



ESTABLISH

*European Science and Technology in Action:
Building Links with Industry, Schools and Home*



www.establish-fp7.eu



**European Science and Technology in Action
Building Links with Industry, Schools and Home**

Bringing real life science to class

Student learn most effectively about science when the material is interesting and relevant.

Current methods of teaching science do not necessarily meet this ideal. The 'European Science and Technology in Action: Building Links with Industry, Schools and Home' (ESTABLISH) project has challenged this deficiency.

By providing three key elements, 1) materials, 2) supports and 3) connections, the goal of this EU-funded 14-member consortium was to share and facilitate the practical use of inquiry-based science teaching approaches for European secondary school science students.



What is inquiry Based Science Education (IBSE)?

IBSE is the classroom practice that encourages the development of inquiry skills through science, so that learners make sense of the world around them. Research has shown that using these methodologies, young people become more interested and motivated in science and technology, through increased interactive activities and topical challenges. These methodologies have been heralded by many policy-makers as a key solution to arrest the decline in science and technology careers across Europe.

ESTABLISH has gathered together over 60 expert partners from across 11 European countries to work together, to encourage and promote the more widespread use of inquiry-based science teaching methodologies in second level schools. Through actions such as the provision of attractive and practical teaching materials together with teacher education support, ESTABLISH has sought to bridge the gap bringing real-life science contexts and applications into the classroom to make the learning experience more authentic, engaging and interesting for young people.

Defining Inquiry

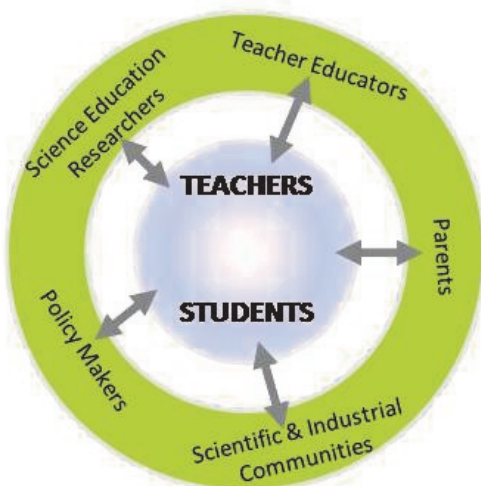
Inquiry, can be defined in multiple ways, but for the purpose of ESTABLISH, is the “intentional process of diagnosing problems, critiquing experiments, and distinguishing alternatives, planning investigations, researching conjectures, searching for information, constructing models, debating with peers, and forming coherent arguments” (Linn, Davis E.A. et al. 2004).

It requires a mind-set change on the part of the teacher away from a deductive approach to a more inductive approach where the teacher creates the atmosphere to allow for student observation, experimentation, planning, and through teacher guidance, students can construct their knowledge.



Stakeholders in IBSE

The ambition of ESTABLISH was to bring together, within a collaborative environment, the key stakeholders in science education across the eleven European countries.



The stakeholders included:

- science teachers and educators;
- the scientific and industrial communities,
- both local enterprises and multinational industries;
- the second level science students and their parents;
- the policy makers responsible for science education at second level, including curriculum developers and assessment agencies;
- and national and international science education researchers.

Through this strategic action, the ESTABLISH participants, have worked with these stakeholders, to generate and implement inquiry in the classroom for the teaching and learning of science and technology, informing education policy, as well as to providing effective pedagogy and professional development support for science teachers across Europe.

ESTABLISH approach to developing materials

Once the definition of inquiry was agreed, a framework to guide the development of ESTABLISH teaching and learning materials was established to encompass key aspects such as **pedagogical content knowledge (PCK)** to support the unit's scientific concepts together with **industrial content knowledge (ICK)**, **learning paths** and **assessment**. Following piloting, the units have been revised, trialed and evaluated for use in teacher education sessions, both at in-service and pre-service level, in each country, to support the implementation of IBSE in classrooms across Europe.

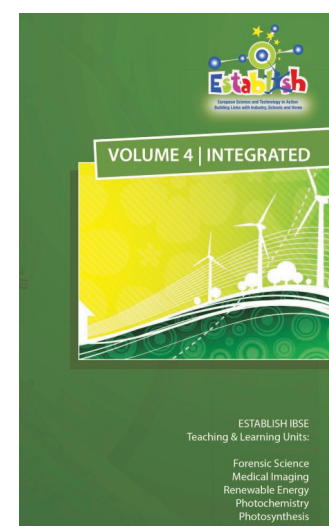
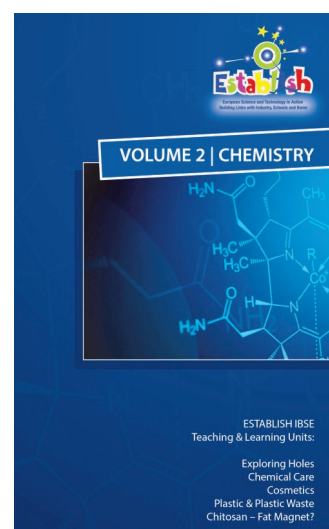
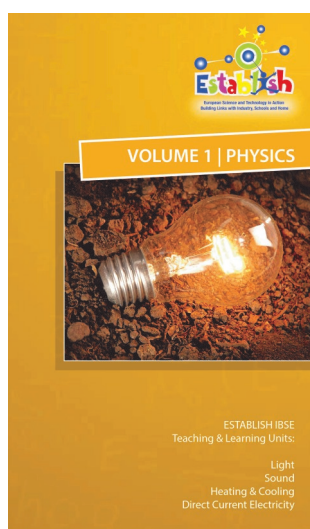
ESTABLISH project partners have collaborated with local actors (from practitioners to policy makers) during the development and piloting of these IBSE teaching and learning materials to offer an extensive range of science activities that are suitable for using in inquiry teaching and learning across the participating 11 countries (Ireland, Germany, Sweden, Cyprus, Czech Republic, Poland, Slovakia, Malta, Netherlands, Estonia and Italy).

Introducing ESTABLISH Teaching and Learning Units

A series of 18 inquiry-based science education (IBSE) teaching and learning units have been developed which have been piloted and tested with teachers in the classroom.

These materials serve as exemplary materials for science teachers and instructors of teacher professional development to experience the benefits of inquiry-based science education approach and are offered openly to inspire, guide and stimulate the further development of IBSE resources and practices.

These booklets provide background information for teachers on the ESTABLISH approach to IBSE and present a variety of inquiry activities appropriate for the second level science curriculum.



What is ICK?

This is a unique feature of the ESTABLISH resources and supports, whereby examples, contexts and, or applications from industrial communities are integrated into the unit providing authentic learning opportunities.

Example of ESTABLISH Unit:

LIGHT

The Light Unit is divided into two subunits that can be used independently or sequentially, and within a hierarchical curriculum.

Subunit 1 is aimed at an introductory level and takes a 'ray-based' approach, whereas Subunit 2 is more appropriate for the higher stages of secondary school and incorporates 'wave-based' phenomena.

Light is a subject area that often involves curriculum-prescribed demonstrations and experiments. For example the dispersion of white light by a prism and image formation by lenses. The activities presented in this unit are suitable for demonstrations / experiments in a format consistent with an IBSE approach.



Sound
Designing a Low Energy Home
Direct Current Electricity
Light
Exploring Holes
Chitosan - Fatmagnet?
Cosmetics
Photochemistry
Chemical Care
Photosynthesis
Plastic and Plastic Waste
Water in the Life of Man
Disability
Blood Donation
Ecobiology
Renewable Energy
Forensic Science
Medical Imaging

ESTABLISH Teaching and Learning Units

Within each unit, materials are offered at various levels to suit the age range of second level students (range 12-18 years) and promote different elements of inquiry so as to offer flexible resources for use in teacher education and in the classroom.

Subunit 1: INTRODUCING LIGHT

In this subunit, students examine the basic physical properties of light and its interaction with materials in a predominately qualitative fashion. They learn that sources of light have specific physical characteristics and these can determine properties of light, such as its colour and intensity. They investigate the interaction of light with matter and explore phenomena such as reflection and refraction.

Supporting use of Inquiry in the classroom

ESTABLISH Teacher Education Programme

To support teachers in using Inquiry in the classroom, ESTABLISH has designed a structured professional development programme to introduce and develop certain teaching skills useful for teaching by inquiry. The programme consists of four core skill elements together with four supporting elements selected to guide you from a basic understanding of inquiry, through to developing and implementing your own inquiry-based materials in the classroom.

Introduction to IBSE
Industrial Content Knowledge
Implementation of IBSE
Development of IBSE
ICT with IBSE
Argumentation
Research and Design Projects
Assessment of IBSE

Each element has a number of key learning objectives and presents exemplary workshop activities to achieve these learning objectives. Following multiple workshops with teachers across Europe, a web-resource, designed as a self-instructive programme for second level science teachers, at both pre-service and in-service levels is available from the project website :

www.establish-fp7.eu/resources

Example of ESTABLISH Teacher Education Programme: Introduction to IBSE

There are many answers to the question "What is scientific inquiry?" and much of this methodology is dependent on your own understanding and experience of science and scientific inquiry.

This first element of the ESTABLISH Teacher Education Programme presents a number of activities, scenarios and challenges to introduce you to the inquiry methodology and through engaging with inquiry activities you will gain a deeper appreciation of the types and benefits of this approach.

The Learning Objectives of this TEP element are to:

- Provide direct experiences of inquiry
- Outline ESTABLISH view of inquiry



Impact

The objective of ESTABLISH to involve all stakeholders of science education, from practitioner to policy maker to design and develop, test and evaluate the implementation of inquiry in the classroom has been realised with positive impact on those involved. The entire collection of **18 ESTABLISH IBSE units, with a total of 281 activities**, now provides an extensive bank of fit-for-purpose resources for teachers and educators in adopting IBSE.

The flexible structure of the ESTABLISH Teacher Education Programme (TEP) has resulted in the implementation of multiple models and has led to the direct participation of **2,090 teachers** in TEPs across the eleven beneficiary countries. Of these participants, 591 in-service teachers completed at least 10 hours of workshops while an additional 796 teachers completed shorter programmes.

To assess the impact of the ESTABLISH approach on second level students 709 students were surveyed from selected countries across Europe



The effect and impact of ESTABLISH have been shown to result in:

- greater implementation of IBSE methodologies by teachers;
- greater understanding, attitude and ability to use IBSE in their teaching;
- increased student's motivation and communication during science lessons;
- greater student attitude towards science and taking up careers in science or technology;
- increased interaction between those teaching and learning about science and those using science.

Supporting Teachers

ESTABLISH is committed to supporting science teachers in research and practice. In June 2012, ESTABLISH hosted a teacher education conference in conjunction with the 5th biennial Science and Mathematics Education Conference (SMEC 2012) which took place on 7-9th June 2012 in Dublin City University, Dublin, Ireland. In addition to the invited representatives from other FP7 projects which support and coordinate actions on innovation in the classroom, this conference was focused on facilitating teachers to network and to share their experiences of implementing inquiry in their classrooms and attracted an attendance of 235 delegates from across 20+ international countries.

Continuing support for Science Teachers is available from the Scientix portal:

About the project

The purpose of ESTABLISH (2010-2014) has been to share and facilitate the practical use of **inquiry-based science teaching approaches** on a large scale across Europe.

ESTABLISH has achieved this by addressing three key issues through the provision of: relevant teaching materials to engage the learner in inquiry based learning; appropriate training support for teachers to implement an inquiry methodology; and sustainable connections with policy makers and scientific and industrial communities.

Project Partners



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University of Umea,
Sweden



Jagiellonian University,
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Frederick University,
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