INSTEM Shaping the future of STEM education

INSTEM State of the Art Report (Synopsis)

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Over the past decade multiple inquiry-based learning (IBSE) projects funded by the European Commission have galvanized advocacy for science education as a direct response of the need to change our educational provision, in order to address the growing societal challenges that we face. For some there was also a desire to increase inclusiveness but this was not the primary driver for the much of the work, which focused on the promotion of science through experiential teaching methodology.

To identify the long-term impact and sustainability of project outcomes, an analysis of the current state-of-the-art within the INSTEM eight partner countries was conducted. The report provides a previously unavailable picture of inquiry based science education within eight different EU countries (including two regions within one country) and establishes recommendations for achieving future progress.

The report was based primarily on document reviews and interviews. According to cultural conventions an analysis was carried out in every INSTEM partnership country/region. The goals of our gathering were to:

- Investigate the current situation on educational innovation (including inquiry-based teaching, gender issues and science career information);
- Explore how and to what extent project knowledge is used (analysis based on text reviews, interviews, according to cultural conventions);
- Identify the relevant key actors to address during the project to ensure that the results are used and acted on.

This INSTEM report was based on the knowledge gathered from inquiry-based learning (IBSE) projects funded by the European Commission since 2007. The major focus of this report is on the long-term impact and sustainability of project outcomes and it is hoped that these will assist in the clarification of objectives for future project funding at European, national and regional levels.

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What is inquiry-based science education? Inquiry is an approach to learning that involves a process of exploring the natural or material world. The process leads to asking questions and making discoveries in the search for new understandings. Inquiry-based science education shares several features with the practice of doing real science.

Founded on the inductive approach to teaching, inquiry-based science education was developed in the 1960s, in the context of the discovery learning movement. In European policies about education, the Rocard Report (2007) supports the reversal of school science-teaching pedagogy from mainly deductive to inquiry-based methods, as a mean to increase interest in science. Similar governmental policies or non-governmental pedagogical movements can be found all around the world.

Our research demonstrated that a great deal has been achieved to support teachers to develop inquiry-based learning pedagogies throughout Europe. Various resources and support measures such as teaching materials, professional development courses for teachers or support for professional development facilitators - just to mention a few - were developed and made available. But a number of key aspects still remain unresolved. Consequently recommendations were derived from our findings; these are based on the specific projects reviewed but also have wider applicability.

A striking feature of the analysis was the absence of children's voices. As the purpose of inquiry-based learning is to enable children to engage with science, at the very heart of this process must be the learning of the child. This raises the very fundamental question as to what do the children themselves think? What are their views on IBSE compared to more traditional teaching methods? What do they think they are learning about science? Do children from different countries think differently about IBSE? There are many more questions of this nature.

Another outstanding feature of the analysis was around the lack of teacher confidence. This should not be interpreted, in any way, as a criticism of teachers, but more of recognition of the very difficult job that they undertake on behalf of society. Most of the projects sought the views and opinions of teachers; however for a variety of reasons the voices of teachers are not clearly audible in the project findings. This appears to be directly linked to the fact that teachers are not being supported by their current education systems to engage with and embrace an inquiry-based teaching methodology, that many welcomed in principle.

A key factor in terms of sustainability of project outcomes was the relationship between European level recommendations and national/regional policy contexts. These IBSE projects were all funded by the European Commission; however educational policy is devised and implemented at national (regional) level. In order for EC funded project findings to be disseminated in such way that they have a long-term impact, then this lack of relationship has to be addressed. Without this, it is difficult to see how European funded IBSE projects can actually lead to systemic change at school level.

The ten Recommendations

Recommendation 1: There is a need to identify a travel plan for the European learning journey in relation to education until 2050 (at least 2020). This should be based on the engagement of all societal actors (children, teachers, parents, educational services, governments, business, media, third sector organisations etc).

Recommendation 2: Genuine participation by societal actors requires supportive structures (e.g. communities of practice) which enable individuals to gain confidence in their own voice, to know their opinion is valued, respected, and is being listened to. This is particularly true for children and teachers

Recommendation 3: In order to engage the range of societal actors involved, there is a need for greater synchronisation between policies and actions in primary, post primary and the tertiary sector, and across funding programmes.

Recommendation 4: Children, as scientists of the future, will have to find interdisciplinary solutions to societal challenges. In order for them to see science in everyday life, and potential career opportunities, they need to be able to see science as inter-connected branches of learning and not as separate linear lines of learning.

Recommendation 5: The desire to promote STEM subjects should provide learning opportunities for students at all levels, with more careful attention given to the needs of locally defined minorities. Underrepresentation of any identified group, including men and women, needs to be addressed from the earliest age.

Recommendation 6: A more open interpretation of 'innovation' would support the development of a science-literate society, benefitting educational and career opportunities, social entrepreneurism and creativity.

Recommendation 7: In order to equip future researchers with the required skills, there is a need for greater synergy and interaction between educational coordination, support and research. This will require that societal actors take responsibility for this within their own sphere of influence.

Recommendation 8: The exponential growth of technological opportunities will require a more open, flexible and innovative approach within the education systems - this includes the development of resources and materials for the classroom.

Recommendation 9: The development of Open Science, which includes children, schools and the public within the research process would enable a participatory approach to education, which will further the ambitions of its students, of all ages, in participating in

STEM.

Recommendation 10: The concept of dissemination (sowing the seeds) needs to be developed to include the active engagement by all societal actors in the process of change, for example by the direct linkages of project findings with regional and national policies and schools seeing their role as a vehicle for public engagement with science.