieve.

4. Conclusion

While it is clear that the FaSMEd toolkit is still at an “early stage of development” as stated in the projects “Technical Review Report” (p.5), this paper shows that the consortium has already taken into account several issues that were stated concerning the toolkit in previous evaluations. If the work of the FaSMEd partners continues to concentrate on disseminating the project’s research findings and integrating the connections between formative assessment practices and the use of (digital) technologies, the final toolkit will accomplish the aim of including “activities for teachers and students, together with guidance on approaches to teaching and assessment and the use of technology” (FaSMEd DOW, 2013, p.8).

5. Resources

ArAl project: <https://www.aralweb.unimore.it/site/home/aral-project.html>.

Cusi, A., Malara, N.A., & Navarra, G. (2011). Early Algebra: Theoretical Issues and Educational Strategies for Bringing the Teachers to Promote a Linguistic and Metacognitive approach to it. In J. Cai & E. Knuth (Eds.), *Early Algebraization: Cognitive, Curricular, and Instructional Perspectives* (pp. 483-510). Springer.

Deliverable D3.1: Prototype Toolkit: A prototype toolkit for teachers to support their use of formative assessment in the classroom including advice and support in using technology (2014). Retrieved from <https://research.ncl.ac.uk/fasmed/deliverables/>.

Deliverable D9.1: FaSMEd Project Evaluation Report Month 12 (2014). Retrieved from <https://research.ncl.ac.uk/fasmed/deliverables/>.

FaSMEd “Description of Work”, Grant agreement no: 612337 (2013).

FaSMEd “Technical Review Report” (2015).

MAP project: <https://map.mathshell.org/>.

Mathspace application: <https://mathspace.co>.

Nrich project: <https://nrich.maths.org/>.

Prototype Toolkit: <https://toolkitfasmed.wordpress.com/>.

“The Meatball Problem”: <https://blog.mrmeyer.com/2013/makeover-meatballs/>.