

Each of the work packages WP2-WP6 produced new insights with potential impact on science education in Europe, while WP6 and WP7 arranged, disseminated and communicated the results.

WP2 gave a short, comprehensive and precise definition of IBE that is easily accessible for teachers and clear criteria for formative assessment. These conceptual clarifications can be a sound basis for future work.

WP3 results allow to envision possible ways to enhance the combination of formative and summative assessment in teacher practice through educational policies:

- Promoting day-to-day formative assessment in combination with summative assessment through teacher education and in-service development.
- Providing teaching resources and guidelines for the implementation of formative assessment and its combination with summative assessment.

The work in WP4, particularly the teacher manual (deliverable 4.4), the final version of assessment methods and competences (deliverable 4.7), and the 20 paradigmatic examples served as a basis for the subsequent steps in the project, in particular for the collaboration with teachers in Local Working Groups. The different deliverables produced in the work package allowed to start communication and discussions with the teachers in the different countries. This collaboration allowed to test the methods and to further develop them in different educational systems.

The outcomes of WP5 are likely to have a significant impact on (a) the research field associated with formative assessment, (b) teaching-practice focusing on formative assessment and (c) teacher professional development (or initial preparation) programs on the effective use of formative assessment in the classroom. Next, we provide more information on each of these three aspects.

Impact on the research field associated with formative assessment: the research findings that have been presented and elaborated in D5.8 - D5.11 could serve to supplement the extant literature on the use of formative assessment in inquiry-based learning environments. The most important impact in this respect is associated with the documentation of features that seem to enhance (e.g. tools to scaffold teachers' attempt to produce useful feedback) or impede (e.g. lack of an appropriate assessment culture in the classroom could lead to unproductive engagement with the peer-feedback process) the enactment of the four assessment methods.

Impact on teaching-practice: The partners developed teaching materials that have incorporated the four assessment methods. These could possibly serve the role of examples of good practice that could be shared within teacher networks. Also, they could illustrate circumstances under which certain factors have inhibited the potential of seemingly powerful teaching materials featuring formative assessment. Finally, the tools that have been developed by the partners to scaffold teachers' attempt to provide effective feedback could be also shared within teacher networks interested in employing formative assessment in their own teaching.

Impact on teacher professional development: the findings that have been reported in the WP5 (but also the tools and the teaching materials that have been developed) could provide useful inputs (and resources) that could inform/supplement attempts to design and implement teacher professional programs centered on the notion of formative assessment.

## **Policy aspects**

The above potential impact areas all relate to the concrete teaching in the classroom. Another important aspect of ASSIST-ME is the policy aspect.

WP6 invented a method for selecting key stakeholders through social network analysis. This is a potentially important way to identify key people influencing a field of interest. The method is described in detail in Deliverable D5.1

The involvement of the stakeholders in the project through the guidelines in D6.2 also turned out to be successful. All National Stakeholder Panels (NSPs) had very engaged discussions, reflecting the importance that all stakeholder representatives attributed to assessment. Despite quite different foci and nuances, as illustrated by the excerpts above, it was possible to extract some common agreements and recommendations which will be outlined in the following 'general recommendations' section.

On reflection on the importance of having a forum for dialogue across political interests and power relations in order to establish mutual trust and understanding, it is clear that the NSP constituted a free space for exchange of ideas and points of view. It is also clear that many controversial questions were openly discussed. The discussions often revolved around the accountability purposes of assessment versus the learning purposes and the potential contradictions between the two purposes.

The tension between these two orientations was clearly articulated in the NSPs and it became clear to all stakeholder representatives that a solution was necessary and that it could only be developed through strengthening the cooperation between teachers, researchers and key stakeholders, especially from official bodies like the Ministry of Education.

The ASSIST-ME Lyon meeting in February 2016 had as a main theme summing up the findings and formulating the project's general recommendations, which had to be reported to the EU as Deliverable D7.3. All partners brought with them the minutes from the NSPs and also minutes from the last meeting in their LWGs where teachers should have discussed questions very much in line with the questions for the third NSP meeting.

Thematic groups were formed with members from all partner institutions. The groups wrote down statements everyone could agree upon based on the different national statements and conclusions. These statements were then edited together into five broad recommendations for policy-makers and other key stakeholders on how formative assessment of inquiry-based teaching and learning might be done more effectively across a range of countries. This process builds on the trial implementation of the four ASSIST-ME assessment methods (i.e., Marking (Grading and Written comments), Self and Peer feedback, On the fly interaction and Structured assessment dialogue) and recommends how these approaches can be strengthened and how existing assessment systems might be modified to enable formative assessment to function effectively in STM classrooms. Many of the recommendations are neither new nor groundbreaking. But they have been carefully discussed among stakeholders from the partner countries involved in educational issues.

## **The impact from ASSIST-ME on education and educational policy**

It will always be difficult to measure the impact of an educational research project. Education is a complex interplay between the teachers in the classroom and the school leaders, both framed and conditioned by the current educational policy. So, the research can influence how some teachers teach their classes and how some school leaders support and promote new teaching approaches – within the given frame. The research can also affect the policy system to change the conditions for teaching, thus from a top-down position steer or support teachers' work. The ASSIST-ME project intended to do both.

Through the work in the LWGs teachers have been supported in changing their assessment practice. They have been introduced to various assessment methods and their implementation in the subject and the class as described in the Chapters four to seven. This work has been disseminated through national channels like national conferences, teacher journals, in-service teacher training etc.

The national policy level has been influenced in various ways from country to country.

In Denmark a new act for upper secondary education has passed the parliament 2016 with intentions of trying new assessment forms and formats inspired by ASSIST-ME. An in-service programme for teachers focusing on feed-back forms is running in the spring 2017 by ASSIST-ME researchers.

ASSIST-ME will have effects on the implementation of the new Swiss curriculum, Curriculum 2014, on teacher programs and CPD, on formative and summative assessment. The Centre for Science and Technology Education (CSTE), which is the Swiss partner in ASSIST-ME, and its members are responsible - in most cases together with other institutions - for the following activities and projects:

1. Educating teacher students at our university and being engaged in CPD, for example in the big program SWiSE (SWiSE 20172016, Swiss Science Education, customers: teachers, ministries of education, universities, and foundations; since 2011);
2. Planning and developing checks in science for the end of grade 8 and 9; IBL and experiments play an important role in these checks (customers: ministries of education of the four cantons of Northwestern Switzerland; annually since 2014);
3. Organization of a one-day conference on formative and summative assessment in science for cantonal ministries (about 30 specialists of cantonal ministries; November 15, 2016);
4. Part of the advisory board for the national monitoring (customer: Swiss Conference of Cantonal Ministers, since 2016);
5. Writing science school books for grades 7-9 with an emphasis on IBL and with hints for formative and summative assessment in the teacher edition (customer: a Swiss publishing company; 2014-2020);
6. Helping to implement Curriculum 21, in particular the ideas of IBL and formative assessment.

These activities and projects show that ASSIST-ME has had and will have an impact in Switzerland. There are a lot of synergistic effects between the European project and several Swiss projects.

The ASSIST-ME project has demonstrated that bringing researchers and teachers and policy-makers in close dialogue about concrete issues regarding assessment gives an enhanced awareness and understanding of the role of formative and summative use of assessment. This has influenced the attitude of the individual policy-maker and given him or her a more nuanced view on problems related to assessment and an informed openness for debating solutions.

ASSIST-ME partners in other countries have also arranged activities and events with high potential impact, like for instance the national French conference 'Colloque international ASSIST-ME 2016: La mise en oeuvre de l'évaluation dans l'éducation scientifique fondée sur l'investigation', Les 6 et 7 octobre 2016 à l'Université Grenoble Alpes.

It is also evident that ASSIST-ME has had influence on the educational policy in the participating countries. The extend of influence differs, of course, from country to country and many effects will only be visible after a longer period of time. But partners have arranged national conferences including policy-makers and all partners give various examples on how their researchers have been invited to participate in curriculum development, teacher professional development workshops, expert groups on assessment etc. Through such activities and through the NSPs the results from ASSIST-ME has have been spread and have affected the public discourse.

It has been crucial that messages spread and the debates in the NSPs were based on research results found in collaboration between researchers and teachers. It gave the background for the debate a high degree of legitimacy, both among teachers and policy-makers, and thus some seriousness and respect for the outcome. It has also been fruitful that NSP members were involved indirectly in the research process. It gave them insight into the complexity of educational research and certain humbleness towards quick solutions.

This has not necessarily led to consensus, which is a rare thing in policy, and it has not eliminated all resistance to change. Much resistance to change has legitimate reasons seen from the point of view of the actor. Teachers have limited capacity for change if not giving the necessary support. Professionals need time and training for professional development. Policy-makers are often restricted in their actions by the point of views they normally represent, talking on behalf of their policy or interest organisation. But the ASSIST-ME approach has pointed at some ways forward for affecting educational policy.