Establish - A model for widespread implementation of Inquiry Based Science Education

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http://www.establish-fp7.eu/

Dublin, 24th June 2014.

The FP7 funded project ESTABLISH

- started in **January 2010** and brings together expertise from across **14 institutions** in **11 European countries** to extend the use of inquiry-based science education (IBSE) in second level schools across Europe.
- Members of the consortium work with local teachers and students to develop and implement IBSE units and evaluation tools that are culturally adapted for each country.
- The aim of this project was to promote innovation in classroom practice through the provision of appropriate teaching and learning IBSE units and appropriate supports for both in-service and pre-service teachers to implement IBSE.

http://www.establish-fp7.eu/

Background, Framework, and Purpose

- **Inquiry based teaching methods** have been suggested as a way to encourage and motivate students in science by increasing student interest. (Fensham 1986, Linn 2006)
- International reports (Rocard 2007, Osbourne and Dillion 2008) have identified the need for an "*engaging curricula to tackle the issue of out-of date and irrelevant contexts and to enable teachers to develop their knowledge and pedagogical skills*".
- Inquiry methods and curricula must be engaging and include up-to-date contexts to be successful in encouraging and motivating students.
- Additionally, as teachers are the agents for change in the classroom, they must be both confident and competent in inquiry methodologies to successfully implement inquiry curricula.

Goal of INQUIRY

Deep understanding of scientific knowledge, facts and concepts

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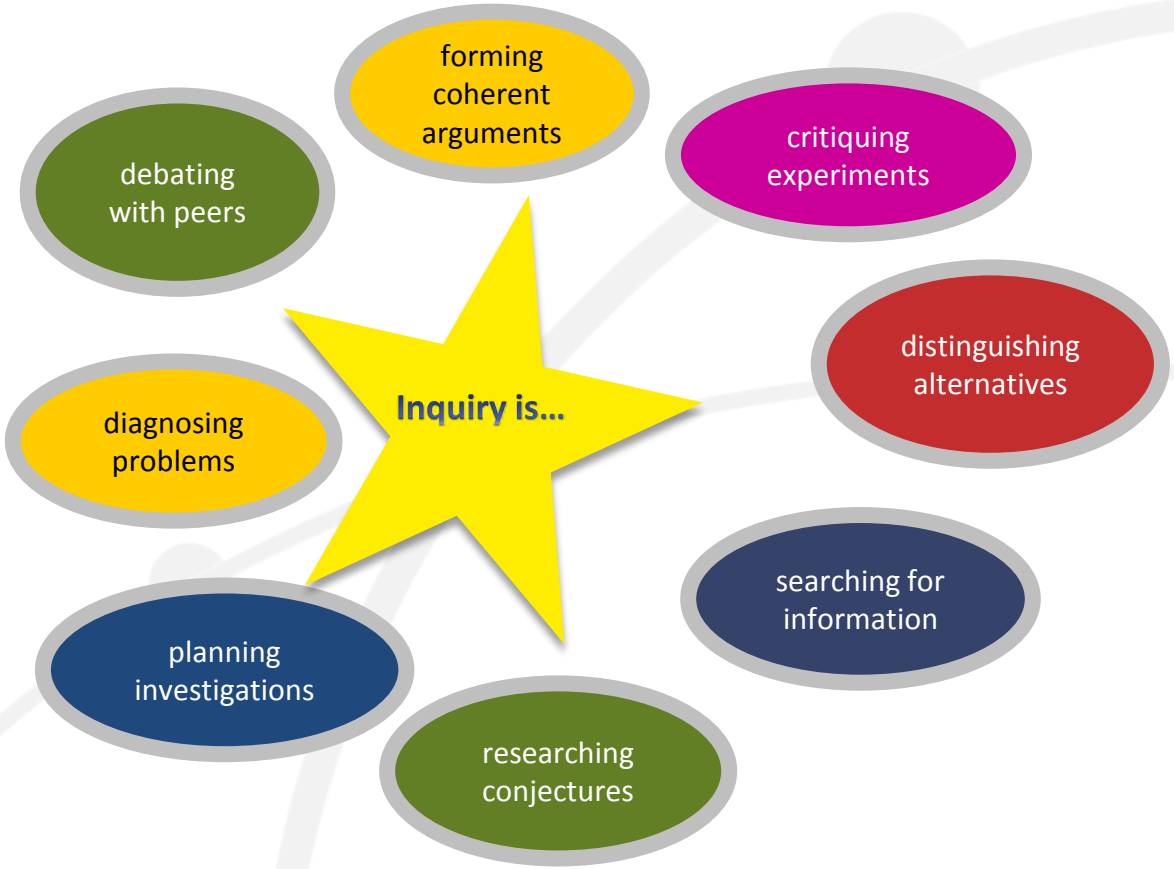
Enhance students' abilities to reason, and to become independent learners who are capable of identifying main questions and find relevant answers

Elements of Inquiry



Definition of Inquiry from:
Linn, Davis and Bell, 2004

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

Inquiry in national curricula and assessment

Elements of Inquiry	CY	CZ	DE	EE	IE	IT	MT	NL	PL	SK	SE
Diagnosing problems											
Critiquing experiments											
Distinguishing alternatives											
Planning investigations											
Researching conjectures											
Searching for information											
Constructing models											
Debating with peers											
Forming coherent arguments											

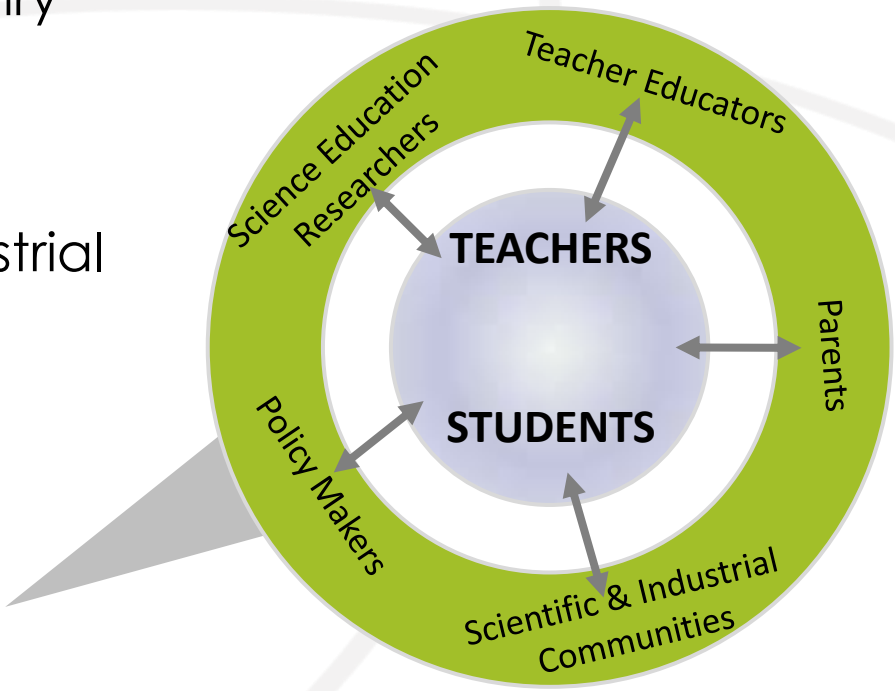
is included in both curriculum and assessment

is included in the curriculum only

Identification of each country is: CY- Cyprus, CZ-Czech Republic, DE-Germany, EE-Estonia, IE- Ireland, IT- Italy, MT- Malta, NL-Netherlands, PL- Poland, SK-Slovakia and SE-Sweden.

Objectives of ESTABLISH:

- Develop appropriate teaching and learning materials for IBSE
- Provide appropriate support for teachers in implementing an inquiry methodology
- Create sustainable connections - policy makers, scientific and industrial communities.



Establish

European Science and Technology in Action:

ESTABLISH IBSE Teaching and Learning Units

Agreed framework for the development of an IBSE unit:

(1) Unit/science topic,

(2) IBSE character,

(3) Pedagogical Content Knowledge,

(4) Industrial Content Knowledge,

(5) Learning Path(s) and

(6) Student Learning Activities and Classroom Materials.

18 Units, 281 activities that:

- are representative of IBSE,
- show benefits of IBSE in classroom,
- inspire teachers to generate own materials.

•ESTABLISH Units

Volume 1

Light
Sound
Heating & Cooling
Direct Current Electricity

Volume 2

Exploring Holes
Chemical Care
Cosmetics
Plastic & Plastic Waste
Chitosan – Fat magnet?

Volume 3

Disability
Eco-Biology
Blood Donation
Water in the Life of Man

Volume 4

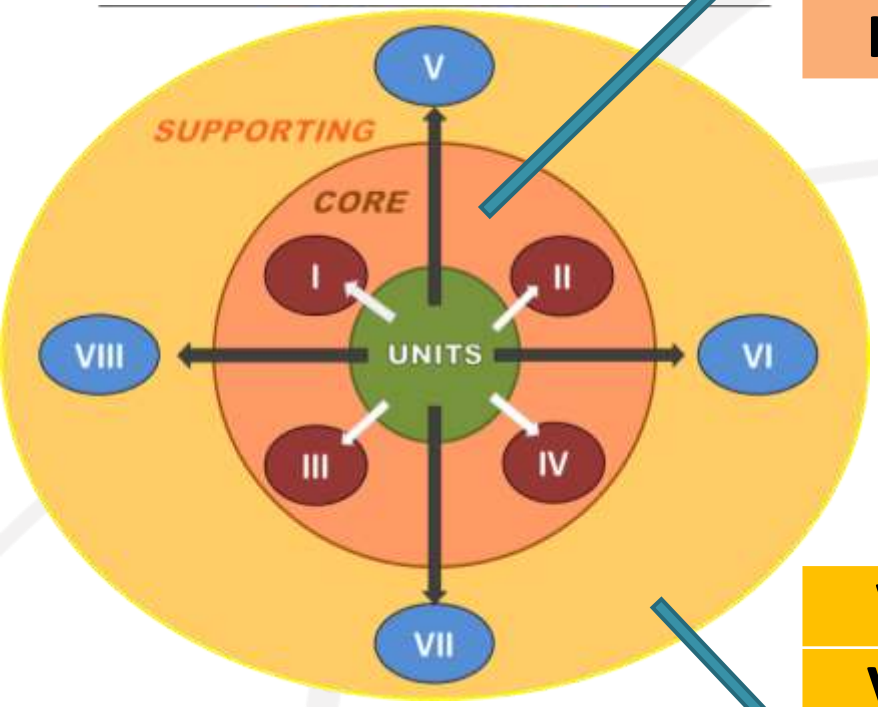
Forensic Science
Medical Imaging
Renewable Energy
Photochemistry
Photosynthesis

ESTABLISH IBSE Teacher Education

ESTABLISH Teacher Education Programmes (TEPs)

- Minimum total time f2f: **10 hours**
- Training is delivered over a minimum of **three stages**;
  - Introduction; workshop,
  - Internalisation of information; teachers trial materials and methodologies in classroom/ invest own time in reflect on the materials,
  - Follow-up; workshop to capture feedback
- Strongly encouraged that the materials are **trialled in the classroom**.
- Recommended that a **minimum of two teachers** per school attend the workshops.
- Recommended that the workshops are **hosted in the schools**.
- Suggested that a workshop take place in a relevant **industrial setting** (e.g. industry-learning centre)
- **ESTABLISH units** central in TEPs

ESTABLISH Framework for Teacher Education



I	Establish view of IBSE
II	Industrial Content Knowledge
III	Science teacher as Implementer
IV	Science teacher as Developer

V	ICT
VI	Argumentation in the classroom
VII	Research and design projects
VIII	Assessment of IBSE

I: ESTABLISH view of Inquiry

characteristics of inquiry, benefits to learning, role of inquiry in curriculum, provide direct experience of inquiry.

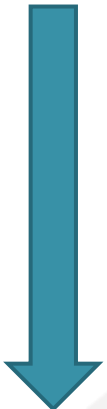
Inquiry is the intentional process of :

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 & Bell 2004)

Types of Inquiry

- Interactive demonstration /discussion
- Guided discovery
- Guided inquiry
- Bounded Inquiry
- Open Inquiry



Student independence

II: Industrial Content Knowledge (ICK)

define ICK, relevance of ICK to support IBSE, experience contexts with links to units/activities, develop own ICK content

Level	Description
I	The activity is linked to industry or everyday context.
II	An industry or a product is studied, preferable by a site visit. The challenges in that industry are used to introduce science activities
III	Analysing an industry's main product or process based on a site visit and study of both the science content and the design process.
IV	An activity where the students need to follow all steps in a design process. During the process they will learn science and do experiments
V	Contacts with industry lead to a design task with a customer

III: Teacher as an Implementer

Prepare for implementing inquiry teaching/learning in their own classroom, identifying challenges and sharing experiences.

- Teachers' reflect on practice of inquiry within the classroom
- Map the attitudes towards and understanding of IBSE and "brainstorm" on what inquiry-based science education means and what one wishes to achieve by employing it.

Sample Activity:

Teachers divided into small groups (~ three per group).

The groups are given cards that shows a model that describes IBSE.

Groups brainstorm on three themes:

1) what inquiry-based teaching is,

2) which skills/competence one seeks to develop

3) which special teaching skills are needed in the teacher to lead this work?

IV: Teacher as a Developer

- enable participants to **develop own** inquiry lessons
- outline criteria for inquiry activities
- demonstrate how to turn activities into inquiry
- inform teachers about adequate resources in online and print media to find possible topics, scientific background, etc.
- help teachers manage and evaluate information from these resources
- provide participants the opportunity to **report back** on self-developed inquiry lessons
- outline and discuss **classroom issues** when teaching by inquiry
- develop **community of practice** to share experiences
- layered design that includes start, examples, links, chat.

Structures of ESTABLISH In-service TEPs

Country	Format	Duration	1-IBSE	2-ICK	3-IMP	4-DEV	5-ICT	6-ARG	7 - R&D	8-ASS
CY	UB	12h	√	III	√	√	√			
CZ	WE	40h	√	III	√	√				
DE	SB	12h	√	I, IV	√	√				
EE	SS	2d	√	I	√		√			
IE	SS	2d	√	I	√	√				
IT	UB	95h	√	I	√	√	√	√	√	√
MT	SS	2d	√	III	√	√				
NL	SB	12h	√	I	√	√	√			√
PL	SS	5d	√	III	√	√	√	√	√	√
SK	UB	12h	√	I	√	√	√			
SE1	UB	16h	√	II,III	√		√			
SE2	UB	16h	√	III	√	√		√		√

WE= Weekend, SS= Summer School, SB=School Based, UB= University Based

Structures of ESTABLISH Pre-service TEPs

Country	Duration	1-IBSE	2-ICK	3-IMP	4-DEV	5-ICT	6-ARG	7 - R&D	8-ASS
CZ	30h	√	III	√	√				
DE	8h	√	IV	√	√				
EE	24h	√	I	√	√				
IE	12h	√	I	√	√				
IT	24h	√	I	√		√			
PL	8h	√	III	√					√
SK	16h	√	III	√	√	√			
SE1	8h	√	I	√					
SE2	10h	√	III	√					

•ESTABLISH IBSE Teacher Education

Country	IN-SERVICE			PRE-SERVICE	TOTAL
	Minimum criteria fulfilled (≥10 hours)	Shorter TEP (<10 hours)	**TOTAL**	duration varied between 2-10 hours	
CY	67		**67**	**62**	129
CZ	80	-	**80**	**50**	130
DE	49	221	**235**	**246**	506
ES	59	6	**65**	**28**	93
IE	60	36	**113**	**59**	172
IT	57	200	**257**	**43**	300
ML	23	-	**23**	**5**	28
NL	29	-	**29**	**27**	56
PL	52	150	**202**	**64**	266
SE	90	136	**226**	**64**	290
SK	50	40	**90**	**30**	120
TOTAL	**591**	**796**	**1387**	**678**	**2090**

•Engagement with Stakeholders

e.g. Industries associated with

- ESTABLISH unit
- ESTABLISH teacher Education Programme

Industry background

- Industrial process, product, expertise, …
- CSR / education policy

Communication/Engagement Strategies

- Introductory newsletter, presentation.
- Personal contacts/individual meetings.
- National Stakeholder events.

Project Outcomes:

- Pre-service teachers
- In-service teachers
- Students (12-18 years) (#=5,602)
  - *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.*
- Engagement with Stakeholders
- National Implementation
- Other projects….