Problemi connessi alla integrazione delle ricerche in didattica della fisica nella pratica educativa:
il caso dell'Inquiry Based Science Education

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Transfer research findings into practice

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Integrating research findings into practice

N.R.C. A FRAMEWORK FOR K-12 SCIENCE EDUCATION : Practices, Crosscutting Concepts, and Core Ideas

- *An uncritical view of experimentalism may fail to recognize key elements of classroom instruction.* ***Experimentalism rests on ideal conditions and has a tendency to trade internal validity for external validity.*** *....Feedback is a critical element that speaks to the* ***adaptability of the process of learning,*** *and raises questions as to whether cause-and-effect is the only and/or best means to describe how to improve classroom practice.*

- *We do not live on a fixed landscape and, consequently, any intervention or perturbation of a system (e.g., the implementation of new curricula) can alter the landscape (**complex systems**)*

- *To recognize the complexity of classroom practices and* ***to provide the kinds of insight needed*** *to assist teachers in accomplishing their challenging task.*

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Teaching/Learning Physics: integrating research into practice

Needs

Design

Scaffolding

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Integration concerning innovation in:

Methods and Strategies

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Curriculum

Methods and Strategies

- Current reform efforts call for educators to **develop students' understandings and abilities with regard to scientific inquiry**

  American Association for the Advancement of Science [AAAS], (1993); National Research Council [NRC], 1996, (2000)

- **Teaching science as inquiry** entails engaging students in asking scientific questions, conducting investigations to answer those questions, and building evidence-based explanations

  Krajcik, Blumenfeld, Marx, & Soloway, (2000)

DESIGNED BASED RESEARCH IN TEACHER EDUCATION

Methods and Strategies

- Research has shown that teachers who use such kind of innovations need to expand their repertoire of instructional practices besides developing their knowledge of content

  Schneider, (2006); Schneider & Krajcik, (2002)

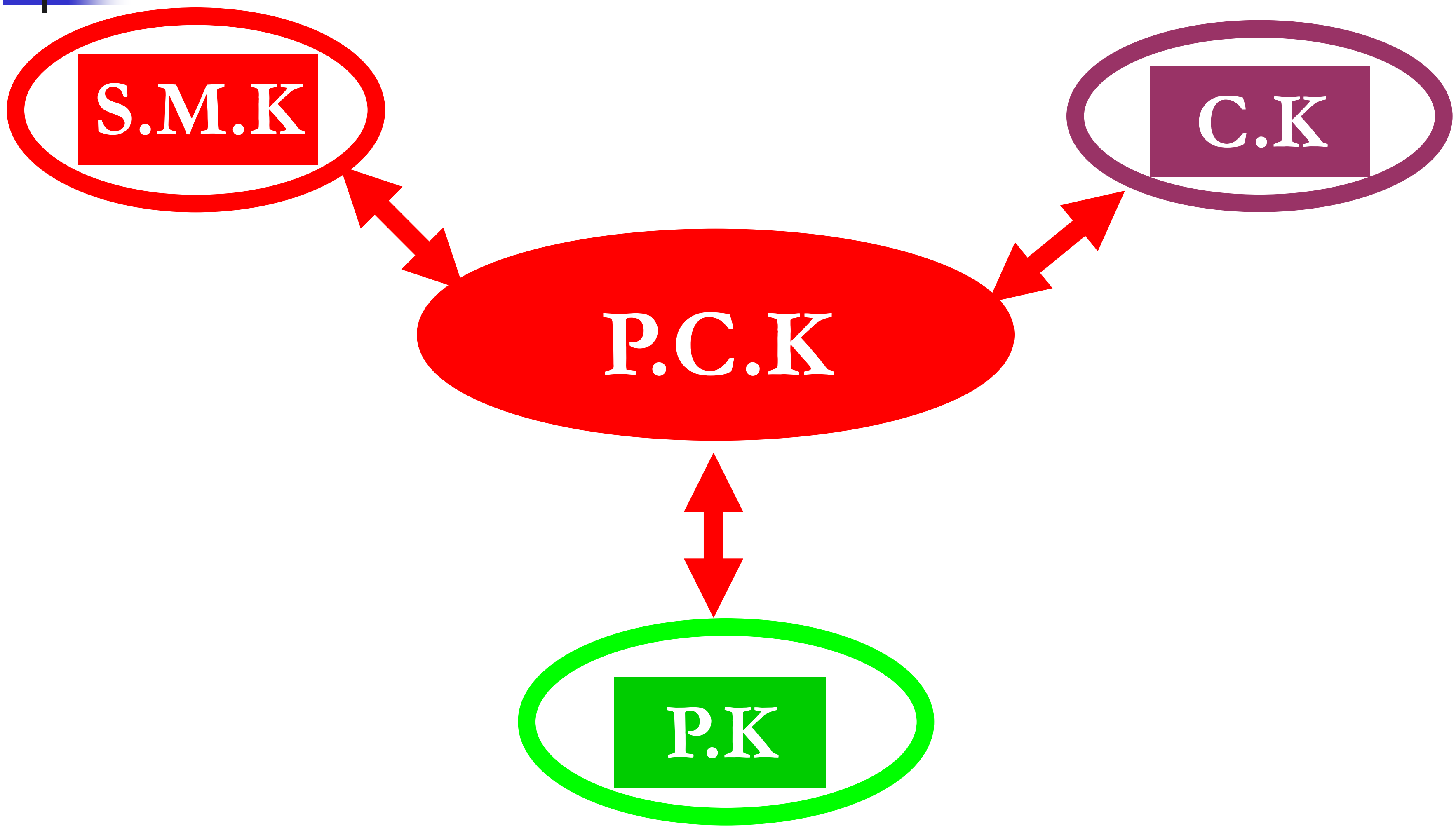
- Knowledge of instructional strategies for representing a specific topic is a relevant component of PCK
  (Grossman, 1990; Shulman, 1986)

- Teachers must also possess PCK for scientific inquiry practices, in order to help students to develop their understandings and abilities necessary to engage in scientific inquiry

  (Davis & Krajcik, 2005; Petish, 2004; Zembal-Saul & Dana, 2000)

The Knowledge Bases for Teaching

Research on Science Education (2008) 38:261–284



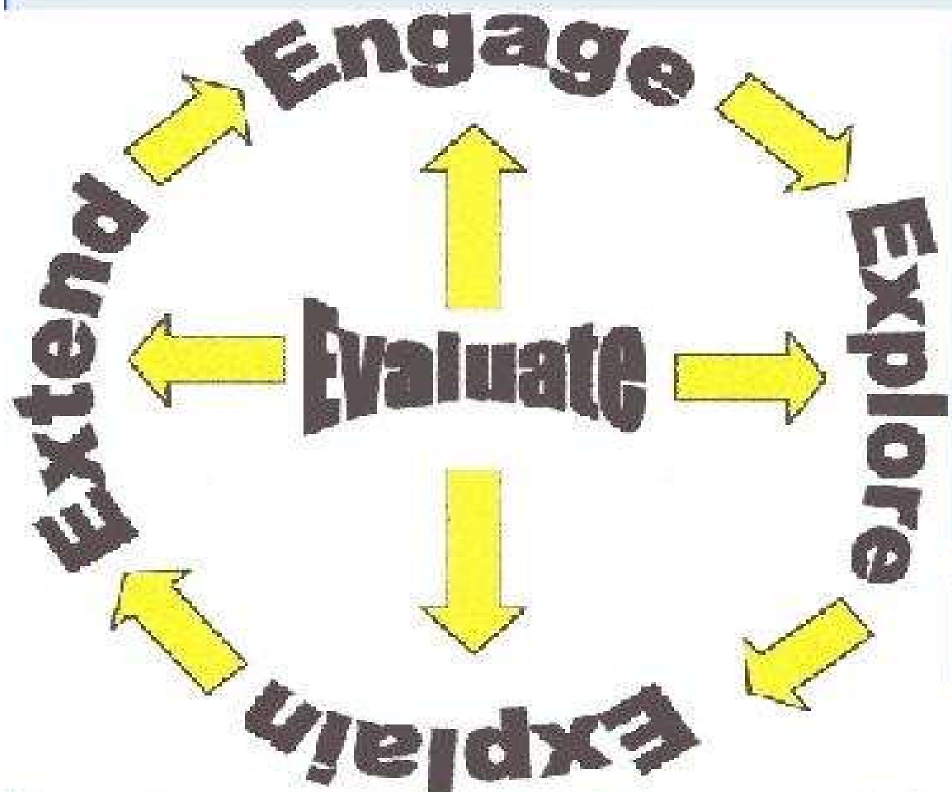
PCK and IBST

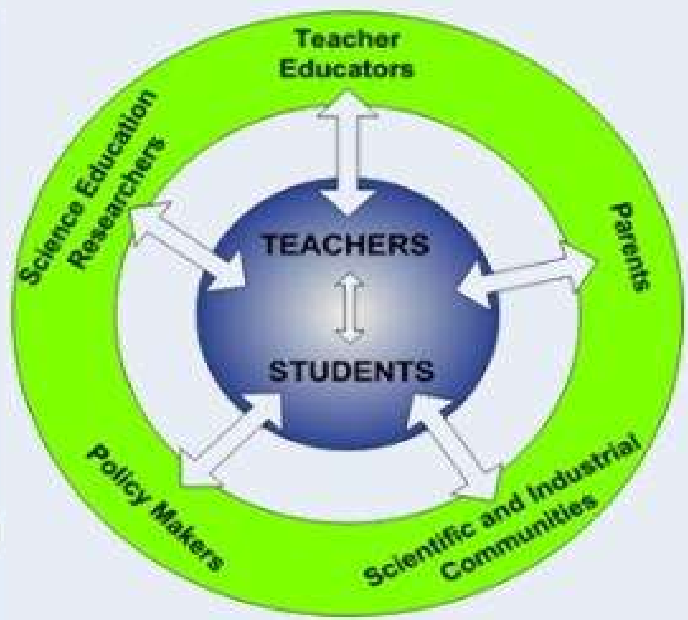
With regard to the features of IBST, teachers especially need to gain pedagogical content knowledge enabling them to "**engage students in asking and answering scientific questions, designing and conducting investigations, collecting and analyzing data, developing explanations based on evidence, and communicating and justifying findings**"

Beyer, Delgado, Davis, & Krajcik (2009)

Establish

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





http://www.establish-fp7.eu

Science and Technology in Action (in Context)

Less emphasis on	**More emphasis on**
Knowing scientific facts and information	Understanding scientific concepts and developing abilities of inquiry
Studying subject matter of disciplines	Learning subject matter in the context of inquiry, technology, science in personal and social perspectives, and history and nature of science
Separating science contents	Integrating all aspects of science content
Covering many science topics	Studying a few fundamental science concepts
Knowing inquiry as a set of processes	Implementing inquiry as instructional strategies, abilities, and ideas to be learned

Physics in Action

Context:

- Noise pollution
- Wind, solar energy
- Electricity at home
- Energy saving
- New materials

....

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Concepts:

- Mechanical waves
- Energy, heat, work
- Electric charge,……
- Heat propagation
- Structure of matter

……………………..

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A model of teacher professional development

Teachers must learn different instructional strategies, but they must also **re-conceptualize or change their conception about the meaning of teaching**

Conceptual change is not only relevant to teaching in the content areas, but it is also applicable to the professional development of teachers

Research questions

Main questions:

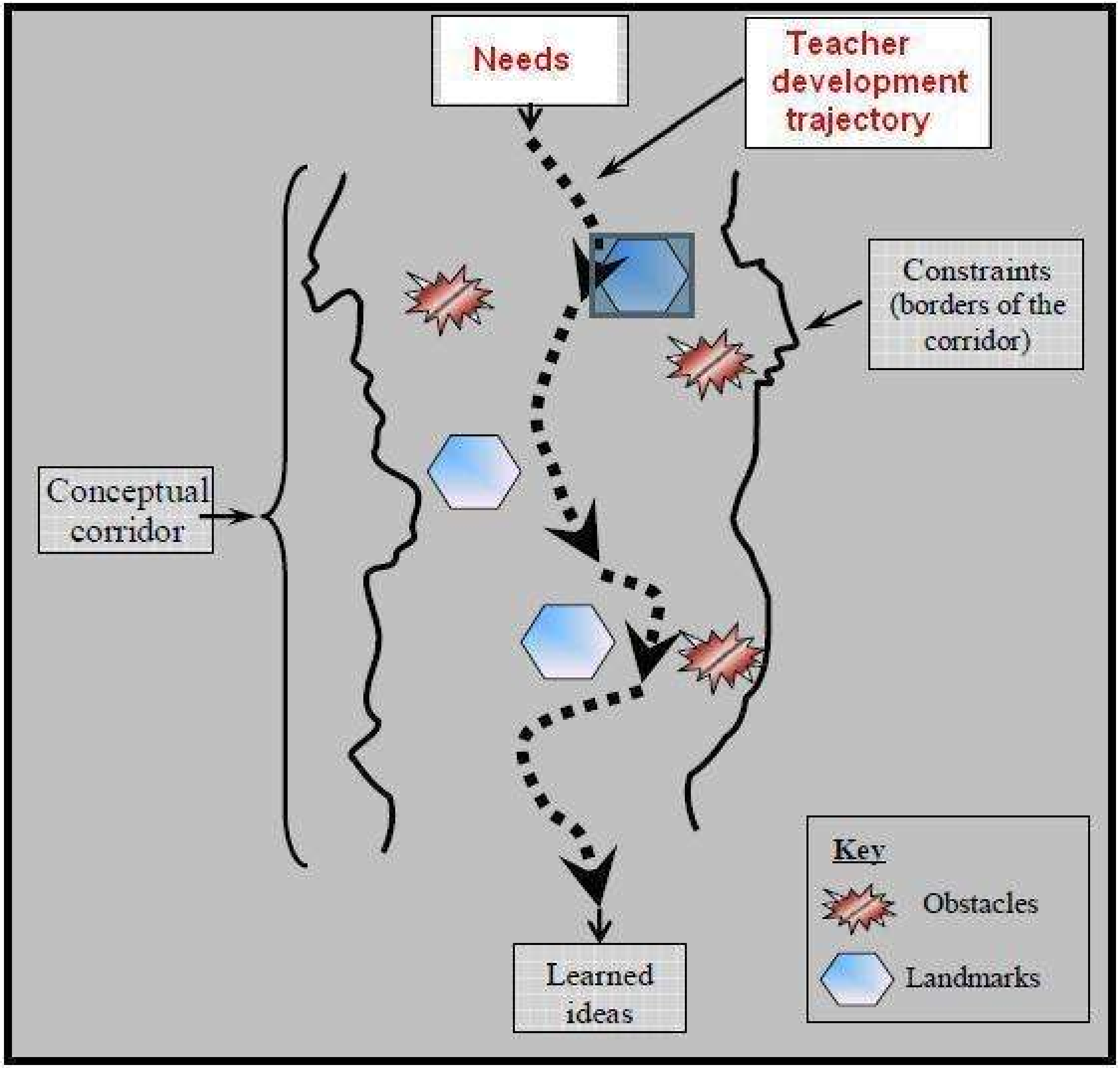
- At what extent teachers are familiar to IB approaches?
- Which approaches to a complex problem are preferred by teachers ? Which cognitive resources are involved?

(1

- What design to implement for teacher professional development?

(2

Conceptual Corridors



A)Needs:

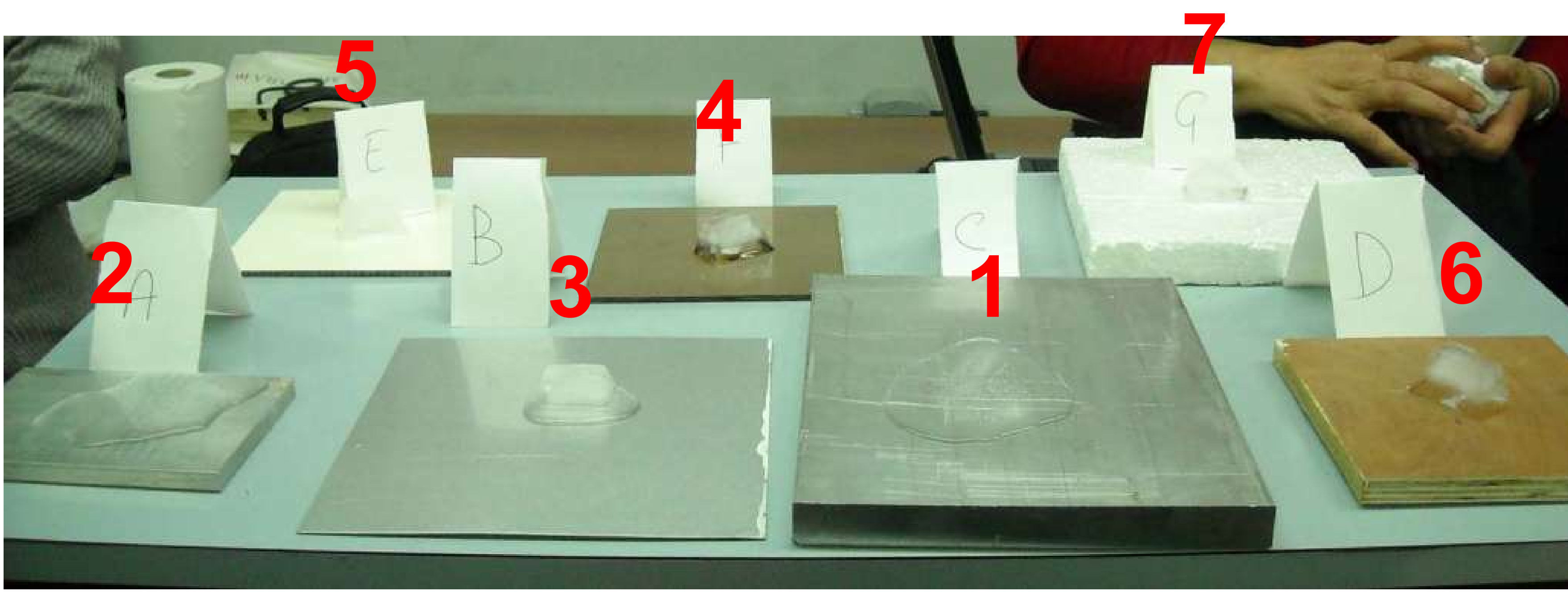
A1) Teacher Cognitive resources put in action in the solution of a complex problem

The research experiment

Experimentation has been carried out with a sample of 15 in-service teachers (graduates in physics, maths and biology) attending a workshop on IBSE in the framework of the EU project ESTABLISH

Analysing teacher approaches to a complex problem :**The problem**

Seven identical ice cubes are placed upon different flat plates. These may differ in material or mass, area and thickness. Which ice cube will melt sooner? Can you predict the sequence of ice cubes melting?



Data Sampling

(15 expert teachers)

Data have been collected by means of a questionnaire

The questionnaire addressed three main points:

- *Prediction of issues of phenomenon*
- *Discussion*
- *Designing of experiments to investigate the phenomenon*

The research findings

1) All teachers identified the material conductivity as the most relevant variable

What happens with the same material (aluminum)?

2) The majority of teachers showed a "cognitivist" approach (activation of cognitive resources as memory of past learning experience in order to make sense of reality)

FAZIO C, TARANTINO G AND SPERANDEO-MINEO RM (2012). Teachers' competences about Inquiry Based approaches to the analysis of Thermal Phenomena: implications for an appropriate training. In:Physics Alive. p. 19-24, Jyväskylä:University of Jyväskylä, ISBN: 978-951-39-4801-6

PIZZOLATO N., FAZIO C., AND BATTAGLIA O.R. (2013).Open Inquiry based learning experiences: a case study in the context of energy exchange by thermal radiation, *EJP*(in press)

Outcomes

- *The "read-out" strategies play a crucial role in achieving the correct description and selecting the relevant variables*

- *In some cases, this strategies seems to activate "textbook-like" cognitive resources like memory and formulas acting as conceptual obstacles to the IB approach*

- ***This works like a sort of** "short-circuit of knowledge" avoiding a phenomenological **approach to the problem and a complete formulation of right hypotheses***

A)Needs:

A2) Teacher reasons to face innovation

a) To increase student interest

b) To improve concept understanding

c) To make esperience student the scientifc method

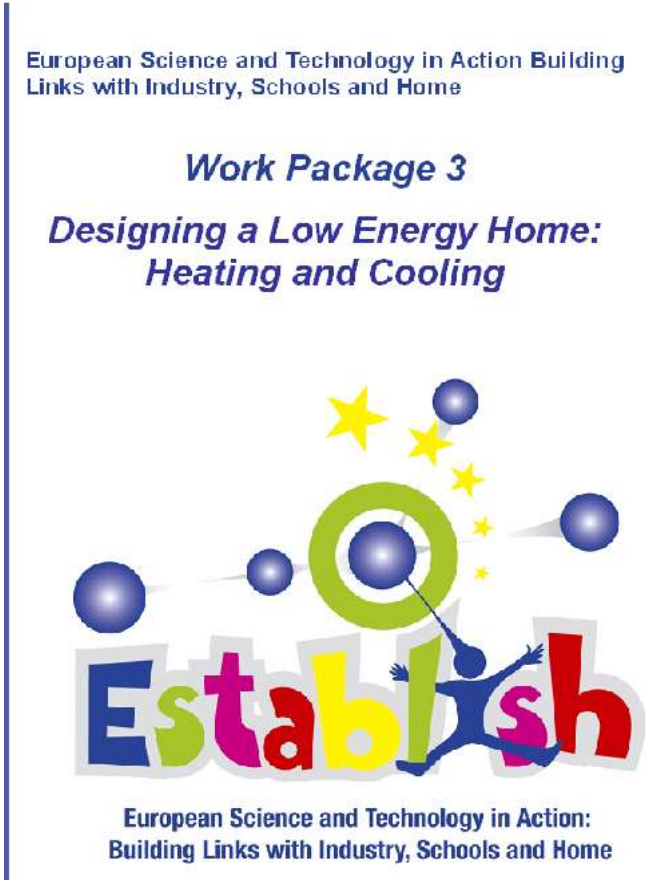
d) To introduce technology

e) To introduce working groups

f) ……………………………….

THE DESIGN OF THE TEACHER TRAINING EXPERIMENT

The Pedagogical Materials



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

Work Package 3

Designing a Low Energy Home: Heating and Cooling

Establish

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

Teacher Information

I. Unit description

II. IBSE character

III. Content Knowledge

IV. Pedagogical Content Knowledge

V. Industrial Content Knowledge

VI. Learning paths

VII. Assessment

VIII. Student learning activities

The activities

Activity	Student Task	Inquiry Type	E-emphasis
1_1	Discussing and experimenting how to maintain warm a house model	Interactive demonstration Guided discovery	Engage Explore
1_2	Experimenting distribution of temperature inside the house model	Guided inquiry Bounded Inquiry	Engage Explore Explain
1_3	Hypothesizing and experimenting the sunshine effects on the house model temperature	Guided inquiry Bounded Inquiry Open Inquiry is also possible	Engage Explore Extend

Designing the classroom activities

Progettiamo la Sperimentazione

Piano didattico (.pdf)
Piano didattico (.doc)

Diario di bordo(.pdf)
Diario di Bordo (.doc)

Assessment Data

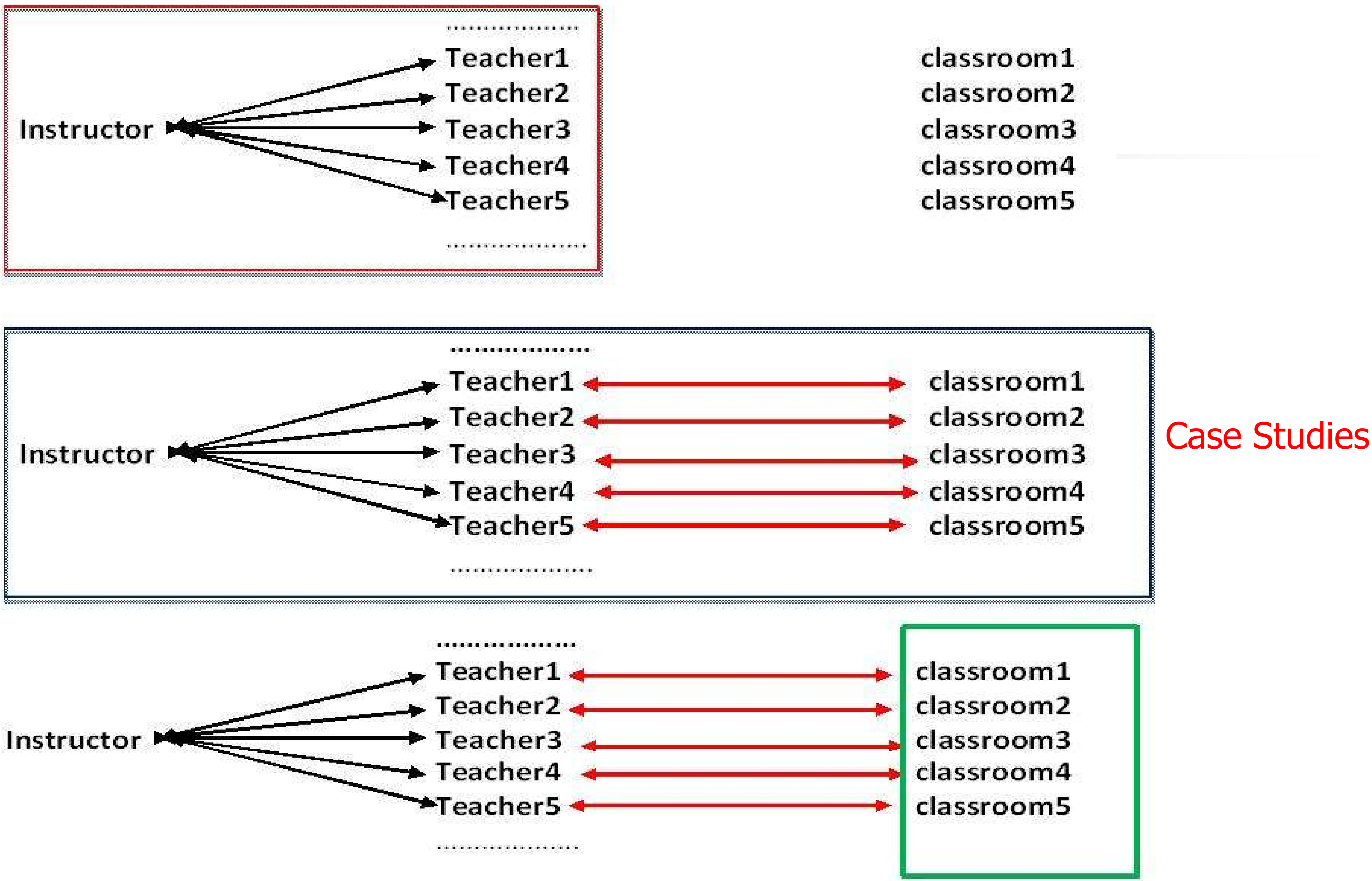
- Teacher questionnaires
- Student questionnaires
- Teachers' materials

Asseessment Data

Seminari-Workshop
IBSE in classe V Ciclo: PROGRAMMA
IBSE in classe IV Ciclo: PROGRAMMA
IBSE in classe III Ciclo: PROGRAMMA
IBSE in classe I-II Ciclo: PROGRAMMA

Asseessment Data

Evaluation design



Results
(Analysis of data is in progress)

Main findings

- Awareness
- Mastership
- Transfer
- Sharing and Dissemination
- ………………….