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Building Evaluation Capacity
in Science Education:
the Case of IBSE


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Inquiry Based Science Education (IBSE)

International studies emphasize a decline in young people’s interest in science and mathematics, largely due to the way science is taught in schools.

Consequently, the Rocard Report (2007) recommended the dissemination of innovative Inquiry-Based Science Education methods (IBSE).
IBSE is an active approach leading students to develop key scientific ideas through learning how to investigate and build knowledge and understanding of the real world (Harlen, 2011).

Just as in a real scientific inquiry, IBSE involves active learning through making observations; posing questions; examining books; planning investigations; using tools to gather, analyze and interpret data; proposing explanations and predictions, and communicating the results (NRC, 1996).

IBSE has emerged as an effective pedagogical practice for renewing science teaching. Several studies have proved its efficacy (Duschl, Grandy, 2008; Minner, Levy, Century, 2010).
To spread IBSE, the 7th European Programme “Science in Society” has funded innovative projects such as Pathway, Profiles, Pri-Sci-Net, and INQUIRE.

“Science in Society” projects include program monitoring and formal evaluation to determine whether the intended findings are actually being achieved.

Nevertheless, compared to the great number of widespread IBSE method projects the evaluation of inquiry-based activities still remains rather undeveloped.

There is a lack of effective program evaluation as well as a lack of confidence among professionals in their ability to use evaluation in their programs (Coyle, 2005).
Inquire is a three year project co-ordinated by Innsbruck University Botanic Garden (Austria) and involving 17 partners from 11 European countries.

INQUIRE aims to reinvigorate IBSE in schools, museums and botanic gardens, fostering the professional development of teachers and educators on the topics of biodiversity loss and climate change and is targeted at the 9-14 age group.

14 botanic gardens have developed 2 training courses of 60 hours on IBSE for practitioners, and a “train the trainers” course.
Evaluation Capacity Building

Our research analyses the INQUIRE Project within the framework of the Evaluation Capacity Building theory (ECB).

**ECB** is the intentional work to create and sustain organizational processes that make quality evaluation and its uses routine, involving the supply of technical skills, tools and resources to produce effective and useful evaluations which become sustainable over time (Stockdill, Baizerman, Compton 2002; Fleming, Easton 2010).

Building the evaluation capacity of individuals and groups means understanding and discussing:

- the motivations necessary to engage in evaluation;
- the assumptions and values supporting evaluation;
- the goals of assessment practices;
- how they contribute to effective decision making and add value to school organization.
Research objectives

We analysed two training courses for teachers and educators run in Italy by the Museum of Natural Sciences of Trento, over the 2011-2013 scholastic years.

The efficacy of the training courses held in the framework of IBSE method.

The effectiveness of IBSE lesson plans put in action by practitioners in schools and gardens.
We used mixed-methods approach because the triangulation of different instruments can provide a plurality of viewpoints of participants and an in-depth description of the reality studied.
Outcomes

Our research shows that the INQUIRE project in Italy has contributed to building evaluation capacity in professionals, providing technical skills and resources which helped practitioners to learn from and about evaluation.

This positive outcome concerns 3 main dimensions:
- **cognitive**
- **behavioural**
- **affective**
Cognitive dimension

Participants showed:

- an increased understanding of evaluation as a multidimensional approach;
- a better comprehension of the difference between summative and formative assessment;
- a broader awareness of the importance of adopting a reflective stance in making evaluations.

“We need to evaluate not only the knowledge that the students acquired, but also the inquiry and social skills developed during the IBSE activities, for example working in small groups”.

“Besides this, evaluation helped me to understand how successful I have been in managing the IBSE activity”. (teacher)
“Evaluation is necessary in order to gain feedback on one’s work. In fact through evaluation I can understand how much content and knowledge has been transmitted to the children and also how effective my teaching methods have been.

I believe that the “way” in which a lesson is taught should also be evaluated and its dynamics and possible variations studied”.

(educator)
Participants showed an enhanced ability to use a plurality of assessment instruments (such as concept cartoons, world café and portfolio) to collect and combine different types of data about environmental education.

**Examples**

- Subject: sustainable diet
- Subject: floatage and submarine
The ball of modelling clay sinks because it is round.

The boat has a broad surface in contact with the water that gives it more up-thrust.

The ball of modelling clay is heavier than the boat therefore it sinks.

The boat floats because it has a sail.
I learned that plants move with their seeds and leaves

I learned that seeds must be light for the wind to carry them away

I learned that other plants exist that I didn’t think existed

I learned that animals help plants to be born when they eat
Inquire Forum allows teachers and educators to share opinions, experiences and questions about how to implement assessment effectively.

Teachers and educators agree about the significance of listening to different opinions and sharing experiences in order to improve knowledge and develop new creative ideas.

Affective dimension

Participants showed:

- a decreased evaluation anxiety;
- an increased confidence in the usefulness of evaluation practices.
“Comparing notes with other teachers and educational staff during the course has been very important. We can always learn from each other’s experience, voice doubts, clarify problems and discuss the difficulties we have met along the way and formulate new ideas”.

(teacher)
Critical points

Our investigation highlights two main critical points:

The “funnel”: seeing one isolated individual where actually there is a group of learners

This individual perspective is particularly emphasized by the use of

- Observation grids
- Multiple choice tests or true-false tests
Teachers and educators usually see assessment more as a summative than a formative practice.

As a consequence

- The “black box”: looking for what is happening pre and post, but not within the educational experience

- Learning potential of students is not maximized.
Conclusions

The evaluation activities developed during the INQUIRE project confirm that ECB would be a reliable framework to integrate time requirements with a high quality assessment.

Fixing the misalignment between cognitive and constructive paradigm and summative and formative assessment would be an important step in the right direction to enhance evaluation practices.

Supporting the continuous training of professionals on the basis of ECB perspective would provide innovative competences and tools for improving daily evaluation practices through the enhancement of the collaborative features of IBSE activities.
Limitations and future research

Up to now, the research has been essentially focused on Italian context. We are now in the process of collecting data about European partners (UK, Austria, Germany, Spain, France, and Belgium) involved in the project.

The data we have collected so far highlights the short-term effects in order to evaluate to what extent and in what way the building of evaluation competences in participants leads them to modify their teaching methods and evaluation through the IBSE approach. To complete this process it would be necessary to carry out further evaluation after a period of six months post-course.
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