

A modern society and our increased insight into learning and teaching make an increased demand to students' outcome of science education – the educational goals are constantly becoming more and more ambitious, demanding advanced professional and generic abilities. These new goals are expressed in competence terms, describing for example inquiry processes or modelling processes as well as innovative or argumentative processes that the students should be able to perform. We know a lot about how to teach for these new competences, for instance through many FP7 projects. A number FP7 projects have also established extensive programmes for teacher professional development for the new competences.

But it is a fundamental problem that the predominant assessment and evaluation forms are not able to capture these new goals. Most assessments are still based on relatively traditional test formats based on a post-positivist paradigm, and mostly as summative assessments without the learning potential of formative assessments. We know that the assessment forms have a deciding influence on teaching – “teaching to the test” is a well-known and reasonable teacher reaction on the test regimes currently invading the educational systems. Thus, traditional assessment forms will encourage ‘traditional’ teaching, so that most of the existing assessment and evaluation forms are blocking for teaching that makes it possible for students to acquire the new learning goals.

It is therefore necessary to develop new assessment forms able to capture these new learning goals and to affect educational policymakers to implement them in the national educational systems.

The overall aim of ASSIST-ME (*Assess Inquiry in Science, Technology and Mathematics Education*) is to provide a research base on effective uptake of formative and summative assessment for inquiry-based, competence oriented Science, Technology and Mathematics (STM) education in primary and secondary education in different educational contexts in Europe and to use this research base to give policy makers and other stakeholders guidelines for ensuring that assessment enhances learning in STM education.

As ASSIST-ME is a research project, the work within the project is driven by the formulated research questions. These are:

1. What are the main challenges related to the uptake of formative assessment in the daily practices in science, technology and mathematics in primary and secondary schools in different European educational systems?

- In their efforts to enact innovative inquiry-based teaching-learning sequences, how do teachers approach the need to monitor student learning as it develops? To what extent do they use structured formative assessment and in what formats?
- What systemic support measures and what tools do teachers need in order to integrate formative assessment of student learning in their classroom practice?

2. What changes are needed in summative assessment practices?

- To bring them into consistency with the learning aims of IBE in STM?
- To ensure that they support and do not inhibit the practice of formative assessment?

3. How can formative and summative assessment methods be used together to promote learning in inquiry-based STM?

4. How can research-based strategies for the formative use of assessment be adapted to various European educational traditions to ensure their use and avoid hindrances?

- How can the diverse roles of summative and formative assessment be clearly delineated for teachers and what strategies can help them make appropriate use of both, each to fit its own purposes?
- How can relevant stakeholders be invited to take co-ownership to the research results and how can a partnership between researchers, policy makers, and teachers be established in order to secure relevant actions following implementation guidelines?

In each participating country teachers worked together with researchers to implement assessment methods developed to be able to capture advanced STM competences. A research design for each assessment method made it possible to collect and analyze data related to the research questions on both a national and an international level. The resulting synthesis of opportunities and restrictions for implementing the assessment methods were discussed in National Stakeholder Panels in order to formulate guidelines and recommendations for policy makers, curriculum developers, teacher trainers and other stakeholders in the different European educational systems.

One overall driver in the project was to establish alignment between the learning goals, the pedagogy, and the assessment, as illustrated in figure 1:

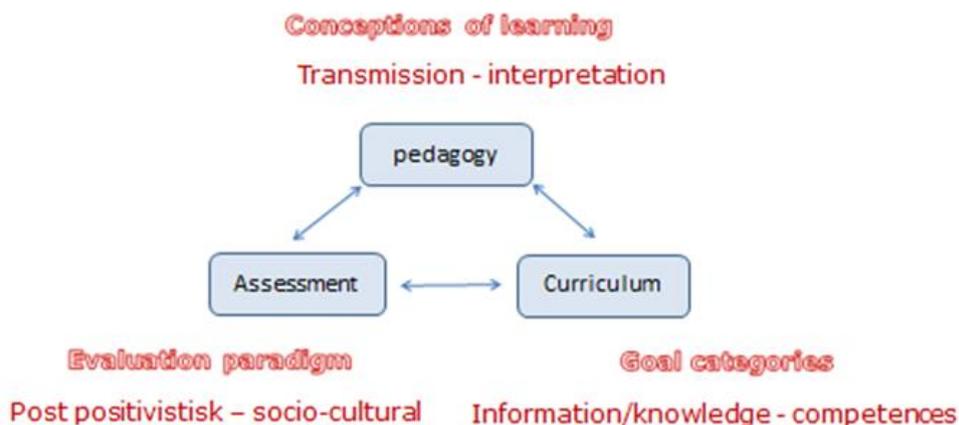


Figure 1. A well balanced educational system must have alignment between the goals, the teaching methods and the assessment methods.

Teaching for competences in an inquiry setting needs a specific pedagogy – in figure 1 labeled as an interpretive approach to teaching in order for the students to obtain the wanted competences (understood as the ability to act in complex settings using the knowledge and the processes of the subject). At the other end of the spectrum, the figure implies that more simple information or knowledge can be learned through more transmissive teaching approaches. Regarding assessment, the point is that student performance can only be assessed through an assessment method able to capture students' ability to apply their knowledge in authentic situations. This means that you must assess the students using a socio-cultural approach (Gipps, 1999) instead of a more traditional, post positivistic approach (seeing student knowledge as independent of the situation in which they are assessed). So, you need to set up a system of goals, corresponding teaching methods and relevant assessment formats. To be able to do this, the project theoretically draws upon design based research which is dealing with the systematic study of designing, developing and evaluating educational programs, processes and products (van den Akker et al. 2006).

Another overall driver was to inform and influence policymakers to initiate educational changes in a direction that allows teachers to a more formative use of assessment instead of the dominating summative use. It was therefore a key aspect of the project to put together the three main players in the changing process: The teachers, the researchers, and the policy makers:

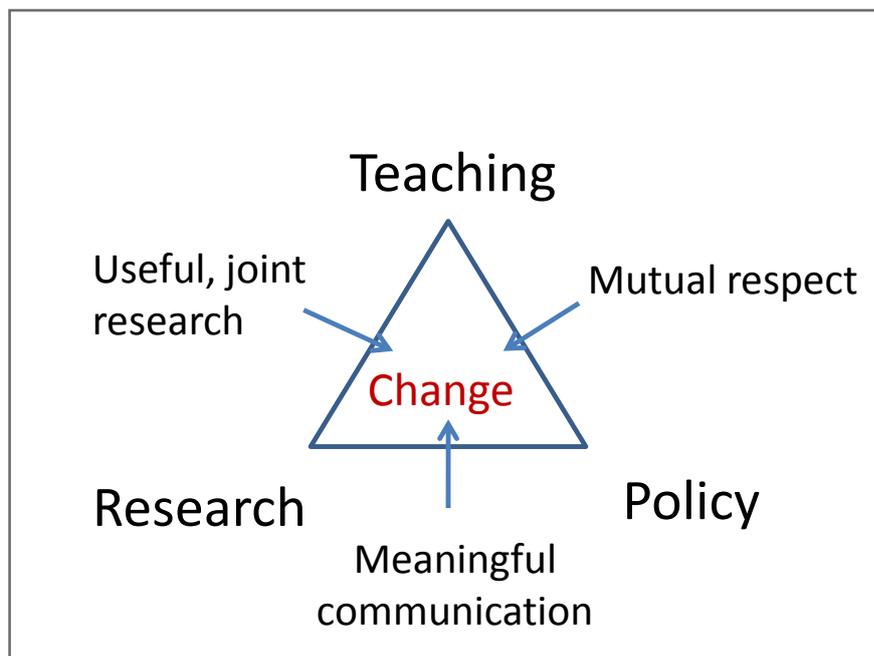


Figure 2. Research form a triangle with policy and practice in order to make change happen.

The collaboration was managed through National Stakeholder Panels with representatives from industry, ministry, heads' association, teachers' association, media, Parliament, foundations etc., and through Local Working Groups with approximately 20 teachers teamed up with 2-3 researchers.

It was an important objective to find a way to identify key stakeholders and to set up a useful working plan for the National Stakeholder Panels. This was done through the use of social

network theory, as described in Deliverable 6.1, and guidelines for the function of the National Stakeholder Panels.

The work performed during the project

ASSIST-ME was structured in three phases:

- Phase 1: Synthesize existing research on assessment and identifying and categorizing Europe's educational cultures.
- Phase 2: (a) Design assessment methods using formative and summative approaches.
(b) Implement the assessment methods in different educational cultures.
- Phase 3: (a) Validate and share results with different stakeholders and expert groups.
(b) Develop guidelines and communicate with policy makers and stakeholders.

After establishing and contextualizing the project in phase 1, the core work was carried through in phase 2. Four assessment methods were selected:

- Questioning and other interactions on the fly
- Marking (grading and feedback)
- Student peer and self-assessment
- Structured classroom dialogue

The project concentrated on three domain specific competences:

- Empirical investigations in Science (Planning, performing, analysis and evaluation of data, presentation and representation of findings)
 - Problem solving in Mathematics (Collection of information, problematization, presentation and representation of findings)
 - Design in Engineering/Technology
- and three cross-disciplinary competences
- Argumentation
 - Modelling
 - Innovation

These competences were implemented in the classrooms and researched.

Phase 3 was devoted to validate the results and share and discuss them with stakeholders in the NSPs and teachers in the LWGs. Based on these discussions the researchers formulated guidelines for change and communicated the results and guidelines to policymakers and stakeholders. This happened through final conferences and roundtable discussions for policymakers in Brussels and for researchers in Copenhagen. The project also delivered national dissemination material in the form of a booklet describing the project and its results and through the national entrances on the project website. The research community is specially addressed via a book 'Transforming assessment – through interplay between practice, research and policy', published on Springer August 2017.